Banking Market Structure and Monetary Policy

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Banking Industry and Monetary Policy: An Overview

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The financial sector and, in particular, the banking industry plays an important role in the allocation of capital resources and risk sharing of future flows in an economy. In the long run, a well-functioning banking sector will facilitate increased growth and welfare, and it will smooth business cycles. These findings have become widely accepted by policymakers and economists, and they stand in contrast to the skepticism about the contribution of financial intermediaries that predominated twenty years ago.

Banks perform a variety of functions. Historically, they have provided money changing and payment processing services. The latter function has gained relevance at the international level owing to the greater integration of financial services. Banks primary function has also been related to the transformation of assets in terms of their maturity, quality, and denomination. Recently, researchers and policymakers have acknowledged that a critical role of banks is to manage and control risks. These functions give banks a central position within the process of saving and investment allocation. However, these functions make banks vulnerable to different sources of shocks, and they have a negative effect on the economy because of banks' central role. Consequently, there is a case for strong regulations in a banking environment. Issues like barriers to entry, market concentration, the borrower-lender relationship, deposit insurance, and the taxation of financial intermediation are at the center of the economic policy discussion to improve the performance of the financial market.

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From a macroeconomic perspective, the nature of banking activities and banks' position as intermediaries makes these institutions relevant for the transmission of monetary policy. Two important channels of monetary policy transmission depend on the functioning of the banking sector: the traditional interest rate channel and the credit channel. The former channel operates when the central bank's adjustments to the nominal interest rate have an impact on the real interest rate (assuming a degree of price stickiness) and thus on the pattern of investment and consumption. This channel will only work, however, if banks transmit the changes in the monetary policy rate to their customers. The credit channel, in turn, assumes some capital market imperfections, such as asymmetric information, that induce a contraction of the quantity of credit when the central bank imposes a restrictive monetary policy.

The papers presented in this book discuss some of these issues. The first group of papers studies the importance of the banking industry in the transmission of monetary policy and the interest rate pass-through from a theoretical and empirical perspective. The second group analyzes microeconomic topics related to regulation and market structure, such as taxation of the financial sector, barriers to entry in the banking sector, and deposit insurance.

1. Monetary Policy and the Banking Industry

In a simple textbook economy, agents hold two types of assets: bonds and money. Agents' portfolios are balanced between these two assets at all times. When the monetary authority controls the quantity of money, therefore, it is also controlling the nominal interest rate in the market. In this so-called money view, banks are agents that issue demand deposit on the liability side of their balance sheet and hold bonds on the asset side of their balance sheet.[1]

In such a framework, monetary policy affects output only if movements in the nominal interest rate are translated into the real interest rate. If there is some level of price stickiness, changes in the nominal interest rate will induce movements in the real interest rate and thus affect real activity in the short run.

1. See Kashyap and Stein (1994) for a complete summary of the two different views of banks' role in monetary policy transmission.

In practice banks introduce a third type of asset: bank loans (Bernanke and Blinder, 1988). Bank balance sheet thus consist of three type of assets: money, bonds, and intermediated loans. Two conditions of the latter, in addition to price stickiness, now create a second channel for monetary policy transmission, namely, the bank-lending channel. These conditions are that bank loans and bonds are imperfect substitutes for both banks and borrowers and that the Central Bank must be able to use the monetary policy to affect the total supply of funds that are available for banks.

This section proceeds as follows. We first review the empirical and theoretical foundations of credit channel, together with the contribution of this volume's papers to the literature. We then discuss the role of banks for the money view and the contributions of the volume in this area.

1.1 Credit Channel: Theoretical Considerations

The empirical side of the bank lending channel hypothesis concentrates on how bank loans and other plausible substitutes react to monetary policy shocks. Evidence of the bank lending channel is found when commercial papers and bank loans are close substitutes (Kashyap, Stein, and Wilcox, 1993).

Bernanke and Gertler (1995) provide a well-organized view of the empirical relationship of monetary policy and aggregates variables that could not be explained using the traditional view of monetary policy. They divide the credit channel into the bank lending channel and the balance sheet effect. They argue, however, that bank lending is becoming less important as a channel for monetary policy transmission owing to changes in regulation, like the ending of Regulation Q, and increasing innovation in financial markets. Their study thus emphasizes the balance sheet effect, which operates through two complementary mechanisms. First, a monetary policy tightening increases interest expenses, reduces net cash flow, and weakens the financial position of firms. Second, an increase in the interest rate reduces the value of the borrower's collateral and, consequently, the borrowing ability of affected firms. In this mechanism, asymmetric information in financial market plays an important role.

Gertler and Gilchrist (1994) provide microeconomic evidence in favor of the above balance sheet effect. They study how small and large manufacturing firms react to a monetary policy shock. A monetary policy tightening causes sales, inventories, and short term debt to decline for small firms, but they remain unchanged for large firms. The authors conclude that financial factors are behind the difference between large and small firm behavior.

Gertler and Gilchrist's findings are closely related with the idea that financial factors will propagate the effect of a monetary shock. Bernanke, Gertler, and Gilchrist (1996) argue that a negative monetary shock will make external finance more expensive relative to funds raised internally; the difference between these two costs is the external finance premium. Since the net worth of the firm is inversely related to the external finance premium for a given amount of finance required, the shrink in the net worth will reduce the borrower's spending and production. This is the idea of the financial accelerator and the flight to quality, which hinges on the asymmetric information and agency cost features of the financial market. In practice this will mean that large publicly listed firms would be less exposed to the financial accelerator, and they will be the recipients of funds.

Bernanke, Gertler, and Gilchrist (1999) formalize this idea in a dynamic macroeconomic model characterized by asymmetric information and agency cost in the banking sector. Calibrating the model, they show that the financial accelerator mechanism amplifies the response of the aggregate variables to a monetary shock.

Following this theoretical avenue, Simon Gilchrist (in this volume) presents a model that shows the importance of the financial accelerator mechanism in a context of open economies. In his model the macroeconomic effects of a shock depend on the source of the shock and the leverage of the economy. The net worth of firms in a high-leverage economy is more sensitive to demand and supply shocks than is the net worth of firms in low-leverage economies. Shocks raise the external finance premium, which magnifies their effect.

This model would explain why a supply shock in a developed economy has such a large effect in developing countries. Gilchrist associates high-leverage economies with developing countries, which is the case in the recent Asian crisis. The transmission mechanism of the shock is the following. A negative supply shock in the developed country produces a negative demand shock in the developing country; this unexpectedly reduces the real return to capital and the net worth of assets. The effect on the net worth depends on the leverage of the economy. The inverse relationship between the net worth and the external finance premium predicts a reduction in investment and output. The impact of the shock on the net worth is magnified in the less developed economy, owing to the leverage associated to that economy.

With regard to the source of the shock, Gilchrist finds that a symmetric shock to disembodied technology in both countries introduces larger waves in output and investment than a similar shock to embodied technology. The presence of the financial accelerator magnifies the effect in both economies, but it is greater for the economy with higher leverage.

1.2 Credit Channel: Empirical Findings

Two papers in this volume deal with the empirical side of the relationship between monetary policy and macroeconomic aggregates. Angeloni, Kashyap, Mojon, and Terlizzese show similarities and differences in the monetary policy transmission in two large economies: the United States and the euro area. The aim of the paper is to contribute to a better understanding of the components of aggregate demand through which the monetary policy operates. The authors make an important effort to construct comparable data since the euro area only covers a five-year period.

Using VAR models under different specifications, they find that both economies show the same response in output and prices. Specifically, output in both economies has a hump-shaped response to a monetary shock, peaking sometime during the second year. Prices tend to react more slowly, but with a long-term deviation from the baseline situation and with no long-run effect on inflation. The most striking feature found, however, is the response of the different components of aggregate demand, which constitutes what the authors call the output composition puzzle. Briefly, the puzzle implies that in the U.S. economy the consumption-to-investment ratio tends to have a larger reaction than its European counterpart.

Angeloni, Kashyap, Mojon, and Terlizzese try to explain this puzzle based on a dynamic stochastic general equilibrium model with certain specific assumptions that capture what is observed in the data in terms of stickiness and inertia in the inflation rate. They argued that five parameters could explain the difference: the size of investment adjustment costs, the persistence in the interest rate induced by the central bank, the strength of habit persistence, the intertemporal elasticity of substitution, and the share of capital in the production function. However, the data show a much larger difference in consumption and investment reaction than could be accounted for in the model.

Finally, the authors find that investment response is similar in both economies and that the difference comes from consumption decisions.

They show evidence that disposable income is less sensible to monetary policy in the euro area than in the United States. They conjecture that the social benefits in Europe, which are much higher than in the United States, help to smooth the effect of monetary policy on disposable income and consumption.

The paper by Alfaro, Franken, García, and Jara (in this volume) focuses on the bank channel of the monetary policy transmission in Chile. They follow two methodologies. First, they use panel data to check how bank characteristics (size, liquidity, and capitalization) matter for the response of loan supply to movements in the monetary policy rate. Second, they estimate a VAR system to analyze a flight-to-quality hypothesis, by constructing a low/high quality ratio as the ratio of consumer loans to large firm loans.

From the first empirical exercise, they find that monetary policy tightening is consistent with a reduction in the growth rate of total loans, which favor the bank lending channel hypothesis. Bank characteristics may enhance or reduce this effect. For instance, in the case of consumer loans, capitalization and liquidity tend to reduce the effect of monetary policy on the supply of loans. In contrast, the derivative of commercial loans to monetary policy rate is only affected by liquidity. The authors read these results as evidence in favor of the bank lending channel, in the sense that monetary policy tightening operates against consumers and small and medium-sized enterprises (SMEs).

The second exercise produces evidence that monetary policy precedes the low/high quality ratio (in the Granger sense), while the latter statistically precedes macroeconomic activity. From the VAR itself, the authors find that a negative monetary policy shock immediately reduces the low/high quality ratio, which tends to favor the flight-to-quality effect explained above. Gross domestic product (GDP) declines two quarters after the negative shock, reaching its maximum decline one year after the shock. This effect is transitory, as expected. The estimated impulse response shows that if investment and durable consumption replace GDP, both variables decline almost at the same time (one and a half years after the monetary policy tightening).

1.3 Interest Rate Pass-through

The traditional channel of monetary policy does not take into account the banking sector as a vehicle for transmitting the interest rate. This sector is a key element, however, since a noncompetitive banking sector may not fully pass through or may delay the transmission of the changes in the monetary policy rate to borrowers. This will affect the effectiveness of monetary policy.

The importance of the banking sector for passing through the policy rate is studied indirectly by Hannan and Berger (1991), who model interest rate rigidity as a consequence of collusive behavior in the banking sector. Hannan and Berger provide a stylized model of monopolistic competition that illustrates how firms with market power change prices asymmetrically for ups versus downs.

On the empirical side, the comprehensive work of Cottarelli and Kourelis (1994) shows that the stickiness of the lending interest rate varies widely across the thirty-one countries included in the study. They fit a simple empirical model in which the lending rate is a function of contemporaneous and lag values of the money market rate, lags of the lending rate, and changes in the monetary policy rate. Their main finding is that the degree of interest rate flexibility increases with the elimination of capital flow restrictions, lower barriers to competition, private property in the banking industry, and the existence of short-term instruments. More competition implies a more flexible interest rate.

Several recent country case studies use this methodology; most find that stickiness varies inversely with the degree of competition and financial liberalization.[2] Other papers study specific countries, including Manzano and Galmés (1996) for Spain, Winker (1999) for Germany, and Moazzami (1999) for the United States and Canada. All of these find a certain degree of stickiness in the short run and a higher long-run pass-through coefficient. The type of borrowers, regulation, and changes in the level of competition seem to be the main determinants of interest rate flexibility.

In this volume, Espinosa-Vega and Rebucci compare the speed of the interest rate pass-through in Chile with that of Australia, Canada, New Zealand, the United States, and a group of European economies. They work with an auto-regressive distributed lag specification reparameterized as an error correction model with lending and deposit rates for different terms and denominations.[3] They find that Chile is not very different than these countries. In fact, the long-run

2. See Borio and Fritz (1995) and Mojon (2000) for cross-country comparisons.

3. One of the peculiarities of the Chilean economy is the existence of an indexed unit of account that is widely used in the financial sector for loans and deposit over ninety days.

coefficient is similar to that found in European economies and New Zealand, and somewhat smaller than in Australia, Canada, and the United States. The short-run adjustment was faster than in Australia, New Zealand, and Europe.

For Chile, Espinosa-Vega and Rebucci find no evidence of differences in the speed of instruments denominated in UF (the indexed unit of account) and pesos (nominal). Their work also shows no evidence of asymmetries in the speed of the interest rate pass-through for ups and downs of the monetary policy rate. This finding goes against the Hannan and Berger (1991) hypothesis.

The second paper on this topic, by Berstein and Fuentes, presents a country case study for Chile. The authors' goal is twofold. First, they explore how the banking interest rate responds to changes in the policy rate using aggregate data for the banking system, based on a dynamic model for the lending rate as a function of the money market rate. Second, they analyze whether the speed of adjustment depends on specific characteristics of individual banks. Here they estimate a dynamic panel data model assuming that the coefficient depends on certain bank characteristic, such as size, risk portfolio, and type of borrowers.

Using aggregate data, they find that the short-term pass-through coefficient is around 0.8 for both indexed and nominal interest rate. The long-term coefficient is larger, and the hypothesis of it being equal to 1 cannot be rejected. Large banks or large borrowers may influence these results, since the interest rate used is a weighted average of interest rates in individual banks, in which the weights are based on the size of the loan. An additional limitation is that this approach does not allow controlling for specific bank characteristics.

Next Berstein and Fuentes set up a very simple monopolistic competition model for the banking industry, deriving a mark-up equation for the equilibrium interest rate. The mark-up depends on the borrowers' demand elasticity and the repayment probability of the loan. They add to this structure a quadratic cost function faced by banks when they have to adjust the interest rate. The intuition for this is that if the debtors are too risky, the bank may not fully pass through a money market interest rate increase (in the short run) because it will stifle the debtors. In the long run, however, the interest rate charged will be according to the risk characteristic of the debtor (mark-up equation). They use this model to derive an empirical equation that allows for interaction between the determinants of demand elasticity and probability of repayment with the monetary policy interest rate.

Based on the panel data estimation, they conclude that the short-term pass-through coefficient is around 0.7. The short-term coefficient for the nominal rate depends negatively on the credit risk (measured as unpaid loans). The long-term coefficient is close to 1, and it is positively related to this proxy for credit risk. Both results are consistent with the theoretical model. The coefficients for the indexed interest rate are very similar in size. They are not consistent with the theoretical model, however, since a higher credit risk corresponds with a lower long-run pass-through coefficient.

2. Lender-Borrower Relationship

The interaction between monetary policy and the macroeconomic determinants of the functioning of the economy is review in the studies cited above, which emphasize the transmission of the monetary policy decision to macroeconomic aggregates and interest rates. The microeconomic determinants of an effective monetary policy transmission, in turn, depend crucially on certain aspect of the real/financial interaction between banks and the agents surrounding them. It is now widely recognized at a theoretical level that banks do play an important role in the economy through the provision of liquidity services, maturity transformation, and the pooling of risks (Freixas and Rochet, 1997). However, the very nature of their activities gives rise to frictions that can have real effects on the level of investment and growth. The main source of frictions in the banking industry arises from informational asymmetries.

García, Repetto, Rodríguez, and Valdés (in this volume) explore one source of distortion that could arise from informational asymmetry, investigating whether firm-bank relationships (measured by the duration of lending ties) and the actual bank concentration faced by the firm affect the access to bank financing. They explore the possible consequences of a given market structure faced by potential borrowers for the case of Chile over the 1990–1998 period. They postulate that the availability of credit should be greater if interactions between banks and their clients alleviate distortions generated by lack of information. A priori, multiple banking relationships are not prima facie beneficial for bank clients. Bolton and Scharfstein (1996) and Petersen and Rajan (1995) show that debt renegotiations become more complicated, and greater competition reduces the ability of banks to finance projects during bad times.

A number of studies capture the strength of the relationship between banks and their clients. Hoshi, Kashyap, and Scharfstein (1991) associate large industrial Japanese groups with weaker asymmetric information, finding that groups with weaker links to banks have difficult access to external finance. Others rely on the market assessments of rating agencies (Whited, 1992) or the concentration of ownership within the firm and the age of the firm as an indicator of transparency of information (Schaller, 1993). The latter finds that young firms and firms with more dispersed ownership face large funding costs from external sources. Asymmetric information can severely constrain access to credit among small and medium-sized firms, and it can also harm the efficiency of monetary policy transmission.

García, Repetto, Rodríguez, and Valdés find that low concentration, proxied by the number of banks with which the firm has formal contracts, has a positive impact on the volume of bank lending. In the case of Chile, the longer the duration of the relationship between a bank and a firm, the greater the access to credit from the banking system. Finally, a valuable contribution of their work is the interaction of two unique databases. The first dataset covers information on credit transactions between banks and their clients, including the fraction of outstanding and past-due loans, and the credit risk rating assigned by a bank to a particular credit. The information per customer is matched with data from a survey of manufacturing firms conducted annually by the National Bureau of Statistics.

3. The Impact of Foreign Banking Entry

This volume includes contributions that analyze the effects of foreign bank entry on the efficiency of the banking system and on macroeconomic activity. This section discusses issues related to how foreign bank entry may affect the volatility of aggregate activity. We then summarize contributions related to the importance of foreign bank for efficiency in the banking system, understood as bank margins.

3.1 Foreign Bank Entry and Macroeconomic Stability

Morgan and Strahan (in this volume) study whether foreign bank entry alters the economic volatility of countries or states where regulations that block entry are removed (economic volatility measured in terms of annual variations in output and investment). They consider the potential negative consequences of opening a banking system to foreign bank entry in terms of the resulting stability of economic activity and bank participation. The effect of foreign bank entry on local markets is relevant not only internationally, as in the case of many developing economies that have opened their banking markets, but also within national boundaries, as in the case of interstate banking in the United States.

The theoretical foundation for their work is based in Morgan, Rime, and Strahan (2003), who extend the macroeconomic model of Holmström and Tirole (1997). Integration of banking markets can have positive and negative consequences for economic volatility. The net effect is ambiguous. Assuming complete mobility of capital across states or countries, a capital squeeze in state (country) A will attract capital from state B if there are good lending opportunities, thereby dampening the impact on investment in state A. Banking allocation in state A will also attract investment by uninformed investors, enhancing the positive effect of integration. However, a collateral shock that has a negative impact on capital invested in country A causes bank capital to move to country B, because of the integration. The reduction in bank capital in country A lowers the level of investment in that country, together with the supply of investment by uninformed capital (large institutional investors).

This latter flight-to-quality effect serves to illustrate the impact of foreign bank presence, or financial service integration in general, on the design of monetary policy. Although collateral shocks are most likely to occur as a result of real shocks (earthquakes, plagues, and so forth), unexpected and large changes in monetary policy can also lead to a significantly decrease in the price of assets. Foreign bank presence can thus reinforce the monetary policy transmission mechanism. In isolated markets, unexpected increases in the monetary policy rate decrease the value of collateral, but this reduction is not enhanced by capital flights to other regions. Banking integration and the sort of dynamics suggested by Morgan and Strahan also highlight the importance of adequate tax and financial policy design, since ill-designed policies in the context of integrated markets can also cause a reduction of bank capital and investment in a country.

At the U.S. level, the authors find that the stabilizing influence of integration across states is large and statistically significant. There is also a positive effect of bank capital inflows on employment growth. The authors control for banking market concentration, since the evidence indicates that more concentrated markets tend to exhibit less capital volatility. They also control for some possible endogenous components of foreign bank entry and investment volatility.

At the international level, the authors use the share of bank assets held by banks with at least 50 percent foreign bank ownership as a measure of foreign bank integration. They control for banking market concentration as in the U.S. case, as well as for the share of foreign trade over GDP as a measure of integration. They employ instrumental variables to control for the potential endogeneity of the estimation owing to similarities in linguistic, institutional, and regional characteristics of the countries involved. Contrary to the U.S. case, the impact of bank integration on business volatility is quite low at the international level, and the relationship even has a positive sign in some model specifications. A tentative explanation that is explored by Morgan and Strahan suggests that collateral shocks tend to predominate at the international level. To confirm their hypothesis they regress the real growth of GDP and investment on the return on the stock market (as a proxy for entrepreneurial collateral) and the growth rate of bank capital. They find that foreign bank presence amplifies capital shocks in the sample of countries selected.

Morgan and Strahan's results point to a strong link between financial integration and the volatility of economic activity in developing economies. This stands as a word of caution for financial regulators in terms of following a blind path of integration; rather, they may need to perform a careful study of macroeconomic conditions before integrating into foreign banking markets. Certainly, Morgan and Strahan's results are not definitive, but given the potential implications, more research is needed in this area, particularly in light of the fact that government authorities continue to strongly promote commercial treaties.

3.2 Foreign Bank Entry and Bank Margins

The financial system is in charge of allocating resources from agents who supply funds to those who demand funds for investment. In this context bank margins or the bank spread is a key variable for measuring how efficient a banking system is in this resource allocation process. The need for financial intermediaries, which provide this service while charging a spread, is widely discussed in the literature. The early contributions emphasize transaction costs (Benston and Smith, 1976) or asymmetric information and the costs of information and monitoring (Leyland and Pyle, 1977; Campbell and Kracaw, 1980; Diamond, 1984, 1991; Haubrich, 1989). The more recent literature stresses risk management, transformation of financial risk, and provision of liquidity (Allen and Santomero, 1997, 2001; Scholtens and van Wensveen, 2000).

All these works justify the presence of financial intermediaries and the need for incurring such costs. Under competition, the bank margin should be high enough to pay for financial services plus the risk involved in banking activity. In a related area, a relatively new body of research addresses the impact of foreign bank entry on the domestic banking system. Clarke and others (2002) study the effect of foreign entry on different aspect of the domestic banking system. They conclude that the presence of these banks enhance efficiency. Claessens, Demirgüç-Kunt, and Huizinga (2001) and Jayaratne and Strahan (1996), for the United States, provide evidence that the existence of foreign banks reduces the profitability and margins of domestic banks. They argue that openness to foreign banks increases the contestability of the market.

This evidence is consistent with Levine (1996), who reports that the entry of foreign banks improves the quality and availability of financial services, increases competition, and stimulates the introduction of modern technologies and management tools. Based on extensive research in this area, Levine (1999) finds that the share of foreign bank assets is negatively correlated with the probability of crises in the incumbent markets.

In this volume, Ross Levine analyzes the impact of denying foreign bank entry on bank interest margins. The contribution of this paper is to measure foreign banks' access to the market rather than the degree of foreign bank participation. Levine also controls for the denial of domestic bank entry, to make sure that the barriers to entry are specifically against foreign banks. Otherwise the impediments to foreign bank entry would just be a proxy for barriers to entry in general. Levine uses a rich dataset of 1165 banks across forty-seven countries, controling for bank-specific and country-specific factors. He concludes that when a country tends to establish barriers to foreign bank entry, bank interest margins increase.

Levine uses instrumental variables to test the robustness of the results, since the entry of a foreign bank may also be determined by the margins. This exercise produces another interesting finding. As instruments, Levine chose variables that capture institutional characteristics. The regulation of foreign bank entry proves to be highly correlated with the institutional characteristics. This exercise confirms the previous finding that foreign bank entry increases the degree of contestability of the domestic market and reduces bank interest margins.

4. Market Concentration, Cross-ownership, and Pricing

Ahumada and Cetorelli (in this volume) review the potential benefits for banks stemming from the relationship in ownership with other financial intermediaries. Specifically, they focus on the Chilean market and study banks that have common ownership with pension fund administrators, the largest providers of external funding in the economy. Pension funds are required by law to diversify their portfolios. Nonetheless, the regulatory requirement for diversification forces pension fund administrators to invest a significant proportion of the funds in the domestic banking system. In addition, regulation restricts, but does not prohibit, the allocation of a proportion of the pension funds in a bank that belongs to the same financial group as the pension fund administrator. This link could generate a competitive advantage for banks related to pension funds in the market for deposits and loans.

Their work is partly based on Berger and Hannan (1989) and Hannan and Berger (1991). They thus control for market characteristics that could influence the pricing behavior of deposit and loans; in particular, they control for the market structure of the industry, proxied by the Herfindahl-Hirschman index of market concentration. They study whether banks with links to pension funds respond to changes in monetary policy differently than banks without such links, both in normal times and during the liquidity shock that the Chilean economy suffered in the aftermath the Asian crisis. Their work is further motivated by the concept of internal capital markets elaborated by Stein (1991) and subsequently extended to developing countries by Tarziján (1999). The latter argues that internal markets provide a tentative explanation for the rise of conglomerates in emerging markets, which are typically characterized by a weak institutional framework, an excessive number of regulations, and shallow capital markets.

The results obtained by Ahumada and Cetorelli indicate that, indeed, during the sample period banks benefited from the pension fund relationship. Related banks exhibited a larger deposit base and enjoyed higher spreads than unrelated banks. These results hold significantly during the liquidity shock, when affiliated banks grew in size and charged higher spreads while the other banks' spread narrowed. Nonetheless, the overall benefit associated with the existence of financial groups in Chile has fallen over time, since pension fund administrators have gradually been allowed to allocate their resources to foreign markets.

5. Taxation on Financial Intermediation: A Review

The issue of taxation of financial services might seem at odds with the other subjects in the volume. However, it is a critical complement of the different topics discussed at the conference, since distortions introduced by the tax structure have become the center of the financial policy debate on economic growth in the context of increasing global competition and integration of financial services. Honohan provides a detailed perspective on the approaches to policy recommendations on this subject, and he uses the theoretical foundations of this literature to analyze and diagnose the current situation in Chile.

Honohan begins by describing the general framework of financial services taxation reform as emerging from two powerful and conflicting perspectives. In one area are those who advocate a widespread simplification of the tax structure, in the form of a flat tax—such as a value-added tax (VAT) and zero taxation of capital income—or a universal transaction tax. Conventional wisdom in the taxation literature is that capital income taxation generates high efficiency costs, with very few offsetting benefits. In the opposing camp are the proponents of a myriad of corrective taxes designed to offset the market distortions that the financial sector is alleged to have derived mainly from informational deficiencies and market structure conditions. These corrective taxes include deposit insurance, provisions, and minimum capital requirements. Honohan points out that in practical applications, the two camps push their conflicting ideas, resulting in most countries in a tax system that challenges even the most complex rationalizations. The author concludes that the main practical implication of the debate on financial services taxation is that policy design should be guided by a *defensive approach*, in which taxes are implemented on the basis of their ability to resist arbitrage and their sensitivity to inflation surprises.

Honohan shows that Chile is no exception to the general observation that tax policy on financial intermediation is far from being an articulated body. The stamp tax on credit operations is the most characteristic lineament of the tax structure of the Chilean financial system. Introduced in the early 1980s, this tax encompasses all credit transactions related to credit operations, is levied over the capital borrowed, and is short-lived since it applies only to the first twelve months of the loan. Honohan, compares the level of different taxes applied on Chile with an equivalent value-added tax on each transaction, using, for example, a measure of spread to approximate the value-added of the banking industry in the case of the stamp tax. In all cases, the author finds that the equivalent VAT rates are, at best, twice as high as the current VAT rate of 19% for nonfinancial transactions.

The impact of the stamp tax on credit transactions is twofold. First, it complies fully with the defensive approach outlined by the author, in that it is immune to inflation and it limits severe arbitrage. Unlike a capital income tax, the stamp tax works fine against tax evasion, which might be a particularly useful feature in countries where the financial system is large but where, nonetheless, tax elasticities are low. Although critics point out that there are obvious ways to arbitrage this feature of stamp taxes, the evidence consistently shows that transaction taxes are surprisingly resilient as tools for government revenue collection, thereby raising doubts about their distorting effects on the financial sector.

In Chile, the design of the stamp tax generates a bias toward long-term credit, which causes a welfare loss for borrowers who might otherwise have had access to credit at a shorter term. In the same line of argument, other authors suggest that the stamp tax discourages borrower mobility; this could have an effect on monetary policy transmission, since borrowers do not renegotiate loans or change bank lenders to avoid paying the stamp tax. These criticisms have recently been taken into account by the Chilean economic authority, which has modified financial regulation to diminish the so-called bias in an effort to stimulate credit activity.

6. Deposit Insurance: A Review and Its Impact on Systemic Risk

Honohan (2003) postulates that explicit deposit insurance systems are corrective quasi-taxes implemented to neutralize informational deficiencies enshrined in the banking system. Demirgüç-Kunt and Kane (in this volume) broaden this perspective, pointing out that deposit insurance systems are part of the regulatory efforts of financial authorities to construct a safety net around the financial system. The safety net is a set of institutional arrangements designed to lower the probability of a systemic crisis and, given an episode of widespread instability, to minimize its costs. It comprises not only a deposit insurance system, but also a lender of last resort (a function typically performed by the central bank) and a set of supervisory practices and financial regulations.

The series of banking crises that occurred over the last twenty years left the certainty that they are costly and disruptive. Using alternative measures to approximate the direct and measurable costs of financial crisis, Demirgüç-Kunt and Kane illustrate that these costs exceeded 30% of GDP in Thailand and Korea and approached 50% of GDP in Indonesia. In the case of the 1982 Chilean banking crisis, the most accurate estimates of the losses incurred report figures around 35% of GDP (Sanhueza, 1999). Perhaps as a result of a natural defensive response from the financial policymakers, deposit insurance systems have grown rapidly in the last thirty years, from fewer than ten countries in 1965 to more than seventy countries in 1999, and still more are being implemented.

Implementing a deposit insurance system has been a primary objective of the safety net program in many countries. However, financial policy regulators face a difficult task in designing a deposit insurance system, since there seems to be a critical balance between protecting the integrity of the financial system and avoiding excessive risk taking by depository institutions owing to ill-structured schemes. The contribution of Demirgüç-Kunt and Kane to this volume provides a synthesis of recent work developed by these and other researchers, which clarifies how the design of a deposit insurance system affects banking crises, market discipline, financial development, and crisis management. The paper also evaluates the Chilean deposit insurance system and compares it with results from their cross-country study. The main finding of their work is that the instauration of an explicit deposit insurance system represents a danger in a weak institutional environment. The evidence shows that in that context, a deposit insurance system induces a downgrade in the monitoring of bank risk profiles.

On the issue of financial stability, Demirgüç-Kunt and Kane hold that the first impact of deposit insurance is to enhance the banking system, since it diminishes depositors' willingness to run on a bank in the event of a crisis. Moral hazard increases, however, when the deposit insurance system aims to protect small depositors. On average, deposit insurance systems increase the probability of a banking crisis when the government administers the system and when the system provides extensive coverage (see Demirgüç-Kunt and Detragiache, 2002).

On the issue of market discipline, the authors find that the absence of adequate monitoring that results from inadequate deposit insurance systems switches the responsibility for controlling bad bank behavior to supervisory institutions. These results highlight the importance of having a strong set of institutions (see Demirgüç-Kunt and Huizinga, 2004). Again, the design of the deposit insurance system is crucial for economic growth, since the perverse incentive created in weak institutional environments distorts real investment decisions, which delays rather than promotes financial development (see Cull, Senbet, and Sorge, 2004). Finally, the authors review the impact of blanket guarantees for a sample of forty crises around the world. Based on Honohan and Klingebiel (2003) they conclude that unlimited guarantees and liquidity support, together with indulgent behavior from regulatory authorities, significantly increase the costs of financial crises.

The Working Group on Deposit Insurance of the Financial Stability Forum (2001) reaches similar conclusions to those outlined by Demirgüç-Kunt and Kane. In particular, their Guidance for Developing Effective Deposit Insurance Systems recommends that an explicit, limited-coverage system is preferable to an implicit protection scheme. They further acknowledge that a deposit insurance system is built to deal with a limited number of bank failures, and it is not expected to cover the demand from depositors in the event of a systemic banking crisis. Nonetheless, the main public policy objective of a deposit insurance system is to contribute to the stability of the financial system and to protect small depositors. The emphasis should be placed on good corporate governance practices and sound risk management policies.

In the case of Chile, Demirgüç-Kunt and Kane observe that two characteristic of the Chilean financial system favor the application of an explicit deposit insurance: Chile features a high level of institutional development relative to other developing countries, and the banking market is highly concentrated. These two features should limit any adverse impact that an explicit deposit insurance system might have on the economy. In all, the current features of the deposit insurance system in Chile are favorably evaluated according to the empirical evidence presented in their previous work. First, the coverage of term deposits is low and imposes a form of coinsurance. Coverage per depositors is currently near $3,000 dollars. Second, the insurer of term deposits (the government) has no explicit reserve fund. Third, membership is compulsory, as is also recommended by the Financial Stability Forum. A downside of the current design, which the authors mention, is the full coverage of demand deposit by the Central Bank, despite the ceiling imposed on maximum coverage of 2.5 times basic capital; in a situation of financial instability, this could cause depositors to shift their term deposits into demand deposits.

As mentioned by Demirgüç-Kunt and Kane, the Chilean banking industry has become a very concentrated market. In 1995, the top five banks (out of a total of 36) held 49 percent of the market. Today, the largest five banks (out of 27) hold 71 percent of the market. The Herfindahl-Hirschman index of market concentration rose from 715 in 1995 to 1,290 in the third quarter of 2003. Cifuentes (in this volume) studies the impact of this consolidation process on the Chilean banking industry's safety net, in terms of both the functioning of the deposit insurance mechanism in place and the level of systemic risk.

Cifuentes (in this volume) begins with an overview of the main objectives and characteristics of deposit insurance systems. He makes some of the same remarks as Demirgüç-Kunt and Kane (in this volume) in their survey, emphasizing the role of deposit insurance in the prevention of bank runs and the protection of small depositors. Diamond and Dybvig (1983) provide the theoretical framework that justifies the construction of a credible system of protection for small depositors as a sustainable equilibrium in a market characterized by unstable conditions. Cifuentes defines credibility as a condition in which the deposit insurance system manages sufficient funds to cover a number of bankruptcies but not a systemic crisis.

However, if deposit insurance systems are not intended to help restore the intermediary role that banks perform in a systemic crisis, then what is the role of a deposit insurance system in a highly concentrated market with few actively operating banks? In this context, the failure of a large bank will probably generate a demand for reserve funds that the deposit insurance system is not able to meet, and the authorities will have to conceive solutions beyond the mere repayment of small depositors with the accumulated funds. Cifuentes suggests that in a very concentrated market with few banks, large depositors will be covered by a too-big-to-fail policy on behalf of the regulatory authorities. Levine (1999) and others point out that financial crises tend to occur less frequently in more concentrated markets, in which case the active use of the accumulated fund is less clear.

Cifuentes compares the degree of effective protection provided by the deposit insurance system in Chile and the United States, as the extreme cases of a country with a few banks and a country with a large number of banks. Cifuentes concludes that the effective protection—that is, the number of cases in which insured deposits are actually less than or equal to the deposit insurance fund—is much lower in the case of Chile than in the United States. Deposit insurance in a concentrated market like Chile is justified on the grounds of the representation hypothesis of Dewatripont and Tirole (1994). Customers could anticipate the application of the too-big-to-fail doctrine, causing a flight-to-size rather than the usual flight-to-quality phenomenon. Finally, the author considers that the participation of the public sector in the funding of the deposit insurance depends on the primary objective of the system. If the intention is to protect small depositors, funding should be privately afforded. Public funding could be justified if the deposit insurance system also serves to facilitate the liquidation of a financial institution in coordination with crisis resolution policies.

Cifuentes also addresses the issue of systemic risk and banking concentration. Systemic risk, defined as the failure of a large part of the banking system to perform its maturity transformation function, can arise from several sources (see Dow, 2000): contagion from insolvent banks that generates bank runs on solvent ones; trough interbank lending; a deterioration of asset prices owing to problems in a group of banks; and common shocks that weaken a large fraction of the banking system. Cifuentes, studies the implications of potential systemic risk stemming from interbank linkages, based on the theoretical foundations of Rochet and Tirole (1996) and Freixas, Parigi, and Rochet (2000).

Using the modeling framework of Eisenberg and Noe (2001), Cifuentes examines whether the increase in the concentration of the Chilean banking market has affected the system's fragility. He finds that systemic risk increases with the level of concentration owing to contagion, but regulations that restrict exposure to interbank lending as a function of bank size are successful in controlling the spread of systemic risk.

7. Concluding Remarks

This volume contains a number of macroeconomic and microeconomic works on the subjects of monetary policy transmission and the regulation of the banking industry. The reason to consider both issues in the same volume lies in the fact that some channels whereby monetary policy reaches the real sector hinges on the structure of the banking sector (barriers to entry, degree of competition, financial taxation, etc.)and on some informational distortions typically ascribed to the financial sector(lenders borrowers-relationship, ownership relations, etc.)

The structure of the volume combines empirical and theoretical contributions on issues that are relevant for Chile and other emerging economies. On the theoretical part we have learned how shock are transmitted internationally and how this strongly affect small open economies. It is argued in this volume that the effect depends on the economy's leverage and the presence of the financial accelerator mechanism as an additional force that propagate the strength of the shock.

On the empirical side the papers on monetary policy transmission show that the banks interest rates takes time to adjust to movements in the monetary policy rate in developed countries. Nonetheless, it is shown that Chile is not different from other countries (even developed ones) in terms of monetary policy rate transmission, and it tends to pass through the monetary policy rate rapidly. The international evidence presented here points the difference between the reaction of consumption and investment to monetary shock in the euro area and US. Some tentative and pioneer hypotheses are discussed here. Concerning Chile, there is evidence of how the credit channel has operated and the importance of the flight to quality hypothesis to explain the transmission of the monetary policy in this economy.

On issues related to the banking sector, the volume includes several contributions that concentrate on the regulatory constraints imposed on the industry based on the argument of its intrinsic vulnerability and the systemic repercussions of potential insolvency. The most prominent of these is undoubtedly the deposit insurance scheme, as part of a broader safety net constructed to dampen isolated banking crises. Among others regulations a paper in the volume review the tax structure levied on the banking industry and how this affect the functioning of the financial system.

Another important institutional aspect of the banking sector is the existence of barriers for foreign banks to entry in domestic capital markets. The work in this book show that financial integration reduces the economic Luisvolatility in different states in the US but the preliminary evidence point in the opposite direction for Latin America. Also, financial policies that emphasize foreign bank entry denial increases bank margins and reduce the efficiency of the banking system.

Finally, but no less important, the industry's market structure - in terms of either market concentration or interaction with related financial intermediaries - is shown to play a key role in several characteristics of the Chilean banking system. This microeconomic characteristic determine the interest rate charged by banks, the access to credit of small debtors and the spread obtained by the banks.

In summary, a common feature of the findings reported in these works is that regulatory distortions have an important effect on the efficiency and profitability of the banking industry. Whether we measure the spread from intermediation or the interest rates charged for traditional banking activities, the microeconomic structure has an effect on these variables. The natural question to pursue involves the effect of this regulatory and industry conditions on the transmission of monetary policy. Certainly, the evidence presented in this volume provides interesting venues for future research and policy implications.

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Financial Markets and Financial Leverage in a Two-country World Economy

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This paper explores the role of financial markets in the international transmission mechanism in the context of a two-country general equilibrium model. I incorporate realistic frictions with respect to the external financing of investment, and I calibrate these frictions to reflect important differences in lending institutions between developed and developing economies. To overcome these frictions, the paper focuses, in particular, on the role of leverage in transmitting shocks from developed economies to developing economies. The results imply that high-leverage economies are particularly vulnerable to external shocks, and that asymmetries between lending conditions across economies provide a strong source of transmission for shocks from developed to developing economies. Furthermore, slowdowns in economic activity are severely amplified by financial frictions. The model implies that the degree of amplification is directly related to the degree of leverage in the economy.

In many developing economies, firms face significant capital market imperfections when raising external funds to finance new investment projects. These frictions stem from underlying asymmetries of information between borrowers and lenders. To overcoming these frictions, lenders must either engage in costly monitoring activities or require significant levels of collateral when financing investment projects. In such an environment, fluctuations in world demand lead to fluctuations in asset values that influence the overall level of self-financing. A contraction in demand causes asset values and hence net worth to fall relative to financing needs. As a result, borrower

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balance sheets deteriorate, and financial intermediaries increase the premiums on external funds. Rising premiums on external finance cause further contractions in investment spending and output. In an international setting, shocks may be rapidly transmitted across countries owing to their effect on foreign asset valuations and thus on borrower net worth.

The lending mechanism outlined above represents a transmission channel linking balance sheet conditions to real spending decisions. Countries where the share of investment financed through external funds is high are likely to experience significant amplification of shocks through such a channel. This channel is also likely to be influential in countries where the health of the financial system is weak.

In this paper, I use the two-country model outlined in Gilchrist, Hairault, and Kempf (2002) to assess the role that leverage plays in transmitting shocks across countries. Gilchrist, Hairault, and Kempf specify a two-country world economy that incorporates the financial accelerator mechanism outlined in Bernanke, Gertler, and Gilchrist (1999). Céspedes, Chang, and Velasco (2000) and Gertler, Gilchrist, and Natalucci (2003) develop models of the financial accelerator for small open-economy settings under alternative exchange rate regimes. Devereux and Lane (2001) also study the role of the financial accelerator in small open economy settings. Natalucci (2001) considers a three-country model where two small economies interact with a larger "rest of the world" economy. Faia (2001a, 2001b) develops a two-country model similar to Gilchrist, Hairault, and Kempf, focusing on the positive and normative properties of different exchange rate regimes.

Section 1 presents a two-country model of the world economy. This model is a two-country variant of the dynamic new Keynesian framework specified in Gilchrist, Hairault, and Kempf (2002). To adapt this framework to study the links between financial conditions in developing economies and the international transmission of shocks, I modify the model in two key ways. First, I allow for incomplete markets in the household sector, which implies the realistic assumption of imperfect risk sharing between the two countries. Second, I allow for a significant degree of heterogeneity in the severity of balance sheet conditions across the two economies. Here I focus on one source of heterogeneity: the degree of leverage or, equivalently, the amount of self-financing. The specification of a world economy in which cross-country differences in financial performance reflect different degrees of leverage effectively focuses the study on what I consider to be the major source of financial vulnerability that plagues developing economies during international downturns—namely, weak balance sheets owing to over-extended credit positions.

An additional contribution of this paper is to provide a simplified and somewhat stripped down version of the Bernanke-Gertler-Gilchrist model that is relatively straightforward to calibrate and solve. In doing so, I assume away some of the steady-state complexities of the Bernanke-Gertler-Gilchrist model by assuming equal external finance premiums in steady state.[1]

I further simplify the dynamic analysis by assuming that entrepreneurs consume no resources and that the direct resource loss stemming from monitoring costs does not influence macroeconomic dynamics. The latter assumption is equivalent to assuming that although the marginal cost of external funds varies over the business cycle and has important macroeconomic consequences, the inframarginal costs associated with resources consumed by monitoring firms are unlikely to have quantitatively significant effects on the economy, at least in a neighborhood of the steady state.[2] This stripped-down version of the Bernanke-Gertler-Gilchrist model is both much simpler to work with and more straightforward to calibrate than the original. In particular, the financial frictions can be summarized by two key parameters: the elasticity of the premium on external funds with respect to leverage and the degree of leverage itself. Both of these parameters influence model dynamics in fairly obvious ways, and both parameters are also easily understood from a calibration perspective.[3]

Finally, I also extend the Bernanke-Gertler-Gilchrist framework to incorporate not only the usual shocks to demand and supply through shocks to preferences and disembodied technology, but also shocks to technology that are embodied in capital. My motivation for this extension is twofold. First, numerous recent papers attribute a large fraction of both overall technological change and the recent U.S. productivity

1. This may be formally justified by the introduction of steady-state subsidies that eliminate cross-country differences in capital-labor ratios owing to capital market distortions.

2. For large shocks, resources devoted to monitoring could be sizeable owing to the inherent nonlinearities in the contracting framework used by Bernanke, Gertler, and Gilchrist. Since the model is log-linearized, however, it does not capture such effects.

3. Although not reported here, a comparison of the fully articulated two-country version of the Bernanke-Gertler-Gilchrist model specified in Gilchrist, Hairault, and Kempf (2002) and the model employed in this paper produce only minor differences in model dynamics.

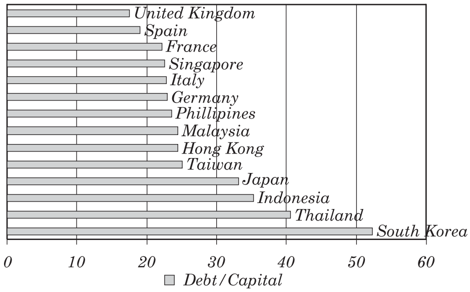
boom to technology embodied in new capital goods (Greenwood, Hercowitz, and Krussel, 1997; Gilchrist and Williams, 2002). It is interesting to study the role of such shocks in an international setting. Second, the dynamic implications of such shocks are less than straightforward in the presence of a financial accelerator. In particular, an increase in technology embodied in new capital raises asset prices through its effect on increased investment demand, but it lowers asset prices since existing capital is now worth less than new capital goods. In such a setting, the overall effect of an expansion in technology on the balance sheet is ambiguous.

1. Empirical Evidence on Cross-country Leverage Patterns

This paper focuses on the role of leverage in amplifying the cross-country transmission of shocks. The model implies that high-leverage economies are more prone to financial instability caused by the financial accelerator mechanism than are low-leverage economies. While formally testing this proposition empirically is beyond the scope of this paper, it is instructive to consider the variation in leverage ratios that occurs across countries. Faccio, Lang, and Young (2002) report leverage ratios for Asian versus European firms using a sample of 3,448 nonfinancial corporations for 1996, the year that preceded the Asian financial crisis (see figure 1). Asian country leverage ratios are, on average, 31.8 percent; the comparable number for European countries is 20.0 percent. With the exception of Japan, the Asian countries are all emerging market or newly industrialized countries. The three countries with the highest leverage ratios—Indonesia (35.3 percent), Thailand (40.6 percent), and South Korea (52.3 percent)—were hit particularly hard by the Asian financial crisis.

Similar results are obtained if the United States and other developed western economies are considered. It is harder to see a direct link between stage of development and leverage ratios, however, when the sample is expanded to include a broader base of countries from different regions. Based on the reported values in Booth and others (2001), some developing economies such as Mexico and Brazil appear to have relatively low leverage ratios, whereas others such as South Korea have extremely high leverage ratios. While many factors determine capital structure, it is plausible that an initial round of financial

Figure 1. Leverage Ratio: Asia versus Europe



Source: Faccio, Lang, and Young (2002, table 2).

liberalization and growth leads to increased indebtedness, making countries such as Indonesia, Thailand, and Korea particularly vulnerable to shocks that are transmitted across countries. It is this mechanism that I explore in the model developed below.[4]

2. A Two-country Model with Financial Accelerator

This section develops a general equilibrium framework that incorporates capital market imperfections into an international environment. I first specify a two-country model without financial frictions and then show how to incorporate financial frictions in a simple yet tractable manor. This framework allows me to analyze the effect of financial heterogeneity that characterizes financial markets in developed and developing economies. To focus on the effect of such heterogeneity, as well as to keep the analysis as simple as possible, I assume that the two countries are otherwise identical.

The main source of financial heterogeneity in the model is differences in cross-country leverage ratios. In the Bernanke-Gertler-Gilchrist framework, leverage is endogenous and reflects the deep parameters in the model that govern the costs of monitoring firms, the variance of unobservable shocks and the extent to which entrepreneurs discount the future relative to households. Indeed, numerical simulations of

4. Even within Europe, the countries with the highest leverage ratios over the 1981–91 period are Finland, Sweden, and Norway (Demirgüç-Kunt and Maksimovic, 1999). These countries were all subject to major contractions owing to financial instability during the late 1980s.

the steady state of the Bernanke-Gertler-Gilchrist model imply that leverage is directly increasing in the rate at which entrepreneurs fail for exogenous (nonfinancial) reasons. As entrepreneurs fail at a faster rate, their accumulated net worth is dissipated. The primary effect of raising entrepreneurial failure rates is thus to lower net worth and raise the amount of debt relative to equity held by the entrepreneurial sector. To the extent that developing economies have higher exogenous failure rates, I would expect them to have higher leverage ratios according to this logic.[5]

The core model corresponds to a two-country monetary economy under a flexible exchange rate regime. Given multiple currencies, it is necessary to convert all prices in to the same currency unit. I use the domestic currency, which introduces the nominal exchange rate, e, in the foreign representative household's optimization problem. The real value of any price is then expressed in the domestic composite good using the real exchange rate, $\tilde{A}$, for the foreign country real aggregates.

Both countries are similar in size and structure and are characterized by a continuum of agents of equal measure. Labor is immobile. Each country is specialized in the production of one good, but consumers in any country consume both goods. Consequently, there is trade across countries.

I assume incomplete markets: households have access to real and nominal bonds but do not have access to a complete set of contingent assets. There is imperfect competition on the good markets, allowing the introduction of nominal rigidities due to price contracts à la Calvo (1983).

2.1 Households

The representative infinitely lived household in each country chooses consumption, C, and leisure, L, where $1 - L = H$ is equal to

5. This suggests that it would be useful to consider the effect of allowing entrepreneurial failure rates to differ across countries and then study the dynamic implications of such an assumption. In a closed-economy setting, it is relatively straightforward to start from such deep parameters to determine steady-state leverage ratios and how economic responses might vary accordingly. In the two-country model, such an exercise is computationally intractable, however, because it produces differences in the steady-state capital-labor ratios across countries and leads to problems with numerical convergence. In addition, other model parameters contribute to higher leverage. Since my goal is to understand the effect of leverage on the economy, it is much more straightforward to manipulate the leverage ratio that enters the log-linearized model, rather than the deeper structural parameters that influence this ratio in a less direct manner.

the working period remunerated at a rate of w, which is expressed in terms of the good produced locally. Consumption, C, is a composite of the two goods indexed by 1 for the good produced in the domestic country and 2 for the good produced in the foreign country.[6]

$$C = \frac{C_1^{\gamma} C_2^{1-\gamma}}{\gamma^{\gamma}(1-\gamma)^{\gamma}} \cdot \tag{1}$$

Similarly, the composite good for the foreign consumers is defined as:

$$C^* = \frac{C_1^{*1-\gamma} C_2^{*\gamma}}{\gamma^{\gamma}(1-\gamma)^{\gamma}} , \tag{2}$$

with $\gamma \in [0, 1]$. I define a price index for the domestic country as

$P = P_1^{\gamma} P_2^{1-\gamma}$,

and for the foreign country as

$P^* = P_1^{*1-\gamma} P_2^{*\gamma}$,

with P_i (P_i*) being the price of the good i expressed in the home (foreign) currency. I assume throughout the paper that the law of one price holds.

Households are assumed to have access to international markets through one-period noncontingent bonds. To price the real interest rate, R, and the nominal interest rate, R^n, in each country, I assume the existence of noncontingent real claims, B, and nominal claims, B^n, traded in local financial markets.

The instantaneous utility, U, depends on three arguments: consumption, real balances, and leisure. The utility function is assumed to be separable:

$$U\left(C_t, \frac{M_{t-1}}{P_t}, L_t\right) = \exp(\upsilon_t)\log C_t + \theta_M \log\left(\frac{M_{t-1}}{P_t}\right) + \theta_H \frac{L^{1-\sigma}}{1-\sigma},$$

with $\theta_M > 0$, $\theta_H > 0$,

6. The foreign country variables are denoted by an asterisk.

where M_{t-1}/P_t is the present real value of the money stock transferred from the previous period and υ_t represents a preference shock that influences the marginal utility of consumption.

The representative household in the domestic country is assumed to maximize the expected discounted sum of its utility flows:

$$E_t\left[\sum_{t=0}^{\infty}\beta^t U\left(C_t, \frac{M_{t-1}}{P_t}, 1-H_t\right)\right],$$

subject to the budget constraint, denominated in local currency as

$$C_t + B_t + \frac{B_t^n}{P_t} + \frac{M_t}{P_t} \le R_{t-1}B_{t-1} + \frac{R_{t-1}^n}{P_t}B_{t-1}^n + \frac{M_{t-1}}{P_t} + W_t H_t + \frac{\tau_t}{P_t},$$

where τ is the total lump-sum transfers received by the domestic households from the monopolistic firms and from the central bank.

The first-order conditions for leisure, consumption, the real bond, and the nominal bond are[7]

$$\theta_H(1-H_t) = \lambda_t W_t \ , \tag{3}$$

$$u'_{C_t} = \lambda_t \ , \tag{4}$$

$$\beta E_t\left(\frac{\lambda_{t+1}R_t}{\lambda_t}\right) = 1 \ , \text{ and} \tag{5}$$

$$\beta E_t\left[\frac{\lambda_{t+1}R_t^n}{\lambda_t(1+\pi_{t+1})}\right] = 1 \ , \tag{6}$$

where π_t represents consumer price index (CPI) inflation.

The representative household in the foreign country maximizes the expected discounted sum of its utility flows:

$$E_t\left[\sum_{t=0}^{\infty}\beta^t U\left(C_t^*, \frac{M_{t-1}^*}{P_t^*}, 1-H_t^*\right)\right],$$

7. In what follows, I specify a monetary policy rule in terms of the nominal interest rate. Given that real balances are separable in the utility function, I can effectively ignore the first-order condition with respect to real balances.

subject to the following budget constraint, written in terms of domestic consumption goods as the numeraire:

$$\Gamma_t C_t^* + \Gamma_t B_t^* + \frac{e_t}{P_t} B_t^{n*} + \frac{e_t}{P_t} M_t^*$$
$$\leq \Gamma_t R_{t-1}^* B_{t-1}^* + \frac{R_{t-1}^{n*} e_t}{P_t} B_{t-1}^{n*} + \frac{e_t}{P_t} M_{t-1}^* + \Gamma_t w_t^* H_t^* + \frac{e_t}{P_t} \tau^*,$$

where e denotes the nominal exchange rate and Γ denotes the real exchange rate: $\Gamma = eP^*/P$.

The analogous foreign household first-order conditions are:

$$\theta_H (1 - H_t^*) = \lambda_t^* W_t^* \Gamma_t \ , \tag{7}$$

$$u'_{C_t^*} = \lambda_t^* \Gamma_t \ , \tag{8}$$

$$\beta E_t \left(R_t^* \frac{\Gamma_{t+1} \lambda_{t+1}^*}{\Gamma_t \lambda_t^*} \right) = 1 \ \text{, and} \tag{9}$$

$$\beta E_t \left[R_t^{n*} \frac{\Gamma_{t+1} \lambda_{t+1}^*}{\Gamma_t \lambda_t^* \left(1 + \pi_{t+1}^*\right)} \right] = 1 \ . \tag{10}$$

From equations (5), (6), (9), and (10), I obtain the Fisher formulas:

$$E_t \left[\left(\frac{\lambda_{t+1}}{\lambda_t} \right) \left(\frac{R_t^n}{1 + \pi_{t+1}} - R_t \right) \right] = 0 \ \text{ and} \tag{11}$$

$$E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \left(\frac{R_t^{n*}}{1 + \pi_{t+1}^*} - R_t^* \right) \right] = 0 \ . \tag{12}$$

I also have the arbitrage condition,

$$E_t \left(\beta \frac{\lambda_{t+1}}{\lambda_t} \right) = E_t \left(\beta \frac{\lambda_{t+1}^*}{\lambda_t^*} \right) , \tag{13}$$

which implies uncovered interest rate parity.

Production

The producers in both countries produce imperfectly substitutable goods with capital and labor. Each country specializes in the production of a single good. The production sector in each country is divided into a monopolistically competitive retail sector and a competitive wholesale sector. Wholesale firms are run by entrepreneurs who purchase capital and hire labor from households to produce a wholesale good that is sold to retail firms. Retail firms differentiate the wholesale goods at no resource cost and sell them to households. Given that the retailers are price setters, this structure allows the introduction of nominal rigidities while maintaining a constant-returns-to-scale assumption in the wholesale sector, which is necessary for aggregation when financial market imperfections are introduced.

The retail goods form the national composite aggregate that is converted into consumption and investment goods. The retail firm's price index defines the aggregate price level, P_1 and P_2*. Profits from retail activity are rebated in lump sum to households. I model nominal rigidities by means of the Calvo pricing assumption: a given retailer is free to change his price in a given period only with probability $1 - \zeta$. The retailer pricing decision implies the new Keynesian Phillips curve:

$$\pi_{1,t} = -\kappa\mu_t + \beta E_t\left(\pi_{1,t+1}\right),$$

where

$$\pi_{1,t} = \log\left(\frac{P_{1,t}}{P_{1,t-1}}\right) \text{ and}$$

$$P_{1,t} = \mu_t P_{1,t}^{w},$$

with μ denoting the mark-up and $P_{1,t}^{w}$ the price of the wholesale good produced in the domestic country. As usual in Calvo-style price contracts,

$$\kappa = \frac{(1-\zeta)(1-\zeta\beta)}{\zeta}.$$

The foreign condition is analogous:

$$\pi_{2,t} = -\kappa\mu_t^{*} + \beta E_t\left(\pi_{2,t-1}\right),$$

where

$$\pi_{2,t} = \log\left(\frac{P_{2,t}}{P_{2,t-1}}\right) \text{ and}$$

$$P_{2,t} = \mu_t^* P_{2,t}^w ,$$

with $P_{2,t}^w$ representing the price of the wholesale good produced in the foreign country.

With regard to wholesale firms, the wholesale goods are produced by entrepreneurs who combine physical capital and labor with a constant-return-to-scale technology:

$$Y_t = A_t K_t^{\alpha} H_t^{1-\alpha} \ . \tag{14}$$

Variable profits for good 1 are

$$v_1(K_t, a_t) = \max_{Ht} \frac{P_{1,t}^w}{P_t} Y_{1,t} - W_t H_t \ .$$

I assume that K_t is chosen one period in advance, while H_t is chosen in period t. Labor demand is thus determined by

$$\mu_t W_t = (1-\alpha) Z_t^{1-\gamma} \frac{Y_t}{H_t} \ . \tag{15}$$

with $Z = P_1/P_2$ being the terms of trade. Given labor demand, the representative wholesale firm purchases K_{t+1} units of capital at price Q_t, to maximize its expected sum of profit flows:

$$E_t V_1(K_{t+1}, A_{t+1}) = E_t\left[v_1(K_{t+1}, A_{t+1}) + Q_{t+1}(1-\delta)K_{t+1} - Q_t K_{t+1}\right].$$

Given constant returns to scale and Cobb-Douglas production, the ex post return on capital associated with these profit flows is

$$R_t^K = \frac{\left[\dfrac{\alpha Z_t^{1-\gamma}}{\mu_t} \dfrac{Y_t}{K_{t-1}} + (1-\delta) Q_t\right]}{Q_{t-1}} \ . \tag{16}$$

In the absence of capital market imperfections, the return on capital is equated to the risk-free return and hence satisfies the household Euler equation:

$$1 = \beta E_t \left(\frac{\lambda_{t+1}}{\lambda_t} R_{t+1}^K \right). \tag{17}$$

Wholesale firms in the foreign country solve a similar problem, resulting in analogous conditions:

$$\mu_t^* W_t^* = (1-\alpha) Z_t^{\gamma-1} \frac{Y_t^*}{H_t^*} \text{ and}$$

$$R_t^{K*} = \frac{\left[\frac{\alpha Z_t^{\gamma-1}}{\mu_t^*} \frac{Y_t^*}{K_{t-1}^*} \Gamma_t + (1-\delta) Q_t^* \Gamma_t \right]}{Q_{t-1}^* \Gamma_{t-1}}, \tag{18}$$

where arbitrage again implies

$$1 = \beta E_t \left(\frac{\lambda_{t+1}}{\lambda_t} R_{t+1}^{K*} \right), \tag{19}$$

with R_t^{K*}, the return of foreign physical capital, expressed in the domestic composite good.

In the absence of capital market imperfections, equations 17 and 19, combined with the household first-order conditions, imply that the expected return on capital is equalized across countries and is equal to the risk-free interest rate.

Capital Producers

I assume that investment in each country is an index of the two goods, 1 and 2, with the same structure as the consumption composite (equations 1 and 2). To allow for adjustment costs, capital evolves according to the following dynamic equation:

$$K_{t+1} = (1-\delta) K_t + \Phi \left(\frac{I_t}{K_t} \right) K_t .$$

The term $\Phi\,(I_t/K_t)\,K_t$ represents the production function for capital goods—the technology to convert I_t units of foregone consumption into capital. Consistent with an adjustment costs interpretation of $\Phi\,(I_t/K_t)$, I assume

$$\Phi'\left(\frac{I_t}{K_t}\right) > 0,\ \Phi''\left(\frac{I_t}{K_t}\right) < 0\,.$$

To keep the analysis simple, I assume a competitive sector of capital producers that take K_t as given (that is, it is external to the firm), and I choose the input, I_t, to equate marginal revenue and marginal cost:

$$Q_t = \frac{1}{\Phi'\left(\frac{I_t}{K_t}\right)}\,.$$

Assuming an identical structure in the foreign country, I obtain analogous conditions characterizing foreign capital accumulation and foreign asset prices:

$$K^*_{t+1} = (1-\delta)K^*_t + \Phi\left(\frac{I^*_t}{K^*_t}\right)K^*_t\,,$$

with

$$Q^*_t = \frac{1}{\Phi'\left(\frac{I^*_t}{K^*_t}\right)}\,.$$

In addition to influencing model dynamics in the absence of financial frictions, adjustment costs to capital cause fluctuations in asset prices—Tobin's Q will deviate from unity in the short run—which lead to fluctuations in net worth.

2.2 Monetary Policy Rules

To close the model, I assume that each country sets the nominal interest rate to target current inflation:

$$R^n_t = \rho_R R^n_{t-1} + \rho_\pi \pi_t \text{ and}$$

$$R^{n*}_t = \rho_R R^{n*}_{t-1} + \rho_\pi \pi^*_t\,.$$

The rule specified above may be viewed as a flexible inflation targeting rule. Since this paper focuses on the role of financial heterogeneity that likely characterizes developed versus developing economies, I make the simplifying assumption that both countries follow the same policy rule.

2.3 Embodied Technological Change

The model can be modified to incorporate embodied technological change by letting θ_t serve as the technology index. In this framework, it is necessary to distinguish between physical capital and effective capital units. I redefine the production function as

$$Y_t = A_t H_t^{\alpha} \left(K_t^{\theta}\right)^{(1-\alpha)},$$

where K_t^{θ} denotes effective capital units that evolve according to

$$K_t^{\theta} = (1-\delta)K_t^{\theta} + \theta_t^{1/(1-\alpha)} \Phi\left(\frac{I_t}{K_t}\right) K_t \, .$$

In the above expression, the term I_t/K_t is a ratio that is expressed in comparable units and is therefore stationary over time. A rise in θ_t thus acts like a technology shifter for the capital-goods-producing sector, lowering the effective cost of new capital goods. The production structure for the foreign sector is adjusted in an analogous manner.

2.4 The Log-linearized Model and Calibration

In the absence of capital market imperfections, the resulting system of equations that describes equilibrium can be specified in log-linearized form. These equations are provided in the appendix. To calibrate the model, I set $\beta = 0.99$, and $\delta = 0.025$. I set the capital share $(1 - \alpha) = 0.5$, which is somewhat high by developed country standards but reasonable for developing countries. I set the degree of openness $\gamma = 0.65$, which implies 35 percent imports in steady state. The elasticity of labor, denoted as eta (η) in the appendix, is set equal to 3, while the markup is set equal to 10 percent. The probability of changing prices is assumed to be 0.5. I set the steady-state elasticity of capital production, $\phi = \Phi''(\delta)/\Phi'(\delta) = 2$, allowing for a moderate degree of adjustment costs, and further assume that $\Phi(\delta) = \Phi'(\delta) = 1$, so that $Q_t = 1$ in steady state. The monetary policy rule sets $\rho_R = 0.9$, and $\rho_\pi = 0.2$, a moderate degree of inflation targeting.

2.5 Financial Market Imperfections

A convenient way to formalize financial frictions is by introducing a financial accelerator, as in Bernanke, Gertler, and Gilchrist (1999). The key mechanism involves a negative link between the external finance premium, *s* (the difference between the cost of funds raised externally and the opportunity cost of funds internal to the firm), and the net worth of borrowers, *N* (defined as the liquid assets plus collateral value of illiquid assets less outstanding obligations).

The inverse relationship between external finance premiums and the strength of the balance sheet arises because when borrowers have little wealth to contribute to project financing, the potential divergence of interests between the borrowers and the lenders is greater, implying increased agency costs. In equilibrium, lenders must be compensated for higher agency costs by a large premium. Because borrower net worth is procyclical through the behavior of profits and asset prices, the financial accelerator enhances swings in borrowing and thus in investment, spending, and production.

In the presence of the financial accelerator, equations 17 and 19 are modified to allow for a premium on external finance, *s*, that is due to the existence of monitoring costs:

$$E_t\left[\beta\frac{\lambda_{t+1}}{\lambda_t}\left(R_{t+1}^{k} - s_t R_t\right)\right] = 0 \text{ and} \tag{20}$$

$$E_t\left[\beta\frac{\lambda_{t+1}}{\lambda_t}\frac{\Gamma_{t+1}^{*}}{\Gamma_t^{*}}\left(R_{t+1}^{*k} - s_t^{*} R_t^{*}\right)\right] = 0\,. \tag{21}$$

The external finance premium is negatively related to the share of the capital investment that is financed by entrepreneurs' own net worth:

$$s_t = S\left(\frac{Q_t K_t}{N_t}\right) \text{ and} \tag{22}$$

$$s_t^{*} = S\left(\frac{Q_t^{*} K_t^{*}}{N_t^{*}}\right). \tag{23}$$

It can be shown that the function, S, is strictly increasing and convex over the relevant range (see Bernanke, Gertler, and Gilchrist, 1999).[8]

The evolution of entrepreneurial net worth, N_t, reflects the equity stake that entrepreneurs have in their firms. In particular, entrepreneurs borrow $Q_{t-1}K_{t-1} - N_{t-1}$ at an expected interest rate of $E_{t-1}\{R_t^K\} = s_t R_t$ and receive the ex post return, R_t^K. Net worth evolves according to

$$N_t = R_t^K Q_{t-1} K_{t-1} - E_{t-1} R_t^K \left(Q_{t-1} K_{t-1} - N_{t-1}\right) . \tag{24}$$

An analogous condition is obtained for the foreign country:

$$N_t^* = R_t^{*K} Q_{t-1}^* K_{t-1}^* - E_{t-1} R_t^{*K} \left(Q_{t-1}^* K_{t-1}^* - N_{t-1}^*\right) . \tag{25}$$

Log-linearizing these expressions results in two additional equations per country to be added to the dynamic system. For the domestic economy, letting lower-case values denote log-deviations, these equations are

$$s_t = \chi\left(q_t + k_t - n_t\right) \text{ and} \tag{26}$$

$$n_t = \left(\frac{1}{n_k}\right) r_t^k - \left(\frac{1 - n_k}{n_k}\right)\left(s_{t-1} + r_{t-1}\right) + n_{t-1} , \tag{27}$$

where

$$s_t = E_t\left(r_{t+1}^k\right) - r_t . \tag{28}$$

For the foreign economy, the equivalent expressions are

$$s_t^* = \chi^*\left(q_t^* + k_t^* - n_t^*\right) \text{ and} \tag{29}$$

$$n_t^* = \left(\frac{1}{n_k^*}\right) r_t^{*k} - \left(\frac{1 - n_k^*}{n_k^*}\right)\left(s_{t-1}^* + r_{t-1}^* + \Delta\gamma_t\right) + n_{t-1}^* , \tag{30}$$

8. See Bernanke, Gertler, and Gilchrist (1999) for a precise presentation of the properties of this stochastic variable and for the derivation of the optimal financial contract.

where

$$s_t = E_t\left(r_{t+1}^k\right) - r_t \ ,$$

and $\gamma_t = \log(\Gamma_t)$ is the log-real exchange rate.

I then rewrite the net worth expression for the domestic economy:

$$n_t = \left(\frac{1}{n_k}\right)\left[r_t^k - E_{t-1}\left(r_t^k\right)\right] + \left(s_{t-1} + r_{t-1} + n_{t-1}\right) . \tag{31}$$

The second term in this expression is the expected return on net worth held by entrepreneurs last period. The first term is the surprise in net worth owing to fluctuations in the ex post return on capital. Such surprises are primarily determined by fluctuation in asset values rather than by fluctuations in the marginal revenue product of capital. The surprise in asset values has an effect on net worth that is inversely proportional to the degree of self financing, $(1/n_k) = K/N$. Leverage, $(K - N)/N = (1/n_k - 1)$, thus plays a key role in propagating shocks to this economy.

To calibrate the model, I assume that credit frictions have no impact on steady-state behavior. This can be justified by the assumption that governments provide fiscal subsidies to capital as a factor of production to eliminate the average distortion created by credit frictions. To determine dynamics, I then need to choose two parameters: χ, the elasticity of the premium on external funds with respect to leverage $(q_t + k_t + n_t)$; and $n_k = N/K$, the degree of self-financing, or equivalently $(K - N)/N$, the leverage ratio, defined as the steady-state debt-equity ratio.

To determine the steady-state value of χ, I rely on the calibration used in Bernanke, Gertler, and Gilchrist (1999), which suggests numbers on the order of 0.05 to 0.066 based on realistic values for monitoring costs and bankruptcy rates. I accordingly set $\chi = \chi^* = 0.065$, implying that a 1 percent reduction in net worth relative to capital expenditures leads to a 6.5 basis point increase in the premium for external funds. Raising χ increases the amplification obtained from the financial accelerator. By choosing 0.065, the model delivers an external premium response to net worth that is slightly high for developed economies but very reasonable for a developing economy. To avoid numerical difficulties in the simulation, I constrain the elasticities to be equal across countries.[9]

With regard to choosing n_k, note that debt-equity ratios for the U.S. economy are on the order of 0.8. For high-leverage economies such as Korea, the debt-equity ratio is on the order of 60–70 percent higher than U.S. ratios. I therefore set $n_k = 0.7$ and $n_k^* = 0.4$ as reasonable values for the low-leverage and high-leverage economies, respectively.[10]

3. The Role of the Financial Accelerator in the International Propagation of Shocks

I start by considering the effect of a reduction in the level of disembodied technology relative to trend (a decrease in A_t) in the domestic country. I then trace out the effect of this contraction on the world economy. Figures 2 through 5 plot the impulse response functions of variables of interest to this shock. In each plot, the solid line represents the model response in the presence of the financial accelerator, while the dashed line represents the response without the financial accelerator.

An α percent reduction in A_t represents a negative supply shock to the domestic economy and a negative demand shock to the foreign economy. In the absence of a financial accelerator mechanism, domestic output falls by less than the size of the shock, as labor rises slightly in response to the negative wealth effect. The contraction in output causes a reduction in domestic consumption and investment, a fall in the real interest rate, and a rise in inflation.

In the model without the financial accelerator, the contraction in the domestic economy causes a depreciation in the domestic terms of trade, an appreciation of the foreign currency, a slight reduction in foreign output and labor, and a drop in foreign consumption. The

9. In the two-country model, I am unable to obtain convergence if the degree of heterogeneity in financial markets is severe. Because I am more interested in the effect of leverage on the economy, I constrain the elasticities to be equal and allow leverage to vary. Model simulations that constrain leverage and allow the elasticity to vary also produce qualitatively interesting asymmetries across the two countries, but they are less interesting from a quantitative perspective.

10. Again, numerical issues limit my ability to allow financial conditions to diverge too much across countries and still obtain a stable numerical solution to the two-country model. These numbers are reasonably consistent with the debt-capital differentials between European and Asian countries reported above.

cross-country transmission mechanism through standard expenditure-switching channels is modest, however.

Figure 2. Effect of an Asymmetric Shock to Disembodied Technology on Output and Labor

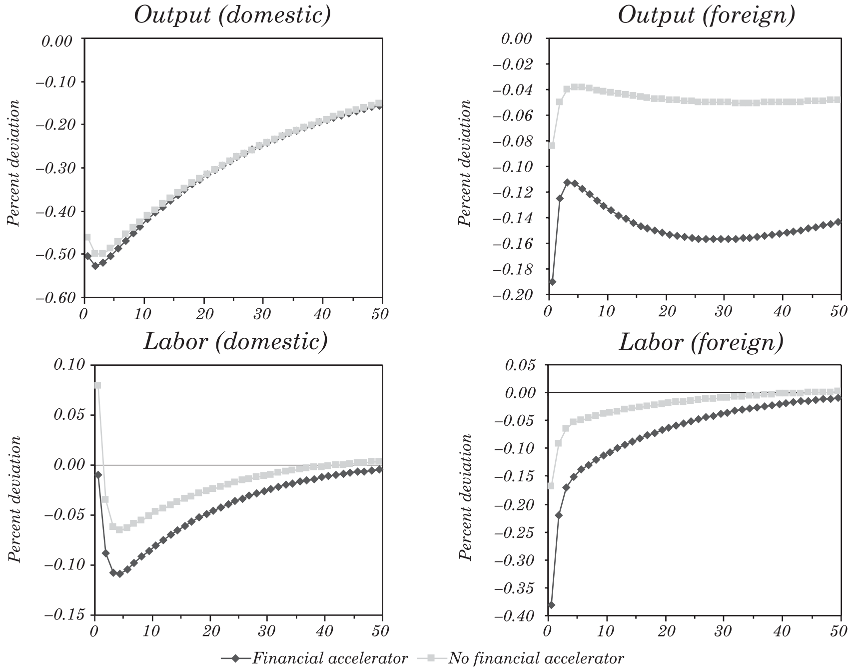


Figure 3. Effect of an Asymmetric Shock to Disembodied Technology on Consumption and Investment

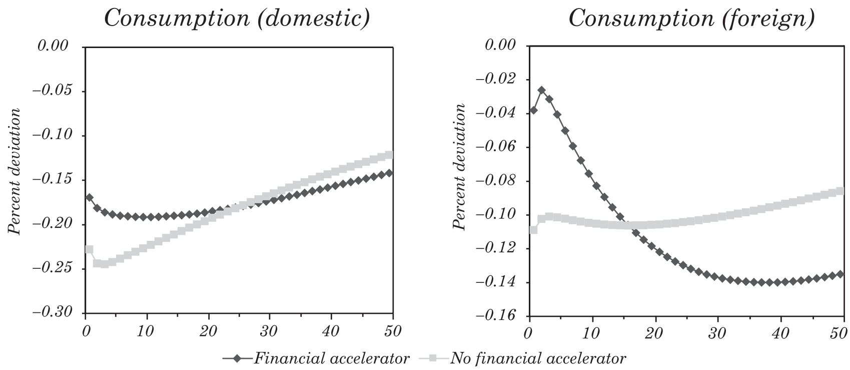


Figure 3. (continued)

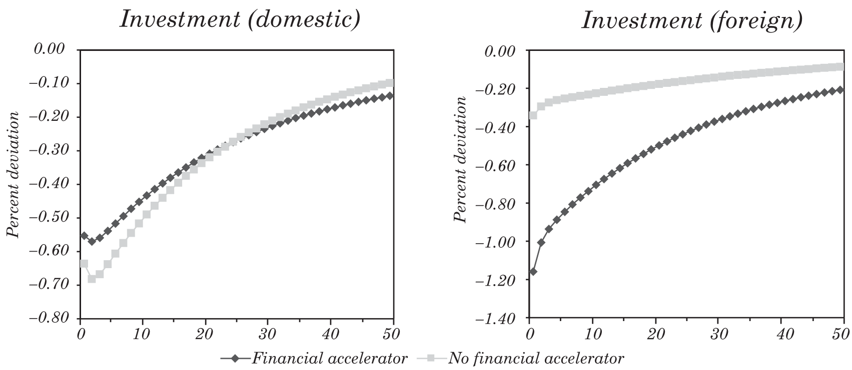


Figure 4. Effect of an Asymmetric Shock to Disembodied Technology on the Real Interest Rate and the Finance Premium

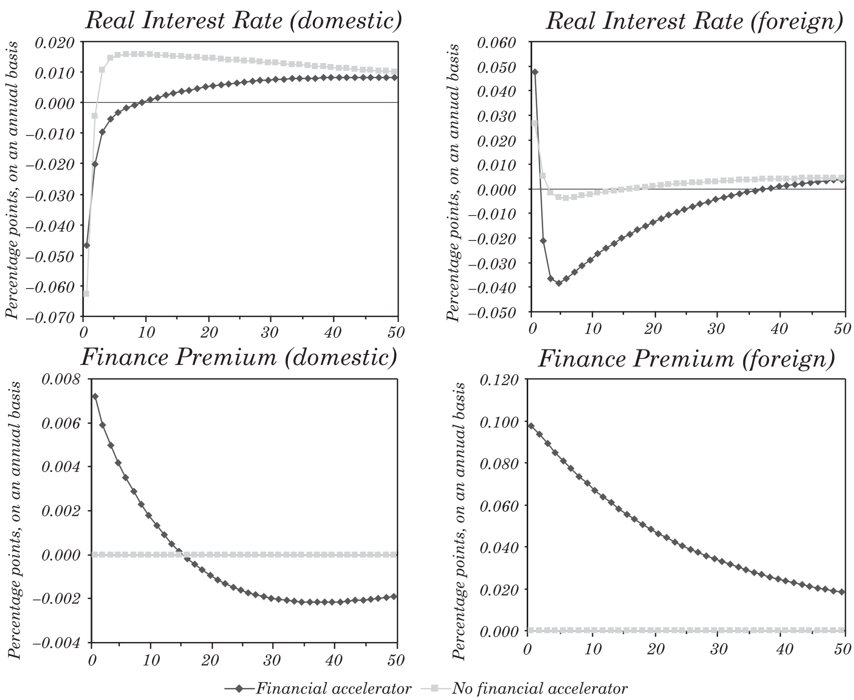
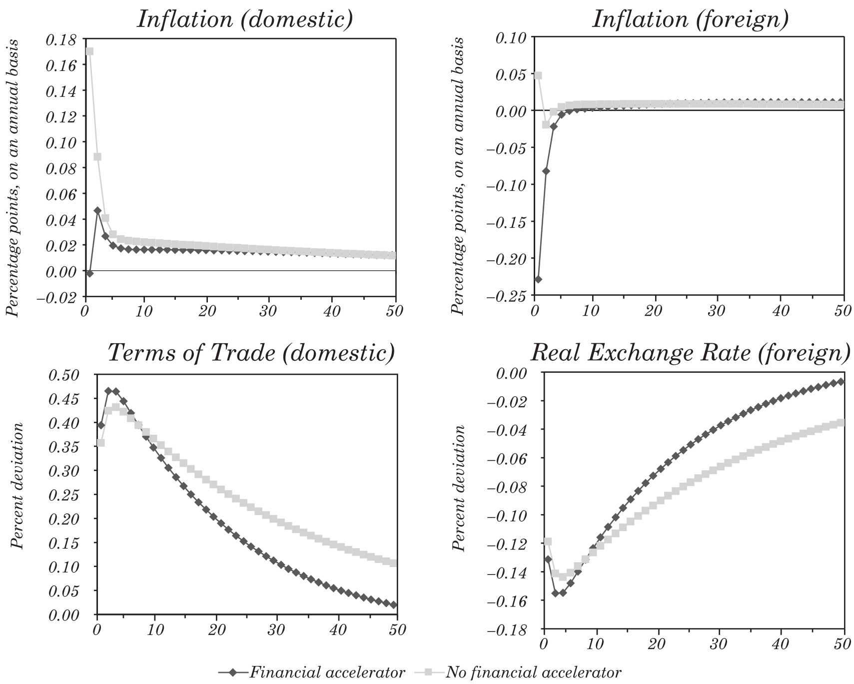


Figure 5. Effect of an Asymmetric Shock to Disembodied Technology on Inflation and the Terms of Trade



In the model with the financial accelerator, the cross-country transmission mechanism is greatly enhanced. The reduction in foreign output and labor is double the response of that obtained in the model without the financial accelerator. The source of this transmission mechanism is the 10 basis point rise in the premium on external funds. As world output falls, domestic and foreign asset values contract, and net worth falls relative to investment spending. The premium on external funds increases as a result, causing an even greater contraction in investment and output.

The primary effect of the financial accelerator is to transmit the shock from the domestic country to the foreign country. This transmission reflects the fact that the foreign country has higher leverage and therefore a stronger financial accelerator mechanism. The high leverage of the foreign country implies that a shock to domestic supply is transmitted partially as a reduction in foreign aggregate demand

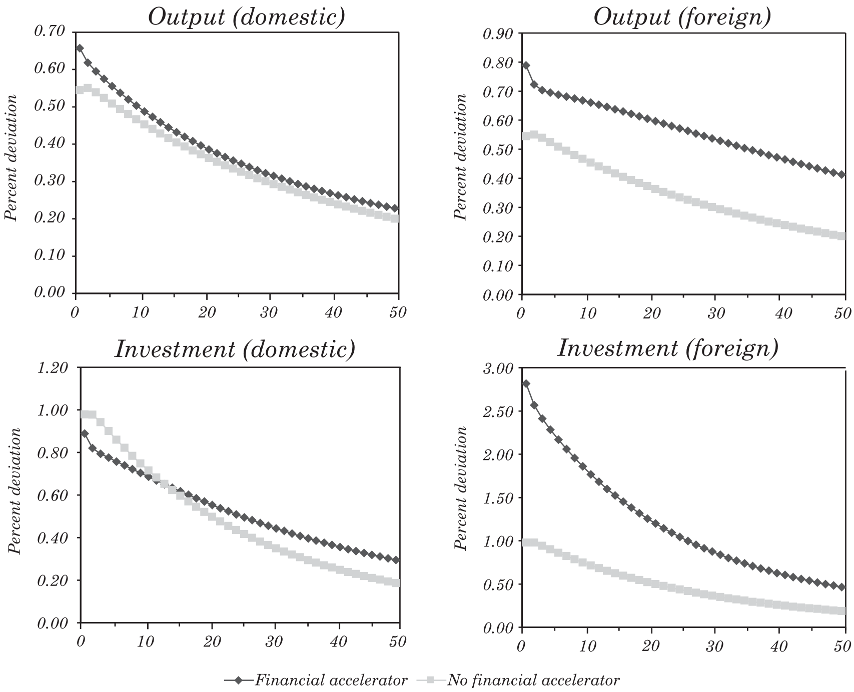
and partially through a change in the effective price of consumption relative to investment. The relative price effect occurs because a rise in the foreign external finance premium increases the cost associated with foreign investment goods relative to foreign consumption goods. The contraction in foreign investment is twice as large as the contraction in domestic investment, despite the fact that the domestic economy received the negative supply shock. Owing to the strength of the cross-country transmission, the reduction in domestic output is actually less with the financial accelerator than without it. Overall, these findings imply that the financial accelerator provides a strong cross-country transmission mechanism and that leverage is a key determinant of the overall strength of the transmission mechanism.

The role of leverage in the transmission channel is explored through symmetric shocks to the world economy. In the exercises that follow, the response of the domestic and foreign economies differs only because the foreign economy has higher leverage and therefore a stronger financial accelerator. This exercise incorporates three separate shocks: a shock to disembodied technology, a shock to preferences, and a shock to embodied technology. The first shock is a positive supply shock of the type usually associated with a worldwide boom in productivity. The second shock represents a demand shock that raises desired consumption spending. The third shock is also a supply shock, but this time it occurs through a reduction in the effective price of capital goods in the world economy. Such a shock is arguably more closely related to the positive supply shocks that have produced recent gains in productivity in the U.S. economy.

Figure 6 plots the effect of the symmetric shock to disembodied technology. In the absence of a financial accelerator mechanism, this shock has the familiar dynamics of a disembodied technology shock in a closed-economy framework. The boom in technology causes an immediate increase in output and hours, an increase in consumption, and a rise in investment as the world economy seeks to smooth the benefits of the shock through increased capital accumulation.

The increase in disembodied technology is magnified by the financial accelerator. The magnification effect is stronger for the foreign economy. The differential response between the domestic and foreign economies is solely due to the different degrees of leverage in both economies. The high-leverage foreign economy experiences a large increase in output (30 percent greater) and an even larger increase in investment (150 percent greater) relative to the model without the financial accelerator mechanism. Interestingly, the financial accelerator has only a modest impact on output and investment in

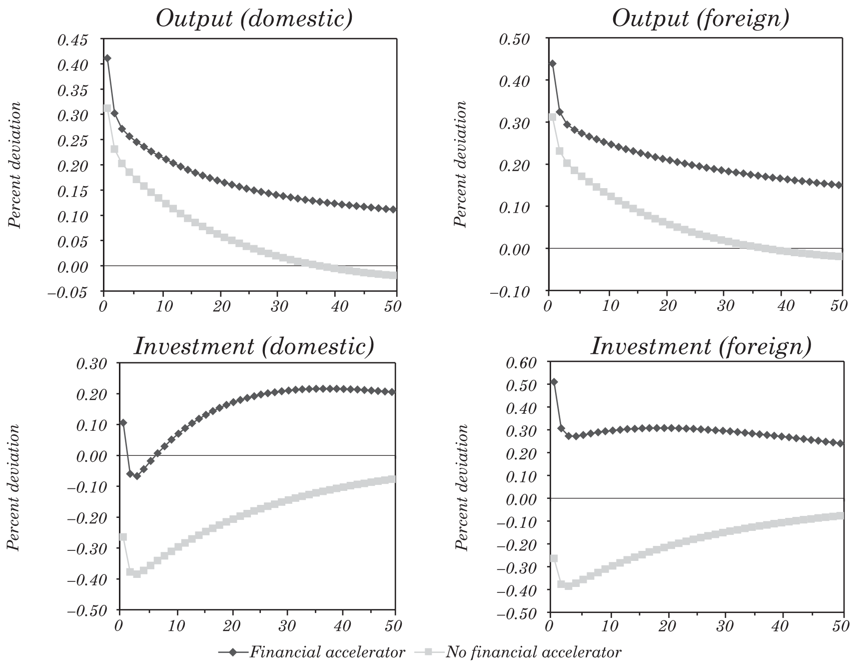
Figure 6. Effect of a Symmetric Shock to Disembodied Technology



the low-leverage economy. These results again confirm the key role that leverage plays in the transmission of supply shocks.

Figure 7 plots the response of investment and output for the domestic and foreign economies to a shock to preferences (υ_t). Again, I assume that the shock is autocorrelated with an autocorrelation coefficient of 0.95. In the absence of the financial accelerator, this shock raises consumption demand relative to investment demand, causing an expansion of output but a contraction in investment. In the presence of the financial accelerator, the positive demand shock reduces the premium on external funds, causing a boom in investment in the high-leverage foreign economy. The falling premiums imply that world output is substantially higher in the model with the financial accelerator than in the model without. There is very little difference in the level of output between the high- and low-leverage economies,

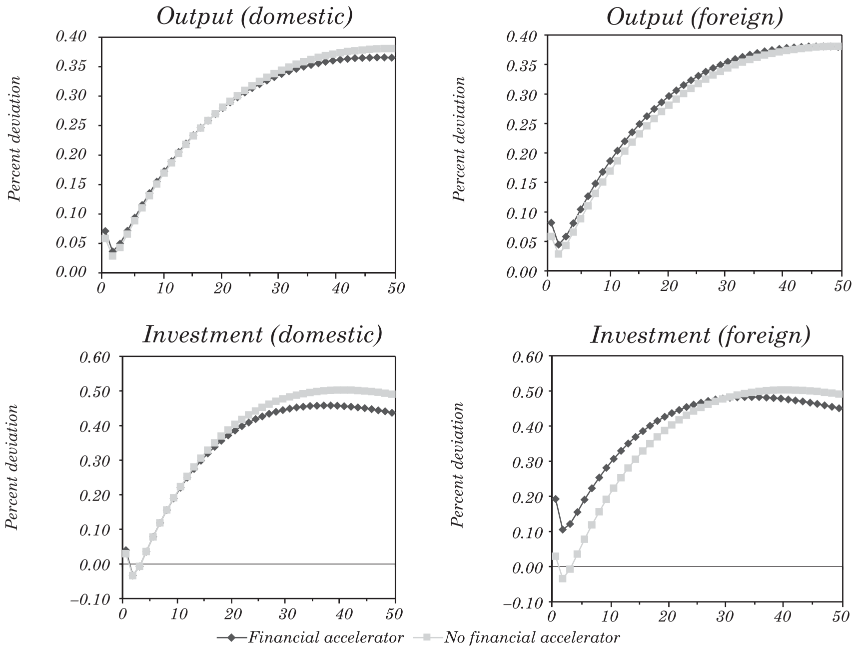
Figure 7. Effect of a Symmetric Shock to Preferences



however. Again, this finding can be associated with a relative price effect. The large reduction in the foreign premium on external funds leads to a switch away from investment goods and toward consumption goods in the low-leverage economy. The opposite occurs in the high-leverage economy. As a result, domestic households benefit more than foreign households in response to a worldwide increase in demand.

The final exercise considers an increase in technology embodied in capital goods. These results are presented in figure 8. Again, the shock is symmetric, but the responses across the two countries differ owing to the degree of leverage and hence the severity of financial constraints. In the absence of financial market imperfections, an increase in embodied technology is equivalent to a reduction in the price of new investment goods. Because the shock is persistent, the positive wealth effect limits the expansion of output, hours, and investment spending in the short run. Over time, output rises as the existing capital stock reflects the newer, more productive technologies.

Figure 8. Effect of a Symmetric Shock to Embodied Technology



Investment tracks output along the path, keeping the investment output ratio relatively constant.

In the presence of the financial accelerator, the reduction in new capital goods prices has very little effect on the premium for external funds. Again, there are offsetting effects. The positive shock to technology raises demand for new investment goods, but it has very little effect on net worth. The intuition here is straightforward. An increase in investment demand raises the value of capital in place and hence of net worth. A reduction in the price of new investment goods reduces the value of existing assets relative to new investment, however, causing a deterioration in net worth. These two effects largely cancel each other. In effect, the advent of the new technology reduces the value of capital in place and dampens the financial accelerator. The financial accelerator thus does not substantially alter the dynamic response of either the domestic or foreign economy.

4. Conclusion

This paper develops a fully articulated model of a world economy with two countries and a financial accelerator mechanism. The financial accelerator provides a strong cross-country propagation mechanism: a slowdown in output relative to trend in the financially developed economy causes a contraction in asset values, rising external finance premiums, and a slowdown in economic activity in the developing economy.

The severity of the slowdown is directly tied to the health of the developing economy's balance sheet, as measured by the degree of leverage in the economy. The results in this paper suggest that reasonable differences in leverage across countries provide quantitatively significant variations in response to worldwide shocks to demand and supply. The strength of the financial accelerator depends on both the degree of leverage and the source of the shock. In particular, supply shocks that are specific to the capital sector, owing to embodied technological change, are less destabilizing than supply shocks that affect the entire production structure.

APPENDIX

The Log-linearized Model

Log-linearizing the model results in the following system of equations:

A.1 Resource Constraints

$$y_t = a_t + \alpha h_t + (1-\alpha) k_t^{\theta}$$

$$k_t = (1-\delta) k_t + \delta i_t$$

$$k_t^{\theta} = (1-\delta) k_t^{\theta} + \frac{\delta}{1-\alpha}\theta_t + \delta i_t$$

$$y_t^* = a_t^* + \alpha h_t^* + (1-\alpha) k_t^{\theta *}$$

$$k_t^{*\theta} = (1-\delta) k_t^{*\theta} + \frac{\delta}{1-\alpha}\theta_t^* + \delta i_t^*$$

$$k_t^* = (1-\delta) k_t^* + \delta i_t^*$$

A.2 Household First-order Conditions

$$\lambda_t = -c_t + \nu_t$$

$$h_t = \eta(w_t + \lambda_t)$$

$$\lambda_t - E_t \lambda_{t+1} = r_t$$

$$\lambda_t^* = -c_t^* - \gamma_t + \nu_t^*$$

$$h_t^* = \eta(w_t^* + \lambda_t^*)$$

$$\lambda_t^* - E_t \lambda_{t+1}^* = r_t^* + E_t(\Delta \gamma_{t+1})$$

A.3 Foreign versus Domestic Demand

$$c_t = \gamma c_{1,t} + (1-\gamma)c_{2,t}$$

$$i_t = \gamma i_{1,t} + (1-\gamma)i_{2,t}$$

$$i_{1,t} = i_{2,t} - z_t$$

$$c_{1,t} = c_{2,t} - z_t$$

$$y_t = \gamma\left(\frac{c}{y}\right)c_{1,t} + (1-\gamma)\left(\frac{c}{y}\right)c^*_{1,t} + \gamma\left(\frac{i}{y}\right)i_{1,t} + (1-\gamma)\left(\frac{i}{y}\right)i^*_{1,t}$$

$$c^*_t = \gamma c^*_{1,t} + (1-\gamma)c^*_{2,t}$$

$$i^*_t = \gamma i^*_{1,t} + (1-\gamma)i^*_{2,t}$$

$$i^*_{1,t} = i^*_{2,t} - z_t$$

$$c^*_{1,t} = c^*_{2,t} - z_t$$

$$y^*_t = \gamma\left(\frac{c}{y}\right)c_{2,t} + (1-\gamma)\left(\frac{c}{y}\right)c^*_{2,t} + \gamma\left(\frac{i}{y}\right)i_{2,t} + (1-\gamma)\left(\frac{i}{y}\right)i^*_{2,t}$$

A.4 Factor Demand

$$u_t + w_t = (1-\gamma)z_t + y_t - h_t$$

$$r^k_t = \left(\frac{r+\delta}{1+sr}\right)[(1-\gamma)z_t + y_t - k_t] + \left(\frac{1-\delta}{1+r}\right)q_t - q_{t-1}$$

$$i_t - k_t = \frac{1}{\phi}q_t$$

$$u^*_t + w^*_t = (\gamma-1)z_t + y^*_t - h^*_t$$

$$r_t^{*k} = \left(\frac{r+\delta}{1+sr}\right)\left[(\gamma-1)\,z_t + y_t^* - k_t^*\right] + \left(\frac{1-\delta}{1+r}\right)q_t^* - q_{t-1}^* + \left(\frac{r}{1+r}\right)\gamma_t$$

$$i_t^* - k_t^* = \frac{1}{\phi}q_t^*$$

A.5 Inflation Dynamics

$$\pi_{1,t} = -\kappa u_t + \beta E_t(\pi_{1,t+1})$$

$$\pi_t = \pi_{1,t} - (1-\gamma)\Delta z_t$$

$$\pi_{2,t} = -\kappa u_t^* + \beta E_t(\pi_{2,t+1})$$

$$\pi_t^* = \pi_{2,t} + (1-\gamma)\Delta z_t$$

A.6 Credit Markets

$$\chi(q_t + k_t - n_t) = s_t$$

$$n_t = \left(\frac{1}{n_k}\right)r_t^k - \left(\frac{1-n_k}{n_k}\right)(s_{t-1} + r_{t-1}) + n_{t-1}$$

$$\chi^*(q_t^* + k_t^* + n_t^*) = s_t^*$$

$$n_t^* = \left(\frac{1}{n_k^*}\right)r_t^{*k} - \left(\frac{1-n_k^*}{n_k^*}\right)(s_{t-1}^* + r_{t-1}^* + \Delta\gamma_t^*) + n_{t-1}^*$$

A.7 Financial Arbitrage

$$r_t^n = r_t + E_t(\pi_{t+1})$$

$$r_t^{*n} = r_t^* + E_t(\pi_{t+1}^*)$$

$$E_t(r_{t+1}^k) = s_t + r_t$$

$$E_t\left(r_{t+1}^{*k}\right) = s_t^* + r_t^*$$

$$r_t - r_t^* = E_t\left(\Delta\gamma_{t+1}\right)$$

A.8 Terms of Trade

$$\gamma_t = \left(1 - 2\gamma\right) z_t$$

A.9 Monetary Policy

$$r_t^n = \rho_r r_{t-1}^n + \rho_\pi \pi_t$$

A.10 Shocks

$$a_t = \rho_a a_{t-1} + \varepsilon_t^a$$

$$\upsilon_t = \rho_v \upsilon_{t-1} + \varepsilon_t^v$$

$$\theta_t = \rho_\theta \theta_{t-1} + \varepsilon_t^\theta$$

$$a_t^* = \rho_a a_{t-1}^* + \varepsilon_t^{*a}$$

$$\upsilon_t^* = \rho_v \upsilon_{t-1}^* + \varepsilon_t^{*v}$$

$$\theta_t^* = \rho_\theta \theta_{t-1}^* + \varepsilon_t^{*\theta}$$

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The Output Composition Puzzle: A Difference in the Monetary Transmission Mechanism in the Euro Area and the United States

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A consensus has emerged during the last twenty years, over the way that the actions of central banks affect the economy (the monetary transmission mechanism). In a nutshell, changes in monetary policy have a persistent, though not permanent, effect on output,

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with the output change being hump shaped; prices react with some delay, and eventually settle down to a new level, with no permanent effect on inflation.

Much of this consensus is based on the examination of the U.S. experience. Yet, recently, twelve European countries embarked upon an unprecedented grand monetary experiment. A new central bank was created from scratch and the currencies of twelve sovereign nations were replaced with the euro. A natural question is whether the consensus view on the monetary transmission mechanism holds for the euro area as well.

While we expect this question will be the subject of intense research in the future, some first answers were provided by a momentous research effort involving the staffs of the European Central Bank (ECB) and of the twelve national central banks (NCBs) forming the euro area (Angeloni, Kashyap, and Mojon, 2003). Some surprising similarities were found, together with some interesting differences.

In this paper, drawing from that body of work, we first check the robustness of the similarities. These are important because, as the euro area is only about five years old, any time series analysis of the euro area transmission necessarily uses mostly data from the previous monetary policy regime. This confounds analyses based on either synthetic data of euro area aggregates or the aggregation of country-level findings. However, some of the uncertainty over the transmission mechanism may be reduced if the time series facts that can be compiled for the euro area resemble those for the United States, a long-functioning monetary union of similar size and openness as the euro area.

The bulk of our analysis focuses on an intriguing difference between the two currency areas. In particular, we call attention to one aspect of the transmission mechanism that has previously received little attention: the composition of the output adjustments that follow a change in monetary policy. Along this dimension, an interesting contrast emerges between the euro area findings and those for the United States. In the United States, changes in consumption spending appear to be a much more important component of monetary adjustment than in the euro area (where investment spending changes appear to be preeminent). We dub this difference the *output composition puzzle*.

We see the motivation for studying the composition of the output response as threefold. First, better understanding the composition effects can improve the central bank's ability to monitor the economy.

For instance, knowledge that consumption adjustments are typically dominant in the United States would suggest that consumer behavior is what needs to be watched carefully to see whether policy changes are working through the economy in the expected way. This ultimately would help determine whether the current monetary stance is appropriate or whether policy changes are called for.

A second, broader motivation is that knowledge of the composition can improve our understanding of the factors behind the monetary transmission mechanism. As discussed later on, the differences between a dominant consumption response in the United States and a dominant investment response in the euro area could be due to a variety of institutional or legal constraints, or frictions, linked for example to the structure of financial or labor markets or to differences in the levels of social insurance. Better understanding the composition seems a useful first step to uncover the relevance of these different factors. Moreover, having identified the relevant factors, one could then discuss whether structural policies—for instance, in the financial or labor markets—might be warranted to alter these institutions.

A third, and closely related, consideration is that this analysis can be informative about the stability of the transmission mechanism. By understanding which transmission channels are dominant and which are dormant, one can decide which changes to the economy merit most attention. For instance, if the consumption response in the United States is dominant, a policymaker might conclude that paying close attention to changes in the mortgage markets is more important than studying changes in the tax treatment of depreciation.

We organize the paper into three parts. We begin with a brief review of the stylized facts about the basic statistical properties of the data and on the transmission mechanisms for the United States and euro area, showing a number of similarities.

In the next section we document the output composition puzzle, arguing that it is a robust feature of the two economies that can be confirmed using a host of statistical techniques and data.

In the following section, we provide tentative interpretations and explanations for it. We first explore the puzzle in the class of tractable dynamic stochastic general equilibrium (DSGE) models that have recently been proposed as an accurate description of the monetary policy transmission (prominent examples are Christiano, Eichenbaum, and Evans, 2001, for the United States and Smets and Wouters, 2002, for the euro area). The idea is to trace the differences in output composition to differences in "deep" parameters characterizing the two economies. We verify that these models, in their current estimated (or calibrated) version, have trouble fully accounting for the differences in the composition of output adjustments that we observe in the data.

To do this we identify the mechanisms in the model that give rise to differences in the output composition, isolating a small subset of the models' parameters that essentially governs the output composition. The differences estimated for these parameters are too small, however, and sometimes even of the wrong sign, to fully account for the differences in the output composition between the two areas. Moreover, the mechanisms identified do not appear to be very powerful. It appears that large changes in these parameters are needed to bring the models in line with our data-based estimates of the consumption contributions to output adjustment.

Whether or not these DSGE models could be modified and reestimated to overcome these problems and account for the output composition puzzle is an issue that we leave for future research. For now, they provide us with a structural (although partial) interpretation of the uncovered differences that can be subject to independent scrutiny. Most importantly, revealing that some potential mechanisms are not enough to account for the puzzle helps direct the search for other mechanisms, so far not included in these models.

We move in this direction in the final section of the paper. There, departing from the maintained assumption in the DSGE models that agents are fully insured against various shocks, we explore differences in employment and income risk to see whether the lack of these kinds of insurance might be responsible for the differences. The evidence is ambiguous but there are some hints that more complete social insurance in the euro area might play a role in resolving our puzzle. Overall, we tentatively attribute the origin of the puzzle to differences in the behavior of consumers rather than in the behavior of firms (through their investment decisions).

1. Basic Facts on Monetary Transmission in the United States and Euro Area

A vast literature of the monetary transmission mechanism exists, with excellent recent surveys provided by the papers in the 1995 symposium in the *Journal of Economic Perspectives* (Bernanke and Gertler, 1995; Meltzer, 1995; Obsfeld and Rogoff, 1995; Taylor, 1995), Christiano, Eichenbaum, and Evans (1999), Mankiw (2001), and Bean, Larsen, and Nikolov (2003). Rather than rehashing the evidence reviewed in these papers, we focus on whether the long U.S. expansion in the 1990s has changed anything and compare the latest U.S. results to some recent findings for the euro area. As they are relatively less known, we start by taking a look at the euro area data.

1.1 Introduction to the Euro Area Data

One major challenge in analyzing the transmission mechanism in the euro area is the data difficulties. The euro area has only had a single monetary policy for about five years. So time series analysis of macroeconomic variables during this time period is not feasible.

Combining the post-ECB data with historical data is also difficult. For one thing, many countries that now use the euro do not have full quarterly data on many relevant macroeconomic series. For example, quarterly data for inventory investment and durable consumption are simply not available for most countries. Furthermore, quarterly euro area trade figures net of trade flows within the euro area are only available from 1992 onwards. Thus, there are certain questions that cannot even be considered.

More fundamentally, it is legitimate to question whether aggregating the country data for the euro area countries prior to the adoption of the euro even makes sense. This was obviously not a single economy with a common monetary policy prior to 1999, though the transition to the single currency and the likely ensuing changes in agents' behavior were gradual. So one might prefer to analyze the member countries separately and then aggregate the findings to the euro area level.

But this approach also has problems. First, the data limitations are substantial even at the country level. Second, we are chiefly interested in how the member countries would respond to common monetary actions. Given that in the historical sample there was no common monetary policy, we need to adjust the country level results anyway (for instance, by imposing a common monetary reaction function in the analysis). Recognizing these problems, we analyze both the synthetic data for the euro area and country-level evidence.[1]

1. The euro area data used in this study are taken from Fagan, Henry, and Mestre (2001). Updates of these data along with a number of other statistical data on the euro area real and financial sectors are available at the ECB website (www.ecb.int).

We begin by reporting some summary descriptive material on the euro area data. Tables 1 and 2, reproduced from Agresti and Mojon (2003), presents a set of descriptive statistics for the (detrended) euro area data along with similar statistics for the United States, which serves as a benchmark. The euro area data are only available from 1970 onwards, so for comparison purposes we show findings for both regions from this date through 2000; in later sections we take advantage of earlier U.S. data where available.

Three main features of these results stand out. First, the *absolute level* of the volatility of gross domestic product (GDP) in the euro area is lower than in the United States.[2] Second, if measured *relative* to GDP, the volatility of the main domestic demand components appear to be broadly similar in the two economies; of relevance for our later findings is the fact that the relative volatilities of consumption and investment are similar in both currency areas. This does not appear to be true for inflation (as measured by consumer price indices), whose volatility appears to be much lower in the euro area.

Third, the dynamic cross and auto-correlations between the main macroeconomic variables display many striking similarities across the two economies. For instance, the serial correlation properties of GDP and the price deflators, as well as the lead-lag patterns of the cross-correlations between GDP and its components, interest rates and credit aggregates are all broadly similar.

There are also several differences. The one that we find most intriguing is that stock prices appear to be strongly positively correlated with future output in the United States, contrary to what is found for the euro area. This could result from the small size of the stock market in continental Europe over most of the sample period. We do not have obvious explanations for the other dissimilarities.[3]

2. In this context it should be noted, however, that the volatility of U.S. GDP has declined over time. See Stock and Watson (2003) for a survey, and Ahmed, Levin, and Wilson (2002), Kahn, McConnell, and Pérez-Quirós (2002), Boivin and Giannoni (2002), Clarida, Galí, and Gertler (2000), and Ramey and Vine (2003) for competing explanations of this reduction in macroeconomic instability.

3. For instance, we do not have interpretations for the following findings: (1) that the correlation between past GDP and current inflation tends to be lower in the euro area; (2) that the sign of the correlation between current inflation and future GDP growth quickly becomes negative in the United States, while it remains positive in the euro area; (3) that M1 seems a better leading indicator of output in the euro area than in the United States; and (4) that real estate prices exhibit very different lead and lag correlations with GDP in the two economies.

Table 1. Descriptive Statistics for Cyclical Components of Euro Area Time Series, 1970–2000[a]

	Standard deviation		*Cross-correlation with GDP (t + k)*								
Variable (t)	*absolute*	*relative/GDP*	*k: –4*	*–3*	*–2*	*–1*	*0*	*1*	*2*	*3*	*4*
GDP	0.84	1.0	–0.19	0.18	0.58	0.88	1.00				
Consumption	0.55	0.7	–0.13	0.09	0.37	0.63	0.79	0.80	0.66	0.40	0.09
Investment	1.85	2.2	0.06	0.34	0.62	0.81	0.86	0.75	0.51	0.21	–0.09
Cumulated inventories	2.40	2.9	0.65	0.83	0.82	0.59	0.22	–0.19	–0.52	–0.70	–0.70
GDP deflator (level)	0.58	0.7	0.29	0.27	0.16	–0.04	–0.30	–0.55	–0.72	–0.76	–0.67
CPI (level)	0.68	0.8	0.28	0.26	0.16	–0.03	–0.26	–0.50	–0.66	–0.72	–0.66
CPI (inflation)	0.31	0.4	0.35	0.34	0.27	0.21	0.20	0.26	0.31	0.30	0.19
Stock prices	12.00	14.3	–0.10	–0.07	–0.01	0.05	0.08	0.06	0.01	–0.03	–0.02
Real estate prices	1.36	1.6	0.53	0.52	0.50	0.45	0.39	0.31	0.20	0.06	–0.08
Short–term rate nominal	1.09	1.3	0.27	0.54	0.73	0.76	0.61	0.30	–0.08	–0.43	–0.67
Short–term rate real	0.76	0.9	0.49	0.65	0.68	0.55	0.26	–0.11	–0.43	–0.61	–0.59
Long–term rate nominal	0.57	0.7	0.22	0.38	0.48	0.47	0.33	0.09	–0.17	–0.37	–0.46
Yield spread	0.83	1.0	–0.20	–0.45	–0.63	–0.68	–0.58	–0.34	–0.01	0.32	0.56
Real effective exchange rate	3.58	4.3	0.22	0.33	0.36	0.30	0.17	0.01	–0.12	–0.18	–0.18
DM-USD exchange rate	5.23	6.2	0.13	0.36	0.56	0.61	0.48	0.22	–0.08	–0.34	–0.46
M1	1.00	1.2	–0.22	–0.26	–0.20	–0.05	0.16	0.39	0.58	0.68	0.67
M3	0.72	0.9	0.45	0.23	0.01	–0.17	–0.26	–0.27	–0.19	–0.06	0.07
Total loans	0.85	1.0	0.59	0.55	0.48	0.37	0.23	0.10	0.00	–0.06	–0.08
			Cross-correlation with own (t + k)								
CPI (level)	0.68	0.8	0.33	0.55	0.77	0.77	1.00				
GDP deflator (level)	0.31	0.4	0.27	0.50	0.74	0.74	1.00				

Source: Agresti and Mojon (2003).

a. Standard deviation of and cross-correlation between the cyclical components of macroeconomic time series. The cyclical component was obtained from a band-pass filter BPF(6,40,8) à la Baxter and King (1999), and the data sources are fully described in Agresti and Mojon (2001, appendix 1).

Table 2. Descriptive Statistics for Cyclical Components of U.S. Time Series, 1970–2000[a]

	Standard deviation		*Cross-correlation with GDP (t – k)*								
Variable (t)	*absolute*	*relative/GDP*	*k: –4*	*–3*	*–2*	*–1*	*0*	*1*	*2*	*3*	*4*
GDP	0.34	1.0	–0.09	0.24	0.60	0.89	1.00				
Consumption	0.01	0.8	–0.24	0.03	0.34	0.64	0.84	0.87	0.74	0.54	0.27
Investment	3.26	2.4	0.11	0.44	0.75	0.94	0.95	0.80	0.53	0.20	–0.10
Cumulated inventories	2.35	1.8	0.74	0.89	0.88	0.69	0.35	–0.02	–0.32	–0.48	–0.48
GDP deflator (level)	0.67	0.5	0.00	–0.16	–0.31	–0.42	–0.48	–0.49	–0.46	–0.42	–0.39
CPI (level)	1.02	0.8	0.23	0.10	–0.07	–0.24	–0.41	–0.52	–0.56	–0.54	–0.49
CPI (inflation)	1.29	1.0	0.48	0.59	0.63	0.56	0.38	0.15	–0.09	0.25	–0.31
Stock prices	7.92	5.9	–0.50	–0.50	–0.37	–0.12	0.16	0.39	0.47	0.40	0.22
Real estate prices	2.12	1.6	–0.18	–0.21	–0.16	–0.06	0.08	0.21	0.24	0.17	0.03
Short–term rate nominal	1.31	1.0	0.38	0.56	0.68	0.67	0.50	0.21	–0.14	–0.44	–0.62
Short–term rate real	1.11	0.8	–0.11	–0.03	0.07	0.14	0.15	0.07	–0.06	–0.22	–0.36
Long–term rate nominal	0.82	0.6	–0.03	0.14	0.28	0.35	0.30	0.14	–0.07	–0.28	–0.41
Yield spread	0.90	1.7	–0.51	–0.60	–0.63	–0.56	–0.39	–0.15	0.12	0.33	0.45
Real effective exchange rate	2.96	2.2	0.08	0.11	0.08	0.00	–0.07	–0.12	–0.12	–0.08	–0.01
DM-USD exchange rate	6.66	5.0	0.19	0.23	0.23	0.23	0.27	0.37	0.45	–0.42	0.27
M1	1.78	1.3	–0.22	–0.23	–0.18	–0.08	0.05	0.16	0.22	0.24	0.22
M3	0.87	0.7	0.25	0.37	0.42	0.39	0.28	0.12	–0.03	–0.13	–0.15
Total loans	1.99	1.5	0.75	0.78	0.68	0.48	0.19	–0.11	–0.34	–0.45	–0.45
			Cross-correlation with own (t + k)								
CPI (level)	1.02	0.8	0.38	0.61	0.81	0.95	1.00				
GDP deflator (level)	1.29	1.0	0.35	0.58	0.80	0.95	1.00				

Source: Agresti and Mojon (2003).

a. Standard deviation of and cross-correlation between the cyclical components of macroeconomic time series. The cyclical component was obtained from a band-pass filter BPF(6,40,8) à la Baxter and King (1999), and the data sources are fully described in Agresti and Mojon (2001, appendix 1).

1.2 Transmission Evidence from VARs

As noted earlier, we use the phrase monetary transmission mechanism to describe the effects of a change in the stance of monetary policy on real quantities and prices. In some cases we cite evidence from vector autoregressions (VARs) that have the interpretation of the response of different variables to an unanticipated shock to the implicit central bank reaction function. In other cases we refer to evidence embodied in traditional macroeconometric models maintained in the central banks. We recognize that, depending on one's preferred theory of monetary nonneutrality, one or another of the various pieces of evidence would be regarded as more relevant. We believe, however, that there is unfortunately not sufficient consensus over which model of nonneutrality is correct (or even most correct), and hence believe that a dogmatic approach of ruling out certain types of evidence would be unwise.

Our first set of evidence looks at VARs, drawing from previous research. We update these specifications to include current data (to see if that matters). For each area we consider three models. We first review the U.S. models and their results and then do the same for the euro area.

The first U.S. VAR follows the recursive identification procedure proposed by Christiano, Eichenbaum, and Evans (1999) that has become the benchmark in this literature. We analyze the variant proposed by Erceg and Levin (2002) that was designed to provide information on the composition of output responses to monetary shocks. Because of this focus, Erceg and Levin modified the Christiano, Eichenbaum, and Evans (1999) specification to include different components of GDP whose interest rate sensitivities might be expected to differ. Consequently, their model includes GDP and a host of demand components, along with a price deflator, a commodity price index, and the federal funds rate.

We depart from this by including only investment and consumption and using a slightly different commodity price series and the consumer price index (CPI) instead of the GDP deflator.[4] We limit the demand components to consumption and investment because we do not have the further disaggregated data for the euro area anyway

4. There is no single commodity price series that is universally used in this literature. Our findings suggest that the choice of the series makes little difference to the estimated impulse responses, although whether the series is smoothed or not makes a slight difference in reducing the size of the "price puzzle" discussed below.

(and we favor treating both areas symmetrically). But even with this crude separation, we can study the composition of the adjustment that underlies the output responses. Given this aim we also replace GDP with GDP less the sum of consumption and investment (that is, by net exports and government spending, which we call the rest of GDP henceforth). This substitution provides us with a parsimonious way to show both the total GDP response to monetary shocks (obtained as the sum of the responses of consumption, investment, and the rest) and its composition. Moreover, this procedure can be interpreted as a quick way to impose in the VAR the constraint provided by the national accounting identity, of the type usually imposed in traditional macroeconometric models. As our choice does not lead to overall GDP responses to monetary shocks that differ from previous findings, we are confident that we are not badly misspecifying the model by making this choice. We make this same substitution in all of the other VARs.

For our consumption series we use private consumption, that is, the sum of nondurable goods, services, and durable goods consumption. For investment we use total private sector investment. These aggregates are the closest match for GDP components that are available for the euro area: private consumption and private investment.[5]

Our baseline estimation period for the U.S. sample begins the first quarter of 1960 and ends in the fourth quarter of 2001—the starting date is given by the availability of the official data for the money supply figures and the ending date by the last quarter with data that were not preliminary as of the time we began the analysis. However, we also consider another subsample that runs from 1965 to the fourth quarter of 2001, but omits the data from the fourth quarter of 1979 until the fourth quarter of 1983. The 1965 start-date is chosen because this is when the market for federal funds began to operate in its current format. The excluded period covers the interval when the Federal Reserve's operating procedures changed to emphasize the importance of nonborrowed reserves.[6] Finally, we also look at a sample that runs from 1984 to the fourth quarter of 2001. This covers the

5. In the case of the euro area, we are missing an exact deflator for euro area government investment because the ESA 95 system of national account does not require total investment to be broken down into its private sector and public sector components. See the data appendix for an explanation of the construction of private investment series for the euro area, Germany, France, Italy, and Spain. However, for the VARs where it is possible to experiment with both private and total investment, there are no important differences that depend on which of these series is used.

6. See Bernanke and Mihov (1998) and Christiano, Eichenbaum, and Evans (1999) for a discussion of the changes in the Federal Reserve operating procedures.

most recent part of the sample only and spans the period during which the operating procedures were relatively stable. The models are estimated with four lags for the first two samples and, in order to preserve degrees of freedom, with two lags for the 1984–2001 sample.

Our second model is based on an identification procedure proposed by Gordon and Leeper (1994). Their model adds a long-term (ten-year) interest rate and M2 to the list of variables examined by Erceg and Levin. Gordon and Leeper opt for an alternative set of identifying restrictions that focus on the information set that the central bank could be expected to have at the time it was setting the short-term interest rate. Accordingly, they do not allow contemporaneous data on inflation and GDP to influence this decision—leaving only contemporaneous commodity prices, the long term interest rate, and M2 as potentially affecting the contemporaneous federal funds rate. In contrast, contemporaneous prices and GDP components enter the money demand equation. Our decomposition of the demand components leads naturally to modifying this identification strategy by assuming that the innovations of consumption, investment, and the rest of GDP have no effect on the innovation of the federal funds rate while they have an effect on the innovation of M2.

Our third model is taken from Christiano, Eichenbaum, and Evans (2001). This model includes consumption, investment, GDP, the CPI, a real wage variable, a labor productivity measure, real corporate profits, the federal funds rate, M2 growth, and the Standard and Poor's 500 stock price index deflated by the CPI. We substitute private consumption and investment for the consumption and investment series that they use in order to match the euro area data (where disaggregated figures are not available).[7] Given the substantial difference between this specification and the other two VARs we consider, this alternative particularly important.

Turning to the results, most of our main findings (aside from the composition of the output response) are summarized in figure 1, with each of the three panels describing one of the models. The Christiano, Eichenbaum, and Evans and the Erceg and Levin models are each just identified, so that the procedure for computing confidence intervals for impulse responses is easily implemented (Sims and Zha, 1999). The

7. In Christiano, Eichenbaum, and Evans (2001), consumption is defined as the sum of nondurable goods, services, and government consumption, while the investment they include in their VAR is the sum of gross private sector investment and durable consumption. We thank Larry Christiano and Charlie Evans for providing us their data.

graphs report the point estimate of the impulse response and the confidence band formed by tenth and the ninetieth percentiles based on 1,000 Monte Carlo simulations for twenty quarters after the initial shock.[8] In the case of the Gordon and Leeper model, which is over-identified, the point estimates and error bands, again the tenth and the ninetieth percentiles of the simulated impulse responses, are based on the Bayesian procedure advocated by Sims and Zha (1999).[9] We notice that the responses of consumption and investment estimated with this procedure are more persistent than—and about twice as large as—the one obtained with the other two VARs.

As a matter of course, the confidence intervals for the second half of the sample are much wider, so these results are in general less certain. But, despite the substantial differences across the VAR specifications, two consistent findings emerge from our analysis of monetary policy shocks. First, the impulse responses clearly show that following an innovation in the funds rate, output declines within one or two quarters and reaches its peak decline within four to eight quarters.[10] The responses are such that the decline is significantly different than zero around the peak (and this is true even for the short sample). The standard errors grow as the horizon extends beyond two years, so that precise statements are not warranted, but we cannot reject the proposition that output is back at its baseline five years after the shock in almost all of the cases.

The second consistent finding is that price responses are more sluggish than the output responses. Here the exact shapes are somewhat sample and model specific. In all of the specifications and time periods, prices show little change in the first couple of quarters after the monetary policy disturbance. In some of the specifications, prices actually rise for more than a year after an increase in interest rates. Sims (1992) labeled this perverse price response the “price puzzle” and explained it as possibly reflecting omitted variables from the VAR to which the Federal Reserve might be responding. Subsequently, Christiano and Eichenbaum (1995), Barth and Ramey (2002), and others have suggested the possibility that this could be due to the effect of higher interest rates on firms’ short-run financing costs. For

8. All the simulations were performed with Rats 5.0. The original Rats program for computing error bands was modified to report percentiles of the simulated impulse responses instead of adding multiples of the standard errors to the mean of the simulated impulse responses.

9. We thank Jennifer Roush for assistance in implementing the Bayesian procedure and computing these confidence intervals.

10. The output responses are always recovered by summing the components.

our purposes, explaining this phenomenon is less relevant than noting that the slow response of prices to policy shocks seems to be a pervasive feature of the data.

In the long baseline sample, the estimated responses after the first year are more in line with standard theoretical predictions. In both the Erceg and Levin and the Christiano, Eichenbaum, and Evans models, the price declines are estimated to be significant by eight to twelve quarters after the initial shock. After that, while the uncertainty surrounding the point estimate becomes fairly large, we typically cannot reject the hypothesis that the price level eventually settles down to a new permanently lower level (with no long-run effect on inflation). For the Gordon and Leeper model, the price-level response even in the long sample is almost always indistinguishable from zero.

In the other two samples, and particularly the recent subsample, we cannot in general detect any statistically significant price effects from the change in monetary policy. In most of these cases, even the point estimates suggest weak responses. Thus, we conclude that the VAR evidence on the transmission mechanism for the United States is much less clear regarding prices than output.

Turning to the euro area, we start with an area-wide analysis, using synthetic data that is created by combining country-level macroeconomic variables to form aggregate data for the area as a whole. The first model we consider for the area-wide analysis follows the specification proposed by Peersman and Smets (2003) and includes GDP components, the harmonized index of consumer prices (HICP), M3,[11] the money market interest rate, and the effective exchange rate of the euro as endogenous variables. In addition, the model includes three U.S. variables that account for shocks to the world economy: the index of commodity prices already used in the VAR models of the United States described above, U.S. GDP, and the federal funds rate. These three variables are exogenous. The monetary policy shock is identified by a Cholesky decomposition, with the variables ordered as above. We report estimates for two samples: 1970–2000, the longest available sample period, and 1980–2000, which starts with the beginning of the European Monetary System (EMS).[12]

11. M3 is the natural choice among monetary aggregates given the importance it has in the monetary policy strategy of the European Central Bank.

12. Within the EMS, countries that then belong to the European community, namely, Belgium, France, German, Italy, Luxembourg, and the Netherlands, pegged their currency to the ECU, a basket of their currencies. De facto, currencies were pegged to the Deutsche-Mark in order to import the credibility of the Deutsche Bundesbank.

Figure 1a. U.S., Ercerg-Levin Identification (quarterly data)

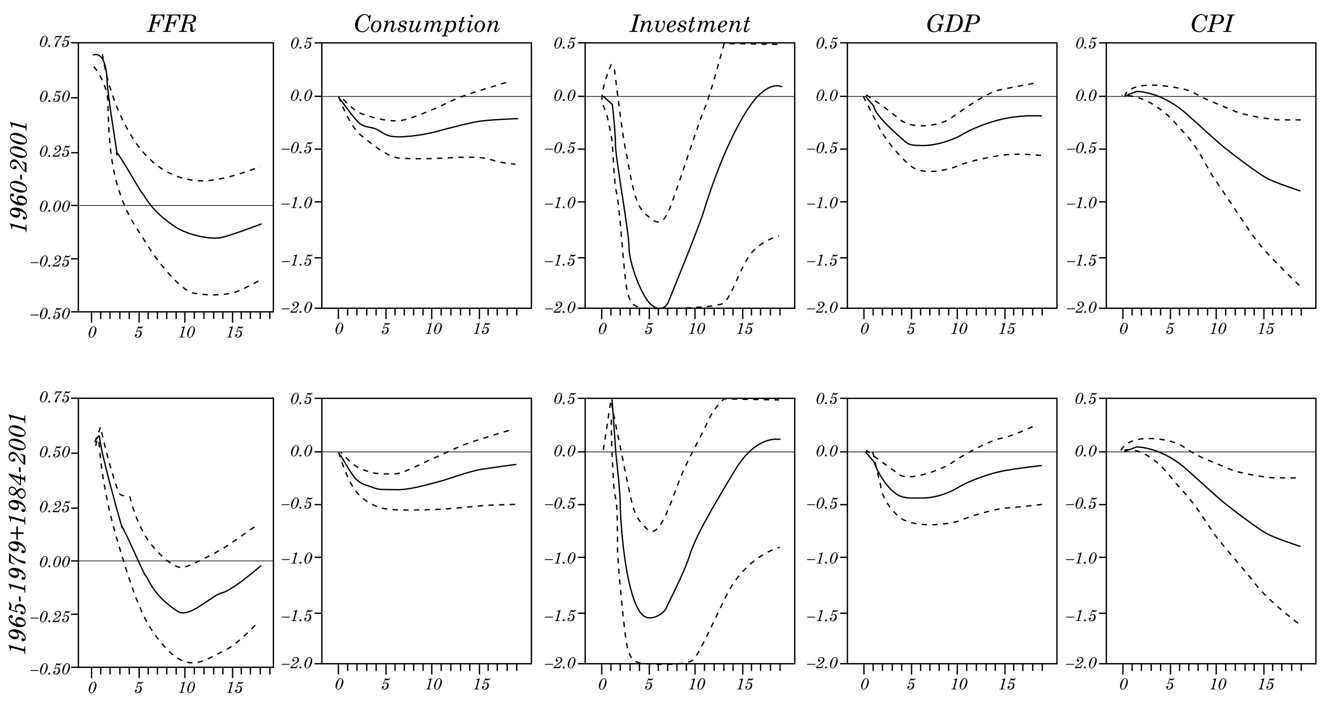


Figure 1a. (continued)

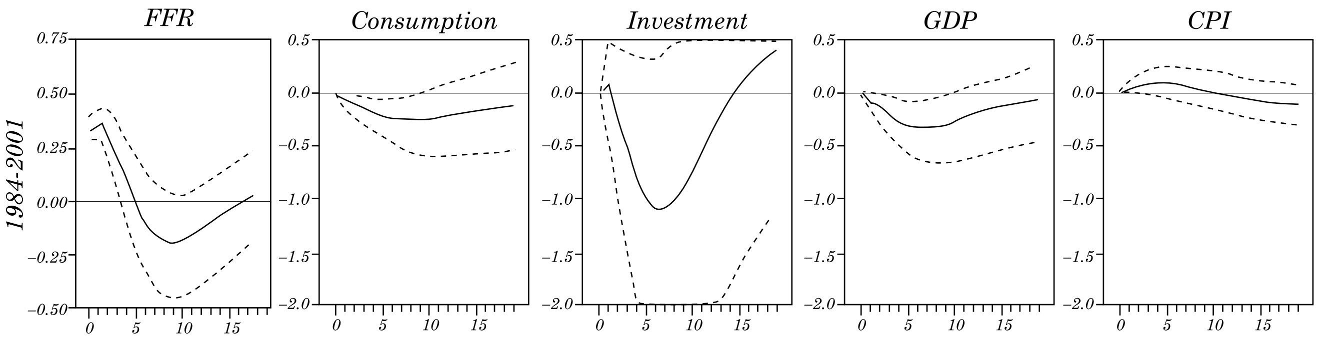


Figure 1b. U.S., Gordon-Leeper Identification (quarterly data)

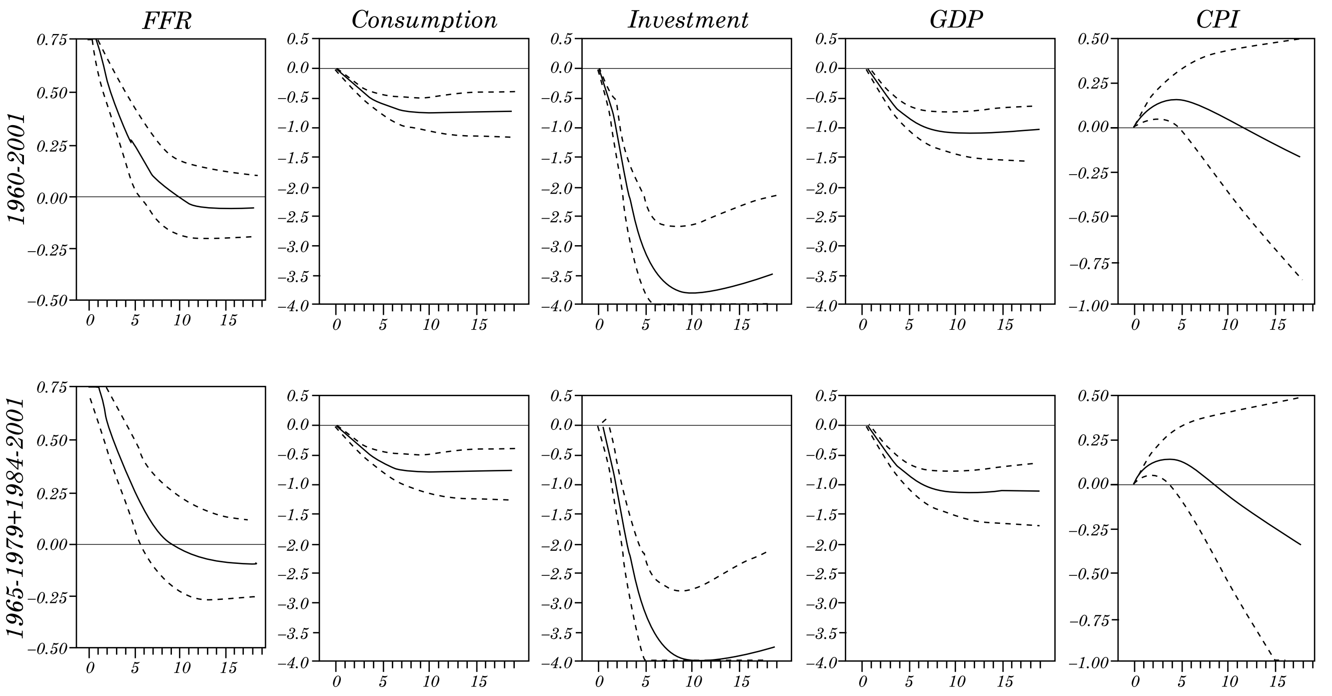


Figure 1b. (continued)

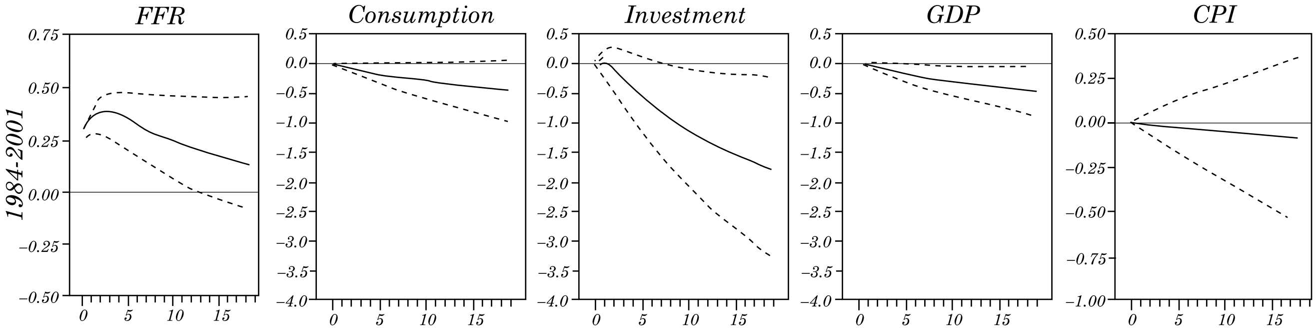


Figure 1c. U.S., Christiano, Eichenbaum, and Evans Identification (quarterly data)

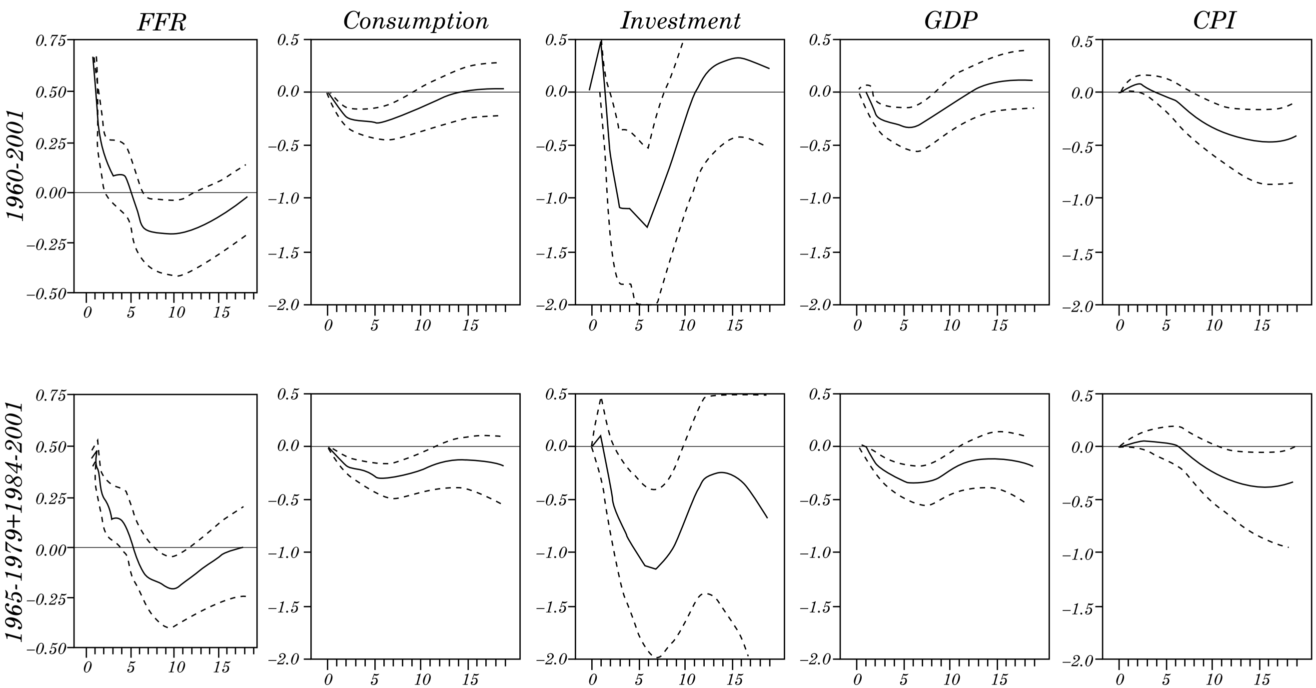
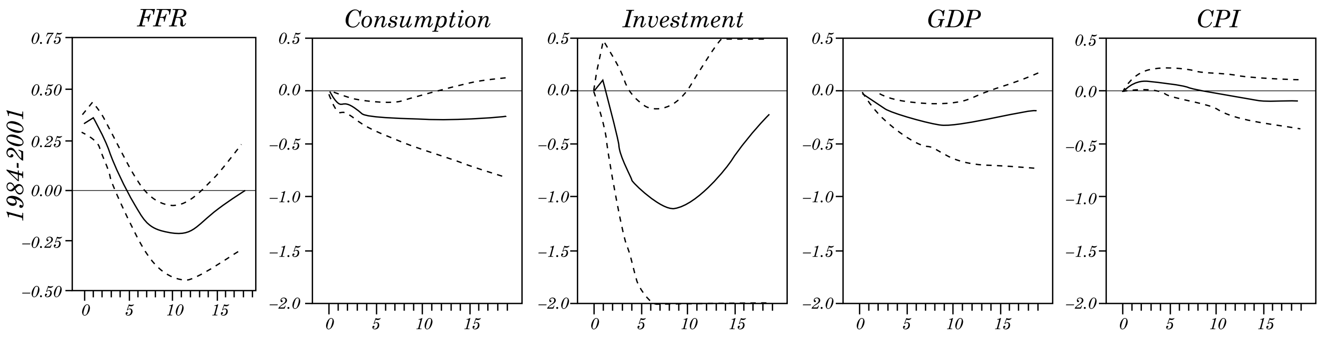


Figure 1c. (continued)



We also report a second version of the Peersman and Smets (2003) model without M3. We consider this alternative for two reasons. First, monetary aggregates were not as prominent in the European central banks' monetary policy strategy in the 1970s as they subsequently became. Second, euro area synthetic monetary aggregates have only recently been backdated to the 1970s. Our models that include M3 for the 1970s should then be taken with caution, at least until the econometric properties of this new series are better known.

Our third model mimics Christiano, Eichenbaum, and Evans (2001) for the euro area.[13] To avoid a perverse money response for one of the two samples, we need to substitute the stock price index by the real effective exchange rate within the model. However, this substitution does not change the effects of monetary shocks on other variables of the model. All the specifications that we analyze also include the time trend and other exogenous variables that Peersman and Smets (2003) advocate.

In order to maximize the degrees of freedom, all the results presented here are based on models estimated with two lags.[14] In addition, the consumer price indices and the monetary aggregates are entered as growth rates. This transformation improves the stability of some of the impulse responses.

Figure 2 summarizes the main findings of the three VARs which we estimated using euro area synthetic data. The output and price responses to the identified monetary policy shock are quite similar to what is observed for the United States. In particular, the response of output to the monetary policy shifts is hump shaped, with the peak occurring about one year after the shock. Likewise, the response of prices is more gradual than that of output. Finally, the effects on output and on inflation are temporary.

However, in contrast with the U.S. estimates, the uncertainty of the responses does not fall when the sample is extended prior to 1980. This is one indication of the instability amongst these European economies in the 1970s.

As a robustness check we also analyze a similar set of VARs for France, Germany, Italy, and Spain, which together account for 80 percent of the euro area GDP. Our goal in doing so is to verify that the use of the synthetic data is not masking any obvious patterns

13. The additional variables relative to the Peersman and Smets model are productivity, profits, and workers' compensation.

14. The pattern of responses are, however, quite similar with either three of four lags in most cases.

Figure 2a. Euro Area, Peersman-Smets Identification with M3 (quarterly data)

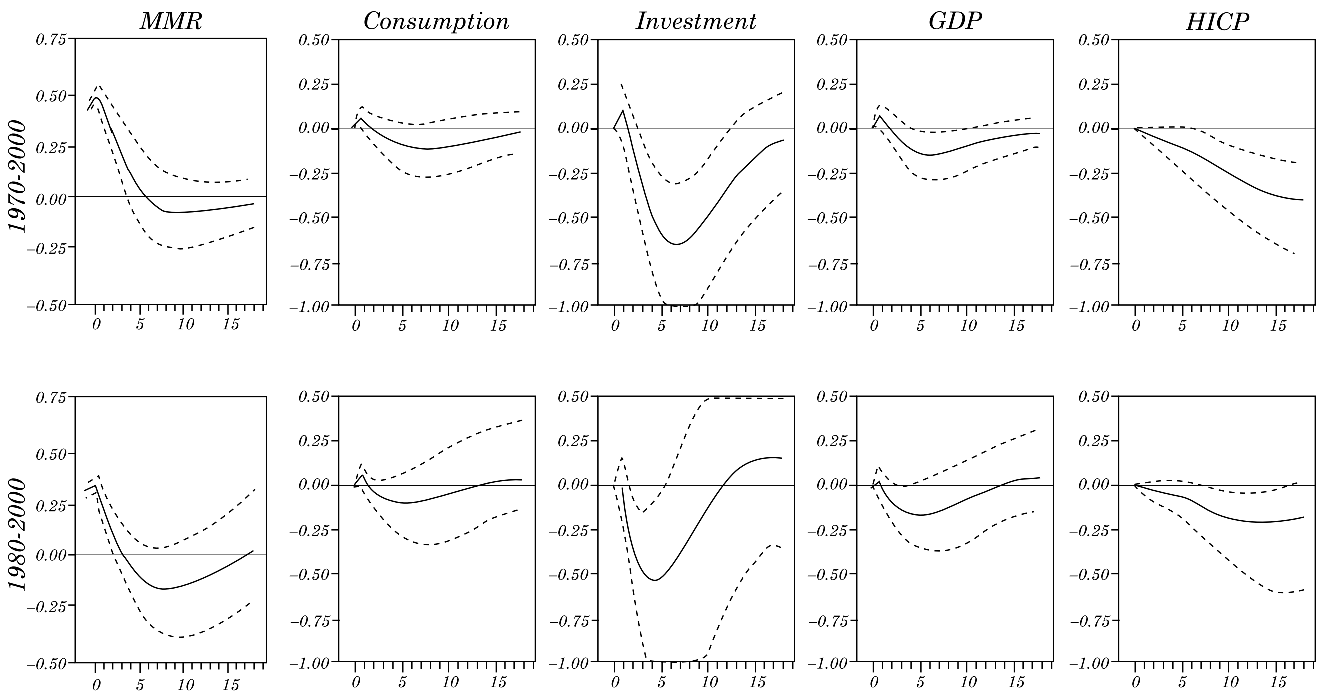


Figure 2b. Euro Area, Peersman-Smets Identification without M3 (quarterly data)

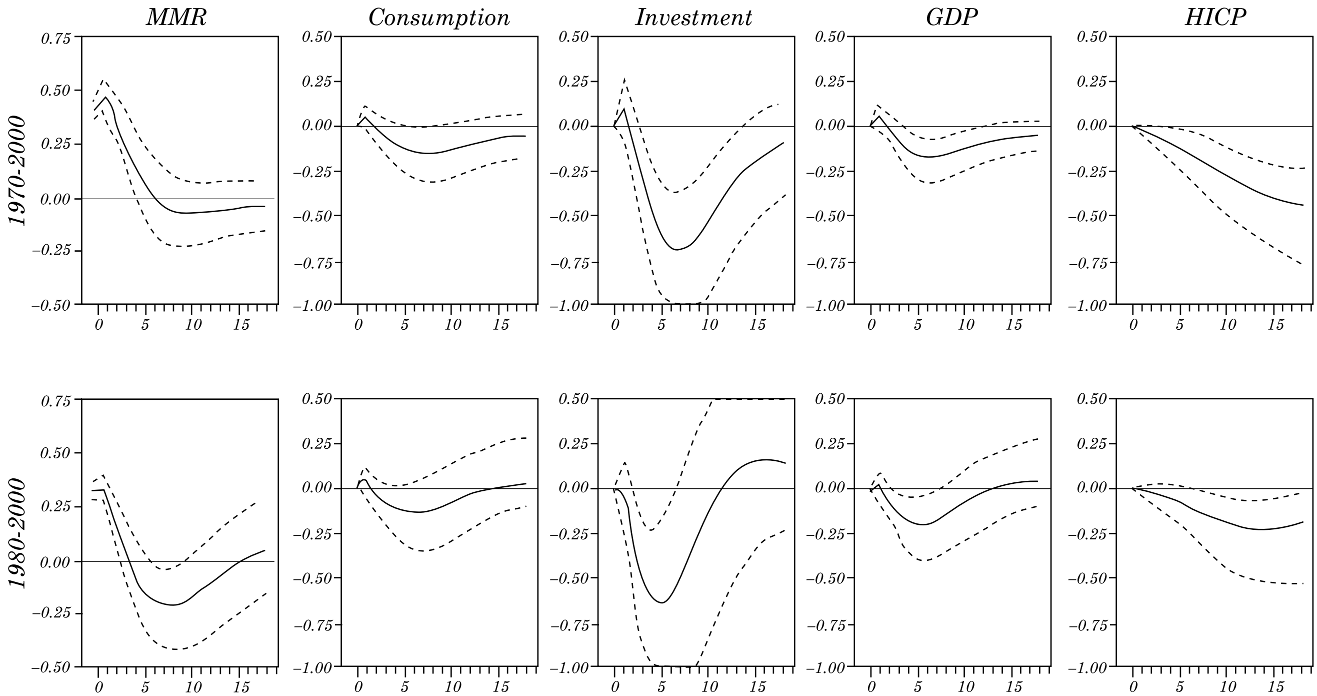
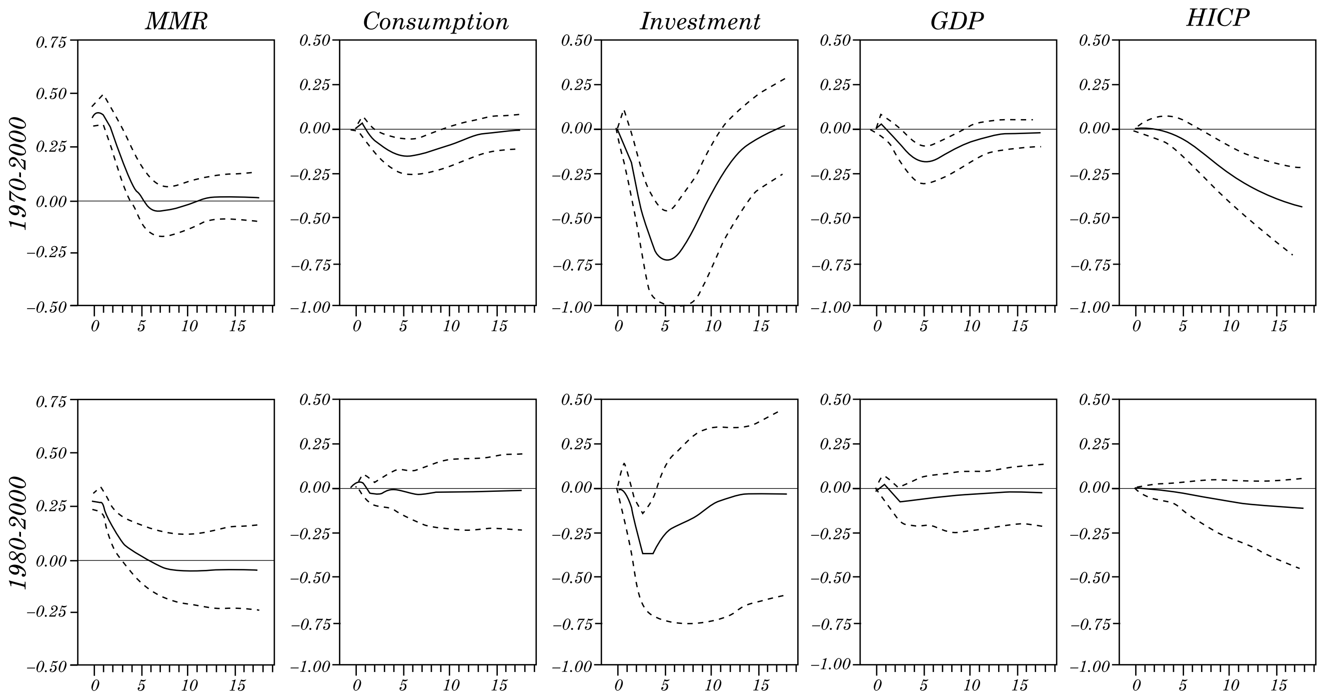


Figure 2c. Euro Area, Christiano, Eichenbaum, and Evans Identification (quarterly data)



that would be present at the country level. To do so, we update the Mojon and Peersman (2003) VARs for these four countries. We include in the VAR the breakdown of GDP into its main components as was done for the United States and with the euro area synthetic data.[15]

The sample period runs from the first quarter of the 1980, right after the European Monetary System started, to 2001—so that it coincides with our short sample for the model estimated with euro area synthetic data. However, given all of the shocks that hit the EMS, we recognize that identifying monetary policy shocks in this short sample is difficult. A full set of robustness checks for these results would take us too far astray. But because the findings are in line with the more comprehensive analysis conducted with Mojon and Peersman (2003), we believe that they are representative of what a typical VAR based approach suggests about the transmission mechanism in these countries. Thus, we see these results as another independent way to check whether our findings with euro area synthetic data are accidental.

The results are shown in figure 3, with one panel for each country. In general the country-level results are qualitatively similar to the findings for the area as a whole, but quantitatively the responses of consumption and GDP are even weaker than in the area-wide data and are almost never significantly different from zero. In the case of Germany, consumption remains above baseline for three quarters after the initial shock. Also, investment appears less persistent at the country level than at the euro area level—although these responses typically are significant after the first year. Finally, prices adjust gradually downward in Italy, Spain, and France, but they hardly deviate from the baseline in Germany.

Overall, we read the evidence from the countries as confirming the area-wide findings and showing that both are broadly consistent with the consensus view on the effects of monetary policy in the United States.

1.3 Transmission Estimates from Large-scale Models

We now look at an alternative characterization of the monetary transmission, that provided by large-scale "structural" macroeconometric models. Relative to VARs, these models incorporate vastly different

15. Two other differences with Mojon and Peersman are that we use private investment instead of total investment and that we extend the sample period to include the first three years of the monetary union. See the appendix for further details.

information sets and modeling priors, hence a rigorous comparison may look impossible. Nonetheless, it is precisely this difference that we regard as potentially informative. If each of these two sets of models incorporate, to some extent, essential features of the data and of the correctly identified transmission mechanism, then findings that are robust across the two may be particularly reliable, as they do not depend on arbitrary modeling choices. In this sense, after having examined several benchmark VARs, we view the contrast between these and structural models as more informative, at the margin, than further comparisons among alternative VARs.

We consider two sets of model results. The first, for the United States, comes from simulations of the Federal Reserve Board's macroeconomic model of the U.S. economy (FRB/US).[16] Ludvigson, Steindel, and Lettau (2002) report some comparisons of how policy rate changes in this model compare to predictions made by the Washington University macroeconomic model and the Data Resources, Incorporated model. Along the dimensions that we emphasize, it appears that these three models are relatively similar.

The euro area results are obtained from two sources. The first is a euro-area-wide model (AWM) developed by the ECB staff (Fagan, Henry, and Mestre, 2001; Dieppe and Henry, 2002), estimated on synthetic data. The second is an aggregation of results from national models developed by the national central banks (NCBs; see van Els and others, 2001).These findings are built up from a set of simulations of identical monetary shocks in each country (in which the intra-area exchange rates are fixed). Likewise a harmonized treatment of long-term interest rates and exchange rates was imposed. Thus, the simulation is intended to crudely approximate the conditions that would prevail in a currency union.

The specific interest rate path that is considered is an eight-quarter increase in the money market rate (the fed funds rate in the U.S. case) by 100 basis points. The long-term interest rate and the exchange rates were respectively assumed to move according to the expectations hypothesis and the uncovered interest parity condition. Specifically, the exchange rate initially appreciates by 2 percent and then gradually returns to baseline over two years; the long-term rate adjusts up immediately, by about 20 basis points, and gradually returns

16. We thank Flint Brayton and Chris Erceg for providing these results to us. The simulations are run with the standard version of the model in which expectations are based on VAR forecasts; see Reifschneider, Tetlow, and Williams (1999) for a full description of the model and its properties.

Figure 3. Euro Area, Country Level VARs (quarterly data)

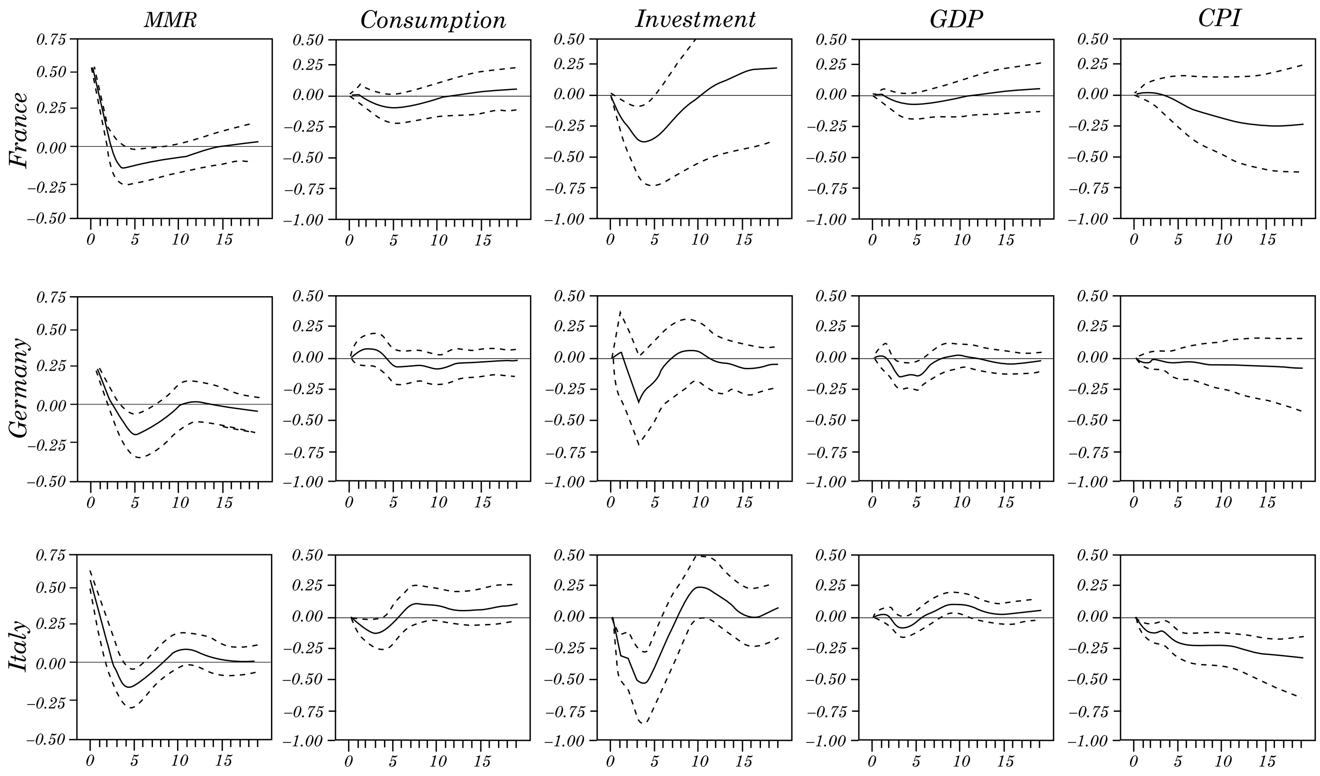
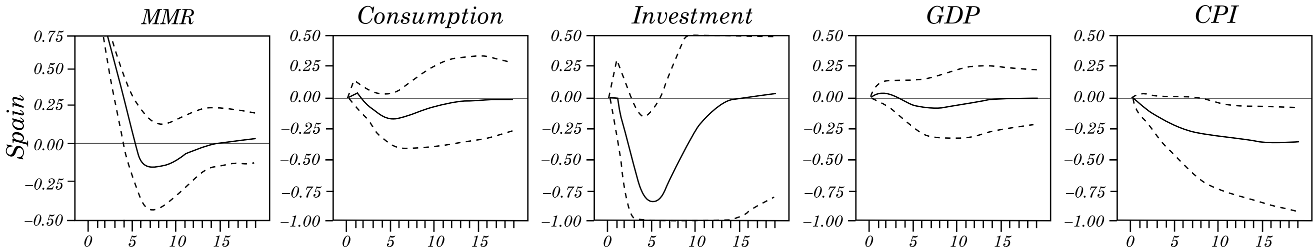


Figure 3. (continued)



to baseline. While the nature of the experiment conflicts with the Lucas policy regime invariance criterion (since the model coefficients are assumed unchanged), we still believe that it is informative for the small, temporary shock that is envisaged.

The left panel of table 3 reports results on the United States.[17] These results are quite similar to those obtained from the VARs in terms of the reactions of prices, output, and the components of output. In particular, output and consumption responses are hump shaped with a maximum decline at the beginning of year three, while investment keeps falling all the way through the third year. Prices are virtually unchanged for the first four quarters after the tightening. From year one onward, prices fall steadily for the next two years. Thus, the relatively slower response of prices compared to output that was observed in the VARs is also present in the FRB/US simulations.

The right-hand side of table 3 reports the euro area simulations. Again, despite the methodological differences, the effects on output and on prices are qualitatively similar to the outcome of the VAR models of the euro area. The hump-shaped response of GDP (which begins moving back to the baseline from year four in the area-wide model) and the gradual response of prices also matches the results obtained for the United States. Robustness across models may suggest that the results reflect underlying features of the data. Moreover, these results are broadly consistent with the pattern observed at the national level in the simulations based on the NCBs model, at least in qualitative terms.[18]

2. Evidence on the Composition of Output Response

The composition of the output response has attracted much less attention than the size and timing of the overall GDP and price responses discussed above (with the notable exceptions of Bernanke and Gertler,1995, and Erceg and Levin, 2002). Yet, whether consumption or investment responds more, or more quickly, to a monetary tightening is an issue of clear importance in the policy debate and in welfare analyses.

17. The results we describe here are very close to the ones (not reported) obtained when following an initial shock, the funds rate evolves according to a Taylor rule, that is, so that it depends on the gap between inflation and the target rate of inflation and the output gap.

18. For a detailed presentation of these results, see van Els and others (2003).

Table 3. Effects of Monetary Policy Shocks in Large-scale Models
Deviation from baseline

	Region and model								
	United States			*Euro area*					
	FRB-US			*NCBs*			*AWM*		
Variable	*Year 1*	*Year2*	*Year 3*	*Year 1*	*Year2*	*Year 3*	*Year 1*	*Year2*	*Year 3*
Short-term interest rate	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Long-term (ten-year) interest rate	0.16	0.06	0.00	0.16	0.06	0.00	0.16	0.06	0.00
Effective exchange rate	1.60	0.63	0.00	1.60	0.63	0.00	1.60	0.63	0.00
CPI	–0.07	–0.41	–1.01	–0.09	–0.21	–0.31	–0.13	–0.26	–0.37
GDP	–0.35	–1.28	–1.37	–0.22	–0.38	–0.31	–0.27	–0.71	–0.79
Consumption	–0.37	–1.35	–1.44	–0.12	–0.23	–0.19	–0.19	–0.57	–0.63
Investment[a]	–0.31	–1.79	–3.16	–0.34	–1.04	–1.22	–0.72	–2.29	–2.93
Disposable income	–0.03	–0.49	–0.67	–0.03	–0.16	–0.14	–0.16	–0.55	–0.65
Unemployment	0.12	0.66	0.77	0.04	0.11	0.17	0.08	0.36	0.61

Source: For the United States: private correspondence with Flint Brayton; Euro area NCBs: van Els and others (2003); Euro area AWM: Dieppe and Henry (2002).
a. Private sector investment in the case of the United States and total investment for the euro area.

To measure the composition of the output response, we take the ratio between the (monetary policy induced) change in each demand component and the total change, obtained as the sum of the changes of the various components.[19] In particular, we focus on consumption and investment, computing what we term their *contributions* to the response of the private sector domestic demand (PSDD)—the sum of consumption plus investment. We view this normalization as a way to minimize the importance of the shortcut that we took in modeling the rest of GDP in the VARs. Also, it allows a direct comparison with the results obtained in the dynamic stochastic general equilibrium models assessed in the next section of the paper, where only consumption and investment are modeled.[20] In what follows we consider cumulative changes, in order to smooth out some of the noise that can be present in the responses (particularly in the first periods).[21] Despite this smoothing, the estimated contributions in these first few periods are rather unstable in a few cases. This occurs whenever the overall response of PSDD to the monetary policy shock is initially close to zero.

A major advantage of the contribution measures is that they are unit-free statistics that can be compared across models and countries, thus sidestepping the problems of comparability among VARs and structural models. This is because, by focusing on a comparison of how much investment or consumption move relative to PSDD following a given policy shift, the nature of the shift that moves both the components to be compared is, in general, less relevant. One exception to this is when the persistence of the policy shift is significantly altered. However, this is unlikely to be the case for the kind of shifts that are considered throughout the paper.

19. If the model is specified in a log-linear form, we recover the contribution as follows: we first take the ratio of the responses of the consumption and investment to the response of GDP, each relative to baseline (these are then semi-elasticities); we multiply these two ratios by the shares of consumption and investment in GDP, respectively; we normalize the results so that they add up to one. In particular, for the euro area we used the average consumption and investment shares over the 1970 to 2000 period: 0.60 and 0.186, respectively. For the United States, we used the average shares from 1960 to 2001: 0.66 and 0.15, respectively.

20. Given that in this metric, the contribution of investment and the contribution of consumption add up to 1, we report only the contribution of consumption for the sake of space.

21. Note that cumulating up to time t the responses to a one-off shock occurring in $t - k$ can also be interpreted as observing, at time t, the response to a shock sustained from $t - k$ to t; the latter is the measure we adopt when looking at structural macroeconometric models.

In the upper half of table 4, we report the estimated contributions based on the U.S. VAR models. The table shows the median contribution along with the tenth and ninetieth percentiles of 1,000 Monte Carlo simulations. In the lower half of the table, we report the point estimates for the FRB/US model. Table 5 reports analogous figures for the euro area VARs and structural models.

Rather than discuss the many potential comparisons between the table 4 and table 5 estimates, we combine the simulations from the different VARs to form one complete set of estimated contributions for each economy. This means that the U.S. distribution is based on 9,000 simulated draws (three models, over the three samples), while the euro area distribution is based on 6,000 simulated draws (three models, over two samples). The three panels in figure 4 show the pair of distributions at three horizons (quarters four, eight, and twelve). On each of the distributions, we also draw vertical lines to show the point estimates from the large-scale models.

Figure 4 provides the basis for our assertion that there is an output composition puzzle. It is apparent from the figure that the size of the consumption contributions in the two economies is quite different. The difference is significant in both economic and statistical terms. For instance, focusing on the VARs, one would conclude that the difference in the medians of the distributions is 32 percentage points at four quarters and remains above 13 at twelve quarters. A formal Kolmogorov-Smirnov test for the equality of two distributions rejects the hypothesis of equality (at a significance level well below one percent at each of the three horizons).

Another way to see the large difference between the VAR estimates for the contributions is to examine the cumulative distributions of these data. At the four-quarter horizon, more than two-thirds of the euro area simulated consumption contributions are below 0.4. In contrast, only about 5 percent of the U.S. simulated contributions are below 0.4. At the twelve quarter horizon, 86 percent of the simulated euro area consumption contributions are below one-half, while only 41 percent of the U.S. contributions are below one-half.

Importantly, these large differences are not tied to using VARs; they are also apparent in the implied contributions coming from the large-scale models. The FRB/US model implies much larger consumption contributions than do the U.S. VARs and all euro area structural models. For instance, the point estimates from the FRB/US model and, for the euro area, the aggregation of the national models consistently show differences in consumption contributions on the order of 30 percentage points.

Table 4. United States: Contribution of Consumption to the Private Sector Domestic Demand Response to a Monetary Policy Shock

Percentiles and point estimates

		Sample of estimation and percentile[a]								
		1960:1 to 2001:4			*1965:1 to 1979:3 + 1984:1 to 2001:4*			*1984:1 to 2001:4*		
VAR model	*Horizon*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*
Erceg and Levin (2002)	4 quarters	0.55	0.69	0.96	0.52	0.64	0.85	0.11	0.58	1.45
	8 quarters	0.47	0.55	0.65	0.45	0.53	0.62	0.33	0.50	0.90
	12 quarters	0.48	0.56	0.66	0.46	0.54	0.63	0.34	0.52	0.86
Christiano, Eichenbaum, and Evans (2001)	4 quarters	0.54	0.68	0.97	0.49	0.61	0.80	0.47	0.69	1.30
	8 quarters	0.47	0.56	0.69	0.46	0.54	0.65	0.46	0.56	0.79
	12 quarters	0.48	0.58	0.72	0.46	0.55	0.65	0.45	0.53	0.71
Gordon and Leeper (1994)	4 quarters	0.42	0.51	0.62	0.44	0.54	0.66	−134	–66.7	0.77
	8 quarters	0.40	0.48	0.55	0.41	0.48	0.56	–0.11	0.53	1.24
	12 quarters	0.39	0.47	0.54	0.39	0.47	0.55	–0.02	0.55	1.03
Federal Reserve Board—U.S. model (point estimate)	4 quarters		0.81							
	8 quarters		0.74							
	12 quarters		0.66							

a. Percentiles are based on 1,000 Monte Carlo simulations.

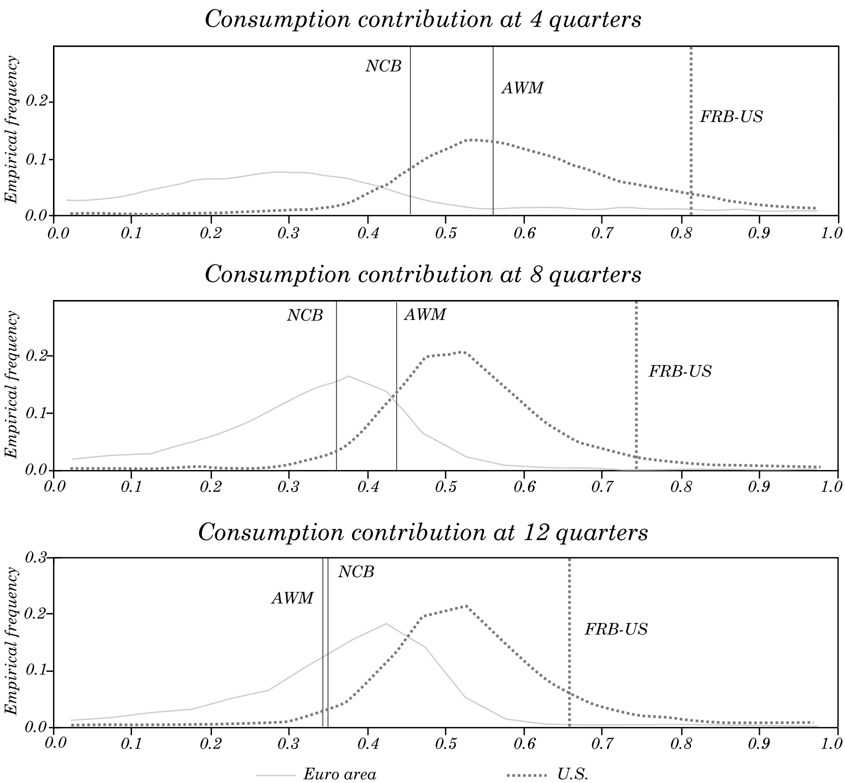
Table 5. Euro Area: Contribution of Consumption to the Private Sector Domestic Demand Response to a Monetary Policy Shock

Percentiles and point estimates

		Sample of estimation and percentile[a]					
		1980:1 to 2000:4			*1970:1 to 2000:4*		
VAR model	*Horizon*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*
Peersman and Smets (2003) baseline model	4 quarters	–0.79	0.20	0.84	–0.71	0.50	1.77
	8 quarters	0.04	0.36	0.48	–0.24	0.31	0.52
	12 quarters	0.15	0.43	0.58	–0.07	0.35	0.51
Peersman and Smets (2003) without M3	4 quarters	–0.70	0.19	1.01	–0.67	0.49	1.82
	8 quarters	0.04	0.35	0.46	–0.10	0.35	0.53
	12 quarters	0.15	0.43	0.53	0.04	0.38	0.52
Christiano, Eichenbaum, and Evans (2001)	4 quarters	–0.43	0.24	0.57	–0.19	0.28	0.45
	8 quarters	–0.34	0.27	0.69	0.21	0.35	0.44
	12 quarters	–0.17	0.36	0.89	0.23	0.37	0.46
Central bank large-scale models (point estimates)							
National models (NCBs)	4 quarters		0.45				
	8 quarters		0.36				
	12 quarters		0.35				
Area-wide model (AWM)	4 quarters		0.57				
	8 quarters		0.43				
	12 quarters		0.34				

a. Percentiles are based on 1,000 Monte Carlo simulations.

Figure 4. Distributions of the Consumption Contribution in the VARs and the Structural Models in the Euro Area and the U.S.



Note: The density curves are based on 6,000 simulations for the euro area (1,000 draws for each of the two samples for each of the 3 VARs) and 9,000 simulations for the U.S. (1,000 draws for each of the three samples for each of the 3 VARs). The vertical lines indicate the contributions as obtained by the structural models.

Given its structural nature, for the FRB/US model it is relatively easy to understand why consumption adjustments are so important. A key part of the transmission mechanism in the model is that changes in the federal funds rate move long-term rates that lead to changes in the value of the stock market. Consumption is estimated to strongly respond to the change in wealth (see Reifschneider, Tetlow, and Williams, 1999). These wealth effects are also quantitatively significant in the Washington University macroeconomic model and the Data Resources, Incorporated model. To the contrary, the effect of stock market prices on wealth and subsequently on consumption is not a prominent feature of the structural models for the euro area (see van Els and others, 2003).

As a further cross-check against figure 4, we also compute the consumption contributions implied by the VARs for France, Germany, Italy, and Spain. The top part of table 6 displays the contributions (median, tenth percentile, and ninetieth percentile) that correspond to the VAR results shown in figure 3. The lower part shows the contributions from the country-level structural models—together with similar calculations for the smaller countries in the euro area, these aggregate to the "NCBs" findings shown in tables 3 and 5.

The noise in the underlying VARs carries over to the contribution statistics, so the individual confidence intervals in table 6 are wide. But when we combine the results from the four countries a clearer picture emerges. Figure 5 shows this combined distribution along with the one from figure 4 that was constructed from the area-wide aggregate data. Conceptually these two sets of contribution estimates are not equivalent because we have not aggregated the country-level results (and because these are only four of the twelve euro area countries). As explained above, a major reason for cross-checking area-wide results with the country-level evidence was precisely to avoid the aggregation problems arising from the lack of a common monetary policy. Despite the underlying differences between the two distributions, we find them interesting in two respects. First, the contributions from these four major European countries do show investment contributions to be dominant. For instance, even at the twelve-quarter horizon, 60 percent of the consumption contributions are less than one-half. Second, the combined country-level distribution shows consistently lower consumption contributions than are found in the U.S. VARs.

Finally, the national structural model (point) estimates also confirm the larger role of investment contributions, except for France. It should be noted that the investment demand equation of the Banque de France model did not include a proxy for the user cost of capital at the time when this simulation exercise was performed.[22] Thus, it is not surprising that the investment contribution in France according to this model was so low. While there are undoubtedly more subtleties to the country-level findings than our discussion suggests, it nonetheless

22. The large response of investment to monetary policy shock is also a feature of Mojon and Peersman (2003) estimations.

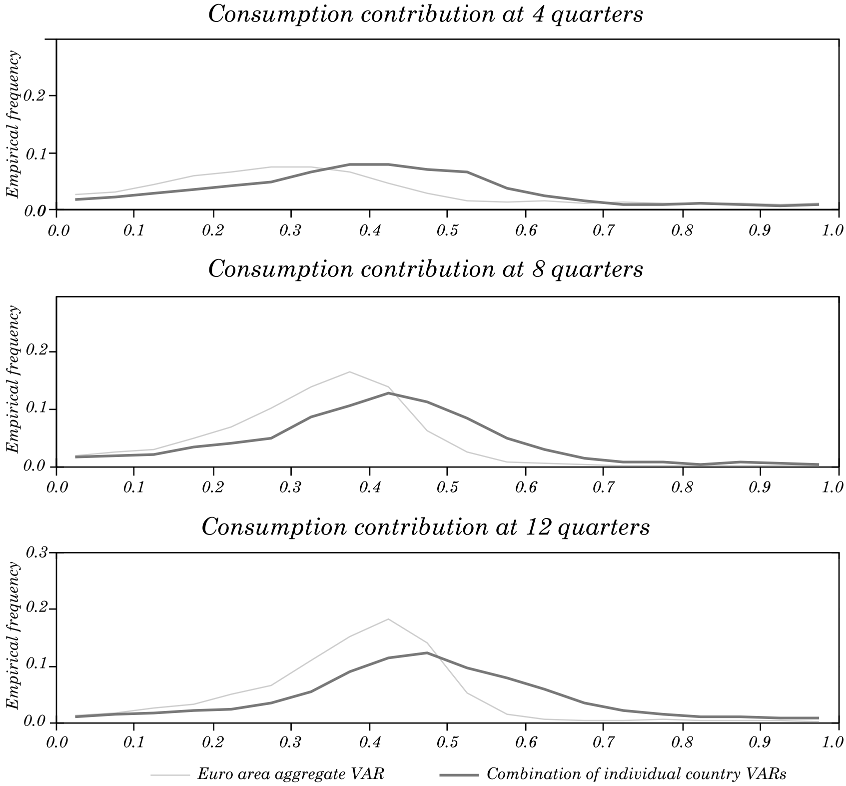
Table 6. Country-Level Evidence on the Contribution of Consumption to the Private Sector Domestic Demand Response to Policy Shocks

Percentiles and point estimates

		Country and percentile[a]											
		Germany			*France*			*Italy*			*Spain*		
Specification	*Horizon*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*	*10th*	*50th*	*90th*
VARs	4 quarters	–1.92	0.64	5.16	–0.40	0.32	0.60	0.30	0.48	0.60	–0.40	0.32	0.90
	8 quarters	–0.38	0.36	1.80	–0.20	0.44	0.60	–0.20	0.36	0.60	0.10	0.39	0.60
	12 quarters	0.07	0.58	0.95	0.30	0.48	0.70	–1.00	0.43	1.90	0.20	0.42	0.70
NCB large-scale models (point estimates)	4 quarters		0.31			0.82			0.47			0.12	
	8 quarters		0.26			0.77			0.26			0.29	
	12 quarters		0.00			0.77			0.16			0.35	

a. Percentiles are based on 1,000 Monte Carlo simulations.

Figure 5. Distributions of the Consumption Contribution Calculated from the Euro Area Aggregate VAR and from the Combination of Individual Country VARs



Note: The density curves are based on 6,000 simulations for the euro area (1,000 draws for each of the two samples for each of the three VARs) and 4,000 simulations for the euro area countries (1,000 draws for each of the four countries).

seems safe to conclude that the country-level results and those for the area as a whole are broadly consistent. It appears that in both cases, the investment contributions are, relative to consumption contributions, substantially larger than in the United States.

A full investigation of the contributions across other economies is outside the scope of this paper. We note in passing that there are a couple of other pieces of evidence on this. We estimated a VAR for the United Kingdom and found that consumption contributions there were larger even than in the United States (results are available on request). Conversely, Fujiwara (2003) estimates a set of VARs for Japan and finds that investment contributions there are much larger than consumption contributions. We look forward to further work aimed at establishing the output composition in other countries, but for the remainder of this paper we focus on the differences between the euro area and the United States.

3. Interpreting the Differences in the Composition of Output Effects

Our starting point is to check whether we can replicate the different compositions by appropriately choosing the parameters in small-scale dynamic stochastic general equilibrium (DSGE) models otherwise calibrated to fit the main features of the transmission mechanisms of the two economies. In this way, we should be able to trace the observed compositional differences back to a (hopefully small) set of differing structural features of the economies. These, in turn, could be checked against independent evidence, to arrive at a reasonably robust interpretation of our finding. Before embarking on this task, we quickly review the basic structure of this class of models.

3.1 DSGE Models in a Nutshell

Starting with the seminal works of Yun (1996), King and Wolman (1996), and Rotemberg and Woodford (1998), a growing body of literature has focused on extending the basic real business cycle (RBC) model to include a number of “real world” rigidities to account for some of the features of the data that the basic RBC model was unable to match. In this task, the main challenge was to remain firmly grounded in the optimizing behavior of a small set of rational, forward-looking representative agents (a consumer, a firm, possibly a financial intermediary, plus of course a government or a central bank) while incorporating a rich enough set of constraints limiting their decisions to fit the data. The constant challenge is to do all this while retaining numerical, if not analytical, tractability.

The challenge was met, with success, by skillfully combining four key ingredients. The first is a specification of the technology and of the market structure, originally due to Dixit and Stiglitz (1977). This assumption allows for product differentiation that is also compatible with aggregation, so that overall economy-wide prices and quantities can be constructed.[23]

The second critical ingredient is the assumption that prices and wages are set in the fashion proposed by Calvo (1983). This price- and wage-setting assumption, coupled with the assumed availability of a rich enough set of insurance markets, makes individual firms' prices (and wages) sticky, and this stickiness carries over to the aggregate levels of wages and price. One major advantage of this modeling strategy is that aggregate levels can be computed without having to keep track of all possible histories of previous pricing decisions.[24]

The final two ingredients are a clever technique of log-linearization around a nonstochastic steady-state equilibrium and the use of efficient solution techniques for linear, rational expectation models. The (solved) theoretical model has then been matched with the data, combining calibration, matching of (selected) moments, or, more ambitiously, full maximum likelihood (cum Kalman filtering) estimation. Particularly good examples of what can be achieved along this route are, for the U.S., the model developed by Christiano, Eichenbaum, and Evans (2001) and, for the euro area, the model developed by Smets and Wouters (2002). Very recently the latter model has been estimated also for the United States (Smets and Wouters, 2003), and we use these estimates in what follows to try to develop an interpretation of differences in the composition of the output response.[25] We also mention some results obtained by Lindé (2003) with the Christiano, Eichenbaum, and Evans model.

These two models are indeed very similar. Relative to the first generation of DSGE models, they both embody a number of notable features aimed at improving the fit. First, together with the so-called Calvo adjustment for prices and wages, an assumption is made of full (in Christiano, Eichenbaum, and Evans) or partial (in Smets and Wouters) indexation to previous-period inflation for those agents that are not allowed to optimally reset their price (wage). This introduces

23. The aggregator is, however, of a constant elasticity of substitution (CES) nature, and it therefore differs from the linear aggregator that underlies national income and product accounts data.

24. In particular, it is the assumption that firms (households) can fully insure against the possibility of not being able to optimally set their price (wage) that makes that possibility a matter of irrelevance as far as the wealth of different agents is concerned, and therefore allows for a history-independent description of the economy's developments.

25. We are very grateful to Frank Smets and Raf Wouters for providing us with the model code.

inertia in the inflation process, a key feature of the data that a purely forward-looking formulation is unable to match.

Second, firms can optimally choose the intensity with which they use installed capital. Increasing (or decreasing) the utilization rate is not costless, and the firm balances the benefit of a marginal increase with its cost. Allowing capital services to be elastic and, in particular, to fall after a monetary policy tightening has the consequence of muting fluctuations in the (future) rental rate of capital, thereby helping to generate the gradual price response observed in the data; moreover, it also reduces the increase in labor productivity that would otherwise occur, thus offsetting the real effect of the tightening.

Third, consumers exhibit habit formation (in the Smets and Wouters model, the habit formation takes an "external form", where the "habit" is provided by aggregate consumption, outside the control of the single household; in Christiano, Eichenbaum, and Evans, instead, the habit is proportional to the household's own past consumption). This feature of the model is needed to get a gradual and hump-shaped response of consumption to a monetary impulse (observed in the data above). Indeed, the concavity of the utility function implies that a rise in the real interest rate (a fall in the price of future consumption, relative to present consumption), should be associated with low current consumption relative to the future, that is, with a counterfactually front-loaded response of consumption to the shock. Habit formation in essence makes the argument of the utility function to be (roughly) the *growth rate* of consumption, rather than its *level*. With this specification the hump-shaped response of consumption observed in the data after an interest rate increase is a consequence of the desire to make the growth rate low (more negative) today relative to tomorrow.

Fourth, changing the stock of capital (that is, investing) involves a cost (of course, above the price to be paid for the new machines). The role of the adjustment cost, much like the assumption of habit formation in consumption, is to prevent a front-loaded response of investment. In particular, any shock (including the types of monetary policy ones considered above) that generates persistent changes in real interest rates will engender (absent adjustment costs) a substantial and immediate drop in investment. Adjustment costs, modeled as penalizing the change in investment, prevent this counterfactually large and immediate response.

While these four features do not exhaust the richness of the two models, they are arguably what enables them to match many features of the empirical transmission mechanism much better than plain-vanilla RBC models do.

It is probably too early to judge whether these models, and DSGE models more generally, will live up to the challenge of replacing the more traditional large-scale econometric models in use by many decisionmakers and practitioners. DSGE models certainly have a number of advantages, notably delivering a set of rigorously grounded theoretical and econometric findings that still adequately fit the data. However, these models have some limitations that might complicate their use in trying to explain our puzzle. In particular, the DSGE models typically assume the availability of a complete set of markets, thus making it difficult to generate precautionary behavior or liquidity constraints that might affect the consumption response to changes in the monetary policy stance. Related to this, we don't know of a DSGE that can explain the different historical patterns of financial market developments. This is one of the most striking differences between the United States and the euro area that might have a bearing on the observed differences in the composition of the output response to monetary policy. It is also worth recalling that the representative-agent nature of these models makes them liable to potential pitfalls resulting from aggregation problems (see Kirman, 1992; Altissimo, Siviero, and Terlizzese, 2002), whose actual importance still needs to be assessed.

Nonetheless, we believe these models are rich enough to provide us with an organized way to interpret the evidence. In particular, they have a number of features— pertaining both to short-run frictions and to long-run equilibrium properties—that make them potentially suitable for identifying the determinants of the puzzle.

3.2 Examining the Output Composition in the Smets-Wouters Model

We use the Smets-Wouters model to address three questions. First, are there identifiable mechanisms that are, in principle, capable of generating a difference in the output composition in the United States and euro area? Second, do the different estimates of the parameters of the model for the two economies imply a difference in the output composition that is *qualitatively* similar to the section 2 findings? Third, are these implied differences in the output composition *quantitatively* in line with the above evidence?

To our first question the answer is a clear yes, as there are several features of the model that could generate different output compositions. Our experimentation simulating the model suggests, however, that not all of the mechanisms present in the Smets-Wouters model matter for the composition of the output response. We determined that out of the large number of parameters estimated, only five parameters make any material difference for the implied consumption contributions (in the wake of a shock to short-term interest rates) at horizons up to twelve quarters after the initial shock.

Four of these five parameters govern fairly intuitive economic mechanisms. The first of these determines the size of investment adjustment costs. Higher values of this parameter dampen investment responses and hence yield relatively larger consumption contributions. In light of these adjustment costs, transitory changes in user cost of capital will have limited effects. This means that the parameter in the central bank's reaction function that measures the amount of interest rate smoothing is also important. The more the persistence that the central bank induces in the (real) short-term interest rate, the larger are the predicted investment responses.[26] A third key parameter measures the strength of the habit persistence in consumption. When habit persistence is stronger, then the adjustment in consumption following an interest rate shock is smaller. Finally, the level of the intertemporal elasticity of substitution is also relevant. When consumers have high willingness to shift consumption over time, a given interest rate change will engender larger consumption responses.

In addition to these behavioral parameters, the share of capital in the (long-run) Cobb-Douglas production function matters. The mechanisms associated with this parameter are less intuitive and somewhat more mechanical. The stability of the model requires the capital-to-output ratio to be restored (eventually) after all shocks. This means that the long-run movement in investment must move in proportion to the long-run change in output. The Cobb-Douglas parameter therefore has two influences on the contributions. First, it plays

26. This is the one exception to our earlier claim about the robustness of the contribution statistics, since changes in this persistence parameter can correspond to very different experiments that need not be comparable. The intuition given above that presumes that persistence increases the importance of investment (implicitly relative to consumption) depends on investment being more interest sensitive than consumption. This is true for the baseline Smets-Wouters parameter estimates.

a role in the initial steady-state level of capital to output that is in place at the start of any simulation. Second, in the wake of any shock, the shape of the investment response is left open, but the total amount of adjustment is constrained by the Cobb-Douglas parameter. In particular, for an economy with a relatively high capital-to-output ratio, more investment adjustment must occur for any given change in the level of output.

Given that the model can, in principle, generate different output compositions, we next ask whether this, in fact, occurs for the (modal) point estimates presented in Smets and Wouters.[27] Our answer is a qualified yes. It turns out that the implied consumption contributions do differ in a way that qualitatively matches the patterns found in the data. However, this does not appear to result from the more intuitive, behavioral channels discussed above, and, most importantly, it hinges on parameter differences that are not estimated.

The consumption contributions implied by the baseline estimates for the United States are, at quarters four, eight, and twelve, respectively, equal to 0.54, 0.48, and 0.45. Those in the euro area are instead 0.48, 0.40, and 0.36.

The mechanisms that drive this result do not depend on the intuitive channels because they tend to offset each other. The intertemporal elasticity of substitution is estimated to be lower in the euro area, and the persistence in the monetary policy reaction function higher; both features imply relatively lower consumption contributions there (as it is in the data). Conversely, the adjustment cost parameter is estimated to be larger in the euro area, and the habit formation parameter smaller; both features imply relatively higher consumption contributions (contrary to what observed in the data). Besides working in opposite directions, the quantitative differences in these four parameters are modest: none of these four parameters is estimated to be much more than one standard deviation different between the two economies.

While these channels largely cancel, the ones tied to the Cobb-Douglas parameter do not. In the Smets-Wouters model this parameter is not estimated, however, but instead is fixed so that it, along with the subjective discount rate and depreciation rate (assumed equal in the two economies), implies a steady-state value of the ratio of investment to output that matches its observed sample average. To this end, the value of the capital share in the euro area is set to be

27. Since their estimation procedure is not explicitly geared to reproducing this specific dimension of the data, this need not be the case.

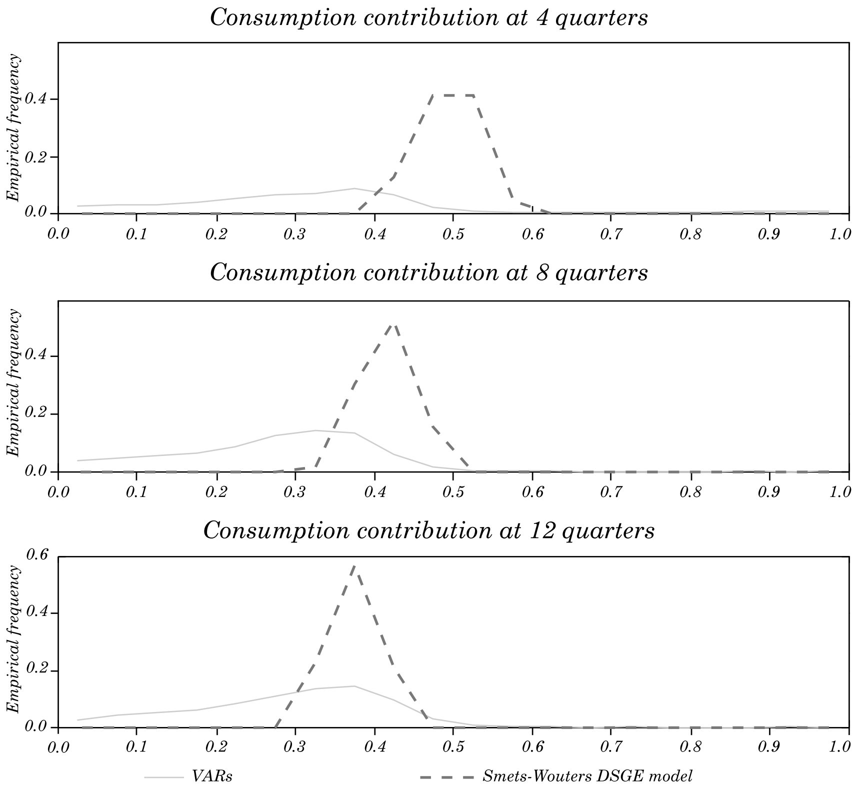
higher (0.30 versus 0.24 in the United States). The model is thus hard-wired to deliver larger long-run investment responses in the euro area. This constraint is, however, unlikely to be relevant within the twelve-quarter horizon that we consider: the long-run responses only tend to prevail much later, between ten and fifteen years after the initial shock. But the short-run values of the contributions are proportional to the starting capital to output levels. Thus, if the semi-elasticity of investment to the interest rates is similar in the two economies, then the amount of overall investment (and the investment contributions we compute) will be higher in the euro area. It turns out that the semi-elasticities generated by the model are indeed similar—at least up to quarter eight—but because of different assumed initial conditions these similarities lead to bigger investment contributions and lower consumption contributions in the euro area.

We now turn to our last question, of whether there is quantitative consistency between the model generated and the observed differences in the output composition. Our answer is, not really. The consumption contributions implied by the point estimates mentioned above already show that the differences, though of the right sign, are not nearly as large as those documented in section 2. To arrive at a more systematic and robust assessment, we conducted a Monte Carlo exercise identical to the earlier ones done for the VARs: this is done by drawing the full set of estimated parameters 1,000 times from the posterior distribution and computing the implied consumption contributions at the four-, eight-, and twelve-quarter horizons. We also reestimated the VARs over the 1974 to 2001 period (because the Smets-Wouters parameters were estimated over this period). The resulting distributions for the Smets-Wouters model and the VARs are shown in figures 6 (for the euro area) and 7 (for the United States).[28]

Figure 7 shows that drawing from the estimated distribution of the parameters for the United States, the Smets-Wouters model generates a distribution of contributions that is relatively close to that based on the VARs, at least at a twelve-quarter horizon. Figure 6 shows that a similar experiment for the euro area yields distributions rather different from those based on VARs—the Kolmogorov-Smirnov tests (at all three horizons) reject the equality of these distributions at significance levels below 1 percent.

28. The median consumption contributions of the model generated distributions in the United States are, at quarters 4, 8 and 12, respectively, equal to 0.57, 0.51, and 0.48, those in the euro area are 0.50, 0.42, and 0.37. These values are close to those reported above in the text, based on the point estimates.

Figure 6. Distributions of the Consumption Contribution in the Euro Area, VARs and Smets-Wouters DSGE model

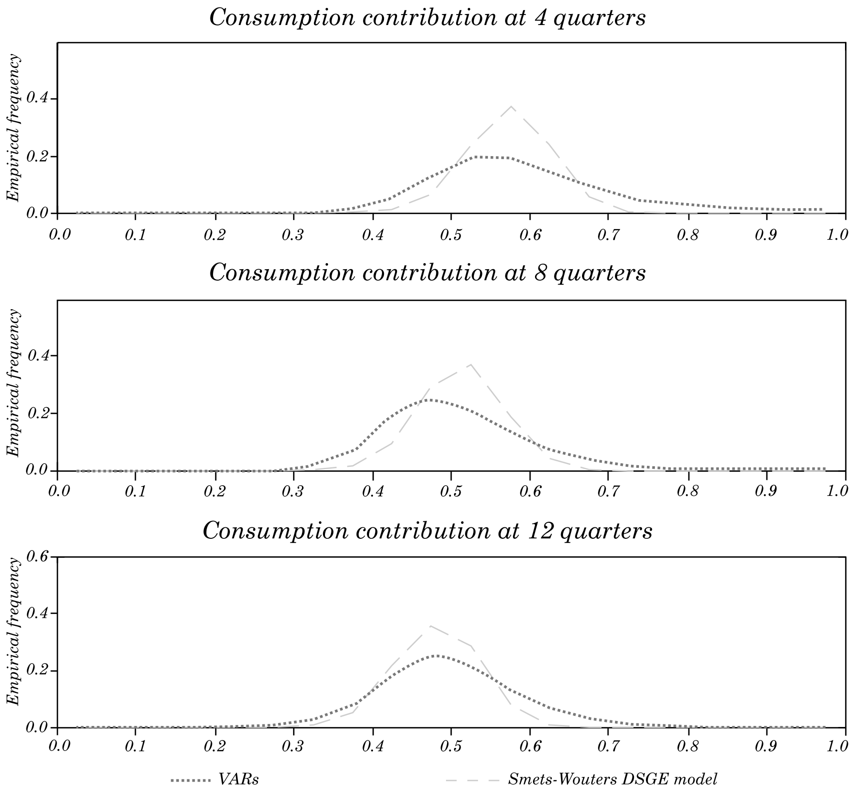


Note: The density curves are based on 3,000 simulations for the VARs (1,000 draws for each of the 3 VARs) and 1,000 simulations for Smets and Wouters model (1,000 draws from the joint distribution of the estimated model parameters).

When instead we take as a benchmark the point estimates of the contributions derived from the structural models (see tables 4 and 5), these are close to the contributions implied by the point estimates of the DSGE model for the euro area (or to the median of the model-generated distribution). However, the contributions implied by point estimates for the United States are far off the point estimates from the FRB/US model.

All in all, the differences in the estimated parameters do not appear able to generate differences in the contributions as large as those

Figure 7. Distributions of the Consumption Contribution in the U.S., VARs and Smets-Wouters DSGE model



Note: The density curves are based on 3,000 simulations for the VARs (1,000 draws for each of the 3 VARs) and 1,000 simulations for Smets and Wouters model (1,000 draws from the joint distribution of the estimated model parameters).

observed in the data. Depending on whether one compares the Smets-Wouters model to the large-scale models or the VARs, it is possible to get the Smets-Wouters model to work for one economy or the other, but not both.

A different way to see this challenge is to ask how big the estimated parameter differences would have to be in order to generate substantial differences in the implied contributions coming from the model. We need relatively large changes in any of the relevant parameters to generate contributions that are close enough to what is observed in the data. For example, if we want the model to generate point estimates of the contribution that are roughly equal to the median of the VAR distribution for the euro area (something around 0.25 at each of the three horizons), we need to reduce (relative to the model's baseline) the adjustment cost parameter by more than four times its estimated standard error, or the intertemporal elasticity of substitution by almost four times.[29] Alternatively, we need to increase the habit formation parameter by about six times its standard error, or the persistence in the policy reaction function by about five times.[30]

It is interesting to note that Lindé (2003), estimating the Christiano, Eichenbaum, and Evans model for both the euro area and the United States, seems to be able to account for the different patterns in the output composition. The estimation procedure adopted by Lindé, in line with the approach originally followed by Christiano, Eichenbaum, and Evans (2001), is less ambitious than that pursued by Smets and Wouters, as it simply tries to match the impulse responses to a monetary policy shock. Therefore, since the output composition that we are trying to reproduce is a feature of those impulse responses, Lindé's result is not really surprising.

It should be noted, however, that the changes in the parameter estimates obtained by Lindé are quite large. In particular, the parameter capturing adjustment costs in investment is, according to Lindé's estimates, thirteen times smaller in the euro area relative to the United States. (There are also other big changes, but we believe they are not really important for the ability of the model to reproduce the output composition pattern.) We see these differences as implausibly large.

Summing up, we conclude that the mechanisms at play in the most recent generation of DSGE models that might potentially account for the output composition puzzle (adjustment costs in investment decisions, habit formation, interest rate smoothing, or willingness to substitute present for future consumption) do not provide a fully satisfactory explanation. Therefore, we believe it is appropriate to explore further the set of potential explanations of the output composition puzzle, relaxing the constraints posed by this version of the models.

29. Both of the mentioned changes generate about the right contribution at quarters 8 and 12, but yield too large a contribution at quarter 4.

30. Even this change, which makes autoregressive component in the policy rate very close to 1, is not enough to match the observed contributions.

3.3 Are the Differences Due to Consumption or Investment?

Our analysis of section 2, was based on “contributions” precisely because we viewed these measures as being relatively robust across models and definitions of monetary policy shocks. A drawback of the contribution statistic is that because it is a ratio, it does not allow us to identify whether the consumption contributions are higher in the United States because U.S. consumers respond more than euro area consumers to a monetary policy shock or because U.S. firms vary their investment less. To identify this we need to look at the *levels* of the responses. These are difficult to compare. Nevertheless, several pieces of evidence suggest that that consumption is more likely to be at the root of our puzzle. Next, we offer some preliminary conjectures as to why consumption might be more responsive to a monetary policy shock in the United States.

We start by examining the structural model simulations. In these models, one can easily trace the effects of the same exogenous interest rate (and exchange rate) path on all the variables in the model, including consumption and investment, and compare the results. While this experiment has the weakness of suspending the policy reaction functions, at least it allows for a neat comparison. These simulations suggest that investment responses are surprisingly similar. In the FRB/US model, the drop is about 0.3 percent relative to the baseline value in the first year, about 1.8 percent in the second year, and about 3.1 percent in the third. In the euro area models, the drop is in the range 0.3 percent to 0.8 percent in the first year, 1 percent to 2.4 percent in the second, and 1.2 percent to 3.0 percent in the third (see table 3).

In contrast, there appear to be large differences in the response of consumption to the policy rate shifts. In the FRB/US model, the drop is about 0.4 percent of the baseline value in the first year and about 1.4 percent in both the second and third years; in the euro area models the drop is in the range 0.1 percent to 0.3 percent in the first year, 0.2 percent to 0.6 percent in the second, and 0.2 percent to 0.5 percent in the third.

Turning next to the VARs, the estimated profile of the investment response to monetary shocks is rather similar in both areas, with the drop peaking about one and half years after the shock and a gradual return to baseline afterwards. Once the differences in the size of the initial shock are broadly taken into account, the magnitude of the (maximum) drop is also roughly similar. For example, for the two Christiano, Eichenbaum, and Evans (2001) specifications (using the longest samples), the maximum drop is slightly bigger than 1 percent in the United States, after an initial interest rate shock equal to 0.7, as compared to about 0.75 percent, following an initial interest rate shock equal to 0.4 for the euro area version.

The VARs also seem to show quantitative differences in consumption responses to a monetary shock. The point estimates for all three euro area models display a mild hump-shaped pattern, but the standard errors suggest that the responses are typically not different from zero. The 90 percent confidence intervals in the long sample typically suggest that the biggest response would be no more than –0.3. For the United States, the consumption responses are significantly different from zero, and the point estimates for the peak responses for all three models in the long sample exceed –0.25.

Overall, we read this evidence as casting doubt on an explanation based on differences in the investment response, instead pointing to consumption differences as the most likely culprit. We therefore proceed by considering explanations for why consumption in the two economies might respond differently to a monetary policy shock.

3.4 Alternative Explanations for the Consumption Differences

One class of explanations that appears intuitively appealing focuses on the relative degrees of social insurance in the euro area versus the United States. In particular, the availability of complete insurance that is assumed in the DSGE model that we have examined limits the extent to which issues pertaining to, for example, precautionary saving in the face of employment or labor income risk can be explored. Yet most of the literature suggests that this is a source of major differences in the structure of personal incentives in the two economies. It is natural to think that this element should affect consumer behavior, as it is believed to affect, for example, labor supply. Hence, we see mechanisms that involve insurance market incompleteness as a natural avenue for exploration, and we focus on this in the final section of the paper.

We examine a select number of potential mechanisms that could give rise to the observed differences. Our first candidate focuses on potential effects of labor market risk in the two economies, focusing specifically on unemployment. The permanent income theory of consumption suggests focusing on the (average) cumulative effect of the shock, so that besides the short-run or peak effects, the duration of any labor market adjustments will matter. This complicates the task, because we believe most prior work suggests that there is more (unconditional) short-run unemployment risk in the United States, but that the risk of a long spell is larger in Europe.[31] We proceed by examining the mean effects of unemployment of monetary shocks as implied by both the VARs and the structural models.

The results obtained from the central banks structural models support the idea that unemployment spells are more likely to result from a monetary policy shock in the United States. In the FRB/US, unemployment increases by 0.12 percentage points in the first year, by 0.56 in the second, and by 0.77 in the third; in the euro area models, the increase is in the range of 0.04 to 0.08 percentage points in the first year, 0.11 to 0.36 in the second, and 0.17 to 0.61 in the third (see table 3).

The VAR evidence suggests otherwise. This evidence is compiled by adding unemployment to the models we used earlier as an extra variable, without changing the identification procedure for the monetary shocks. Table 7 shows the results for the Erceg and Levin model and the Peersman-Smets model without M3 for the long sample periods—the results for other models and sample periods are similar. For both VARs, unemployment is hardly estimated to change in response to a monetary shock (with effect being less than 0.1 percentage points at all horizons for both models).

Given the conflicting findings from the two methodologies, the explanation of the puzzle based on differences in labor market risk in the two economies cannot be confirmed. The issue remains open until further evidence is available. Meanwhile, we explore other possible alternatives.

A closely related possibility is that the combination of more generous unemployment benefits, national health care systems, and generous pay-as-you-go pension schemes all help to insulate euro area residents more from adverse economy-wide shocks than Americans. For example, Martin (1996) compares benefit replacement rates (net of housing and taxes) for households of varying family size across the United States and European countries. Roughly speaking, the replacement rates in most European countries are at least twice as high in the first year of unemployment as in the United States and five to ten times higher in subsequent years. The latter result is due to the U.S.

31. For instance, Bean (1994) shows that transitions probabilities both in and out of unemployment are larger in the United States than in Europe.

Table 7. Effects of Monetary Policy Shocks on Disposable Income and Unemployment[a]
Deviation from baseline

		Region and sample				
		United States			*Euro area*	
Variable	*Horizon*	*1960-2001*	*1965-1979 + 1984-2001*	*1984-2001*	*1980-2000*	*1970-2000*
Disposable income	4 quarters	–0.15	–0.15	–0.02	–0.02	–0.02
	8 quarters	–0.16	–0.04	–0.14	–0.15	–0.17
	12 quarters	–0.07	0.08	–0.21	–0.10	–0.18
Cumulated disposable income	4 quarters	–0.33	–0.28	–0.02	0.14	0.04
	8 quarters	–0.93	–0.53	–0.39	–0.32	–0.46
	12 quarters	–1.33	–0.38	–1.16	–0.84	–1.21
Unemployment	4 quarters	0.05	0.05	0.05	0.04	0.03
	8 quarters	0.07	0.08	0.14	0.09	0.09
	12 quarters	0.04	0.02	0.10	0.07	0.06

a. The U.S. model is the Erceg–Levin VAR, while the euro area model is the Peersman–Smets model without M3. Authors' calculation of the impulse response function of the variables of interest in VARs presented in section 1 of the paper. Disposable income and unemployment were included after the three GDP components in the baseline VARs.

benefits dropping sharply after the first year, so that most families could not expect to recover even 15 percent of their income.

However, while evidence suggests that *social* protection is higher in the euro area, *market* protection, either in the form of straight insurance markets or in the form of risk-sharing transfers taking place among regions, is arguably bigger in the United States. In fact, the typical finding from the literature on risk sharing (for example, Asdrubali, Sorensen, and Yosha, 1996; Sorensen and Yosha, 1998; Forni and Reichlin, 1999) is that it is low in European countries compared with the United States.[32]

On our reading, the main focus in this literature is not on the overall amount of uninsured risk that consumers in the two areas ultimately end up bearing—which is what matters for our purposes—but rather on the forms and relative importance of implicit insurance mechanisms. One result, from Forni and Reichlin (1999), suggests that the variance of income is higher in the United States at business

32. For instance, Forni and Reichlin (1999) write that "the extent of risk-sharing through capital markets and EC structural funds is very little if comparison is made with the United States."

cycle frequencies and is higher in Europe at long-run frequencies. We are unaware of any direct studies that focus on risk sharing in the wake of monetary policy shocks per se.

As an admittedly indirect attempt to assess this, we look at the effect of the policy shock on aggregate personal disposable income, both in central banks structural models and in VARs. Looking at central banks models, the evidence is mixed. Comparing the FRB/US model with the aggregation of NCBs models (see table 3), the response of disposable income to a monetary policy shift is about the same up to the first year, but is substantially smaller (by something between three and five times) in the euro area in the following two years. If the comparison is made with the area-wide model (AWM), however, the response of disposable income is larger in the euro area in the first year and of the same order of magnitude in the following two years.

The associated VAR evidence is shown in table 7. We again show the results for the Erceg and Levin specification for the United States and the Peersman and Smets model without money for the euro area (but the results from the other models are similar).We find some evidence that the response of disposable income is somewhat stronger and quicker in the United States. In particular, for the first few quarters, disposable income increases in the euro area, while it falls immediately in the United States. In terms of the cumulated response of disposable income in the two areas, the response in the United States is substantially larger for the first two years. However, the gap seems to close during the third year.

While the overall findings are somewhat ambiguous, it is striking that across models the relative movements in consumption and disposable income in both economies following a monetary policy shift are similar. In the euro area both the VARs and the structural models suggest that disposable income and consumption move roughly in proportion to each other, whereas the FRB/US model and the U.S. VARs suggest that the decline in consumption is roughly twice the size of the decline in disposable income.

We view this finding as certainly meriting further exploration. For instance, marshalling all available data on the components of the budget and nature of transfer programs and checking whether these transfers effectively buffer the risk associated with a given decline in disposable income would be an interesting next step.[33]

33. Potentially larger response of consumption relative to disposable income could be due to capital market imperfections, if one believed that U.S. households faced more severe borrowing constraints, something that we believe is doubtful.

A final possibility is that the differences in the consumption response could be due to different wealth effects of monetary policy. Reliable comparable data on the structure of wealth is hard to obtain, but it is widely believed that the structure of wealth holding differs across the two economies. For instance, total financial assets in the hands of households were, in 2001, 321 percent of GDP in the United States and 202 percent in the euro area (Agresti and Claessens, 2003). Besides the tendency of Americans to hold more of their wealth in financial securities, the form of the holdings appears to differ. The Europeans tend to hold more government debt in their portfolios than Americans, whereas Americans hold relatively more equity market claims and corporate debt. But given the limited detail available on the holdings, we cannot directly measure the response of most components of wealth to changes in interest rates. We thus cannot assess this channel.

4. Conclusions

Our focus in this paper is a comparison of certain key macroeconomic features of the transmission mechanisms of monetary policy between the United States and the euro area. After the establishment of the euro area as the largest currency area in the world, with a new and independent central bank, a comparative understanding of the two transmission mechanisms has, in our view, become important. Looking at them together can not only sharpen our understanding of each and identify clues as to where and why they differ, but also allow us to better appreciate the global implications that the independent conduct of monetary policy in each of the two areas generates.

We proceed in steps. We first compare the cyclical properties of euro area and U.S. macroeconomic time series. Here the striking fact, already reported by other recent papers, is that such properties are, in fact, broadly similar, suggesting that common underlying market forces are at work.

Next we analyze a small set of VAR models for the two areas. We find that, again, the main macroeconomic facts are similar. Specifically, after a monetary shock, real GDP displays a hump-shaped profile, returning to baseline, whereas the price level diverges gradually but permanently from the initial value. Thus, the consensus on the way monetary policy operates in the United States has held up through the long business cycle expansion of the 1990s. Moreover, the consensus view seems to well describe the euro area facts, too.

However, prior work has paid relatively little attention to the underlying adjustments that accompany the change in output. In this respect the two areas differ. In particular, after a change in monetary policy, the role of household consumption in driving output changes is greater, and that of investment smaller, in the United States relative to the euro area. This difference is present in VAR estimates and those of large-scale structural econometric models. We call this the output composition puzzle.

To explore and explain the puzzle we take two tacks. First, we consider a class of dynamic stochastic general equilibrium models. Our main result here is that these models, at least in the versions that are now considered on the research frontier, have difficulty fully accounting for the puzzle. The (full information) estimates of one such model do not quite deliver the pattern present in the data.

Given this conclusion, we turn to several less tightly structured tests and hypotheses. We first make a tentative assessment of whether the puzzle is more likely due to divergent behavior of consumers or firms. It appears to us that the consumers are responsible for the differences. Unfortunately we do not have a compelling explanation for why this is the case. It appears that disposable income may be less responsive to monetary changes in the euro area than in the United States. We were motivated to make this comparison by the hypothesis that the social safety net in Europe might cushion the effects of monetary policy on consumption more there. It appears that movements in consumption relative to disposable income are larger in the United States, too. Explaining this finding and sharpening the tests of the conjecture about the importance of the social safety net are an obvious next step.

APPENDIX A
Country-level VARs

Country level VARs were estimated for France, Germany, Italy, and Spain, for which we could gather, thanks to Alberto Locarno, unpublished private sector investment series. Except for the inclusion of consumption and investment inside the VARs, these country-level VARs are quite similar to the ones presented in Mojon and Peersman (2003).

In Germany, the VAR model includes consumption, investment, what we call the rest of GDP, inflation, the short-term interest rate, the real effective exchange rate, a trend, and a constant. For the other countries, we include the same variables plus the German interest rate in order to account for the anchoring role of the Bundesbank monetary policy during the EMS. The models are estimated for the period following the launch of the EMS (1980 to 2001) and the identification of the French, Italian, and Spanish monetary policy shocks are performed by a Cholesky decomposition, ordering the domestic money market interest rate last.

In the case of Germany, we solve the endogeneity bias between the interest rate and the exchange rate innovations by imposing that a 1 percent interest rate shock triggers a simultaneous 1 percent appreciation of the effective exchange rate. While arbitrary, this identification assumption solves the price puzzle with a smaller appreciation than the one obtained by instrumental variable estimation in Mojon and Peersman (2003).

There are three other differences with the country-level VARs of Mojon and Peersman (2003). First, we use the European System of Accounts 1995 (ESA95) national account data and we extend the sample period by three years, from 1999 to 2001.[34] Second, we choose the effective exchange rate variable rather than the bilateral rate to the deutsche mark for France and for Spain. This seems more appropriate given that the bilateral rates converged to their final parity in the second half of the 1990s and then remained constant after the launch of the euro. This change of variable was, however, not feasible in the case of Italy. There, we kept the lira–deutsche mark exchange rate, and we included the same set of exogenous variables as that used in the PS model of the euro area in order to obtain well-behaved responses

34. In the case of Germany, the data before 1991 were obtained by back dating the growth rates of the ESA79 West Germany national account data.

to interest rate shocks, that is, to avoid a persistent price and output puzzle. Finally, we estimated the German VAR with dummies that exclude nine "reunification" observations, from 1990:1 to 1992:1. These dummies allow us to eliminate the effect of the reunification period when interest rates, in parallel prices and GDP, increased in a somewhat unusual way. Mojon and Peersman (2003) managed to minimize the weight of this episode by estimating their German VAR on a sample that also included the 1970s. Having the estimates for the four countries for a sample for which we could compare the effect of monetary policy shocks with the outcome of the VAR estimated with synthetic euro area data seemed to us more appropriate.

Appendix B
Data Sources

Euro Area

Most euro area time series are taken from the ECB Area-Wide Model database. These data are presented on page 51 in Fagan, Henry, and Mestre (2001). Updates of these series up to 2000:4 can be obtained from Alistair.Dieppe@ecb.int.

We use both the previously available historical time series for M3 (February 1999 monthly bulletin of the ECB) to conform with Peersman and Smets (2003) and the more recent series backdated to 1970 (not yet published) for the VAR models estimated over a sample covering the 1970s.

The stock price, available only from 1973 onward, is the EMU-DS market index of euro area stocks published by Datastream.

Aside from the historical M3 series dating to the 1970s and the HICP, all the series we use were already seasonally adjusted. We adjusted these remaining two series using the seasonal adjustment routine in Eviews.

Country-level Data

We use ESA95 national account data for GDP and consumption. Private investment series are obtained by subtracting public investment series from the total investment series that are available in ESA95. The public investment series come from the quarterly national account published by the statistics institutes in the case of Germany and France. The Italian and Spanish public investment series come from Banca d'Italia and Banco de España. We are grateful to Alberto Locarno for providing us with these series for the four countries.

In the case of Germany, national account series prior to 1991 were backdated using the growth rate of the West German ESA79 series.

The interest rates are the three-month money market interest rates, which, from 1999:1, were set equal to the euro area three-month money market rate. For France, Germany and Spain, we used the CPI based real effective exchange rate produced by the BIS, while for Italy, we used the lira-DM exchange rate (from the ECB's internal database).

United States

Most U.S. macroeconometric time series are downloaded from www.freelunch.com. We list the original source for the different series in table B1.

The private consumption series available from the Bureau of Economic Analysis starts only in 1967. To arrive at a longer time series, we added the nondurable goods, durable goods, and services consumption series provided to us by Larry Christiano. He also supplied us with the real wage and labor productivity data that we use. These series were downloaded from economics.dri-efa.com/webstract.

Finally, the profits series corresponds to the corporate after tax profits as available in the Bank for International Settlements (BIS) database.

Table B1. Sources of U.S. Macroeconometric Time Series

Series	*Source*
GDP and all GDP components	Bureau of Economic Analysis
CPI: urban consumer—all items, (1982–84 = 100, SA)	Bureau of Labor Statistics
Commodity price index	KR–CRB futures price index, (1967 = 100), Knight–Ridder
Stock price index 500 composite	Standard & Poor's, (index 1941–43 = 10, month end)
Federal funds rate	Federal Reserve Board: H.15
Ten–year constant maturity securities	Federal Reserve Board: H.15
Total reserves and nonborrowed reserves (adjusted for changes in reserve requirements, millions $, SA)	Federal Reserve Board: Aggregate reserves of depository institutions—H.3
M1 and M2, (SA billions $)	Federal Reserve Board: H.6 Money stock and liquid assets, and debt measures

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The Bank Lending Channel in Chile

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Modigliani and Miller (1958) undermined enthusiasm about the role of credit in the economy by suggesting that the capital structure of the firm was mostly irrelevant. Moreover, the strong and robust correlation between money and real variables found in the empirical literature of the 1960s provided strong support for the view that the main transmission mechanism for monetary policy operates through changes in the cost of capital and their impact on investment (the interest rate channel).[1] In that view, banks were important only because they created money. In the 1970s, however, the new field of the economics of information underscored the relevance of capital market imperfections and the uniqueness of bank loans against other forms of debt.[2] In this context, the "credit view" emerged as a new

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1. See, for example, Friedman and Schwartz (1963).
2. The seminal paper is Akerlof (1970), who draws on the market for used cars to illustrate the problem caused by asymmetric information between dealers and buyers. Later references include Jaffee and Russell (1976), Townsend (1979), Stiglitz and Weiss (1981), and Diamond (1984), among many others.

way of understanding the monetary policy transmission mechanism. This literature distinguishes among two subchannels, namely, the broad credit channel and the bank lending channel, although more recent interpretations of the role that banks play in the transmission of monetary policy highlight the interaction between the two channels.[3]

This paper focuses on the bank lending channel, which emphasizes the role played by banks in the transmission of monetary policy.[4] Thus, if the Central Bank follows a tight monetary policy, interbank lending is curtailed and the supply of funds for banks drops. Some individual banks might succeed in raising funds elsewhere, thus insulating their loan portfolios against monetary policy. Other banks, however, are forced to curtail their supply of credit, especially in the face of a strong negative monetary shock. Such a decrease in the bank loan supply is likely to be heterogeneous, as well, in the sense that heavily indebted households and small and medium-sized enterprises (SMEs), which are presumably bank dependent, are crowded out of the market for bank loans and become severely financially constrained.[5] On the other hand, less binding adverse selection and moral hazard problems allow large enterprises to maintain, if not increase, their access to domestic bank loans and other domestic

3. See, for example, Huang (2003).

4. The broad credit channel (also known as the balance sheet channel) is related to the supply of credit by all financial intermediaries, emphasizing the role of asymmetric information in the existence of an external financing premium. This premium is defined as the difference in the costs of external and internal financing. The external financing premium depends negatively on the net worth of a potential borrower and positively on the stance of monetary policy. Hence, it is a financial accelerator mechanism that amplifies the effects of monetary policy on investment and consumption decisions. See the appendix for an overview of how both the broad credit channel and the bank lending channel are related to the whole set of monetary transmission mechanisms.

5. Because of their comparative advantages in information collection and processing, as well as their capacity to establish long-term relationships with their clients, banks are the only ones able to offer credit to certain types of borrowers. However, banks that serve clients without any other market alternative have to deal with an asymmetric information problem, since it is difficult for the market to value their loan portfolios. Those banks will therefore experience difficulties in substituting their financial sources. For example, Goldberg, Cole, and White (2002), using a survey on small firms conducted by the Federal Reserve, find that larger banks rely on standard techniques based on financial statements to make their commercial loan decisions. Smaller banks tend to deviate from these criteria, supporting their decisions with a much more personalized assessment of the entrepreneurs (of SMEs). In other words, the role played by asymmetric information is twofold: it affects the capacity of some banks to raise funds in situations of low market liquidity, and it generates a set of captive clients among banks.

financial sources.[6] As a result, the bank lending channel exacerbates the impact of a negative monetary policy shock in aggregate spending.

In distinguishing between movements of the demand for and supply of bank credit —a key issue for interpreting the evidence on the bank lending channel—we follow a strategy of identification through heterogeneity, by comparing economic agents that are more likely to be affected by financial frictions with economic agents that are less likely to be so affected. In the words of Gilchrist and Zakrajsek (1995), "By observing and measuring the differential behavior of economic agents under consideration, one can potentially attribute some, if not all, of the difference in behavior to frictions caused by credit markets."

Although we are well aware that the asymmetric nature of financial frictions also implies time varying differences, that is, in and out of times of tight monetary policy, we concentrate on explaining cross-sectional differences by following a two-step approach. First, we follow a panel data approach to test how bank characteristics (size, liquidity, and capitalization) affect the response of loan supply after a change in monetary policy. Second, using the evidence gathered in the previous step regarding the main forces behind the bank lending channel, we construct an aggregate variable—the low/high quality ratio— aimed at capturing the availability of bank credit to households and SMEs vis-à-vis large enterprises. Using the low/high quality ratio, we test—within a vector autoregression (VAR) system—whether the bank lending channel exacerbates the effect of a monetary policy shock over macroeconomic activity.

Our panel data approach is closely related to Hernando and Martínez-Pagés (2001) and, to a lesser extent, to Kashyap and Stein (1995, 2000) and Kishan and Opiela (2000).[7] Our VAR approach is mainly related to Gilchrist and Zakrajsek (1995). Using this two-step approach, we conclude that the bank lending channel operated as a monetary policy transmission mechanism in Chile within the sample period, having a significant impact on macroeconomic activity.

6. For example, if large firms are at the same time being directly affected by an external shock that is restricting their access to international financial markets, they will satisfy their financial needs domestically, thereby further crowding other agents out of financial markets. In addition to taking bank loans, large Chilean enterprises have been actively issuing new domestic bonds in recent periods.

7. See Cavieres (2002) for a study about the bank lending channel in Chile that follows closely Kishan and Opiela (2000).

The rest of the paper is organized as follows: section 1 describes the data, section 2 examines some methodological issues and presents the empirical results, and section 3 concludes.

1. The Data

The data used in this paper come mainly from financial statements of banks and publicly listed enterprises.[8] Our dataset covers the period from the first quarter of 1990 to the second quarter of 2002. We also make use of several macroeconomic series, which are mostly taken from the Central Bank of Chile.

When using bank statements, we consider only banks that are active participants in the credit market, excluding branches of foreign banks that are mainly engaged in cash and portfolio management activities.[9] This diminishes the problems associated with heterogeneous demand shocks, because the share of different types of loans in the banks' portfolios does not differ significantly (see table 1). Even after this adjustment, our dataset is quite representative of the credit market, accounting for more than 90 percent of total loans at any point in time (see figure 1).

From these bank statements we collect total loans, consumer loans, and commercial loans. The distinction between consumer loans and commercial loans points also toward a better identification of movements in the supply of credit.[10] Indeed, evidence indicates a differential behavior of various types of loans during the business cycle (see figure 2), which suggests that various types of loans may be affected differently by demand shocks.

We also collect our proxies for bank characteristics—size, liquidity, and capitalization—which are based on how the existing empirical

8. The bank statements are published in the statistical bulletin of the Superintendency of Banks and Financial Institutions (SBIF); the statements of publicly listed enterprises are taken from a dataset assembled by the Santiago Stock Exchange containing all the information provided by the Fecu (ficha estadística codificada uniforme), a standardized statement that every listed company in Chile is required to file quarterly.

9. When estimating the panel data, the original dataset is adjusted slightly to take into account mergers that occurred during the sample period. We follow the intermediate strategy proposed by Hernando and Martínez-Pagés (2001), generating a new bank when a merger of banks of similar size takes place. If the merger is between banks of significantly different sizes, the data of the merged bank is considered as data of the largest merging institution and no new bank appears.

10. As suggested by Hernando and Martínez-Pagés (2001).

Table 1. Characteristics of the Banking System[a]

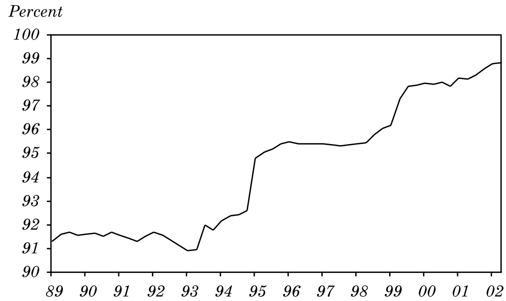
	Size (percentile)				Capitalization (percentile)			
Characteristic	<25	25-50	50-75	>75	<25	25-50	50-75	>75
Market share (percent)								
Total assets	3.9	10.0	23.1	63.0	29.5	40.0	22.8	7.7
Loans	1.1	4.5	20.5	73.9	36.6	46.2	16.5	0.8
Deposits	1.4	5.2	20.6	72.8	35.5	46.0	17.2	1.3
Size indicator								
Average number of bank-branches	2.7	12.5	31.3	113.6	78.7	87.3	29.3	1.2
Average total assets[b]	12,134.2	32,117.3	71,943.6	20,5512.1	12,2427.5	18,0963.9	97,109.9	34,402.5
Asset composition (percent)	12.9	20.3	40.2	53.1	55.4	51.6	32.2	4.7
Loans	11.6	18.9	38.9	50.7	53.5	49.3	30.0	3.1
Loans to firms	44.3	44.7	57.4	57.0	59.4	58.9	53.4	48.3
Consumer loans	13.6	27.0	10.3	6.1	11.7	7.8	8.7	5.5
Mortgage loans	0.5	2.6	12.3	16.4	11.6	17.6	20.3	0.1
Other loans	41.7	25.7	19.9	20.5	17.3	15.8	17.6	46.1
Securities	6.8	7.8	9.6	14.7	8.8	12.8	10.6	4.6
Other assets	81.6	73.3	51.5	34.6	37.7	38.0	59.3	92.3
Liabilities composition (percent)								
Deposits	51.2	68.4	63.9	62.5	66.3	64.3	61.1	52.0
Overnight deposits	7.5	4.8	8.6	14.1	11.4	12.7	13.4	7.2
Time deposits	43.8	63.6	55.3	48.4	54.9	51.6	47.7	44.8
Mortgage bonds	0.4	2.0	14.7	16.9	17.1	18.4	18.1	0.1
Foreign loans	8.0	9.5	6.7	7.7	4.6	4.2	5.7	2.8
Subordinate bonds	0.0	0.2	1.8	1.7	2.3	2.3	1.2	0.0
Stock of provisions	1.4	2.6	2.4	2.6	2.1	1.9	2.0	1.0
Capital and reserves	38.9	17.3	10.4	8.6	7.6	8.9	12.0	44.0

Source: SBIF and authors' calculations.

a. This analysis if performed for the whole sample period (1990–2002). Percentiles are calculated for each period.

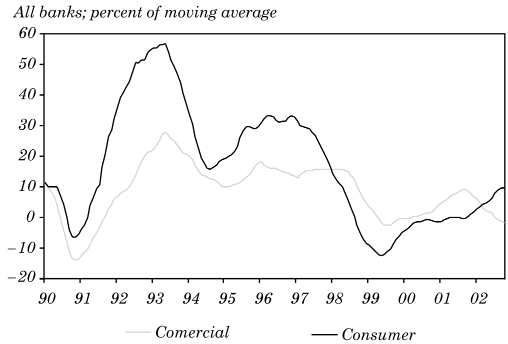
b. Millions of pesos.

Figure 1. Share in the Loans Market of Banks Included in the Sample, 1989 to 2002



Source: SBIF.

Figure 2. Annual Growth of Total Loans, 1990 to 2002



Source: SBIF.

literature about the bank lending channel captures the potential problems associated with asymmetric information.[11] Size is defined as the bank's share of the total assets of the banking system; liquidity is defined as the ratio of liquid assets to total assets; and capitalization is defined as the seasonally-adjusted ratio of capital and reserves to total assets. Table 2 presents the main descriptive statistics on this set of bank characteristics.

From the statements of publicly listed enterprises, we take the total large corporate sector bank debt. Using this variable as the denominator and the consumer loans of the banking system as the numerator,

11. See, for example, Kashyap and Stein (1995, 2000) and Kishan and Opiela (2000).

we construct a variable that we call the low/high quality ratio, to capture the availability of bank credit to households and SMEs vis-à-vis large enterprises. Two features of this ratio deserve further explanation: the extent to which consumer loans capture not only household credit but also loans directed to SMEs; and the relation of this ratio to a flight to quality. With regard to the first feature, we could have measured credit to SMEs more directly using data that is available by loan size, but this series is only available since 1996, and with less than quarterly frequency. However, when graphing the small business loans and consumer loans together (see figure 3), the two series follow a relatively similar path (the correlation is over 90 percent). Credit to SMEs is, in fact, known to usually take the form of a consumer credit in the Chilean banking industry, whereas credit to large enterprises follows a very different path.

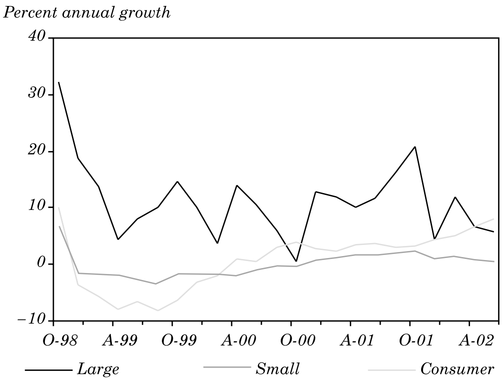
With regard to the second feature, our low/high quality ratio is (inversely) related to the indicator of a flight to quality constructed

Table 2. Descriptive Statistics of Bank Characteristics

Characteristic	Mean	Standard Error	Minimum	Maximum	Percentile 25	Percentile 50	Percentile 75
Size	4.21	4.01	0.03	19.04	0.87	3.24	5.92
Liquidity	20.69	9.01	4.48	53.92	13.41	19.58	27.26
Capitalization	8.76	9.43	1.09	63.44	4.64	5.68	7.95

Source: Authors' calculations.

Figure 3. Small Loans and Consumption Loans

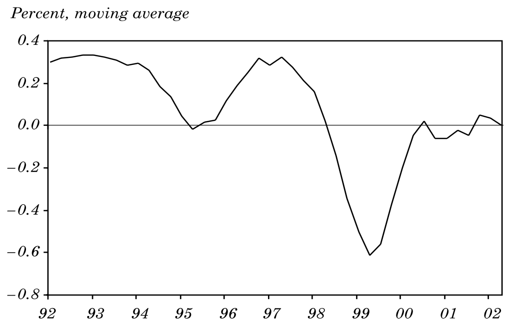


Source: SBIF.

by Caballero (2002) using precisely the share of large loans from the available data by loan size. Although our story is different from Caballero's, in the sense that we are trying to pin down the effect of a monetary policy shock instead of an external shock, the operative financial mechanism is basically the same: indebted consumers and especially SMEs are crowded out of the banking system by large firms, thus becoming severely financially constrained. Figure 4 shows a severe flight-to-quality effect in 1998–99, a period of extremely tight monetary policy.

To identify the effect of a monetary policy shock on the supply of bank loans, we need an indicator that is closely tied to monetary policy. The international empirical literature offers several alternatives, but the set of choices in the case of Chile is limited by data availability. Within this limited choice set, we choose the term spread, defined as the difference between the monetary policy rate and the PRC8.[12] As explained in Gertler and Lown (2000), a positive movement in the term spread (so defined) simply reflects that the monetary tightening is inducing a fall in long-term rates, because there are expectations of a drop in the short-term interest rate in the near future (see figure 5).

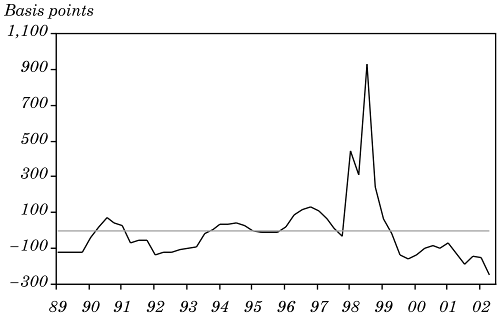
Figure 4. Annual Growth in Low/High Quality Ratio, 1992 to 2002



Source: Central Bank of Chile and authors' calculations.

12. The PRC8 are long-term indexed bonds issued by the Central Bank of Chile. See Estrella and Mishkin (1998) for a positive assessment of the predictive power of the term spread; see Gertler and Lown (2000) for an explanation of the close relationship between the term spread and monetary policy, particularly in periods of significant monetary tightening.

Figure 5. Term Spread, 1989 to 2002



Source: Central Bank of Chile.

Finally, we use several macroeconomic series in the panel and the VAR system. Specifically, in the panel of banks we use the annual growth of real GDP to capture changes in income, and the annual depreciation of the real exchange rate to capture movements in relative prices. Both variables are intended to control for demand effects. In the VAR system, we use three additional endogenous variables (besides the low/high quality ratio and the term spread): namely, a proxy for macroeconomic activity (in logs and seasonally adjusted), the consumer price index (in logs and seasonally adjusted), and the real exchange rate (in logs). We use six different proxies for macroeconomic activity: real GDP, industrial production, business investment, durable goods consumption, unemployment rate, and residential investment. In addition to these endogenous variables, every VAR model includes the following set of exogenous variables: terms of trade, inflation target, external output, and a time trend.[13]

2. Methodological Issues and Empirical Results

Our main goal in this section is to analyze whether the bank lending channel played any role as a transmission mechanism for monetary policy in the Chilean economy during the period 1990 to 2002 and, if so, whether this transmission mechanism plays any

13. This is justified on the grounds that Chile is a small open economy with an inflation target regime operating since the early 1990s. In particular, by including the terms of trade, we are controlling for external shocks. Hence, if we find that the low/high quality ratio influences economic activity following a monetary policy shock, we can interpret the flight-to-quality effect as being domestically driven.

significant macroeconomic role. We follow a two-step approach. First, we use a panel of bank data to identify shifts in the loan supply curve in response to changes in monetary policy by exploiting the heterogeneity among banks. Such an exercise lets us gather evidence about where the bank lending channel has operated most strongly. Second, we use that knowledge to construct a variable that is likely to be a good proxy of how the bank lending channel exacerbates the monetary policy shock, thus having an independent and significant impact on aggregate spending. This variable is the low/high quality ratio, which captures the availability of bank credit to households and SMEs vis-à-vis large enterprises. Here again, we appeal to heterogeneity for identification purposes, this time among borrowers. Finally, we embed the low/high quality ratio within a VAR system to test whether the bank lending channel exacerbates the effect of a monetary policy shock over macroeconomic activity.

2.1 First Step: A Panel Data of Banks

As discussed in the introduction, a tight monetary policy reduces the amount of funds available for the banking system, and some banks are unable to offset the reduction in interbank funds owing to information problems. How do bank characteristics affect the response of loan supply following a monetary policy shock? To answer this question, we follow a panel data approach in which bank characteristics (size, liquidity, and capitalization) interact with the term spread (our indicator of monetary policy) to disentangle the differential behavior of banks with regard to total loans, consumer loans, and commercial loans.

In this panel model, the dynamic structure is adequately handled by introducing one lag for the endogenous variable and four lags for the term spread, the variables aimed at controlling for demand effects, and the variables related to bank characteristics. Although including a lag of the dependent variable is trivial in the time-series context, the fixed-effects estimator is severely biased in a dynamic context. Instead of following the traditional approach to dealing with such a problem—namely, the Arellano and Bond generalized method of moments (GMM) procedure—we use the bias-corrected estimator proposed by Hahn and Kuersteiner (2002).[14]

14. The Arellano and Bond GMM procedure is subject to substantial finite sample bias, as shown by Alonso-Borrego and Arellano (1999) and Hahn, Hausman, and Kuersteiner (2002). For a more technical discussion of the methodological issues, see Brock and Franken (2003).

The empirical specification within this panel data approach is the following:

$$y_{it} = \rho y_{it-1} + \sum_{j=0}^{4} \mathbf{x}'_{it-j}\beta + \mathbf{z}'_{it-1}\gamma + \sum_{j=1}^{4} \mathbf{x}_{3it-j}\mathbf{z}'_{it-1}\phi + \sum_{s=1}^{4} \sigma D_{st} + u_{it} \,,$$

where y_{it} represents the annual growth of total loans, commercial loans, and consumer loans, respectively; $\mathbf{x}_{it}$ is a vector of macroeconomic variables aimed at controlling demand-side shocks (annual growth of GDP and annual depreciation of the real exchange rate) in addition to the monetary policy indicator (term spread); $\mathbf{z}_{it}$ denotes a vector of bank-specific variables (liquidity, size and capitalization); D is a set of seasonal dummies; u_{it} is i.i.d; $i = 1, \ldots , N$ represents the number of banks included in the dataset; and $t = 1, \ldots , T$ is the time index from 1990:1 to 2002:2. Note that the bank-specific explanatory variables $\mathbf{z}_{it}$ are included with one lag to account for potential endogeneity.

We disentangle loan-supply from loan-demand effects by looking at cross-sectional differences in the response of bank loans to a monetary policy shock. Were these differences to be related to indicators of the degree of informational asymmetries (size, liquidity, or capitalization), they would support the existence of the bank lending channel. More specifically, if the bank lending channel holds, we should expect a positive and significant cross-coefficient between the term spread and bank characteristics.

Table 3 shows the long-run coefficients for each of the explanatory variables. First, note that the long-run coefficient for the annual growth of real GDP, when statistically significant, is positive. Second, the long-run coefficient for annual real depreciation is always significant and negative. Third, the long-run coefficient of the term spread, which is positively related with a tighter monetary policy, is always significant and negative. Finally, regarding the interaction of bank characteristics with monetary policy, the results show that liquidity is always significant and positive, size is positive and significant only for total loans, and capitalization is positive and significant only for consumer loans.

Table 4 shows the overall effects of a tight monetary policy in terms of the annual growth rate of total loans, consumer loans, and commercial loans.[15] As can be seen from the table, tightening monetary policy

15. The overall effects include the direct effect of monetary policy plus the interactive effects of bank characteristics with monetary policy. If the parameter is nonsignificant, it is computed as being equal to zero. Bank characteristics are evaluated at three representative levels for each category.

Table 3. Long-run Coefficients and Standard Errors

Dependent variable	*Coefficient*	*Standard error*
1 Growth of total loans		
Real GDP growth	0.57*	0.19
Real exchange rate devaluation	–0.93*	0.11
Term spread	–4.31*	0.46
Bank characteristic and term spread:		
Liquidity	7.83*	1.56
Size	13.24*	2.83
Capitalization	–1.43	3.85
2 Growth of consumer loans		
Real GDP growth	1.09*	0.19
Real exchange rate devaluation	–0.20**	0.10
Term spread	–2.65*	0.57
Bank characteristic and term spread:		
Liquidity	6.41*	1.66
Size	3.44	3.89
Capitalization	5.39*	1.37
3 Growth of commercial loans		
Real GDP growth	–0.02	0.37
Real exchange rate devaluation	–1.71*	0.21
Term spread	–6.85*	0.99
Bank characteristic and term spread:		
Liquidity	13.59*	4.01
Size	2.22	4.21
Capitalization	–3.94	6.28

*Statistically significant at the 1 percent level.
**Statistically significant at the 5 percent level.

results in a larger drop in the growth rate of total loans for small banks than for large banks.[16] In addition, the drop in the growth rate of all types of loans is larger for less liquid banks than for their more liquid counterparts.[17] In the case of consumer loans, the bank lending channel operates through less capitalized banks.[18]

16. A one percentage point increase in the term spread accounts for an annual reduction of 4.2 percent in total loans when the bank is small, but only 3.5 percent when the bank is large.

17. A one percentage point increase in the term spread accounts for an annual reduction of 3.3 percent in total loans, 1.8 percent in consumer loans, and 5.0 percent in commercial loans for a less liquid bank. On the other hand, a one percentage point increase in the term spread accounts for an annual reduction of only 2.2 percent in total loans, 0.9 percent in consumer loans, and 3.1 percent in commercial loans for a highly liquid bank.

18. A one percentage point increase in the term spread accounts for an annual reduction of 2.4 percent in consumer loans when the bank is less capitalized, but only 2.2 percent when the bank is more capitalized.

Table 4. Overall Effect of a Monetary Policy Shock on the Growth Rate of Loans

	Size (percentile)			*Capitalization (percentile)*			*Liquidity (percentile)*		
Type of loan	*25*	*50*	*75*	*25*	*50*	*75*	*25*	*50*	*75*
Total	–4.2	–3.9	–3.5	–4.3	–4.3	–4.3	–3.3	–2.8	–2.2
Consumer	–2.6	–2.6	–2.6	–2.4	–2.3	–2.2	–1.8	–1.4	–0.9
Commercial	–6.9	–6.9	–6.9	–6.9	–6.9	–6.9	–5.0	–4.2	–3.1

Our preliminary results thus support the idea that the bank lending channel has operated in Chile. Furthermore, consumer loans seems to better capture the role played by informational asymmetries in the response of bank loans to monetary policy shocks. Indeed, both liquidity and capitalization have played a restrictive role for consumer loans, while commercial loans have only been affected by liquidity. We argued above that consumer loans are a reasonably good proxy for bank credit directed to both households and SMEs. Hence, our results in this first step suggest that the decrease in banks' loan supply may have actually been heterogeneous, affecting more SMEs and, to a lesser extent, highly indebted households, than large enterprises. The next step concentrates on providing more solid evidence along this line.

2.2 Second Step: A VAR System Including an Aggregate Proxy for the Bank Lending Channel

The fact that the banks' loan supply affects borrowers heterogeneously can be exploited to identify how the bank lending channel exacerbates a monetary policy shock. We therefore construct the low/high quality ratio to capture the availability of bank credit to households and SMEs vis-à-vis large enterprises.[19] More specifically, we ask the following question regarding the impact of monetary policy on the real sector of the economy: does the bank lending channel play any significant macroeconomic role as a monetary transmission mechanism? To answer it, we analyze whether the low/high quality ratio has marginal predictive power over a set of macroeconomic variables.

19. See section 1 for a more detailed explanation of this particular variable.

We expect a negative monetary policy shock to reduce the low/high quality ratio (flight to quality), which would strongly affect bank-dependent households and SMEs by eliminating their only source of external funding.[20] For example, casual evidence for the Chilean economy shows that SMEs have quite limited access, if any, to bond issuing or capital raising in the stock market.[21] In other words, the decline in the low/high quality ratio represents a decrease in portion of the banks' loan supply directed to those economic agents (households and SMEs) who bear the largest share of the costs associated with information problems. This may, in turn, have a significant effect on economic activity.[22]

The empirical approach used in this section consists in estimating a set of VAR models in levels, each of which includes the low/high quality ratio that accounts for the existence of the bank lending channel. Four endogenous variables are also included, namely, the term spread as the indicator of the monetary policy stance, a proxy for macroeconomic activity (with six different alternatives), the real exchange rate, and the price level. Finally, every model includes a set of exogenous variables: terms of trade, inflation target, external output, and a time trend.[23]

To assess the macroeconomic importance of the bank lending channel, we test for the marginal predictive power of the credit variable (low/high quality ratio) by carrying out Granger causality tests and reporting the corresponding *p* values. A rejection of the null hypothesis that the credit variable is irrelevant for predicting macroeconomic activity is one piece of evidence in favor of the bank lending channel. This evidence has to be complemented with two simultaneous

20. See footnote 5.

21. This is consistent with the international empirical evidence, which shows that finding alternative sources of credit is quite difficult for SMEs.

22. The drop in the supply of bank credit pushes SMEs to curtail their productive activities, which are usually labor intensive. This has a strong impact in terms of job destruction, since the affected workers are generally unskilled and thus difficult to absorb into other sectors in the economy. Because increasing unemployment rates are strongly correlated with consumer confidence (in the United States and elsewhere), aggregate demand falls. Hancock and Wilcox (1998) find that small banks engage in "high power" credit activities, with a small drop in their credit supply having a large impact on economic activity, measured in terms of unemployment, real wages, GDP, and number of bankruptcies.

23. We use a two-step procedure to define the optimal lag structure (Johansen, 1995): the first step uses the Schwarz-Bayesian criterion; the second step adds additional lags for eliminating any evidence of serial correlation detected by the multivariate LM test statistics for residual serial correlation.

conditions, however: rejection of the null hypothesis that the term spread is irrelevant for predicting the credit variable, and failure to reject the null hypothesis that the proxy for macroeconomic activity is useless in predicting the credit variable. In other words, the bank lending channel requires that lagged values of the term spread be significant in predicting the credit variable, which in turn must be significant in predicting either macroeconomic activity or other macroeconomic variables.

Table 5 shows the Granger causality test for each VAR model. The results support the hypothesis that the low/high quality ratio

Table 5. VAR Pairwise Granger Causality/Block Exogeneity Wald Tests[a]
P values from exclusion test

Models classified according to proxies for macroeconomic activity	*Low/high quality mix ratio[b,c,d]* *Variables excluded from:* *Macroeconomic activity equation*	*P values (percent)*	*Low/high quality mix ratio equation*	*P values (percent)*
GDP[e]	Monetary policy shock	95.6	GDP	73.6
	Low/high quality mix ratio	0.0	Monetary policy shock	0.2
Industrial production[e]	Monetary policy shock	4.5	Industrial production	90.7
	Low/high quality mix ratio	0.5	Monetary policy shock	0.6
Business investment[e]	Monetary policy shock	68.7	Business investment	66.5
	Low/high quality mix ratio	0.0	Monetary policy shock	0.2
Durable consumption[f]	Monetary policy shock	0.2	Durable consumption	52.6
	Low/high quality mix ratio	1.9	Monetary policy shock	3.3
Unemployment rate[e]	Monetary policy shock	44.7	Unemployment	95.6
	Low/high quality mix ratio	0.0	Monetary policy shock	0.8
Residential investment[f]	Monetary policy shock	3.1	Residential investment	55.4
	Low/high quality mix ratio	1.9	Monetary policy shock	2.5

a. This table shows the results obtained from six VAR models. Each one uses a different option for measuring macroeconomic activity: real GDP, industrial production, business investment, durable consumption, the unemployment rate, and residential investment. Each proxy is added one at a time to the base VAR. The base model comprises five variables: real GDP, the consumer price index, the term spread, the low/high quality mix ratio, and the real exchange rate. The exogenous variables are the terms of trade, the inflation target, external output, and a time trend.
b. The numbers in the table are the *p* values for the null hypothesis that some variables contain no information for the dependent variable. For each model, we choose the equations that represent both the proxy for macroeconomic activity and the credit variable (low/high quality mix ratio). We then test, respectively, whether the term spread and the credit variables do not Granger cause macroeconomic activity and whether macroeconomic activity and monetary policy do not Granger cause the credit variable. In other words, if the *p* value is lower than 5 percent, we can reject the null hypothesis.
c. Ratio of credit bank loans for consumer and small firms to short-term bank debt of all firms, from Fecu dataset.
d. The exogenous variables are a time trend, the inflation target, the terms of trade, and external output.
e. Endogenous variables have two lags; exogenous variables have two lags.
f. Endogenous variables have three lags; exogenous variables have two lags.

predicts macroeconomic variables in all cases. These results also indicate that the lags of the term spread are significant for predicting macroeconomic variables in just three out of six cases.[24] On the other hand, macroeconomic variables are not helpful for predicting the low/high quality ratio in each case, whereas the term spread is helpful for predicting the low/high quality ratio in all cases. The empirical evidence thus strongly supports a causality running from monetary policy to credit and from credit to macroeconomic activity.

To study the dynamics of the bank lending channel, we estimate a structural vector autoregression (SVAR) and report impulse responses to a monetary policy shock. The set of identifying assumptions is borrowed from a vast list of authors who use this type of identification scheme in VAR models.[25] Variables are thus divided into three recursive sets: nonpolicy variables that are not contemporaneously affected by the policy variables; policy variables; and nonpolicy variables that are contemporaneously affected by the policy variables.[26] In other words, the Central Bank's feedback rule is identified by dividing the set of nonpolicy variables into variables that cause a policy reaction and variables that are affected by the policy reaction. For the policy variables, we assume the following sequence of events: the Central Bank first sets an inflation target, which is an exogenous variable, and it then sets the monetary policy stance.[27] For the nonpolicy variables, we assume a recursive causal relationship ordered as follows: price level, output, and the credit variable.[28] Our positioning of the variable used as a proxy for the bank lending channel (low/high quality ratio) in last place is based on the assumption that the Central Bank is able to affect it contemporaneously

24. At the 5 percent level of significance.

25. See, for example, Christiano, Eichenbaum, and Evans (1996, 1997, 1999); Eichenbaum and Evans (1995); Strogin (1995); Bernanke and Blinder (1992); Bernanke and Mihov (1998); and Gertler and Gilchrist (1994). For the case of Chile, see Bravo and García (2002).

26. In our particular case, we use an exactly identified VAR because additional identifying restrictions in the parameters do not change the results obtained in the impulse response functions.

27. This assumption is consistent with the fact that the monetary policy rate is used as a fine-tuning policy, given a known inflation target.

28. The assumption behind this order is that the price level is stickier than output, a fact that is consistent with the high level of backward indexation in the Chilean economy (Jadresic, 1996).

through the monetary policy stance, since capital markets tend to respond faster than goods and labor markets.[29]

Figure 6 displays the estimated impulse responses (black lines). The low/high quality ratio decreases following the monetary policy shock, a result that is consistent with a flight-to-quality effect as described above. GDP declines about two quarters after a tightening in monetary policy. The maximum decline occurs about a year after the shock, and the effect gradually dies out thereafter. We observe a similar pattern when GDP is substituted by industrial production or unemployment rate, although the effect seems to be more persistent in the latter case.

When both investment and durable consumption replace GDP, these two components of aggregate output decline during the first year and a half. Such a result differs from the international empirical evidence. For example, Bernanke and Gertler (1995) find evidence that in the United States the decline of durable consumption and residential investment precede business fixed investment. Their interpretation is against the conventional monetary policy transmission mechanism that operates through an earlier decline in investment. In the Chilean case, however, the impulse responses indicate that durable consumption and both types of investment decrease at approximately the same time. We interpret this as evidence that both transmission mechanisms are relevant for Chile.

The empirical strategy described above allows us to compare the impulse responses to a monetary policy shock in two different systems, in which the variable used as a proxy for the bank lending channel (i.e. the low/high quality ratio) is first defined as endogenous (black lines) and then as exogenous (gray lines). Shutting down the bank lending channel effect on other macroeconomic variables following a monetary policy shock establishes a measure of the macroeconomic relevance of the bank lending channel: namely, the difference between the two impulse responses.[30] To determine whether this

29. To illustrate the identifying assumptions described above, assume that the Central Bank contemporaneously knows the evolution of the inflation rate but is not able to affect it. If the economy faces an inflationary shock (an oil shock, for instance), the Central Bank could respond with a change in the monetary policy rate. This, in turn, would have an immediate impact on other variables, such as the low/high quality ratio and the exchange rate. Only then might monetary policy affect variables such as GDP, investment, consumption, and inflation.

30. From the Granger causality tests, we already know that the empirical evidence strongly supports a causality running from monetary policy to credit and from credit to macroeconomic activity. What we are doing here, therefore, is determining whether the flight-to-quality effect occurs as a result of a monetary policy shock or is driven by other factors.

difference is statistically significant, we display the dashed lines that represent a 95 percent confidence interval for each impulse response function when the bank lending channel is endogenous. If the impulse response functions calculated under the assumption that the credit variable is exogenous fall outside this confidence interval, we interpret this as evidence in favor of the macroeconomic relevance of the bank lending channel.

What do we find? The bank lending channel is unambiguously relevant in terms of GDP, business investment, and the unemployment rate, since the responses of these variables are definitely much weaker if the proxy for the bank lending channel is exogenously included in

Figure 6. Response to Structural One S.D. Innovations ± 2 S.E. on Monetary Policy Shock[a] (quarters)

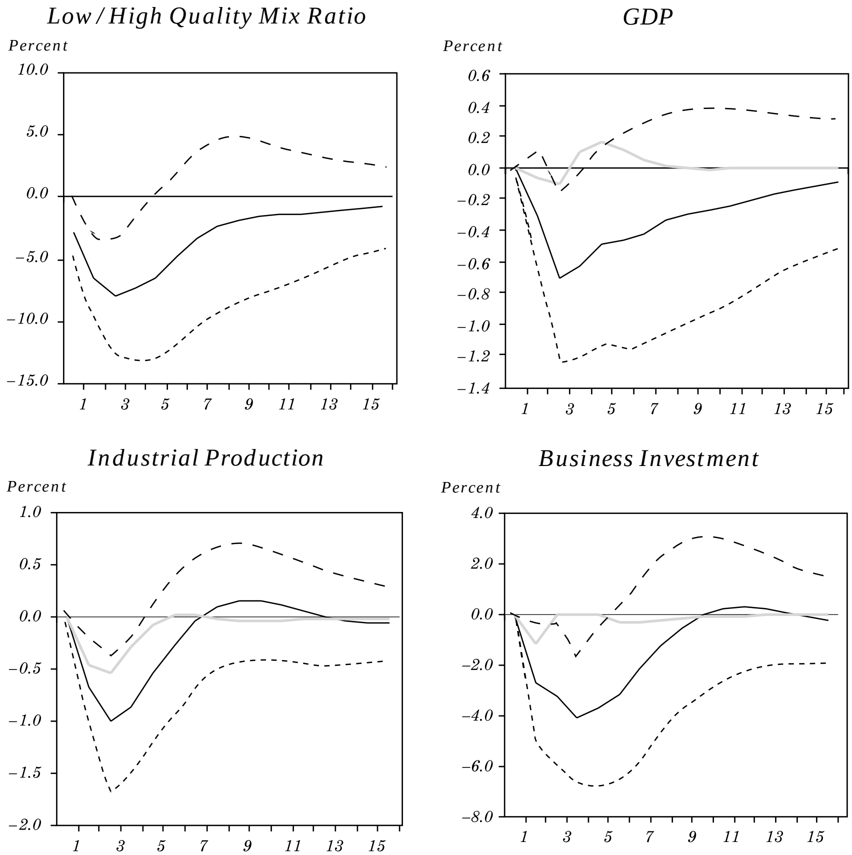
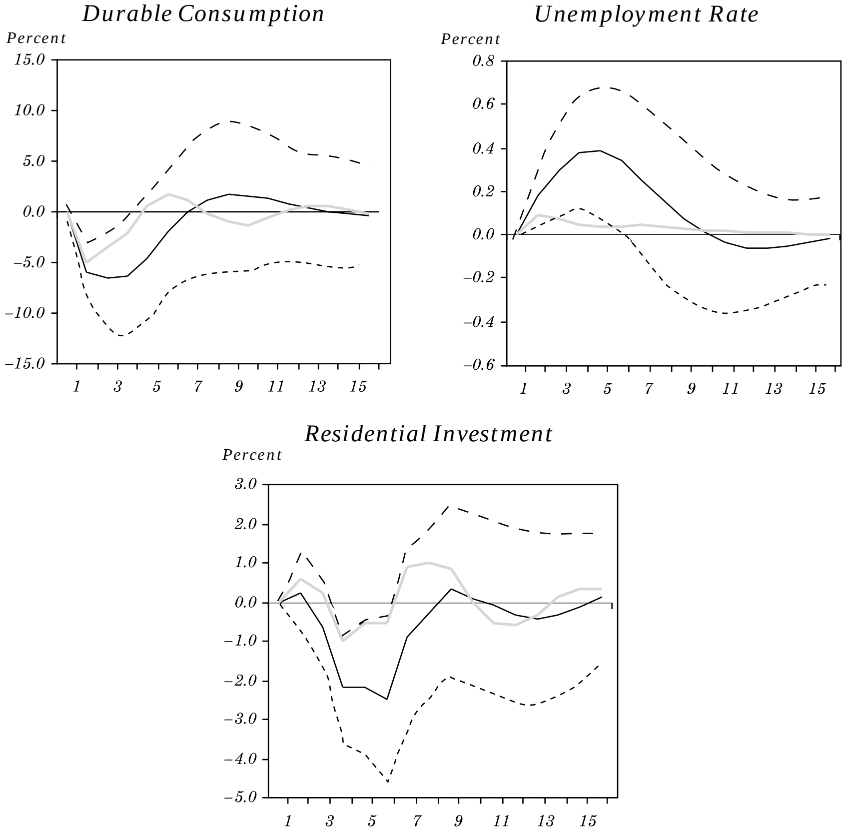


Figure 6. (continued)



the system. The other results also support the macroeconomic relevance of the bank lending channel to a degree, since durable consumption, residential investment, and industrial production are on the brink of being statistically different from the case of an endogenous bank lending channel.[31]

31. We are using a relatively small dataset given the relatively large set of variables included in the VAR system, meaning that we are dealing with large sampling uncertainty. The 95 percent confident interval is thus a rather strict test. For instance, researchers tend to use +/-1 standard deviation when dealing with large sampling uncertainty, meaning that a 67 percent confidence interval for the true impulse response function is considered good enough for the purpose at hand (see, for example, Stock and Watson, 2001). If we use the latter benchmark, the macroeconomic relevance of the bank lending channel is unambiguously supported for all variables used as proxies for macroeconomic activity.

3. Concluding Remarks and Directions for Future Research

We conclude that the bank lending channel operated as a monetary policy transmission mechanism in Chile during the period 1990–2002, with an independent and significant effect in terms of macroeconomic activity. The way that the bank lending channel seems to have operated in Chile is consistent with the international empirical evidence: first, some banks—less liquid banks and, to a lesser extent, small and less capitalized banks—are forced to curtail their supply of credit following a monetary policy shock; second, the access of households and SMEs to external financing is severely restricted following the drop in the supply of bank credit; third, the uneven distribution of the drop in the supply of bank credit, which can be associated to a flight-to-quality effect, has a significant influence in terms of macroeconomic activity. By pushing toward a better understanding of the way in which the bank lending channel operates as a transmission mechanism of monetary policy in Chile, our paper contributes to an improvement of the monetary policy decision framework.

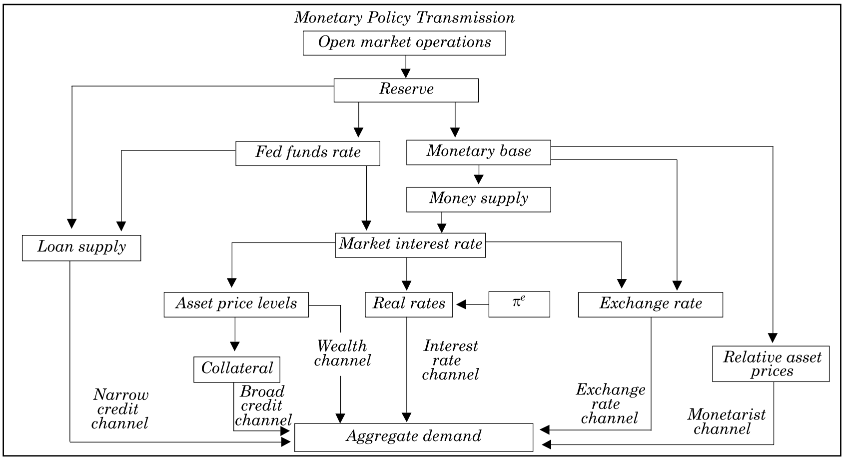
Our focus in this paper is on explaining cross-sectional differences among economic agents (banks, firms, and, to a lesser extent, households). The evidence gathered in this paper therefore points toward a bank lending channel operating across the sample period, abstracting from the asymmetries related to times in and out of tight monetary policy and from the evolution of certain features in the economy that may affect the strength of the bank lending channel. For example, information problems are likely to be less binding in periods of relatively loose monetary policy, rendering the bank lending channel much less relevant as a transmission mechanism in comparison with periods of a tighter monetary stance. In particular, the large monetary policy shock in 1998–99 probably represents the bank lending channel operating at its maximum strength, although the counterfactual exercise of what would have happened had the exchange rate been allowed to depreciate sharply points to the possibility of a financial accelerator mechanism as well, through larger balance sheet effects. Another example is the role played by the increase in the capital base of banks during the 1990s, as well as the more widespread use of credit scoring. Both trends have probably strengthened the capacity of banks to deal with informational asymmetries.

This study underscores at least four avenues for future research that may deepen our knowledge of the functioning of the credit channel, in general, and the bank lending channel, in particular, as transmission mechanisms for the monetary policy in the Chilean economy: (i) improvements in measuring the monetary policy shock; (ii) improvements in measuring the costs for bank-dependent borrowers associated with a drop in banks' credit supply; (iii) improvements in incorporating the effects of policy changes and financial sector developments; and (iv) improvements in assembling more comprehensive datasets at the microeconomic level.

Appendix
Subchannels of Monetary Transmission

The different transmission mechanisms of monetary policy can be illustrated by means of the diagram in figure A1 (Kuttner and Mosser, 2002). The transmission mechanism process begins with the Central Bank's definition of a monetary policy rate. The interbank rate then converges to this objective through the regulation of the liquidity of the financial system. Once the liquidity of the financial system is adjusted, different mechanisms start operating in the transmission channel. Four of these are activated by market interest rates moving in tandem with the interbank interest rate. These are the interest rate channel, in which an increase in the cost of capital reduces the domestic aggregate demand through a fall in investment and in the consumption of durable goods; the exchange rate channel (in open economies), which operates through the effect of the uncovered interest rate parity on net imports; the asset price channel (stocks, bonds, and real estate), which generates a wealth effect that has an impact on consumers' decisions; and the broad credit channel, which is also related to the market value of assets and which is described in the introduction. The transmission mechanism of monetary policy does not end there, however. It is possible to distinguish two additional channels, namely, the monetarist channel related to changes in relative asset prices and the bank lending channel, the main issue of our paper.

Figure A1. Channels of Monetary Policy Transmission



Source: Kuttner and Mosser (2002).

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Retail Bank Interest Rate Pass-through: Is Chile Atypical?

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There is little disagreement among economists that monetary policy affects the rate of inflation and, at least in the short run, the level of real economic activity. From an operational perspective, many central banks currently target a short-term market interest rate. This is done on the premise that this instrument is linked more or less stably to the final objectives of monetary policy through the so-called transmission mechanism of monetary policy.

Most of the literature on the transmission mechanism of monetary policy implicitly assumes that once the monetary authority's target rate is changed, short-term market and retail banking rates will follow suit—that is, there will be immediate and complete "pass-through" to retail banking rates (see, for example, Bernanke and Gertler, 1995; Bernanke and Gilchrist, 1999). If the pass-through to banking interest rates were sluggish or incomplete, those specific channels of the transmission mechanism of monetary policy that operate through banking rates would also be affected.

Stickiness of retail banking interest rates was first documented in the United States by Hannan and Berger (1991) and Neumark and Sharpe (1992). These authors study deposit rate setting using econometric models that are based on theoretical models developed to

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analyze price stickiness in goods markets. Implicit in their analyses is the notion that banks cannot influence the behavior of lending rates because they are atomistic players in that market. Hence, the authors assume that the pass-through to retail lending rates is immediate and complete. They then investigate the degree to which market power in the deposit market affects stickiness in deposit interest rates by looking at disaggregated data from large surveys of banks. Among other things, these early studies find that the pass-through to deposit rates is asymmetric, with lower pass-through when the market rate is increasing than when it is decreasing. These authors interpret their findings of asymmetric pass-through as evidence of market power in the deposit market.

Cottarelli and Kourelis (1994) were the first to measure and compare the degree of pass-through to lending rates across countries, with both developed and developing countries included in their sample. Their empirical analysis is based on an autoregressive distributed lag specification estimated with aggregate time series. They estimate the response of lending rates to changes in money market rates at different time horizons. They then regress these responses across countries against various measures of financial market structure, while also controlling for other country characteristics such as the effects of interest rate volatility. The analysis thus not only documents the extent to which interest rate pass-through differs across countries, but also tries to explain why this is the case. In particular, the authors suggest that the following three factors might reduce the degree of stickiness: the existence of a market for negotiable short-term instruments; relatively limited volatility of money market rates; and relatively weak barriers to entry (though they do not find evidence that market concentration per se affects loan rate stickiness). Based on these findings, they suggest that policymakers can enhance the effectiveness of monetary policy by enriching the menu of short-term marketable instruments and removing barriers to competition, rather than trying to reduce the level of market concentration.

More recent studies of the interest rate pass-through use similar econometric specifications, but they focus mostly on euro-area countries. Mojon (2000), for example, measures the degree of pass-through for lending and deposit rates in five European countries: Belgium, France, Germany, the Netherlands, and Spain. He assumes that there is full pass-through in the long run and concentrates on estimating its size in the short term. He then goes on to study different interest rate cycles, trying to uncover possible asymmetries in the pass-through across states of this cycle. His main findings are that retail rates respond sluggishly to changes in the money market rate, that short-term rates generally respond faster than long-term rates, and that there is asymmetry in the degree of pass-through, with a larger pass-through to lending rates when the money market rate increases than when it decreases and the opposite effect for deposit rates. He also finds that the results vary somewhat across countries. He conjectures that this heterogeneity could be due to differences in the microeconomic structure of the different countries' banking systems, but he provides no direct evidence on this.

A second example is provided by Bondt (2002), who estimates an aggregate autoregressive distributed lag specification reparameterized as an error-correction model for the euro area as a whole. In his analysis, deposit and lending rates of different maturities are paired with government bond yields of similar maturities. He finds that pass-through is incomplete on impact for both lending and deposit rates, reaching only 50 percent within a month, but that it is complete in the long run for most lending rates.[1]

Following Cottarelli and Kourelis (1994), Mojon (2000),[2] and Bondt (2002), this paper compares Chile with a number of other countries. Specifically, it provides a set of stylized facts about the pass-through in Chile and compares them against the benchmark of pass-through in a group of advanced economies. We estimate the aggregate, dynamic reduced-form relation between the money market interest rate and retail bank rates for Australia, Canada, Chile, New Zealand, the United States, and a number of European countries, based on monthly data from 1993 to 2002, and we try to interpret the evidence in light of previous studies and analyses.[3] We do not, however, test explicit hypotheses on the structure of the Chilean banking system. The analysis is based on an autoregressive distributed lag specification reparameterized as an error-correction model, which is a standard methodology used in this literature. We estimate both the size and the speed of the pass-through from policy to retail banking rates, in the short run (on impact, within a month) and in the long run (in the steady state).

1. The pass-through from policy interest rates to retail banking rates may still be incomplete if the pass-through from policy rates to government bond yields is incomplete.

2. See also Borio and Fritz (1995).

3. See Berstein and Fuentes (in this volume) for a complementary analysis using Chilean bank-by-bank data.

For Chile, we also ask whether these estimates differ across states of the interest rate or the monetary policy cycle and whether they have changed over time, especially after the 1998 Asian crisis and after the introduction of “nominalization” of the policy interest rate target in 2001. By implementing these robustness checks, we provide indirect evidence on whether the interest rate pass-through has been affected by market power in the banking sector—consistent with the findings of Hannan and Berger (1991) and Neumark and Sharpe (1992) for the United States and Mojon (2000) for Europe—or by other factors such as interest rate volatility—consistent with Cottarelli and Kourelis (1994) for developing countries.

Our main conclusion is that the interest rate pass-through in Chile, overall, is not significantly different from that of the other economies considered. In particular, we find that the size of Chile’s long-run pass-through is slightly smaller than that of Australia, Canada, and the United States and is comparable to that of New Zealand and the European countries in our sample. In Chile, however, the speed of the pass-through is faster than in Australia, New Zealand, and several of the European countries. Moreover, it is only slightly slower than the pass-through in the prime rate for Canada and the United States in the short term.

We also find that both the size and the speed of the pass-through decline as the maturity of the bank instruments considered increases, not only for Chile but also for most of the countries in the sample. Unlike the studies reviewed above, we do not find evidence for Chile of significant asymmetry in the pass-through. We do find some evidence of parameter instability over time, especially around the 1997–98 Asian and Russian crises, but we do not find marked evidence that there has been any further significant difference following the nominalization of Chile’s interest rate targets.

A distinctive institutional feature of Chile is that there are two different types of domestic currency deposits and loan instruments: standard nominal instruments and instruments denominated in the Unidad de Fomento (UF), a unit of account that indexes financial contracts and transactions to the previous month’s inflation rate. We look at both nominal and UF interest rates, but find that the results are broadly comparable, especially in the long run: the size of the long-run pass-through is about the same across these instruments. In the short run, however, the pass-through for most UF rates appears slightly smaller than the pass-through for nominal rates.

As we explain below, we interpret the aggregate evidence reported on the symmetry and instability of the pass-through in Chile as suggesting that the behavior of retail banking interest rates is likely to be affected by factors other than market power in the banking system, most notably external shocks. Chile is a very open economy both on the current and the capital accounts of the balance of payments. The Chilean banking system is thus exposed to competition and entry from foreign banks (even if its current structure appears rather concentrated), and this might be mitigating the market power of individual banks. At the same time, Chile's openness, together with the fact that the country was buffeted by significant external shocks during our sample period, might have affected banks' reactions to policy changes. High external volatility may also force frequent policy changes.

On balance, Chile's interest rate pass-through at the aggregate level does not appear too different from that of the other countries considered. These results, however, would not be inconsistent with the presence of some differences in the pass-through across individual bank instruments. A natural extension of our work would therefore be to investigate explicit structural hypotheses across countries based on microeconomic data and the predictions of an open economy model of banking system competition.

The remainder of the paper proceeds as follows. Section 1 describes the data we use and presents a brief review of key cross-country similarities and differences in the raw data. Section 2 outlines the empirical model used. Section 3 reports the estimation results, and section 4 concludes.

1. The Data and a Few Stylized Facts

This section describes the dataset we constructed, presents relevant summary statistics, and highlights the main features of the data and its key moments.

1.1 Sources and Definitions

In addition to Chile, we consider Australia, Belgium, Canada, France, Germany, the Netherlands, New Zealand, Spain, and the United States. In all cases except Chile, the sample period is April 1993 to June 2002; for Chile, the sample ends in September 2002. The data are from national central banks, the European Central Bank, and the International Monetary Fund. A complete list of the interest rate series used is presented in the appendix. These series are also featured in figures 1 through 7.

The money market rate is an overnight interbank lending rate. The only exception is Australia, for which we use the thirteen-week treasury bill rate owing to apparent anomalies in the data for the interbank lending rate.

Retail interest rates are classified into three maturity buckets. Retail interest rates on instruments with maturities of less than three months are classified as short-term rates, rates on instruments with maturities of three months to a year are classified as medium-term rates, and rates on instruments with maturities of one to three years are classified as long-term rates.

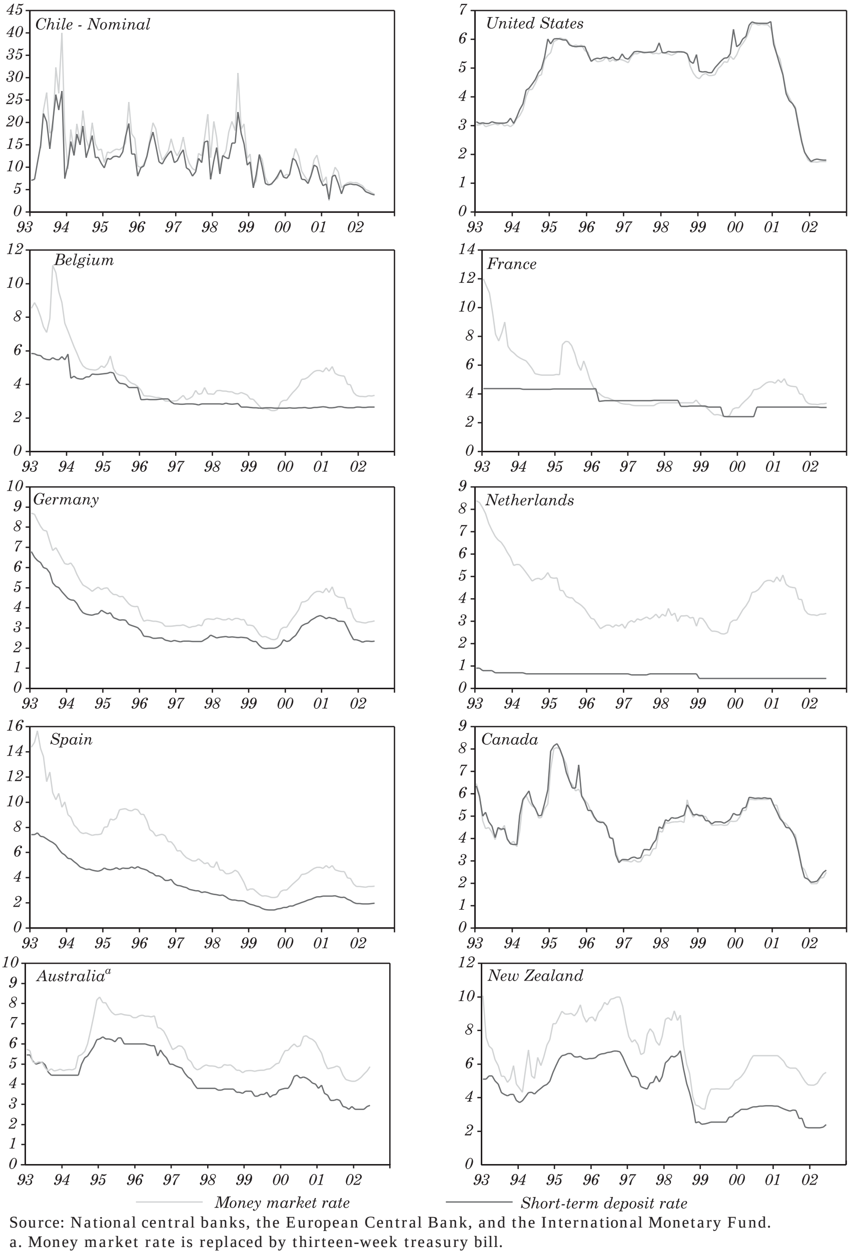
The lending rates are for commercial loans, with three exceptions: Canada's medium- and long-term lending rates are for mortgages; the German long-term lending rate is for consumer loans; and the Chilean rates are for both consumer loans and commercial loans. For the United States, the only lending rate we consider is the prime rate, which is the base on which many other loan rates are calculated. Canada's short-term lending rate is defined similarly, while its long-term lending rate is for one-year and three-year conventional mortgages.[4] The lending rates for Germany and Spain are averages for transactions that took place throughout the month, while for Belgium, France, and the Netherlands they are end-of-period rates. For Australia and New Zealand, we do not have data on lending rates by maturity. For New Zealand, therefore, we used the weighted average base business rate charged by the six largest banks (each bank reports the average rate on new loans of all maturities weighted by amount); for Australia, we used the weighted average rate charged by banks on business loans.

Our deposit rate series are generally more homogeneous. Most of them are for demand deposits, certificates of deposit, or time deposits, with maturities in the three buckets described above.[5]

4. Using the prime lending rate for Canada and, in particular, the United States might bias the cross-country comparison against all other countries. In fact, these are among the very few interest rate series displaying full pass-through in the long run. The prime rate is a lending rate applied to the best borrowers. It usually moves immediately following policy announcements to signal banks' readiness to move their pricing schedule, but it does not necessarily move one-to-one with the policy rate. Therefore, it is not evident that pass-through should be complete in the long run for prime rates.

5. We do not use short-term deposit rates for Belgium, France, and the Netherlands, although they are available, because they do not appear to be market determined.

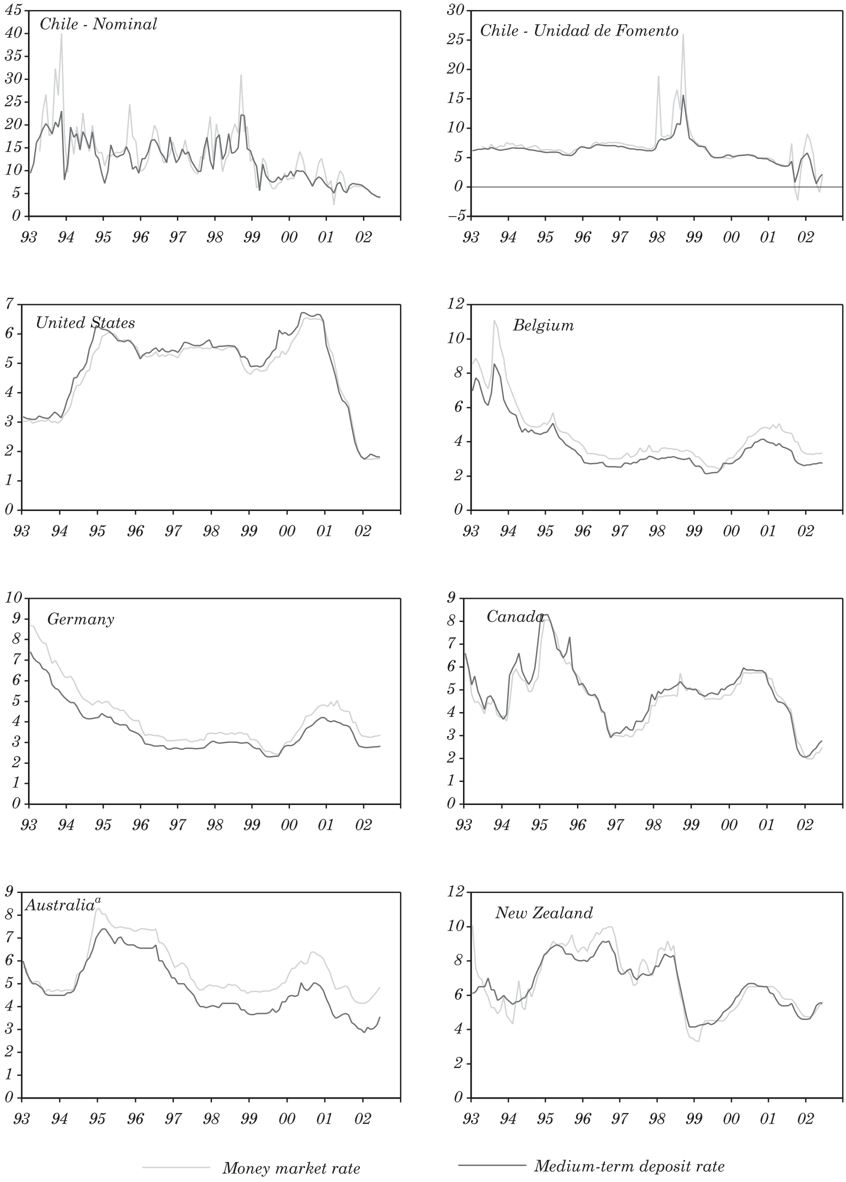
Figure 1. Short-term Deposit Rates and Money Market Rates, 1993 to 2002 (percent)



Source: National central banks, the European Central Bank, and the International Monetary Fund.

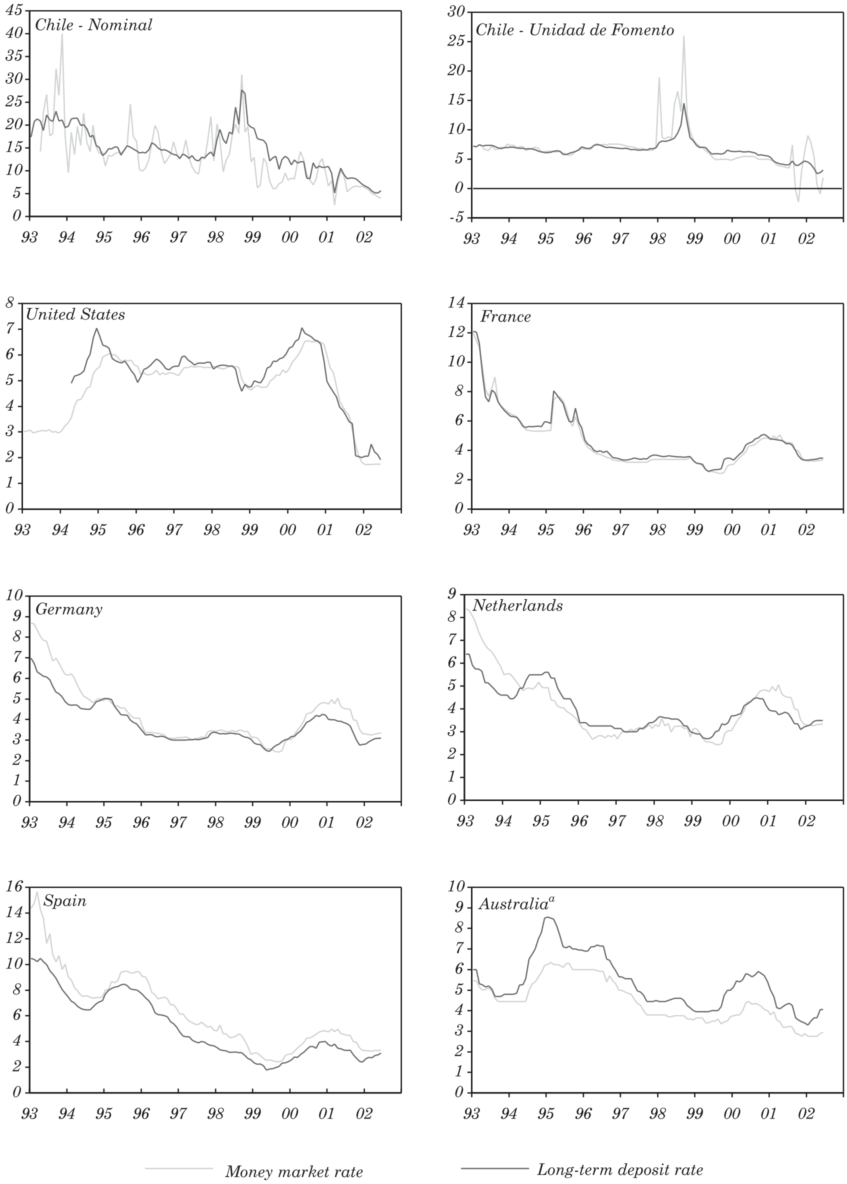
a. Money market rate is replaced by thirteen-week treasury bill.

Figure 2. Medium-term Deposit Rates and Money Market Rates, 1993 to 2002 (percent)



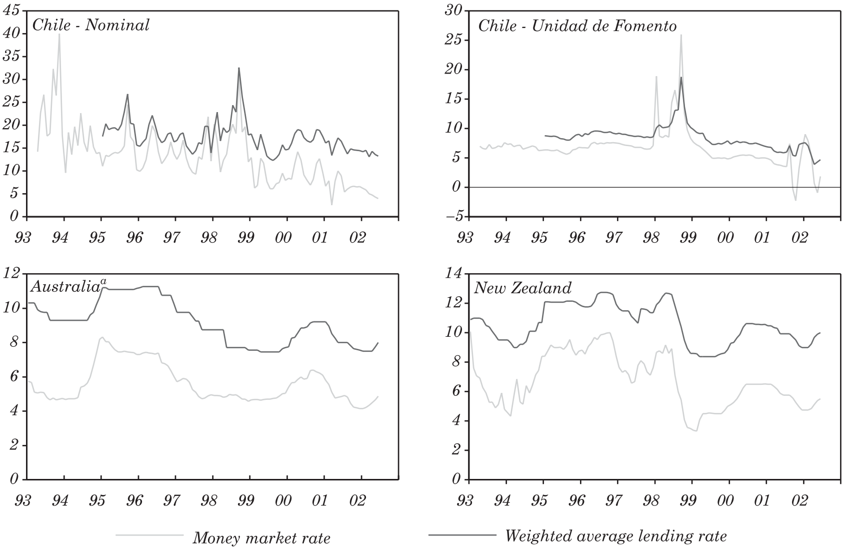
Source: National central banks, the European Central Bank, and the International Monetary Fund.
a. Money market rate is replaced by thirteen-week treasury bill.

Figure 3. Long-term Deposit Rates and Money Market Rates, 1993 to 2002 (percent)



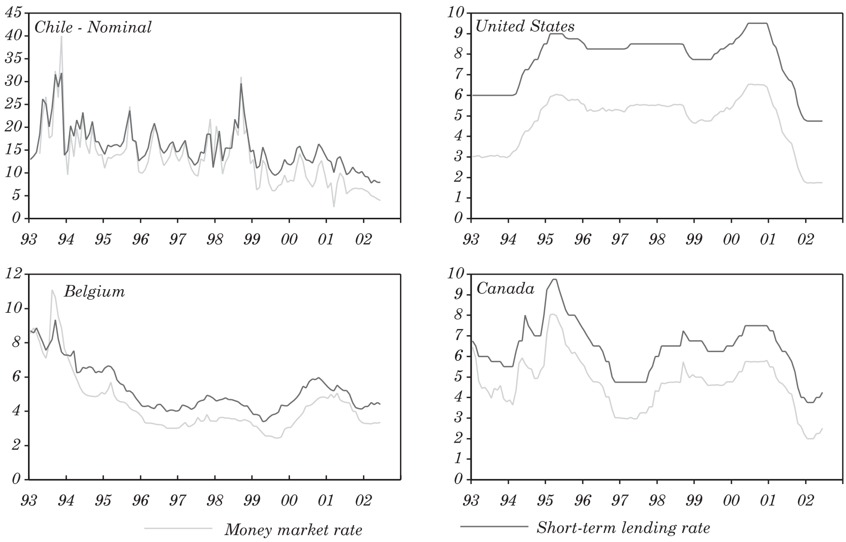
Source: National central banks, the European Central Bank, and the International Monetary Fund.
a. Money market rate is replaced by thirteen-week treasury bill.

Figure 4. Weighted Average Lending Rates and Money Market Rates, 1993 to 2002 (percent)



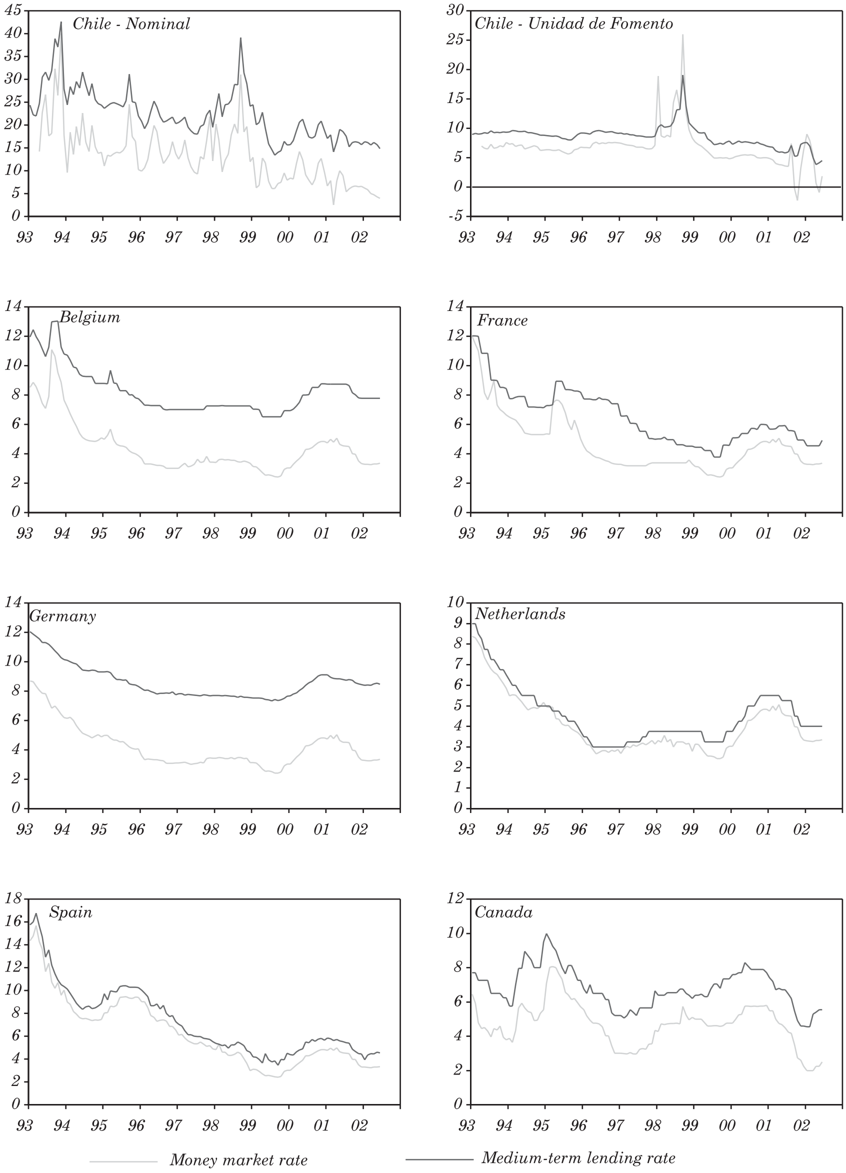
Source: National central banks, the European Central Bank, and the International Monetary Fund.
a. Money market rate is replaced by 13-week treasury bill.

Figure 5. Short-term Lending Rates and Money Market Rates, 1993 to 2002 (percent)



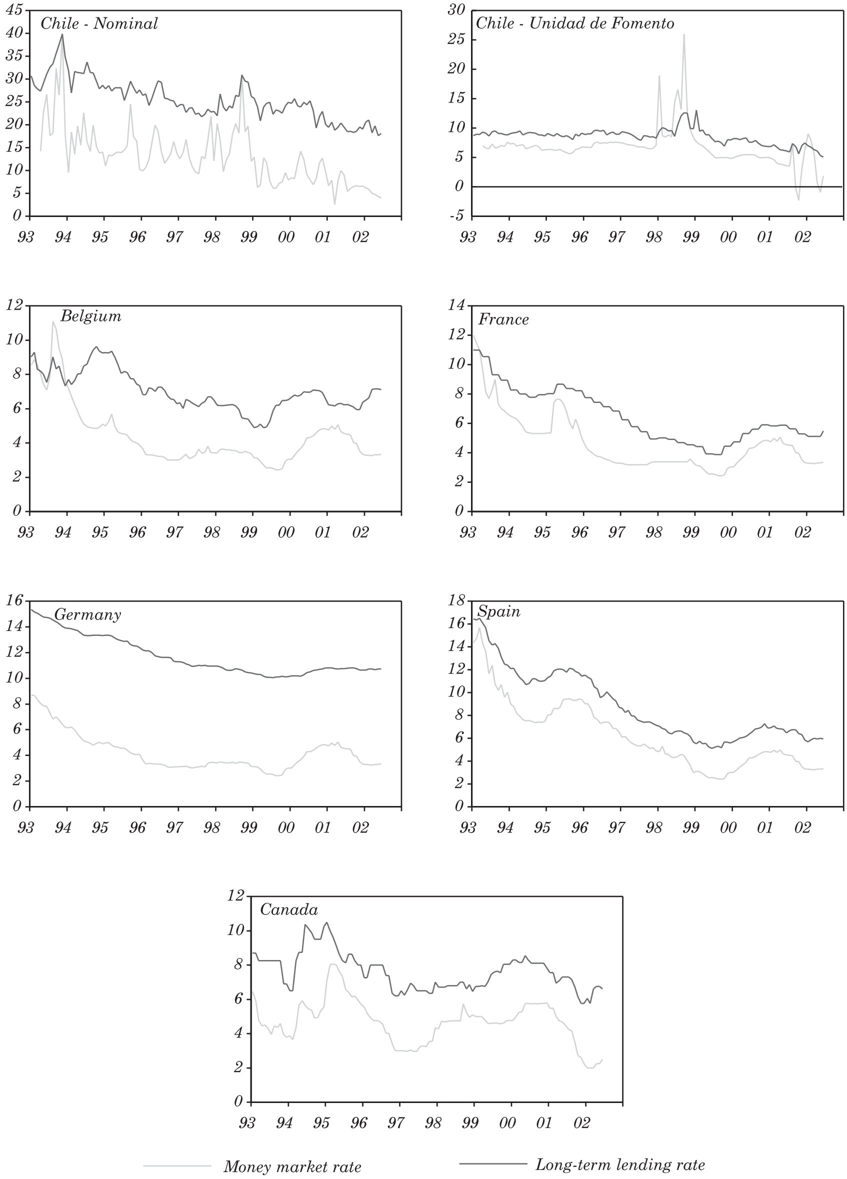
Source: National central banks, the European Central Bank, and the International Monetary Fund.

Figure 6. Medium-term Lending Rates and Money Market Rates, 1993 to 2002 (percent)



Source: National central banks, the European Central Bank, and the International Monetary Fund.

Figure 7. Long-term Lending Rates and Money Market Rates, 1993 to 2002 (percent)



Source: National central banks, the European Central Bank, and the International Monetary Fund.

For Chile, we consider both nominal domestic currency and UF interest rates. Studying UF interest rates is important because most bank intermediation was based on this unit of account before August 2001. At that time, the Chilean Central Bank stopped targeting the UF-denominated money market rate and switched to more conventional nominal interest rate targeting—a change we call nominalization in the rest of the paper.

1.2 Summary Statistics for the Raw Data

Preliminary analysis of the data reveals some noteworthy similarities and differences between Chile and the other countries considered. Over the sample period, Chilean interest rates are on average higher, more volatile, and less persistent than the interest rates for the other countries. In Chile, however, the degree of comovement between retail bank interest rates and the money market rate is essentially the same as in other countries. These stylized facts are highlighted in tables 1 through 4, which report summary statistics for the interest series of all countries considered.

Chilean data display the highest sample mean, even in UF terms, while the Netherlands shows the lowest average level of interest rates (table 1). This may reflect the generally higher rate of inflation in Chile during most of our sample period, but it could also reflect other factors, such as higher average risk premia or faster economic growth in Chile. In any case, it is not evident whether or how higher average interest rates per se might affect the pass-through.

Chilean data display the highest interest rate volatility, for both UF and nominal rates, as measured by the sample standard deviation (table 2). At all maturities, the interest rates for Australia, Canada, and the United States exhibit the lowest volatility. Higher volatility is usually associated with higher uncertainty, which in turn may slow down agents' reaction to change by exacerbating precautionary behavior and increasing the option value of waiting.

Chile has the lowest interest rate persistence in our sample, again whether we look at UF or nominal rates (table 3). In contrast to all other countries, Chile's interest rate series also appear stationary.

Table 1. Sample Mean of Interest Rates, April 1993 to June 2002[a]

Country	*Money market rate*	*Short-term deposit rate*	*Medium-term deposit rate*	*Long-term deposit rate*	*Short-term lending rate*	*Medium-term lending rate*	*Long-term lending rate*	*Weighted ave. of all loans*
Chile (nominal, full sample)	12.92	11.12	11.79	14.14	15.36	22.13	25.17	17.40
April 1993 to June 1997	16.33	14.05	14.61	16.43	18.12	25.50	28.60	18.11
April 1993 to June 1999	15.82	13.45	14.30	16.78	17.50	24.99	27.34	18.70
April 1993 to June 2001	14.10	12.09	12.76	15.33	16.35	23.13	26.15	17.90
Chile (UF, full sample)	6.53		5.93	6.35		8.45	8.34	8.41
April 1993 to June 1997	6.85		6.43	6.75		9.08	8.93	8.84
April 1993 to June 1999	7.78		6.92	7.16		9.48	9.19	9.52
April 1993 to June 2001	7.08		6.42	6.80		8.92	8.70	8.79
Australia	5.61	4.41	4.79	5.33				9.12
Belgium	4.28	3.33	3.62		5.18	8.14	6.95	
Canada	4.66	4.75	4.84		6.37	6.79	7.57	
France	4.45	3.53		4.58		6.34	6.38	
Germany	4.10	3.06	3.52	3.71		8.52	11.61	
Netherlands	3.94	0.58		3.90		4.43		
New Zealand	6.66	4.44	6.59					10.55
Spain	6.02	3.38		4.92		7.01	8.59	
United States	4.80	4.89	4.95	5.25	7.79			

a. Data for Chile are through September 2002, except weighted average loans, which are from January 1995 through June 2002.

Table 2. Sample Standard Deviation of Interest Rates, April 1993 to June 2002[a]

Country	*Money market rate*	*Short-term deposit rate*	*Medium-term deposit rate*	*Long-term deposit rate*	*Short-term lending rate*	*Medium-term lending rate*	*Long-term lending rate*	*Weighted ave. of all loans*
Chile (nominal, full sample)	6.35	4.92	4.74	4.94	5.00	5.87	4.61	3.40
April 1993 to June 1997	5.64	4.28	3.48	3.15	4.55	5.08	4.01	2.73
April 1993 to June 1999	5.73	4.26	3.69	3.54	4.60	5.09	3.87	3.56
April 1993 to June 2001	6.00	4.57	4.31	4.15	4.61	5.63	4.17	3.38
Chile (UF, full sample)	3.36		2.09	1.76		2.07	1.67	2.03
April 1993 to June 1997	0.50		0.45	0.39		0.42	0.53	0.41
April 1993 to June 1999	3.09		1.52	1.27		1.53	1.22	1.76
April 1993 to June 2001	2.98		1.64	1.36		1.70	1.43	1.87
Australia	1.13	1.06	1.20	1.31				1.28
Belgium	1.64	0.97	1.31		1.25	1.42	1.11	
Canada	1.28	1.31	1.34		1.30	1.16	1.08	
France	1.59	0.63		1.49		1.67	1.69	
Germany	1.25	0.93	1.00	0.87		0.99	1.39	
Netherlands	1.19	0.11		0.84		1.21		
New Zealand	1.80	1.51	1.45					1.33
Spain	2.66	1.54		2.35		2.67	2.80	
United States	1.28	1.29	1.31	1.22	1.28			

a. Data for Chile are through September 2002, except weighted average loans, which are from January 1995 through June 2002.

Table 3. Sample Persistence of Interest Rates, April 1993 to June 2002[a]

Country	*Money market rate*	*Short-term deposit rate*	*Medium-term deposit rate*	*Long-term deposit rate*	*Short-term lending rate*	*Medium-term lending rate*	*Long-term lending rate*	*Weighted ave. of all loans*
Chile (nominal, full sample)	0.68	0.72	0.79	0.93	0.75	0.87	0.92	0.72
April 1993 to June 1997	0.47	0.50	0.52	0.94	0.62	0.79	0.87	0.65
April 1993 to June 1999	0.47	0.50	0.53	0.85	0.61	0.76	0.87	0.61
April 1993 to June 2001	0.61	0.65	0.73	0.89	0.69	0.85	0.90	0.68
Chile (UF, full sample)	0.64		0.88	0.92		0.87	0.87	0.87
April 1993 to June 1997	0.82		0.92	0.92		0.90	0.53	0.87
April 1993 to June 1999	0.54		0.82	0.84		0.76	0.75	0.76
April 1993 to June 2001	0.62		0.87	0.89		0.85	0.85	0.85
Australia	0.98	1.00	0.99	0.98				0.99
Belgium	0.97	Nonmarket rate	0.98		0.97	0.97	0.97	
Canada	0.96	0.96	0.97		0.97	0.95	0.93	
France	0.97	Nonmarket rate		0.97		0.98	0.99	
Germany	0.99	0.99	0.99	0.99		1.00	1.00	
Netherlands	0.99	Nonmarket rate		0.98		0.99		
New Zealand	0.96	0.98	0.98					0.97
Spain	0.99	1.00		1.00		0.99	1.00	
United States	0.99	0.98	0.99	0.98	0.99			

a. First-order autocorrelation of rate with rate at (t − 1). Data for Chile are through September 2002, except weighted average loans, which are from January 1995 through June 2002.

Over the sample period, the null hypothesis that Chilean interest rates have a unit root without drift can be rejected with 99 percent confidence for all rates except the nominal long-term deposit rate.[6] This hypothesis cannot be rejected for most other countries.

External shocks are more likely than policy to explain higher volatility and lower persistence in Chile relative to other countries. On the one hand, the lower persistence of interest rates in Chile may suggest that there have been periods in which the central bank was not willing to smooth rates to the same extent as some other central banks in the sample. Prior to the recent switch to nominal interest rate targeting, the UF money market rate—the old target rate—followed a fairly smooth pattern, except during the Asian and Russian financial crises (see figure 2). On the other hand, it is also possible that the Chilean economy has simply been subject to larger and more frequent external shocks than the other economies throughout sample period. For instance, Edwards (1998) emphasizes the role of external factors in explaining interest rate volatility in emerging economies. In addition, Caballero (2000) argues that the financial reforms adopted in Chile in recent years may have produced speedier transmission of external shocks, which in turn would imply greater measured volatility. Larger and more frequent external shocks than in other countries would naturally require more frequent adjustments of policy interest rates.

In any case, all countries in the sample exhibit a relatively high degree of contemporaneous correlation between retail banking interest rates and the relevant money market rate (table 4 and figures 1 through 7). For Chile, in particular, the first principal component explains more than 90 percent of the variability of the ten interest rate series considered, suggesting that a single common factor explains most of the comovement of these data (results not reported).[7] The relatively high value of the simple correlation between the money market rate and retail bank rates also suggests that this common factor is most likely associated with domestic monetary policy.

Interestingly, table 4 shows that the strength of this correlation tends to decline with the maturity of the retail rate in most countries.

6. The regression includes a constant, a linear trend, and a variable number of lags between one and five. These results are not reported in the paper, but they are available from the authors on request (as are all other nonreported results).

7. Since we can reject the null hypothesis of a unit root in the Chilean interest rate series, cointegration tests would not be informative on the degree of comovement between the money market interest rate and retail bank rates.

Table 4. Sample Correlation of Interest Rates, April 1993 to June 2002[a]

Country	*Money market rate*	*Short-term deposit rate*	*Medium-term deposit rate*	*Long-term deposit rate*	*Short-term lending rate*	*Medium-term lending rate*	*Long-term lending rate*	*Weighted ave. of all loans*
Chile (nominal, full sample)	1.00	0.94	0.84	0.76	0.94	0.92	0.77	0.65
April 1993 to June 1997	1.00	0.91	0.70	0.61	0.93	0.89	0.69	0.87
April 1993 to June 1999	1.00	0.90	0.71	0.58	0.92	0.88	0.63	0.87
April 1993 to June 2001	1.00	0.93	0.80	0.70	0.93	0.91	0.71	0.87
Chile (UF, full sample)	1.00		0.89	0.84		0.88	0.81	0.74
April 1993 to June 1997	1.00		0.88	0.72		0.80	0.33	0.91
April 1993 to June 1999	1.00		0.89	0.86		0.89	0.78	0.89
April 1993 to June 2001	1.00		0.90	0.87		0.90	0.81	0.91
Australia	1.00	0.73	0.91	0.88				0.88
Belgium	1.00	Nonmarket rate	0.98		0.94	0.98	0.59	
Canada	1.00	0.99	0.97		0.99	0.89	0.72	
France	1.00	Nonmarket rate		0.99		0.84	0.88	
Germany	1.00	0.99	0.99	0.96		0.97	0.83	
Netherlands	1.00	Nonmarket rate		0.85		0.98		
New Zealand	1.00	0.92	0.96					0.94
Spain	1.00	0.98		0.98		0.99	0.99	
United States	1.00	0.99	0.98	0.92	1.00			

a. Correlations with policy rate. Data for Chile are through September 2002, except weighted average loans, which are from January 1995 through June 2002.

In addition, an analysis of the lagged autocorrelation between the money market interest rate and retail bank rates shows that it is highest within the first month for most of the countries considered. However, changes in money market rates do not seem to pass through completely to retail banking rates, except for Australia, Canada, and the United States. In fact, money market rates appear more volatile than the retail rates.

A first look at the (unconditional) moments of the data thus suggests that there are both important similarities and differences between Chile and the group of other countries considered: Chilean interest rates comove with the policy rate as strongly as those of other countries, with the strength of this comovement decreasing with the maturity of the bank instrument analyzed. In addition, the volatility of the policy rate is slightly higher than the volatility of retail interest rates, as in most other countries. This indicates that policy and retail interest rates generally move very closely together, even though not all changes in the former are passed on to the latter. However, the average level and volatility of Chilean interest rates is higher than in other countries, while persistence is lower.

As we shall see in the next section, if the degree of (conditional) comovement between policy and retail interest rates is comparable across countries, then lower persistence in Chilean rates would most likely be due to higher volatility. It would follow that the key difference between Chile and other countries would be the greater interest rate volatility in Chile. On the other hand, as mentioned earlier, both interest rate volatility and market power in the banking system may affect the pass-through process. In the last section of the paper, therefore, we compare the pass-through across countries and try to investigate the relative role of volatility and market power in this process by using a simple aggregate, dynamic reduced-form econometric model, which we now present.

2. The Econometric Model

To analyze the dynamic reduced-form relation between retail banking interest rates and the money market rate, we first specify and estimate the following simple autoregressive distributed lag (ARDL) model:

$$RtailR_t = \alpha_o + \alpha_1 t + \alpha_2 MMR_t + \alpha_3 RtailR_{t-1} + \alpha_4 MMR_{t-1} \,, \tag{1}$$

where RTAILR is the relevant bank interest rate, MMR is the money market rate, and *t* is a time trend. The trend is intended to capture the disinflation process and other factors that change slowly over time (for example, financial market liberalization and other structural reforms).

For all the countries considered, we specify equation (1) including only one lag of both the retail and the policy interest rate, which is here assumed to be exogenous—a reasonable assumption within the month. For Chile, standard lag-length selection criteria over the entire sample period cannot reject this one-lag specification. This suggests that there is no serial autocorrelation in the residuals and thus no need to consider a higher-order dynamic (results not reported). For the other countries, however, we impose this lag-structure a priori, without testing its adequacy, to ensure full comparability with the Chilean specification.

Comparing time series models across countries always implies a trade-off between the need to implement the comparison as neatly as possible and the need to fit models to individual countries as well as possible. If we used different lags for different countries, we would risk losing full comparability. Running the exercise with a common specification across countries, however, carries the risk of comparing Chile with other countries on the basis of a model that is possibly misspecified for other countries. In principle, one could try to determine the optimal lag length for each interest rate series and country considered, but that would involve a core set of about 60 regressions in our analysis. We thus prefer a common parsimonious specification across all countries and interest rate series because it would be difficult, if not impossible, to uncover the "true" lag length for all cases considered. Moreover, as the sample period is not very long, we would lose efficiency by considering specifications with longer lag structures.

Following Hendry (1995), we then reparameterize and reestimate the ADL in equation (1) as the following error-correction model (ECM):

$$\Delta RtailR_{t} = \alpha_2 \Delta MMR_{t} + \beta_3 \left(RtailR_{t-1} - \beta_o - \beta_1 t - \beta_2 MMR_{t-1} \right), \qquad (2)$$

where

$$\beta_o = \frac{\alpha_o}{(1-\alpha_3)}, \beta_1 = \frac{\alpha_1}{(1-\alpha_3)}, \beta_2 = \frac{\alpha_2 + \alpha_4}{(1-\alpha_3)}, \text{ and } \beta_3 = (\alpha_3 - 1). \qquad (3)$$

The parameters of equation (2) are linked to the parameters of equation (1) by equation (3). Hence, estimating the former equation allows all the parameters of the latter to be recovered (and vice versa) without altering the estimated residuals. From a statistical point of view, however, the two representations are not equivalent: if the series are stationary, or nonstationary but cointegrated, then the parameters of equation (2) may be estimated more efficiently because the error-correction term and individual series represented in first differences are less likely to be collinear. If the series are integrated but do not cointegrate, then neither representation is statistically satisfactory.[8]

In equation (2), the term $\Delta RtailR_t = \alpha_2 \Delta MMR_t + \beta_3 (RtailR_{t-1} - \beta_0 - \beta_1 t - \beta_2 MMR_{t-1})$, which represents the lagged deviation of the retail interest rate from its steady state value, can be interpreted as the solution of a representative bank's optimization problem, as, for instance, in the model developed by Bondt (2002) and those reviewed by Freixas and Rochet (1998, chap. 3). Nonetheless, since our empirical analysis is not tied to any particular structural model, we use equation (2) simply to characterize the dynamic, reduced-form relation between retail and money market interest rates.

Our empirical results focus particularly on the degree of pass-through in the short term (α_2, or the size of the pass-through on impact and thus within a month), the degree of pass-through in the long run (β_2, or the size of the pass-through in the long run or in steady state), and the speed of adjustment to the long-run value (β_3). The latter variable, together with α_2, determines the average number of months needed to reach the long run of the pass-through: $(1 - \alpha_2) / \beta_3$. This is sometimes called the mean lag.

3. Results

In this section, we report and discuss the estimation results. We begin by presenting a set of benchmark results for all the countries

8. As noted, all Chilean interest series are stationary, while most non-Chilean series appear to have a unit root. Therefore, in the case of Chile, it would be pointless to investigate the presence of cointegration between the money market and retail interest rates. For the other countries, we find that a standard augmented Dickey-Fuller (ADF) test on the estimated long-run relation (RTAILR – $\beta_0 \beta_1 t - \beta_2$MMR) rejects the null hypothesis of a unit root in most cases. This suggests the presence of cointegration in the vast majority of the cases analyzed.

considered. We then check whether these results are robust across different states of the interest rate or monetary policy cycle and stable over time. We perform these robustness checks only for Chile. These tests help us interpret the small cross-country differences in pass-through that we detect in the benchmark results.

3.1 Is Chile's Interest Rate Pass-through Atypical?

The benchmark set of estimation results reported in table 5 suggests that, overall, Chile's interest rate pass-through is not atypical. In Chile, the pass-through appears incomplete even in the long-run, but this is also true for most European countries, for New Zealand, and for Australian deposit rates.[9] Pass-through appears complete only in the case of the Australian lending rate analyzed, Canada, and the United States. For Chile, however, the size of the short-term pass-through is larger than in Europe, Australia, or New Zealand. As a result, the Chilean mean lag is markedly smaller than in Europe, and it is comparable to that in Australia, Canada, New Zealand, and the United States. In fact, the mean lag for Chile is at most four months, compared with a mean lag of at most two months for New Zealand and the United States.[10]

As one might expect, the shorter the maturity of the bank lending or deposit instrument, the larger and faster the pass-through. For given maturities, there appears to be only a small difference between deposit and loan rates. Moreover, in the case of Chile, we find little difference between the pass-through to UF and nominal interest rates.

Chile and Europe display slightly less than full pass-through, but the reasons appear different. In Chile, incomplete but relatively fast pass-through appears more likely to be due to external macroeconomic factors than to market power in the banking system, if one is willing to assume that lower persistence in interest rates is primarily due to external shocks. In the case of Europe, the existing literature points

9. The reported estimate for Europe is an average of the individual country estimates. The literature on dynamic panel data models (for example, Pesaran and Smith, 1995) shows that such an average may yield a consistent estimate of the typical relation in the cross section. Its efficiency may be questioned in this case given the small number of country estimates available, but such an averaging is statistically legitimate and economically sensible.

10. The mean lag for short-maturity interest rates in Chile is less than a month. It follows that one should not expect a statistically significant difference between the short- and long-run pass-through coefficient estimates.

Table 5. Retail Interest Rate Pass-through, All Countries, April 1993 to June 2002[a]

	Chile[b]			*Europe*[c]			*Canada*			*United States*			*Australia*[d]			*New Zealand*		
Retail bank rate	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*
Nominal rates																		
Lending rates																		
Short-term	0.63	0.56	0.69	0.29	0.61	3.74	0.83	1.01	0.27	0.86	1.00	0.21						
	(22.80)	(7.27)					(15.40)	(42.90)		(29.30)	(195.00)							
Medium-term	0.58	0.88	2.10	0.43	0.82	3.23	0.63	0.51	2.47									
	(25.10)	(6.24)					(7.23)	(2.38)										
Long-term	0.18	0.55	1.95	0.18	0.57	11.34	0.46	0.24	4.15									
	(6.38)	(5.84)					(4.67)	(0.94)										
Weighted average	0.61	0.71	0.95										0.46	1.09	3.86	0.21	0.77	1.98
	(17.60)	(7.73)											(6.87)	(8.72)		(5.32)	(23.60)	
Deposit rates																		
Short-term	0.68	0.54	0.37	0.27	0.60	2.03	1.13	0.98	–0.15	1.00	1.00	0.00	0.40	0.67	1.43	0.34	0.74	2.13
	(25.50)	(11.40)					(18.40)	(55.20)		(12.40)	(57.50)		(8.08)	(26.80)		(11.10)	(22.10)	
Medium-term	0.39	0.39	1.09	0.57	0.72	1.45	1.05	0.93	–0.09	0.84	0.93	2.00	0.69	0.87	0.66	0.42	0.71	2.32
	(9.78)	(4.09)					(10.70)	(22.70)		(9.57)	(12.00)		(13.20)	(37.40)		(9.72)	(13.30)	
Long-term	0.20	0.68	4.21	0.40	0.63	17.38				0.87	0.64	0.87	0.87	0.81	1.00			
	(6.31)	(3.39)								(6.60)	(3.31)		(11.90)	(5.13)				
UF rates																		
Lending rates																		
Weighted average	0.31	0.54	1.64															
	(14.70)	(11.60)																
Medium-term	0.32	0.58	1.84															
	(15.90)	(12.10)																
Long-term	0.21	0.45	1.52															
	(9.86)	(11.90)																
Deposit rates																		
Medium-term	0.31	0.57	2.16															
	(13.20)	(9.21)																
Long-term	0.19	0.55	4.26															
	(11.20)	(6.73)																

a. *t* statistics are in parenthesis.
b. Results for Chile are on data through September 2002, except weighted average loans, which are from January 1995 to June 2002.
c. Simple average of results on available rates from Belgium, France, Germany, the Netherlands, and Spain.
d. Thirteen-week treasury bill is used instead of money market rate owing to unit root in the latter.

to some role for market power in the banking sector.[11] As evident from equation (3), for a given size of the short-term pass-through ($\alpha_2 + \alpha_4$), the size of the long-run pass-through (β_2) is an increasing function of the persistence parameter, α_3, which in turn is a decreasing function of interest rate volatility. Chile's long-run pass-through and the correlation between money market and retail interest rates is comparable to Europe's (tables 4 and 5). At the same time, the short-term pass-through is higher in Chile than in Europe, while interest rate persistence (and volatility) of both money market and retail interest rates is lower (higher) in Chile than in Europe (table 3), thus reconciling the differences and similarities noted in section 1, as well as the econometric results reported here.

How to interpret these results? Chile has a financial structure in which domestic capital markets have played an increasingly important role over the last decade. In addition, the Chilean banking system is exposed to competition not only from domestic capital markets but also from foreign banks. The Chilean banks might thus have limited market power even if the banking system exhibits some degree of concentration—at least with regard to the largest borrowers that have access to both domestic and foreign capital markets.

This conjecture is not incompatible with some role for banks' behavior in the explanation of incomplete pass-through, but it de-emphasizes the role of market power to highlight the role of the relatively high degree of openness to trade in goods and assets of the Chilean economy. Domestic and foreign banks operate in a rather volatile external environment by international standards. As noted in section 1, bank intermediation may be riskier in Chile than in other economies (because of the more volatile external environment or other reasons). Indeed, banks' pricing decisions might be slowed down by the high degree of uncertainty. On the other hand, banks might also react promptly to monetary policy impulses, but external shocks force frequent and sometimes sharp policy changes in policy rates, resulting in a fast but less than full pass-through, on average. Either way, by affecting banks' behavior or interest rate persistence, volatility induced by external shocks might result in slower and more incomplete pass-through than otherwise.

11. This interpretation is consistent with the observation by Cottarelli and Kourelis (1994) that reducing the fluctuations in money market rates could help enhance the size of pass-through, although they tie a reduction in the money market rate volatility to structural regulatory changes, rather than external shocks.

If incomplete pass-through were due mainly to market power in the banking system, one would expect this to result in an asymmetric pass-through in periods of increasing and decreasing interest rates. On the other hand, if external shocks were the main factor affecting pass-through incompleteness, one would expect to find evidence of a more complete pass-through before the Asian, Russian, Brazilian, and Argentine crises that buffeted Chile after June 1997. While we cannot discriminate between these two competing hypothesis based only on aggregate macroeconomic data, in the next two subsections, we assess the robustness of the benchmark estimation results presented here and their interpretation by investigating whether the Chilean pass-through is characterized by asymmetries across states of the interest rate cycle or by instability over time.

3.2 Is Chile's Interest Rate Pass-through Asymmetric?

To investigate this hypothesis, we follow Sarno and Thornton (2003) in creating a dummy variable that is equal to one if the retail rate is above or equal to its long-run equilibrium level—given by the estimated error-correction term (RTAILR – β_0 – β_1t – β_2MMR)—and zero otherwise. We then reestimate the model in equation (2) by interacting the coefficients α_2 and β_3 with this dummy.[12] We thus obtain estimates for the size of the short-term pass-through and its speed of adjustment in the two states of the interest rate cycle, which we call interest rate tightening and easing, respectively.

Surprisingly, we find little evidence of asymmetry in the pass-through for Chile when measured in this manner (table 6). In most cases, either the estimates of the parameter of interest in one state are not statistically different from those in the other state or the significant differences have the wrong sign.

The approach used by Sarno and Thornton (2003) to investigate these asymmetries does not address whether the deviations from the long-run equilibrium relationship are caused by changes in the stance of monetary policy or other temporary shocks. We experimented with a different dummy to explore the possibility that asymmetric behavior is more pronounced when the deviations from the long-run equilibrium are associated with policy shocks. This variable tracks

12. β_2 is kept constant in this exercise. Sarno and Thornton (2003) also keep α_2 constant.

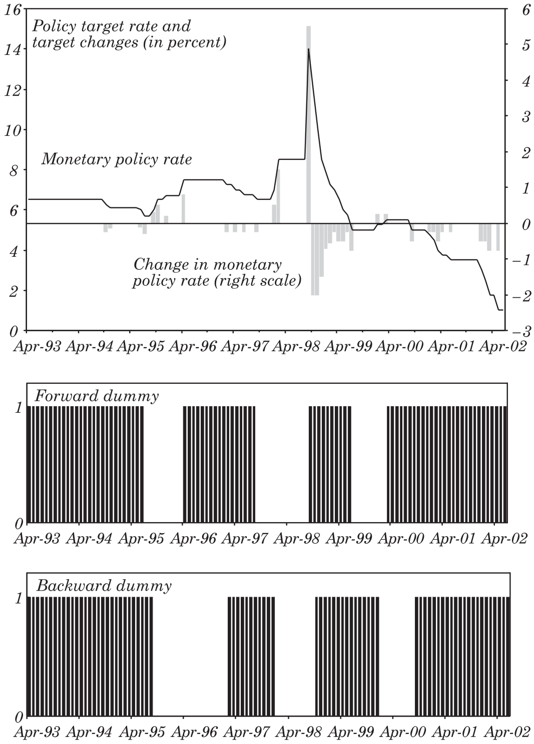
Table 6. Chile: Retail Interest Rate Pass-through Asymmetry[a]

			Interest rate cycle				*Monetary policy cycle (with forward expectations)*				*Monetary policy cycle (with backward expectations)*			
	Baseline		*Easing*		*Tightening*		*Easing*		*Tightening*		*Easing*		*Tightening*	
Retail bank rate	*On impact*	*Mean lag*	*On impact*	*Mean lag*	*On impact*	*Mean lag*	*On impact*	*Mean lag*	*On impact*	*Mean lag*	*On impact*	*Mean lag*	*On impact*	*Mean lag*
Nominal rates														
Lending rates														
Short-term	0.63	0.67	0.58	1.24	0.69	0.38	same	same	same	same	same	same	same	same
	(22.80)		(1.45)		(13.80)		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Medium-term	0.58	2.10	same	same	same	same	0.55	2.89	0.65	1.18	same	same	same	same
	(25.10)		n.a.		n.a.		(–1.69)		(9.71)		n.a.		n.a.	
Long-term	0.18	2.00	same	same	same	same	same	same	same	same	0.21	1.53	0.10	3.53
	(6.38)		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.	(1.54)		(1.43)	
Deposit rates														
Short-term	0.68	0.37	0.62	0.61	0.76	0.24	same	same	same	same	same	same	same	same
	(25.50)		(1.47)		(12.30)		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Medium-term	0.39	1.09	0.23	1.33	0.54	0.80	same	same	same	same	same	same	same	same
	(9.78)		(3.90)		(9.64)		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Long-term	0.20	4.00	0.23	2.96	0.13	n.a.	0.16	3.82	0.34	3.00	same		same	
	(6.31)		(1.07)		(1.83)		(–1.25)		(2.44)		n.a.		n.a.	
UF rates														
Lending rates														
Medium-term	0.32	1.66	0.41	2.57	0.27	1.43	0.30	3.04	0.30	1.23	0.40	2.57	0.16	1.90
	(15.90)		(2.13)		(3.82)		(1.97)		(2.50)		(4.86)		(4.92)	
Long-term	0.21	1.46	0.28	1.71	0.17	1.28	same	same	same	same	0.25	1.74	0.10	1.53
	(9.86)		(1.92)		(3.94)		n.a.	n.a.	n.a.	n.a.	(4.26)		(4.17)	
Deposit rates														
Medium-term	0.31	1.86	same	same	same	same	0.38	2.29	0.26	1.60	0.39	1.85	0.14	2.61
	(13.20)		n.a.		n.a.		(1.08)		(2.56)		(6.92)		(4.56)	
Long-term	0.19	3.38	same	same	same	same	0.17	4.77	0.17	2.49	0.24	3.45	0.07	4.23
	(11.20)		n.a.		n.a.		(2.30)		(2.35)		(3.43)		(4.95)	

a. *t* statistics are in parenthesis.

tightening and easing in the monetary policy stance more closely than the previous approach, and it is based on the publicly announced target for the money market interest rate (figure 8).[13] Again, as shown in table 6, we find little evidence of asymmetry in the pass-through for Chile irrespective of the source of the deviation from the long run equilibrium.

Figure 8. Chile: Timing of the Monetary Policy Cycle, 1993 to 2002



Sources: Central Bank of Chile and IMF staff estimates.

13. This variable, called forward (backward) dummy in figure 8, is equal to one if the next (previous) policy change is an interest rate target decrease. This approach is similar to the one used by Mojon (2000), who identifies interest rate cycles directly by inspecting plots of retail interest rates. We also considered the possibility of disentangling the impact of the banking structure on the pass-through by comparing the response of retail banking rates with that of market interest rates of similar maturities. However, data availability prevented us from carrying out this type of analysis.

Hannan and Berger (1991) and Neumark and Sharpe (1992) find evidence of asymmetric pass-through for deposit rates in the United States and concluded that the most likely explanation is banking market power. It might be possible to conclude, on the basis of their argument, that the lack of asymmetric pass-through for the Chilean banking system means absence of market power. This evidence cannot be conclusive, however. In fact, using bank level data, Bernstein and Fuentes (in this volume) find evidence that they interpret as suggesting that market power may be present in some segments of the Chilean banking system.

3.3 Is Chile's Interest Rate Pass-through Stable over Time?

To determine whether Chile's interest rate pass-through has changed in recent years as a result of international crises, changes in the exchange rate regime, and, most recently, the nominalization of monetary policy, we follow Morandé and Tapia (2002) by reestimating the model over three progressively longer samples: a subsample that excludes the Argentine crisis and the nominalization of monetary policy (so that it ends in June 2001), a subsample that excludes the whole free-floating period (this sample ends in June 1999), and a subsample that excludes the entire Asian-Russian financial crisis period (and subsequent periods, ending in June 1997). Table 7 reports the estimates of our parameters of interest for Chile.

The evidence on parameter stability suggests that the pass-through might have slowed down in the post-1997 period. There is less evidence, however, that things changed further after 1997. The estimates for UF-denominated interest rates based on the sample through June 1997, in particular, appear to differ somewhat from those obtained on longer samples. These estimates display larger pass-through in the long run than those based on longer sample periods.[14]

Summary statistics on the raw data are consistent with this econometric evidence: table 2 indicates that the standard deviation of UF-denominated interest rates through June 1997 is only about a third

14. Those estimates of the long-run pass-through based on the shortest sample period that appear equal to zero result from an estimated α_4 equal in size to α_2 but of the opposite sign, thus annihilating the term $(\alpha_2 + \alpha_4)$ and hence also the long-term pass-through. These are cases in which a different, possibly even shorter lag length would likely be appropriate (say, including only contemporaneous variables).

Table 7. Chile: Retail Interest Rate Pass-through, Various Sample Periods[a]

Retail bank rate	*April 1993 to June 1997*			*April 1993 to June 1999*			*April 1993 to June 2001*			*April 1993 to Sept. 2002*		
	On impact	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*	*On impact*	*Long-run*	*Mean lag*
Nominal rates												
Lending rates												
Short-term	0.68	0.42	0.45	0.64	0.61	0.58	0.63	0.56	0.66	0.63	0.56	0.69
	(17.73)	(2.62)		(19.80)	(8.26)		(21.30)	(6.86)		(22.80)	(7.27)	
Medium-term	0.54	0.51	0.67	0.57	0.84	2.39	0.58	0.88	2.21	0.58	0.88	2.10
	(18.11)	(6.84)		(17.36)	(4.66)		(23.83)	(5.86)		(25.10)	(6.24)	
Long-term	0.18	0.44	1.64	0.18	0.57	1.78	0.18	0.57	2.00	0.18	0.55	1.95
	(4.83)	(5.41)		(5.16)	(6.36)		(6.04)	(5.42)		(6.38)	(5.84)	
Deposit rates												
Short-term	0.75	0.45	0.24	0.68	0.53	0.37	0.68	0.53	0.37	0.68	0.54	0.37
	(19.76)	(4.73)		(13.40)	(8.96)		(23.74)	(10.50)		(25.50)	(11.40)	
Medium-term	0.45	0.06	0.95	0.40	0.38	1.02	0.39	0.38	1.07	0.39	0.39	1.09
	(8.34)	(0.33)		(5.32)	(3.69)		(9.06)	(3.78)		(9.78)	(4.09)	
Long-term	0.98	0.07	0.04	0.19	0.62	4.26	0.20	0.62	3.81	0.20	0.68	4.21
	(3.24)	(0.45)		(3.92)	(3.22)		(5.91)	(3.32)		(6.31)	(3.39)	
UF rates												
Lending rates												
Medium-term	0.34	0.77	2.00	0.34	0.59	1.06	0.34	0.60	1.08	0.32	0.58	1.84
	(4.87)	(8.53)		(3.87)	(15.10)		(18.10)	(21.00)		(15.90)	(12.10)	
Long-term	0.26	0.50	0.84	0.21	0.48	1.18	0.21	0.48	1.20	0.21	0.45	1.52
	(1.58)	(4.57)		(3.54)	(11.60)		(10.50)	(15.70)		(9.86)	(11.90)	
Deposit rates												
Medium-term	0.30	0.83	6.36	0.29	0.57	1.37	0.29	0.60	1.42	0.31	0.57	2.16
	(4.02)	(5.20)		(3.90)	(15.10)		(16.48)	(20.10)		(13.20)	(9.21)	
Long-term	0.23	0.07	5.92	0.23	0.48	1.60	0.22	0.50	2.05	0.19	0.55	4.26
	(2.99)	(0.10)		(4.31)	(12.80)		(12.80)	(13.80)		(11.20)	(6.73)	

a. t statistics are in parenthesis.

of that computed on longer sample periods, while table 3 shows that the persistence of the money market rate is about 25 percent higher. This suggests a break after mid-1997. The fact that the break occurred at the time of the Asian and Russian crises supports the view that pass-through incompleteness, in the case of Chile, is more likely due to external shocks than to market power in the banking system.

The changes in exchange rate and monetary policy regimes that took place in September 1999 and August 2001, respectively, do not appear to have had much impact on the interest rate pass-through over and above the impact of the external environment. The estimates based on the two sub-samples through June 2001 and June 1999 are essentially identical to that based on the entire sample period (through September 2002). In particular, though it might be early to assess the effects of nominalization of monetary policy, these results suggest that nominalization has had no significant impact on the interest rate pass-through.

A standard stability test based on recursive ordinary least squares (OLS) estimates from April 1997 onward confirms the broad thrust of the these conclusions. As shown in figure 9, the estimated model displays clear signs of parameter instability around the time of the Asian and Russian and only much weaker evidence of instability after mid-1999 and mid-2001.

Figure 9. Chile: One-step Chow Test, 1993 to 2002[a]

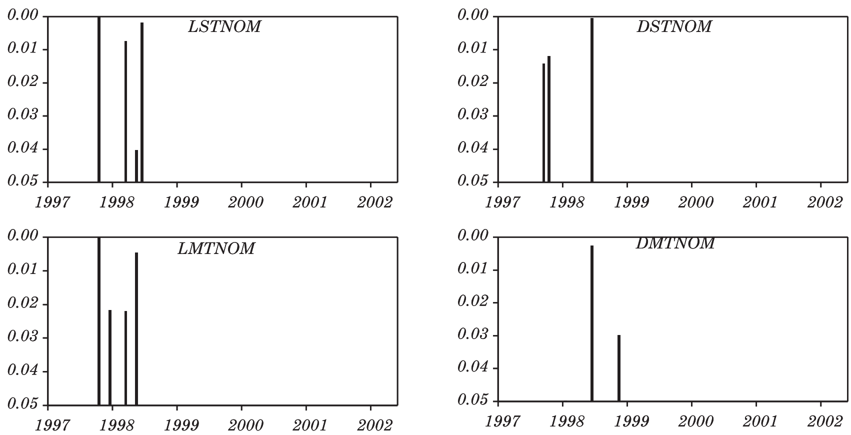
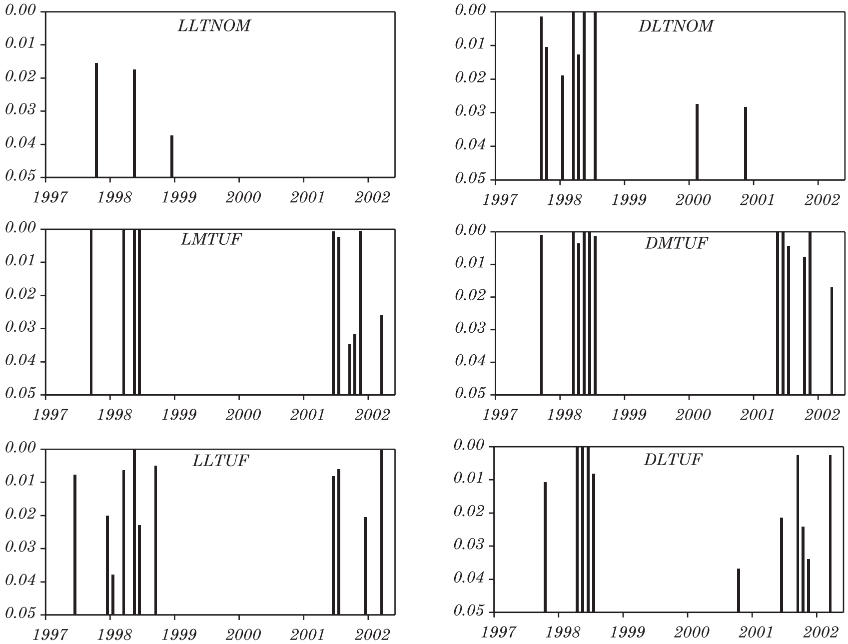


Figure 9. (continued)



Source: IMF staff estimates.
a. *P* values less than 0.05 (that is, greater than 95 percent significance). The null hypothesis is parameter stability.

4. Conclusions

In this paper, we have conducted an empirical analysis of the pass-through of changes in money market interest rates to retail banking deposit and lending interest rates. We have compared Chile with Australia, Canada, New Zealand, the United States, and five European countries. Based on broadly comparable aggregate monthly data from 1993 to 2002 and an identical standard error-correction econometric specification, we found that, overall, Chile's pass-through is not atypical. Although our results indicate that Chile's pass-through is incomplete in the long run, the same holds for most of the other countries considered. Chilean interest rates are more volatile and less persistent than in many other countries, but the pass-through in the short term is larger than in many of these countries. Chile's pass-through is also faster than in most other countries.

Slow or incomplete pass-through is usually attributed to market power in the banking system. This paper, however, suggests that external volatility should be considered more carefully as a possible factor giving rise to pass-through incompleteness in a small open economy. Indeed, we have argued that it is plausible that external volatility could be responsible for a fast but incomplete pass-through in Chile.

We find no significant evidence of asymmetric behavior across states of the interest rate cycle, regardless of the criterion used to identify different states of the cycle. On the other hand, we do find some evidence of parameter instability around the time of the Asian crisis. The pass-through mechanisms appear faster and more complete before June 1997 (that is, before the Asian and Russian crises), especially for UF-denominated interest rates. However, we showed that neither the switch to a fully flexible exchange rate regime in 1999 nor the adoption of nominal interest rate targeting in August 2001 seems to have affected pass-through markedly.

These results are consistent with the view that the differences between Chile and the other countries we have studied, if any, are due mainly to external shocks, rather than to differences in market power in the banking system or to the recent changes in Chile's exchange rate and monetary policy regimes. It would therefore be interesting to evaluate this hypothesis more rigorously on microeconomic data based on the predictions of a banking sector model of imperfect competition in an open economy.

Appendix
Interest Rate Descriptions and Abbreviations

Country and type of rate	*Abbreviation*	*Description*
Chile		
Monetary policy rate	tpm	Monetary policy rate of the Central Bank, used for setting the interbank lending rate. Real rate through July 2001; real rate is derived from nominal thereafter
Overnight interbank rate	mmrnom	Nominal money market rate: overnight interbank lending rate
	mmrrl	UF money market rate: overnight interbank lending rate adjusted by previous month's inflation
Deposit rates	dstnom	Nominal deposit rate on commercial and consumer deposits of 30 to 89 days
	dmtnom	Nominal deposit rate on commercial and consumer deposits of 90 to 365 days
	dmtuf	Deposit rate on commercial and consumer deposits in UF of 90 to 365 days
	dltnom	Nominal deposit rate on commercial and consumer deposits of 1 to 3 years
	dltuf	Deposit rate on commercial and consumer deposits in UF of 1 to 3 years
Lending rates	lstnom	Nominal lending rate on commercial and consumer loans of 30 to 89 days
	lmtnom	Nominal lending rate on commercial and consumer loans of 90 to 365 days
	lmtuf	Lending rate on commercial and consumer loans in UF of 90 to 365 days
	lltnom	Nominal lending rate on commercial and consumer loans of 1 to 3 years
	lltuf	Lending rate on commercial and consumer loans in UF of 1 to 3 years
	lwtnom	Weighted average interest rate on peso loans
	lwtuf	Weighted average interest rate on UF loans
Australia		
Overnight interbank rate	atrb	Thirteen-week treasury bill used because of irregularities in the money market rate.
Deposit rates	adst	Bank deposits of 3 months
	admt	Bank deposits of 6 months
	adlt	Bank deposits of 1 year
Lending rate	alwt	Weighted average of all loans
Belgium		
Overnight interbank rate	bmmr	Overnight interbank rate
Deposit rates	bdst	Deposits of less than 3 months
	bdmt	Deposits of 3 months to 1 year
Lending rates	blst	Commercial loans of 6 months
	blmt	Commercial loans of up to 1 year
	bllt	Commercial loans of 1 to 5 years

APPENDIX (continued)

Country and type of rate	*Abbreviation*	*Description*
Canada		
Overnight interbank rate	cammr	Overnight interbank lending rate
Deposit rates	cdst	Commercial certificates of deposit of 30 days
	cdmt	Commercial certificates of deposit of 90 days
Lending rates	clst	Prime business short-term lending rate
	clmt	Conventional mortgage rate, 1 year
	cllt	Conventional mortgage rate, 3 years
France		
Call money rate	fmmr	Call money rate
Deposit rates	fdst	Deposits of up to 3 months
	fdlt	Deposits of 1 to 2 years
Lending rates	flmt	Commercial loans of up to 1 year
	fllt	Commercial loans of over 1 year
Germany		
Overnight interbank rate	gmmr	Overnight interbank rate
Deposit rates	gdst	Deposits of 1 to 3 months
	gdmt	Deposits of 3 months to 1 year
	gdlt	Deposits of over 3 months notice period
Lending rates	glmt	Commercial loans of up to 1 year
	gllt	Consumer loans of greater than 1 year
Netherlands		
Overnight interbank rate	nmmr	Overnight interbank rate
Deposit rates	ndst	Demand deposits
	ndlt	Deposits of 2 years
Lending rate	nlmt	Commercial loans of up to 1 year
Spain		
Overnight interbank rate	smmr	Overnight interbank rate
Deposit rates	sdst	Deposits of overnight
	sdlt	Deposits of 1 to 2 years
Lending rates	slmt	Commercial loans of up to 1 year
	sllt	Commercial loans of 1 to 3 years
New Zealand		
Overnight interbank rate	zmmr	Overnight interbank rate
Deposit rates	zdst	Call deposit rate
	zdmt	Bank deposits of 6 months
Lending rate	zlwt	Weighted average of all loans
United States		
Federal funds rate	fed	Overnight interbank lending rate
Deposit rates	udst	Average of dealer offering rates on nationally traded certificates of 1-month deposits
	udmt	Average of dealer offering rates on nationally traded certificates of 3-month deposits
	udlt	Deposits of 9 to 12 months at the Federal Home Loan Bank of New York
Lending rate	ulst	Prime lending rate: overnight loans to businesses

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IS THERE LENDING RATE STICKINESS IN THE CHILEAN BANKING INDUSTRY?

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This paper studies the transmission of monetary policy in terms of the interest rate pass-through in the case of Chile. Specifically, we are interested in the response of the commercial bank lending rate to a money market interest rate movement. International evidence suggests that lending interest rates are somewhat sluggish to adjust to changes in the policy rate. This stickiness is generally related to lack of competition in the banking sector, capital flow restrictions, and volatility of the policy rate.

One of the first comprehensive empirical studies on bank interest rate pass-through for monetary policy is Cottarelli and Kourelis (1994). They find important differences among countries: the estimated impact effects vary between 0.06 and 0.83, and the long-run effects range from 0.59 to 1.48, with an average of 0.97. Our estimates for the Chilean case are an impact of 0.81 and a long-run pass-through of 0.97 for nominal interest rates.

Previous studies suggest that sluggish adjustment is associated with market conditions and regulation of the banking sector. In this paper, we use bank-level data to explore other factors that may influence the degree of delay in market interest rate response to changes in the policy rate. The aim is to identify which characteristics may

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explain the differences in the average rates charged by each bank and their responsiveness to movements in the policy rate. The main variables considered are bank size, type of customers, and the loan risk level, which is related to demand elasticity and the cost of adjustment for banks. The theoretical model presented in the paper motivates the choice of these factors, and dynamic panel data estimation supports the implications of the model.

The paper proceeds as follows. In section 1, we briefly review the previous literature and present our own estimations for the Chilean case, at an aggregate level. Section 2 discusses some stylized facts for the Chilean banking industry and presents a model of monopolistic competition with asymmetric information for bank lending rates, together with the panel data econometric analysis. In section 3, we summarize and present some concluding remarks.

1. Chile versus the International Evidence

This section offers a brief review of empirical studies related to the flexibility of the bank lending rate in different countries. We also present our own estimations for Chile and compare them with results for other countries.

The lending rate stickiness refers to the small response of commercial banks' lending rate to a money market interest rate movement. Berger and Hannan (1989), Hannan and Berger (1991), and Cottarelli and Kourelis (1994) provide arguments and evidence for a sluggish adjustment of the lending interest rate in the short run. They find that in the long run, the lending rate fully adjusts to the shift in the money market rate. Many subsequent papers test the monetary policy transmission for specific countries under different periods and types of regulation. All of them are based on different parameterization of the following basic model:

$$i_t = \delta + \sum_{j=1}^{m} \beta_j i_{t-j} + \sum_{k=0}^{n} \alpha_k m_{t-k} + \sum_{l=0}^{p} \gamma_l \Delta \mathrm{MPR}_{t-l}\,, \tag{1}$$

where i represents the bank-lending rate, m is the money market or interbank rate, and ΔMPR is the change in the monetary policy interest rate. The difference between the money market or interbank rate and the monetary policy rate is that the first two are interest rates determined in the market, while the latter is set by the Central Bank as a target value. In Chile, as in many other countries, monetary policy is conducted by managing liquidity, such that the interbank or money market rate is in line with the policy rate. We can therefore separate the effect of monetary policy into two steps: from policy rate to money market rate and from money market rate to lending rate; we are interested in the second step. The coefficient of interest is α_0, which indicates the impact or the short-run effect of the money market or interbank rate on the lending rate. It is expected to be positive and less than or equal to one. The coefficient that measures the long-run effect of the money market rate on the lending rate is estimated as

$$\lambda = \frac{\sum \alpha_k}{1 - \sum \beta_j} . \qquad (2)$$

This coefficient is expected to be positive and close to one in an industry that is highly competitive.

1.1 Literature Review

In the empirical literature we find two types of studies, those that analyze monetary transmission mechanisms using cross-country data and those that give evidence using time series data for specific countries. The first group computes impact and long-run effects for different countries and then relates their findings with financial structures and macroeconomic variables of the different economies included in the sample. The second group uses country case studies to look for changes in the monetary policy transmission over time and for variation in interest rates. The main idea of both types of studies is to capture the effect of institutional features on the transmission of monetary policy.

One of the first comprehensive empirical studies on interest rate pass-through for monetary policy is Cottarelli and Kourelis (1994). This study estimates equation (1) for thirty-one countries, including developed and developing countries. They find important differences across countries in the impact coefficient, but the long-run coefficient tends to one in most cases. In a second step, they correlate the different coefficients with possible explanatory variables. The main finding here is that the impact coefficient is highly correlated with the structure of the financial system. Specifically, the lending interest rate becomes more flexible when the barriers to entry to the banking industry are low, the share of private ownership in the banking system is high, there are no constraints on international capital movement, and there is a market for negotiable short-term instruments. Neither market concentration nor the existence of a market for instruments issued by firms affects the degree of interest rate stickiness.

An important policy implication obtained by Cottarelli and Kourelis is the relevance of the discount rate or monetary policy rate as a policy instrument. In general, they argue that the movement in the discount rate is interpreted as a signal that helps reduce the degree of stickiness, especially in those economies with a weak financial structure.

Borio and Fritz (1995) examine the relationship between the monetary policy rate and the bank lending rate for a group of member countries of the Organization for Economic Cooperation and Development (OECD). Canada, Great Britain, and the Netherlands show a high short-run coefficient (above 0.7), while Germany, Italy, Japan, and Spain exhibit the highest degree of interest rate stickiness. The pass-through is more homogenous across countries in the long run, and it moves closer to one. Borio and Fritz argue that the difference in the results across countries may have to do with the type of lending rate available. In fact, interest rates for prime customers tend to adjust faster than other interest rates.

Mojon (2000) analyzes monetary policy transmission across euro area countries. He also looks for the implications of different financial structures for the stickiness of the retail interest rate. Like Cottarelli and Kourelis, he finds large differences in the short-run coefficients for different countries, ranging from 0.5 in Italy to 0.99 in Netherlands.[1] The pass-through coefficient is lower the higher is the volatility of the money market rate and the lower is the competition from other sources of finance (the level of banking disintermediation). Competition among banks reduces asymmetries through the interest rate cycle; that is, the size of the pass-through coefficient is less affected for upward movement in the interest rate than for downward movement.

A second group of studies concentrates their analysis on specific country cases. Following Cottarelli and Kourelis (1994), Cottarelli, Ferri, and Generale (1995) explore why the transmission of the monetary policy rate is so slow in Italy. They find that the high degree of

1. Toolsema, Sturm, and de Haan (2001) find similar results for the same group of countries.

stickiness is explained by the constraints to competition in the banking and financial system. Banks that operate in more competitive markets tend to translate movements of the money market rate into lending interest rates faster than do banks operating in a less competitive environment. This conclusion is based not only on the international comparison of Italian banking industry with the rest of the countries, but also on data analysis at the individual bank level. The stickiness of lending rates tends to decline with financial liberalization in Italy, which is consistent with the results using microeconomic data for different banks and regions of that country.

Using the same methodology as earlier studies, Moazzami (1999) confirms that interest rate stickiness in the United States was higher than in Canada during the 1970s and 1980s. The degree of flexibility has changed for both countries, however, moving in opposite directions over the first half of the 1990s. The short-run pass-through has thus converged to around 0.40 for both Canada and United States. The author attributes these changes to a more competitive environment for the U.S. banking system and a less competitive one for Canada.

Winker (1999) combines an adverse selection model with a marginal-cost pricing model to find an empirical equation in which the lending and deposit rates depend on the money market rate in the long run but not in the short run owing to the adverse selection problem. Based on the same argument, he justifies the lending rate's lower speed of adjustment toward its long-run level compared with the deposit rate, since the short-run coefficient for the lending rate is much smaller than that of the deposit interest rate. Winker provides evidence for his model for the case of Germany.

For the case of Spain, Manzano and Galmés (1996) use an interesting database that allows them analyze the speed of interest rate adjustment by type of bank. They define four groups of financial institutions: national banks specialized in commercial banking, savings banks, foreign banks, and merchant banks. The degree of short-run interest rate response to changes in the interbank rate varies greatly across groups, from 0.25 to 0.75 in the short-term impact coefficient. In the long run, all but saving banks have a total impact coefficient greater than one based on the reported confidence interval. In the case of savings banks, the coefficient is strictly less than one, although the deposit rate shows a higher degree of stickiness in both the short run and the long run. The impact coefficient ranges from 0.2 to 0.46, and the total impact varies between 0.63 and 0.81.

Table 1 summarizes the results of the literature reviewed.

Table 1. Summary of Results of Reviewed Literature

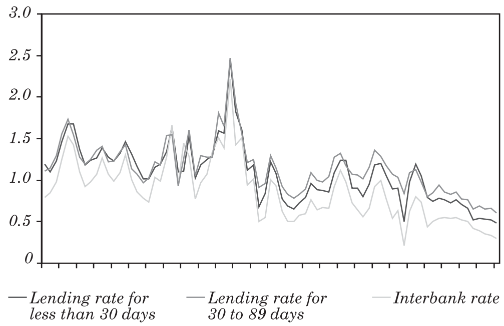
Study and sample	*Degree of transmission*	*Main conclusions*
Cross-country studies		
Cottarelli and Kourelis(1994) Sample: 31 countries	Short term: 0.06 to 0.83 Long term: 0.59 to 1.48, with an average equal to 0.97	The degree of flexibility increases with the elimination of capital flow restrictions, lower barriers to competition, private property in the banking industry, and the existence of short-run instruments
Borio and Fritz (1995) Sample: 12 OECD countries	Response to a simultaneous change in policy and money market rate Short term: 0.0 to 1.08 Long term: 0.74 to 1.17	The type of lending interest rate used could explain the differences across countries. For some countries the lending rate is applied to the best larger customer while for others the rates correspond to retail banking.
Mojon (2002) Sample: Panel data on 6 European countries	Short term: 0.5 (Italy) to 0.99 (Netherlands) Long term: Around 1 for all countries	The flexibility of interest rate increases with lower volatility of the monetary policy interest rate, and higher external and within-industry competition
Country case studies		
Cottarelli, Ferri, and Generale (1995) Italy	Short term: 0.07 Long term: 0.92	The degree of stickiness is inversely related to the degree of competition and financial liberalization
Moazzami, B. (1999) Canada and United States	Short term (CAN): 0.46 to 1.1 Short term (USA): 0.25 to 0.6 Long term (CAN): 0.6 to 2.0 Long term (USA): 0.8 to 1.2	The impact coefficient has increased over time in the United States and decreased in Canada. The reason could have to do with changes in financial system structure in those countries.
Winker, P. (1999) Germany	Short term: 0.1 (lending rate) and 0.42 (deposit rate) Long term coefficient tends to 1	The speed of adjustment to changes in the money market rate is lower in lending rates than in deposit rate
Manzano and Galmés (1996) Spain	Short term: 0.25–0.75 (lending rate) and 0.2–0.5 (deposit rate) Long term: 0.66–1.2 (lending) and 0.63–0.81 (deposit)	The lending rate tends to response faster in the short and the long run. The type of customer affects the degree of response.

1.2 Chile Compared with Other Countries

This section presents the results at the aggregate level for the Chilean banking industry. The lending rate at the aggregate level was constructed using a weighted average of interest rate for individual banks; the weights were the total amount of loans in the corresponding category. Figure 1 plots the lending interest rate and the interbank rate for the period under analysis. The lending rates follow the interbank interest rate very closely.

An important feature to take into account is that Chilean banks conduct transactions in pesos and in *unidades de fomento* (UF), which is a unit of account indexed to past inflation.[2] This unit of account is used for medium- and long-term transactions. We therefore estimated equation (1) for peso-denominated loans and UF-denominated loans. The most common maturity for the former is less than thirty days (approximately 50 percent of total nominal loans). For the latter, the typical maturity is 90 to 360 days, but it is mainly concentrated around 90 days (approximately 40 percent of total UF-indexed loans). Figure 2 presents the evolution of the lending interest rate for loans of longer maturity and the interest rate on ninety-day Central Bank indexed promissory notes (PRBC). Again, the two interest rates move closely together.[3]

Figure 1. Lending Interest Rate and Interbank Rate

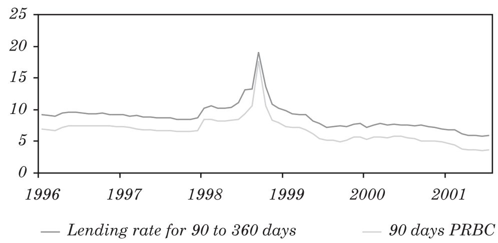


Source: Superintendence of Banks and Financial Institutions (SBIF) and Central Bank of Chile.

2. See Schiller (2002) for a discussion of the use of indexed unit accounts around the world and the UF.

3. Monetary policy is handled through the interbank interest rate, although the ninety-day PRBC interest rate is a good measure of the monetary policy rate for ninety days.

Figure 2. Lending Interest Rate and Ninety-day PRBC



Source: SBIF and Central Bank of Chile.

Next, we estimated a model represented by equation (1). The number of lags chosen was sufficiently high such that the error term becomes white noise. Several papers estimate this equation using different parameterization. The most popular is the error correction model, based on the idea that interest rates are not stationary. There are good economic arguments for disregarding that possibility for interest rates.[4] Nevertheless, to be skeptical, we ran different tests for unit roots, which are presented in the appendix. All the tests reject the presence of unit roots, so we proceeded to run the model in levels.

Table 2 presents the results for the interest rate applied to peso-denominated loans. Columns 1 and 3 show the results of equation (1) controlling for inflation; columns 2 and 4 take into account the dramatic increase in the interest rates during 1998, using a dummy variable, D98, that takes the value one for January 1998 to October 1998. Although the dummy variable is statistically significant, the overall conclusions do not change much. The impact coefficient fluctuates between 0.7 to 0.8, while in all cases the hypothesis of the long-run coefficient being equal to one cannot be rejected. Therefore, on average, banks fully adjust the lending rate to a change in the interbank interest rate in the long run.

Table 3 shows the results for the indexed lending rate. Again, we controlled for the 1998 interest rate turmoil, but it was not statistically significant except for July 1998. The inflation rate was not included, since the variables are indexed interest rates. The impact coefficient is around 0.85, while the long-term coefficient is statistically equal to 1.

4. See Chumacero (2001) for a discussion of unit roots based on economics.

Table 2. Interest Rate Transmission: Nominal Lending Rate[a]

Variable	*30-day lending rate*	*30-day lending rate*	*30- to 89-day lending rate*	*30- to 89-day lending rate*
Interbank rate	0.7932	0.8109	0.7122	0.7098
	(14.7964)**	(22.8482)**	(12.6719)**	(18.8454)**
Interbank rate (t – 1)		–0.3355	–0.1670	–0.1994
		(–3.8715)**	(–1.8404)	(–2.3729)*
Interbank rate (t – 2)	–0.3129	–0.3193	–0.2659	–0.3330
	(–2.3391)*	(–2.9958)**	(–4.4942)**	(–4.1670)**
Interbank rate (t – 3)			0.0750	0.0874
			(2.2498)*	(2.3841)*
Interbank rate (t – 4)		–0.0560		
		(–2.1570)*		
Interbank rate (t – 6)		0.0784		
		(3.4636)**		
D(MPR)	0.0281	0.0259	0.0419	0.0406
	(2.8474)**	(3.2080)**	(4.0445)**	(4.2109)**
Lending rate (t – 1)	0.2865	0.5629	0.4583	0.4059
	(3.0554)**	(6.1349)**	(4.0831)**	(4.6310)**
Lending rate (t – 2)	0.2320	0.2750	0.1896	0.3185
	(2.2617)*	(2.8149)**	(2.5192)*	(3.2959)**
Inflation (t – 2)	–0.1033	–0.0953	–0.2190	–0.5084
	(–2.7302)**	(–3.5682)**	(–4.1982)**	(–3.8040)**
D98				0.4462
				(3.9445)**
D98* Interbank rate		–0.3820		
		(–3.1078)**		
D98* Interbank rate (t – 1)		0.3547		
		(2.9385)**		–0.1996
D98*D(MPR)		0.2038		(–4.8414)**
		(4.6452)**		
Constant	0.1358	0.0473	0.1737	0.1538
	(3.8643)**	(1.2736)	(3.4792)**	(3.2508)**
Long-run coefficient (λ)	0.9972	1.1017	1.0060	0.9604
Wald test (λ = 1)	(0.0015)	(0.3202)	(0.0044)	(0.0932)
Summary statistic				
R^2	0.9554	0.9742	0.9466	0.9569

a. t statistics are in parentheses.
* Statistical significance at the 5 percent level.
** Statistical significance at the 1 percent level.

How do these results compare with the international evidence? Table 4 exhibits the comparison between the coefficient reported in column 2 of tables 2 and 3. The estimates for Chile show a high flexibility of the banking interest rate. In fact, the estimation positions Chile close to Mexico and the United Kingdom. According to Cottarelli

Table 3. Interest Rate Transmission: Indexed Lending Rate

Variable	*90- to 360-day lending rate*	*90- to 360-day lending rate*
PRBC	0.8575	0.8553
	(63.3162)**	(48.3335)**
PRBC (t – 1)	–0.4324	–0.2931
	(–4.9115)**	(–4.7812)**
PRBC (t – 2)	–0.0775	–0.0694
	(–5.1854)**	(–3.5892)**
PRBC (t – 4)	0.0357	
	(4.0652)**	
PRBC (t – 5)	–0.0245	–0.1674
	(–1.7402)	(–2.9301)**
Lending rate (t – 1)	0.6396	0.4940
	(6.1577)**	(7.4194)**
Lending rate (t – 5)		0.1643
		(2.8632)**
D98 (July)		1.6035
		(9.1060)**
Constant	0.8019	0.8342
	(3.3145)**	(4.6351)**
Long-run coefficient (λ)	0.9953	0.9520
Wald test (λ = 1)	(0.0757)	(0.0404)
Summary statistic		
R^2	0.9837	0.9924

a. t statistics are in parentheses.
* Statistical significance at the 5 percent level.
** Statistical significance at the 1 percent level.

and Kourelis, the variables that tend to increase the interest rate pass-through are the degree of competition and financial liberalization. It is important to take into account that the time periods are different for the countries included in Cottarelli and Kourelis (1994) with respect to the present study. The former uses data for the 1980s, while we use data for the 1990s. Relevant conditions for interest rate sluggishness were different in the 1990s than in previous decades.

2. Evidence for Chile at the Bank Level

The previous section exposed some evidence in favor of interest rates stickiness. This is the case for almost all the countries that have been studied to date, and it is also the case of Chile, to some

Table 4. International Comparison of Interest Rate Stickiness

Region and country	*Impact*	*Long term*
Latin America		
Chile (nominal rate)	0.81	0.97
Chile (indexed rate)	0.86	0.95
Colombia	0.42	1.03
Mexico	0.83	1.29
Venezuela	0.38	1.48
North America		
Canada	0.76	1.06
United States	0.32	0.97
Europe		
Germany	0.38	1.04
Italy	0.11	1.22
Spain	0.35	1.12
United Kingdom	0.82	1.04

Source: Cottarelli and Kourelis (1994) and authors' estimates for Chile.

extent.[5] We further argued that previous studies suggest that sluggish adjustment is related to market conditions and regulation of the banking sector. In this section, we use bank-level data to explore the factors that may influence the degree of delay in market interest rate response to changes in the policy rate.

For this purpose, we analyze the differences in the interest rate levels charged by banks and the adjustment to changes in the policy rate. In the Chilean case, we observe an important divergence between the interest rates charged by banks, as well as significant differences within a bank depending on the kind of loan, the type of customer, firm or household, and the amount of the loan. Legislation imposes a ceiling on the interest rate charged by loan category, which somewhat limits this dispersion (50 percent above the average market interest rate by loan category).[6]

Our aim is to identify which characteristics might explain the differences in the average rates charged by each bank and their responsiveness to movements in the policy rate. The main characteristics considered were the size of the bank, the type of customer, and the loan risk level. Other variables, such as solvency or liquidity, were also considered, but they did not prove to be significant for explaining differences in lending rates, so the results are not presented.

5. As shown in section 1, the impact effect of changes in the policy rate were less than one for most of the countries studied, including Chile.

6. SBIF (2000).

The data used is at the bank level. We do not have enough information at this point on different transactions within a bank, but this area represents an important future extension of the study.

2.1 Stylized Facts for the Chilean Banking Industry

Tables 5 and 6 show that larger banks charged, on average, lower interest rates than smaller banks during the sample period. For smaller banks, the nominal monthly rate was 1.21, whereas for larger banks this rate was 1.16 for the period 1996–2002. In the case of the UF rate, smaller banks showed a yearly rate of 8.55 percent, on average—that is, 3.5 percent higher than the average for larger banks (8.26 percent). This evidence might support two alternative hypotheses: namely, the structure-performance hypothesis or the efficiency-structure hypothesis. Under the first hypothesis, differences in prices would respond solely to imperfect competition, with differences in price elasticities across markets served by different banks. The second would imply that there are cost advantages for larger banks, together with some degree of market imperfection that allows inefficient banks to survive, at least in the short run.

Table 5. Large Banks: Thirty-day Nominal Rate and Correlation with the Interbank Rate, by Loan Risk and Type of Customer[a]

	Loan Risk[c]		
Type of customer[b] indicator	*< 2 percent*	*> 2 percent*	*Total*
Household loans < 10 percent			
Interest rate			
Correlation			
No. Banks	0	0	0
Household loans > 10 percent			
Interest rate	1.08	1.20	1.16
Correlation	0.90	0.86	0.88
No. Banks	2	4	6
Total			
Interest rate	1.08	1.20	1.16
Correlation	0.90	0.86	0.88
No. Banks	2	4	6

Source: Authors' calculations using data from SBIF.
a. Average for the 1996–2002 period. Large banks are those that have a market share over total loans of more than 5 percent.
b. Type of customer is measured as household loans as a percentage of total loans.
c. Loan risk is measured as past-due loans as a percentage of total loans

Table 6. Small Banks: Thirty-day Nominal Rate and Correlation with the Interbank Rate, by Loan Risk and Type of Customer[a]

	Loan Risk[c]		
Type of customer[b] indicator	*< 2 percent*	*> 2 percent*	*Total*
Household loans < 10 percent			
Interest rate	1.12	1.37	1.19
Correlation	0.83	0.76	0.81
No. Banks	5	3	8
Household loans > 10 percent			
Interest rate	1.25	1.21	1.23
Correlation	0.87	0.79	0.83
No. Banks	3	3	6
Total			
Interest rate	1.17	1.27	1.21
Correlation	0.85	0.78	0.82
No. Banks	8	6	14

Source: Authors' calculations using data from SBIF.
a. Average for the 1996–2002 period. Small banks are those that have a market share over total loans of less than 5 percent.
b. Type of customer is measured as household loans as a percentage of total loans.
c. Loan risk is measured as past-due loans as a percentage of total loans

In terms of loan risk, banks with a higher percentage of past-due loans (more than 2 percent) charged, on average, higher interest rates to their clients, as expected. This is 11.1 percent higher in the case of nominal rates and 8.6 percent in the case of UF rates, over the sample period. When we compute a simple correlation between lending rates and our indicator for the policy rate (the interbank rate in the case of nominal interest rates and the ninety-day PRBC in the case of UF interest rates), this correlation is smaller for banks with lower-quality loans. This may be due to adverse selection problems, in the sense that if interest rates increase, only riskier projects (with a higher expected return) would stay in the market and the average quality of the loan portfolio would decrease, thereby lowering the bank's profits. Banks will thus not respond rapidly to an increase in the policy rate, especially in the case of banks with a higher portion of past-due loans. On the other hand, if the policy rate decreases, we would expect less responsiveness from banks with a riskier portfolio, because it is more difficult for riskier clients to move to other banks. Banks with a larger portion of past due loans thus have less incentive to decrease interest rates, at least in the short run.

Finally, in tables 7 and 8 we analyze differences in interest rates charged by banks classified by type of loan.[7] We are able to make this distinction only for smaller banks because larger banks do not display much difference within this category, since all of them have more than 10 percent of household loans. So, for smaller banks we have two groups: those with less than 10 percent of the loans given to households and those with more than 10 percent.

In the case of both nominal interest rates and UF interest rates for smaller banks, the higher average rate charged corresponds to banks that have a larger portion of past-due loans and a lower share of household loans, while banks with low risk and a low share of household loans charge lower interest rates. This indicates that there is an important dispersion of interest rates charged to firms, which seems to be larger than in the case of households. This evidence suggests that the demand elasticity of households is larger than that of firms. A possible explanation for this is that asymmetric information leads firms to establish a long-term relationship with their banks to a greater extent than households; this gives additional market power to the banks, owing to higher switching costs for firms.

Table 7. Large Banks: Ninety-day to One-year Indexed Rate and Correlation with the PRBC Rate, by Loan Risk and Type of Customer[a]

	Loan Risk[c]		
Type of customer[b] indicator	*< 2 percent*	*> 2 percent*	*Total*
Household loans < 10 percent			
Interest rate			
Correlation			
No. Banks	0	0	0
Household loans > 10 percent			
Interest rate	8.02	8.38	8.26
Correlation	0.95	0.94	0.95
No. Banks	2	4	6
Total			
Interest rate	8.02	8.38	8.26
Correlation	0.95	0.94	0.95
No. Banks	2	4	6

Source: Authors' calculations using data from SBIF.
a. Average for the 1996–2002 period. Large banks are those that have a market share over total loans of more than 5 percent.
b. Type of customer is measured as household loans as a percentage of total loans.
c. Loan risk is measured as past-due loans as a percentage of total loans

7. The type of loan is measured as the percentage of total loans made to households (consumption plus mortgage).

Table 8. Small Banks: Ninety-day to One-year Indexed Rate and Correlation with the PRBC Rate, by Loan Risk and Type of Customer[a]

	Loan Risk[c]		
Type of customer[b] indicator	*< 2 percent*	*> 2 percent*	*Total*
Household loans < 10 percent			
Interest rate	8.17	9.14	8.52
Correlation	0.92	0.80	0.87
No. Banks	5	3	8
Household loans > 10 percent			
Interest rate	8.38	8.80	8.59
Correlation	0.91	0.94	0.92
No. Banks	3	3	6
Total			
Interest rate	8.25	8.96	8.55
Correlation	0.92	0.87	0.90
No. Banks	8	6	14

Source: Authors' calculations using data from SBIF.
a. Average for the 1996–2002 period. Small banks are those that have a market share over total loans of less than 5 percent.
b. Type of customer is measured as household loans as a percentage of total loans.
c. Loan risk is measured as past-due loans as a percentage of total loans.

2.2 A Model for Lending Rate Stickiness

This section presents a model that we use to build on some of the hypotheses that we test for the Chilean banking industry. These hypotheses are related to the stylized facts presented in the previous section. The model gives us some insights about what to expect from our empirical analysis, as well as possible explanations for our findings.

It seems appropriate to assume an imperfect competition model in the case of the banking sector, where there are significant barriers to entry and an important degree of product differentiation.[8] We also assume that there is asymmetric information in this industry, which leads to adverse selection and moral hazard problems. We combine these two issues by assuming that banks make a two-step decision, which considers the long-run equilibrium and the short-run behavior that will take them to this condition.[9]

For the long run, we assume a simple Monte-Klein model for a monopolistic bank that faces a downward sloping demand for loans

8. Freixas and Rochet (1998).

9. This method of combining these two factors is similar to Scholnick (1991), Winker (1999), and Bondt (2002).

$L(i_L)$ and an upward sloping supply of deposits $D(i_D)$. This captures the fact that banks have some monopoly power. The decision variables for the firm are the quantities of loans (L) and deposits (D). Bank k maximizes the following profit function:

$$\pi_k(L,D) = [\gamma_k i_{L,k}(L) - m]L_k + [m(1-\alpha) - i_{D,k}(D)]D_k - C(D_k, L_k) , \tag{3}$$

where γ_k is the probability that the loan will be repaid, m is the interbank rate (which is given for individual banks), α is the proportion of deposits that constitutes cash reserves, i_D is the deposit interest rate, and i_L is the lending interest rate. $C(D,L)$ accounts for the total cost of intermediation services, which is a function of the total amount of deposits and loans.

Solving for the first-order conditions and rearranging terms, we get to the following expressions for the lending interest rate:

$$i_L^* = \frac{\varepsilon_k}{(\varepsilon_k - 1)\gamma_k}(m + C_L') , \tag{4}$$

where ε_k is the absolute value of the demand elasticity for loans, which is greater than 1 since we are assuming monopolistic competition. For the purpose of this paper, we are interested in the loan market and we assume that costs are separable, so that the optimal lending rate is independent of the characteristics of the deposit market. This simple model leads us to conclude that different interest rates charged on loans may reflect different demand elasticities and the probability of loan repayment (portfolio risk).

The above model is interpreted as the long-run equilibrium for banks. To simplify our model, we assume each bank faces a constant elasticity demand function. In other words, ε might be different for each bank, but it is independent of i_L. We can write this relationship between the lending rate and the interbank rate as $i_L^* = \Phi_k m$. (Here, $\Phi_k = \varepsilon_k / (\varepsilon_k - 1)\gamma_k$ is a mark up, which is a function of demand elasticity and the repayment probability). Thus, the long-run pass-through coefficient is larger the smaller is the demand elasticity and the smaller is the probability of repayment. This long-run coefficient may or may not be equal to 1, when there is some degree of monopoly power.

Asymmetric information, however, results in a sluggish adjustment process to get to this long-run equilibrium. In fact, we are interested in finding out whether there is some delay in the response of market interest rates to changes in the policy rate and whether this delay depends on bank characteristics related to demand elasticity and asymmetric information.

Specifically, we are thinking of a setup in which in the short run, banks solve an intertemporal problem characterized by a cost of adjusting too slowly to this long-run equilibrium and a cost of moving too fast. This latter cost is due to adverse selection and moral hazard problems in the banking industry. For instance, if a bank increases the lending rate in response to an increase in the money market rate, the bank's adjustment to its new long-term equilibrium may involve attracting debtors that have a lower repayment probability, thereby lowering the bank's profits. At the same time, moral hazard arises because a higher interest rate gives debtors incentives to invest in riskier projects, which would also decrease the bank's profits.[10] Under this framework, therefore, we assume that there are some adjustment costs stemming from asymmetric information. This is modeled as a quadratic loss function following Nickell (1985), Scholnick (1991), and Winker (1999), which is tractable because it generates a linear decision rule.[11] The loss function for bank k in period t is the following:

$$\Gamma_{t,k} = \sum_{s=0}^{\infty} \delta^{s} \left[\omega_{1,k} \left(i_{k,L,t+s} - \Phi_k m_{t+s} \right)^2 + \omega_{2,k} \left(i_{k,L,t+s} - i_{k,L,t+s-1} \right)^2 \right], \tag{5}$$

where ω_1 and ω_2 represent the weight that the bank gives to achieving the long-run target value for the lending rate and the cost of moving to that target value, respectively. Recall that Φ_k is a function of the demand elasticity and the probability of repayment that bank k faces, whereas ω_j, j = 1,2, depends on the bank's average loan risk. If the portion of past-due loans for bank k is higher, the adverse selection or moral hazard problem for that bank becomes more important and the bank will give more weight to changes in the interest rate, which implies a slower adjustment. On minimizing equation (5), we obtain

$$i_{k,L,t+s} = \frac{\omega_{1,k}}{\omega_{1,k} + \omega_{2,k}} \Phi_k m_{t+s} + \frac{\omega_{2,k}}{\omega_{1,k} + \omega_{2,k}} i_{k,L,t+s-1}. \tag{6}$$

10. Stiglitz and Weiss (1981).

11. Scholnick (1991) and Winker (1999) also include a third term in the loss function, but it is not included in our setup. For an argument, see Nickell (1985). The other difference is that we have a multiplicative mark-up instead of an additive mark-up.

Equation (6) shows that the impact coefficient depends on the size of $\omega_{1,k}$ relative to $\omega_{1,k} + \omega_{2,k}$ and the mark up, Φ_k. Therefore, the long-run coefficient is always larger than the short-term coefficient. The bank's loan risk determines Φ_k and $\omega_{2,k}$: the lower the probability of repayment (higher risk), the higher are both Φ_k and $\omega_{2,k}$. If the debtors are too risky and the effect on $\omega_{2,k}$ is more important, the bank may not completely pass through a money market interest rate increase (in the short run) because it would stifle the debtors. In the long run, however, the interest rate charged will reflect the risk characteristic of the debtor. In other words, unpaid loans should have a negative effect on the impact coefficient and a positive effect on the long-term multiplier.

The main difference between our setup and the one presented by Scholnick (1991) and Winker (1999) is that they derive an error correction model (ECM) from this quadratic loss function. Our variables are stationary, however, even if we assume that there is a long-run relationship between the interbank rate and the lending rate. We therefore estimate our econometric model in levels and not in an ECM form. Recall that the ECM has this interpretation only if the variables are nonstationary and cointegrated, which is not the case for our data.[12]

The other important difference is that we use the above model in a panel data estimation (in section 2.3) that allows the parameters to be different for different banks depending on their characteristics.

2.3 Econometric Results

The model described above suggests that differences in interest rate pass-through might be related to product characteristics such as the type of customer or the risk level of the loan portfolio. The econometric analysis presented in this section allows us to address this issue by estimating a dynamic panel data model in which bank characteristics are interacted with the interbank rate and its lags. An alternative method is time series estimation by bank, but it has the drawback that changes in bank characteristics during this time may be affecting the sluggishness of adjustment for each bank, which is not correctly captured.[13]

12. Unit root tests is presented in the appendix. Derivation of the ECM and explanation of why it is not appropriate with stationary data are found in Nickell (1985) and Wickens and Breush (1988).

13. See Berstein and Fuentes (2003) for time series estimations at the bank level.

We estimate the following equation, which is based on the model described in section 2.2. Adverse selection is captured by the adjustment cost coefficient of the model, which is a function of the quality of loan portfolio, and we allow demand elasticity to be a function of the type of customers the bank has and the size of the bank.

$$i_{h,t} = \eta_h + \sum_{j=1}^{m} \beta_j i_{h,t-j} + \sum_{k=0}^{n} \theta_k m_{t-k} + \sum_{k=0}^{n} \alpha_k X'_{h,t-k} M_{t-k} + \sum_{l=0}^{p} \phi_{t-l} \Delta MPR_{t-l} \qquad (7)$$

where M is a vector that contains the lagged lending rate and the money market rate, and X' is a vector of bank characteristics, which includes: the loan portfolio risk, measured as the portion of past-due loans; type of consumers, measured as the share of household loans (consumption and mortgage); and bank size, measured as the percentage of total loans. Finally, η_h is a bank-specific effect.

The problem of estimating dynamic panel data has been widely discussed in the literature, and different methods have been proposed to obtain consistent estimates of the parameters. Anderson and Hsiao (1982) propose a method based on instrumental variables (IV), which consists in taking first differences of the equation to eliminate unobserved heterogeneity and then using instrumental variables to estimate consistently the parameters of the lag-dependent variables.

For instance, the following equation is to be estimated using panel data:

$$y_{it} = \rho y_{it-1} + \beta x_{it} + \eta_i + u_{it} \,, \qquad (8)$$

where y_{it} represents the lending interest rate, x_{it} represents a dependent variable like the interbank interest rate, and η_i is the unobserved heterogeneity. After taking the first difference, the equation to be estimated is

$$y_{it} - y_{it-1} = \rho\left(y_{it-1} - y_{it-2}\right) + \beta\left(x_{it} - x_{it-1}\right) + u_{it} - u_{it-1} \,. \qquad (9)$$

Anderson and Hsiao propose $y_{i,t-2}$ or $(y_{i,t-2} - y_{i,t-3})$ as an instrument for $(y_{i,t-1} - y_{i,t-2})$, but Arellano (1989) shows that $y_{i,t-2}$ is a much better instrument for a significant range of values of the true in equation (9).

Arellano and Bond (1991) propose an alternative methodology based on generalized method of moments (GMM) estimators. This method uses several lags of the variables included as instruments, so it is especially efficient when T is small and N is large.[14] The method is applied to equation (6), using moment restrictions that come from the use of instrumental variables. Judson and Owen (1999) provide evidence that for small T, GMM is a better estimator than Anderson and Hsiao's methods under the mean square error criterion. It is unclear, however, which method is better for unbalanced panel data and T around 20.

Several other methods have been developed based on the traditional within-group, IV, and GMM estimators. The IV method tends to work better than the within-group estimator when N tends to infinity (N is very large) and T is fixed. Alvarez and Arellano (2002) show the asymptotic property of the within-group, GMM, and limited information maximum likelihood (LIML) estimators. An important result for our case is that regardless the asymptotic behavior of N, the estimator of ρ is consistent when T goes to infinity. Moreover, if $\lim(N / T) = 0$ (as T goes to infinity) there is no asymptotic bias in the asymptotic distribution of the within-group estimator, while in the opposite case of $\lim(T / N) = 0$ (as N goes to infinity), there is no asymptotic bias in the asymptotic distribution of the GMM estimator. In our panel, T is large and increasing over time, while N remains relatively fixed. The traditional within-group estimator will thus provide the best results.[15]

Tables 9 and 10 show the results for the thirty-day nominal interest rate and for the 90- to 360-day indexed interest rates, respectively. The first column of tables 9 and 10 present the results of the panel estimation without controlling for the 1998 effect and without considering the interaction between bank characteristics and the right-hand-side variables. If we compare these regressions with the ones from section 1, we observe that the impact and long-run effects (shown at the bottom of each table) are smaller than what we found previously. Note that previously, we were estimating impact and long-run effects at an aggregate level using the weighted average interest rates, so that large banks drive the results to a larger extent on those regressions than on the panel data estimation.

14. See Judson and Owen (1999) for further discussion of the advantages of different methodologies.

15. See Berstein and Fuentes (2003) for panel data estimations using Anderson and Hsiao, and Arellano and Bond methods.

Table 9. Panel with Interaction and 1998 Dummies, Thirty-day Nominal Rate

Explanatory variable	*(1)*	*(2)*	*(3)*
Interbank rate	0.74	0.72	0.74
	(41.51)**	(34.80)**	(24.92)**
Interbank rate (–1)	–0.30	–0.41	–0.48
	(–10.86)**	(–14.44)**	(–13.02)**
Interbank rate (–5)	–0.12	–0.06	
	(–6.91)**	(–3.84)**	
Interbank rate (–6)	–0.06		
	(–2.43)**		
Nominal rate, 30 days (–1)	0.57	0.67	0.68
	(26.84)**	(32.80)**	(28.36)**
Nominal rate, 30 days (–3)	0.05		
	(3.44)**		
Nominal rate, 30 days (–6)	0.14	0.06	0.04
	(6.58)**	(4.05)**	(2.72)**
D (MPR)	0.04	0.03	0.06
	(8.62)**	(5.71)**	(7.08)**
Inflation			
Inflation (–2)	–0.13	–0.08	–0.09
	(–6.83)**	(–4.60)**	(–3.65)**
Interbank * risk (–1)			–2.31
			(–2.13)*
Interbank (–1) * risk (–2)			5.05
			(4.80)**
Interbank (–1) * market share (–1)			–0.72
			(–2.84)**
Interbank * Cons.			0.18
			(1.77)
Long-run coefficient	1.07	0.88	1.09
Standard deviation	(0.07)	(0.06)	(0.08)
Summary statistic			
No. observations	1,447	1,447	1,105
No. banks	20	20	20

a. The dependent variable is the thirty-day nominal interest rate. Models (2) and (3) control for the year 1998. The models were estimated using fixed effects, which are not reported; *t* statistics in parentheses.
* Statistical significance at the 5 percent level.
** Statistical significance at the 1 percent level.

The second column of tables 9 and 10 present the results of the panel estimation controlling for the 1998 effect. The impact and the long-run coefficients decrease relative to those reported in the first column of each table, but the values are consistent with the idea that the long-term coefficient is larger than the short-term coefficient. However the long-term coefficient is not statistically equal to 1. The

Table 10. Panel with Interaction and 1998 Dummies, Ninety-day to One-year Indexed Rate[a]

Explanatory variable	*(1)*	*(2)*	*(3)*
PRBC	0.88	0.71	0.72
	(90.95)**	(37.19)**	(25.41)**
PRBC (–2)	0.05	–0.03	
	(2.62)**	(–2.30)*	
PRBC (–3)	–0.38	–0.21	–0.21
	(–12.22)**	(–7.61)**	(–6.54)*
PRBC (–4)	–0.09		
	(–3.10)**		
PRBC (–5)	–0.05	–0.13	–0.13
	(–3.98)**	(–4.98)**	(–4.18)**
PRBC (–6)	–0.09	–0.05	
	(–3.31)**	(–1.96)*	
	0.25	0.24	0.19
UF rate, 90 days to 1 year (–1)	(14.10)**	(19.36)**	(12.13)**
	0.26	0.24	0.24
UF rate, 90 days to 1 year (–3)	(9.41)**	(9.52)**	(8.02)**
	0.09		
UF rate, 90 days to 1 year (–4)	(3.19)**		
UF rate, 90 days to 1 year (–5)		0.12	0.12
		(4.32)**	(4.20)*
UF rate, 90 days to 1 year (–6)	0.09	0.05	
	(3.47)**	(2.19)*	
D [MPR (–1)]	–0.34		
	(–6.14)**		
PRBC (–2) * risk (–3)			–2.48
			(–4.12)**
UF rate, 90 days to 1 year (–1) * risk (–2)			1.47
			(3.34)**
PRBC * market share			–0.34
			(–3.11)**
PRBC (–2) * Cons.(–2)			0.18
			(3.83)**
Long-run coefficient	1.04	0.84	0.85
Standard deviation	(0.03)	(0.03)	(0.04)
Summary statistic			
No. observations	1,368	1,368	1,368
No. banks	18	18	18

a. The dependent variable is the thirty-day nominal interest rate. Models (2) and (3) control for the year 1998. The models were estimated using fixed effects, which are not reported; *t* statistics in parentheses.
* Statistical significance at the 5 percent level.
** Statistical significance at the 1 percent level.

last column in each table allows us to check the hypotheses provided by the theoretical model. In the case of nominal interest rates, the riskier the portfolio, the lower is the impact coefficient, which is consistent with the idea that banks will not pass interest rate change on to debtors in the short run, according to the difference equation (6). In the long run, however, the pass-through will be larger the riskier is the portfolio. This relationship is represented in figures 3 and 4, which illustrate how the average loan risk has increased over time and the estimated impact effect has decreased while the long run effect gets larger.

In the case of the indexed interest rate, the results are different. The impact coefficient is not affected by the portfolio risk, while the level of the unpaid loans affects the long-run coefficient by reducing it (see figure 5).

Figure 3. Impact Effect and Loan Risk, Thirty-day Nominal Rate

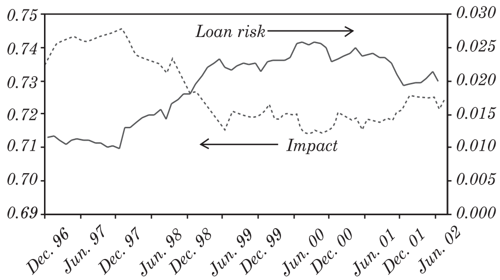


Figure 4. Long-run Effect and Loan Risk, Thirty-day Nominal Rate

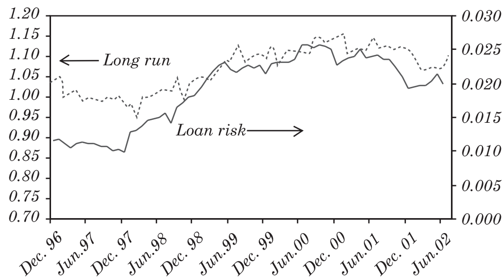
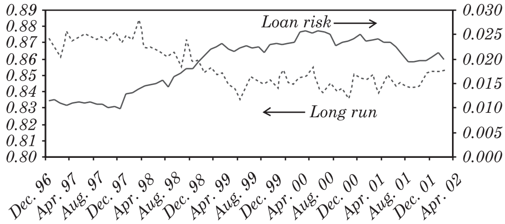


Figure 5. Long-run Effect and Loan Risk, Ninety-day to One-year UF Rate



Finally, for both nominal and indexed rate, bank size negatively affects the pass-through, while banks that are more oriented toward households have a larger pass-through.

3. Concluding Remarks

The estimates presented in this paper support the fact that the banking interest rate in Chile is highly flexible. In fact, the estimation positions Chile close to Mexico and the United Kingdom, countries displaying the highest degree of flexibility.

An earlier study by Cottarelli and Kourelis (1994) identifies the degree of competition and financial liberalization as the main determinants of interest rate stickiness. We used bank-level data to explore other factors that influence the degree of delay in market interest rate response to changes in the policy rate. The main characteristics identified in our analysis of differences in the interest rate levels charged by banks and their adjustment to changes in the policy rate are bank size, type of customers, and the loan risk level.

Our bank-level econometric analysis found significant differences in banks' responses to changes in the policy interest rate. Moreover, the smaller the bank, the lower the portion of past-due loans, and the larger the share of household consumers—the faster is the response of lending interest rates to movements in the money market rate. These results are consistent with the model and the stylized facts presented in the paper.

Topics for future research include alternative measures for capturing loan risk and other characteristics that would help improve measures of different demand elasticities, at the bank level. Furthermore, the availability of disaggregated information on the interest rates charged for different types of loans within a bank would improve estimates of the effects of loan risk or type of customer on the interest rate responses to changes in policy rates.

Appendix
Unit Root Tests

We ran different tests for unit roots, all of which reject the presence of unit roots. The results are presented in table A1. The tests consider a trend for the nominal interest rates, and we used the modified Akaike information criterion to choose the number of lags. We use augmented Dickey-Fuller (ADF) and Phillips-Perron tests with the modified Akaike to solve the size problem of the tests, but the power is very low. The power of the tests is higher when using Dickey-Fuller generalized least squares (DF-GLS) and Phillips-Perron-Ng.

Table A1. Unit Root Tests, 1995 to 2001

Rate	*ADF*	*DF-GLS*	*Phillips-Perron*	*Phillips-Perron Ng Mzt*
PRBC	–1.928	–1.949*	–2.630	–1.995*
Interbank rate	–3.733*	–3.175*	–4.364**	–3.135*
UF, 90 days to 1 year	–2.258	–2.292*	–2.204	–2.134*
Nominal rate, 30 days	–4.169***	–4.612**	–4.686**	–3.562**

* Nonstationarity rejected at 5 percent.
** Nonstationarity rejected at 1 percent.

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CONCENTRATION, HOLD-UP, AND INFORMATION REVELATION IN BANK LENDING: EVIDENCE FROM CHILEAN FIRMS

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The efficiency of allocating physical capital and consumption goods over time depends on the functioning of the financial system. Within this market, banks play a fundamental role as financial intermediaries, providing access to the payment system, transforming assets, managing risk, and monitoring and processing information (Freixas and Rochet, 1998).

In this paper we empirically study the role of banks in overcoming the frictions that arise from asymmetric information. Specifically, we study the effects on the volume of firm borrowing of the relationships that firms and banks develop as a result of banks' monitoring activities. Whenever a bank lends to a firm, the bank gathers information

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about the quality of the client that is not shared by other intermediaries, that is, banks and firms establish relationships. These relationships reduce the extent to which moral hazard and adverse selection problems affect the flow of credit to otherwise qualified borrowers. Developing relationships allows the lender to better judge the quality of a borrower, which reduces the extent of credit rationing and benefits firms. The bank may be able to use this information to extract rents, however, building an informational monopoly that may reduce credit availability and distort the firms' investment decisions.

We use a unique dataset to empirically investigate these specific but crucial aspects of financial markets. We examine bank-client relationships in a large sample of Chilean manufacturing firms during the 1990–98 period. In particular, we investigate whether firm-bank relationships—measured by the duration of lending ties—and actual bank concentration faced by firms affect access to bank financing. On the one hand, if the interaction between a bank and its clients mitigates informational asymmetries over time, then the availability of credit should increase with the length of such relationships, conditional on the creditworthiness of a firm. On the other hand, if a single lender can exploit an informational monopoly, firms that rely on multiple lending ties should have better access to bank loans. Dealing with more than one bank involves transactions costs, however, because monitoring efforts are duplicated and banks may free ride on each other, reducing the level of screening effort. Debt renegotiation also becomes increasingly complicated when the number of creditors involved grows (Bolton and Scharfstein, 1996). Finally, credit market competition reduces the ability of the firm and the creditor to intertemporally share a surplus, as well as the extent to which the bank can finance profitable projects when the firm's cash flows are low (Petersen and Rajan, 1995). Multiple banking relationships thus are not necessarily beneficial for borrowers.

Since the consequences of concentration and relationship length for access to bank lending are theoretically unclear, the empirical assessment of these effects is especially valuable. Moreover, given the particular characteristics of an emerging economy like Chile, this assessment should ideally be done using country-specific data.

Most of the empirical literature on financial market imperfections focuses on the consequences on investment of internal funds availability (in the line of Fazzari, Hubbard, and Petersen, 1988) to conclude that borrower-lender information asymmetries are a key determinant of external funding access. A number of articles have studied the effects of lender-borrower relationships on firm performance, such as on the value of the firm and investment decisions. Relationships and the extent of the asymmetric information problem have been measured in many ways. For instance, in studying the sensitivity of investment to cash flow according to the degree of attachment to banks, Hoshi, Kashyap and Stein (1991) associate belonging to a large industrial group as a proxy for weaker asymmetric information. With this same purpose in mind, Schaller (1993) uses the degree of ownership concentration as a measure of information problems, Whited (1992) uses a dummy to capture whether a firm has a bond rating, and Fohlin (1998) uses the number of the firm's board members who sit on a bank's board of directors. Both Medina and Valdés (1998) and Gallego and Loayza (2000) examine this same issue for Chile, using alternative measures of information asymmetries. This paper takes one step back and studies the empirical plausibility and importance of the asymmetric information problem on bank lending. It also investigates the implications of competition and concentration for bank lending at the microeconomic level.

The issues we examine in this paper are important in their own right for the functioning of the financial market, particularly regarding credit access of small and medium-sized firms, and they have distinct implications for both market performance and policy. They are also relevant for understanding monetary policy. For instance, monopoly power arising from either information asymmetries or straight lack of competition may modify an otherwise standard transmission mechanism of monetary policy. Bank lending could further amplify or dampen the effects of monetary policy through endogenous changes in the external finance premium (the credit channel of monetary policy).[1]

Our results indicate that lower concentration, measured by the number of banks to which a firm is related, has a positive and economically relevant impact on the volume of bank lending. After we control for firms' age, the length of borrower-lender relationships has a positive effect on loans, although its significance is not robust to alternative estimation methods.

The rest of the paper is organized as follows. Section 1 quickly revisits some theory and previous empirical work. Section 2 describes the construction and main characteristics of the dataset. Section 3

1. See, for example, Bernanke and Gertler (1995) and Kashyap and Stein (1994).

presents the main findings, evaluating the effects of bank concentration and the length of the lender-borrower relationship on borrowing volume. Finally, section 4 presents the main conclusions and discusses a few policy implications.

1. Theory and Previous Empirical Evidence

From a theoretical point of view, both bank concentration and the length of lender-borrower relationships have ambiguous consequences on access to bank loans. As for concentration, Diamond (1984) develops a model in which bank financing is less expensive than borrowing from public lenders, since intermediaries can save on monitoring and agency costs. Ramakrishnan and Thakor (1984) and Allen (1990) give banks a special screening role. In either model, concentration may further reduce costs or enhance efficiency under increasing economies of scale. Márquez (2002) shows that increased competition among banks may lead to information dispersion, increasing the costs of borrowing. A market with few large banks, he concludes, can have lower interest rates than a market with many small banks. In the same venue, if too many banks serve one particular client, incentives to properly monitor may weaken owing to the commons problem, which, in turn, increases costs.

At the same time, while bank control can reduce costs and increase efficiency, market power by banks may result in monopoly pricing if competition or contestability (or both) are weak. Furthermore, a single bank may build up an ex post information monopoly that adversely affects lending (Sharpe, 1990 and Rajan, 1992). This hold-up problem can make it costly for a firm to switch lenders, as it may signal that the bank with the information monopoly is unwilling to lend to the firm. In this case, the bank can extract rents from the firm and possibly distort its investment decisions. Concentration, therefore, may produce a borrower capture. This problem is likely to be more relevant if banks observe other banks' lending, because the stigma arising from denying or cutting financing is stronger than it would be otherwise.

Competition may also affect the value of relationship lending, modifying the amount banks are willing to invest in a relationship. Petersen and Rajan (1995) show that greater inter-bank competition reduces bank lending rents and decreases the importance of relationship lending. Boot and Thakor (2000) extend Petersen and Rajan's model to allow for competition from the rest of the capital market (for example, mutual funds and investment banks). They find that increased inter-bank competition may increase relationship lending, but then each loan has lower value-added for borrowers. Furthermore, they find that higher competition from the capital market reduces total bank lending as well as relationship lending, although each relationship loan has higher value-added for borrowers.

As for lender-borrower relationships, it is straightforward to argue that a lengthier relationship produces a more durable connection that alleviates information asymmetries, thereby reducing financial costs.[2] Long relationships, however, can potentially be costly for a borrower, if the stigma of cutting financing is higher the longer—and thus the more informed—is the relationship.

A number of empirical studies address the effects of concentration and relationships. Regarding concentration, Houston and James (1996) undertake an analysis based on detailed information on the debt structure of American publicly traded corporations; they find that firms that borrow from a single bank, as opposed to firms that borrow from multiple banks, depend less on bank loans to finance their operations when growth opportunities are important. This evidence is consistent with the notion that information monopolies allow banks to extract rents from borrowers. They also find that banks specialize in lending to smaller, less risky firms (relative to the typical firm in their sample).

Cetorelli (2001) reviews both the theory and the evidence of the effects of competition on the banking industry and concludes that the common wisdom that restraining competition always reduces welfare is not necessarily correct. For instance, using a panel of thirty-six industrial sectors for a group of forty-one countries, Cetorelli and Gambera (2001) find that bank concentration does impose a deadweight loss on the credit market as a whole, resulting in a reduction of credit supply. However, the effect is heterogeneous across industrial sectors: industries that depended heavily on banks for investment and growth benefit from concentration, presumably because they develop closer relationships. Using the ratio of banks' small business loans to total assets, Berger, Goldberg and White (2001) study the effects of banking entry and of bank mergers and acquisitions (M&As) on the supply of small business credit by other banks. They

2. Of course, a lengthier relationship is not the same as firm age, which is probably negatively correlated with information asymmetries.

find that there are modest aggregate external effects of both M&As and new entries, and that these effects depend on bank size. Using a panel of country experiences, Levine (2000) finds that bank concentration is not strongly associated with negative outcomes in terms of financial development, industrial competition, or banking fragility.

On the subject of bank-client relationships and concentration, Petersen and Rajan (1994) study the effects of lender-small-business relationships on interest rates and loan availability (the latter proxied by the percentage of a firm's trade credits paid late). They find a positive association between the number of banks that lend to a firm and the interest rate charged for the latest loan, but no significant connection between this rate and the length of the firm-lender relationship. They also find a negative effect of the length of the longest relationship and the firm's age on loan availability, although this latter variable is positively related to the number of banks from which the firm borrows. Berger and Udell (1995) analyze the role of lender-borrower relationships on the loan rate spreads (over the lending bank's premium rate) paid by small firms. They find a negative correlation between the length of the firm's relationship and these spreads. Blackwell and Winters (1997) find a positive correlation between the bank's monitoring effort and the loan's interest rate and that banks monitor firms with which they have closer ties less often. Cole (1998) studies the effect of preexisting relationships between firms and lenders on loan availability and finds a positive association. He does not find any role for relationship length.

Chakravarty and Scott (1999) empirically study the effects of relationships in the market for consumer loans using a dataset that allows them to identify credit-constrained individuals. They find that the following characteristics significantly lower the likelihood of being liquidity constrained: the length of the relationship between a household and a potential lender; the number of activities a customer has with his or her bank (proxied by the number of accounts); and the number of financial institutions with which a household has relationships. Furthermore, they find that the rates charged on collateralized loans are less sensitive to these relationship variables than the rates on uncollateralized loans.

All these papers use data from the U.S. economy, from which lessons are not directly applicable to an emerging market economy like Chile. In a closely related paper and using Chilean manufacturing data, Repetto, Rodríguez, and Valdés (2002) find that lower concentration, measured by the number of banks from which a firm borrows, is associated with lower costs of loans. They also find that the length of lender-borrower relationships has a negative effect on interest rates paid. These findings are at odds with the results of Petersen and Rajan (1994), based on U.S. firm data. In comparison with the United States, Chilean firms and the financial market structure are both considerably different. Among other things, bankruptcy procedures are not alike, firm size differs substantially, the number of banks is much smaller in Chile, and the Chilean market is highly collateralized.

2. Data

The data in this study come from two sources. The first dataset covers information on all credit transactions between commercial banks and firms. The information is collected by the Superintendence of Banks and Financial Institutions (SBIF), Chile's commercial bank regulatory and supervision agency. The dataset contains information on the amount borrowed by each firm from each commercial bank, the fraction of outstanding and past-due loans, (cartera vencida, including data on credits paid late, or mora), and the credit risk rating of the loan assigned by each lending bank. In Chile, all individuals and firms are assigned a unique identification or taxpayer code when they are born or legally incorporated, known as the Rol Unico Tributario or RUT. This code is recorded in the dataset and allows us to follow firms over time.[3]

This dataset has been matched with the second source we use, the Annual National Industrial Survey or ENIA, a survey of manufacturing firms conducted annually by the government statistics agency (National Statistics Institute, INE). The ENIA covers all manufacturing plants that employ at least ten individuals. It thus includes all newly created and continuing plants with ten or more employees, and it excludes plants that ceased activities or reduced their hiring below the survey's threshold. The ENIA covers about 50 percent of total manufacturing employment.[4] It collects detailed information on plant characteristics, such as manufacturing subsector (at the four-digit level

3. SBIF and Central Bank statisticians deleted the RUTs from our sample to protect the firms' identity. However, they randomly assigned firms a new identification code that allows us to follow them over time.

4. Industrial employment accounts for roughly 16 percent of total Chilean employment.

of the International Standard Industrial Classification, or ISIC), ownership status, sales, employment, location, and investment. Although not reported in the publicly available dataset, the survey records the firms' RUT, so the two datasets can be matched.[5]

Matching firms across surveys induces a series of measurement problems. The most important is that the SBIF data gathers information on all the firm's activities, whereas the ENIA only records manufacturing-related activities. Thus, if a firm produces manufacturing and nonmanufacturing goods and services under the same RUT, the SBIF data will represent a broader set of activities than will the ENIA. This means that we may overestimate the debt. Furthermore, the ENIA registers information at the plant level, not at the firm level. Still, we were able to add up information on plants belonging to the same firm as long as they produce under the same RUT.

After we exclude firms with no debt, our dataset contains almost 13,000 observations on 2,063 firms over the 1990–98 period. Nominal figures were deflated using the value-added and gross production deflators constructed by ECLAC at the three-digit ISIC level (see Yagui, 1993). These adjustments take into account that stock variables are recorded at year-end prices, whereas the prices of flow variables represent within-year averages.

Table 1 reports basic statistics on sales, employment, physical capital stock, and profits, by industrial sector.[6] The average firm hires 149 employees, sells just over 4.6 billion pesos (US$11.2 million), holds a capital stock of almost 2.9 billion pesos (US$7.0 million), and earns profits of 1.4 billion pesos (US$3.4 million).[7] The largest firms belong to ISIC sectors 372 (nonferrous metals), 314 (tobacco), 353 (petroleum refining), 371 (steel products), and 341 (pulp and paper). The smallest firms belong to sectors 385 (scientific and professional equipment), 390 (other manufacturing products), 354 (oil and coal products), 323 (leather products), and 331 (wood products, except furniture).

5. The surveys were matched by Central Bank and SBIF statisticians, who assigned our new identification codes to the firms.

6. Capital is reported (at book value) only since 1996. We constructed the series using the information on investment and the capital accumulation equation, $K_t = (1 - \delta)K_{t-1} + I_{t-1}$. We used the depreciation rates in Liu (1993) and the investment deflators in Bergoeing, Hernando, and Repetto (2002). This procedure forces us to drop a large number of observations in regression models that include the capital stock, because capital cannot be estimated for firms that were in the sample only in years prior to 1996. Capital stock includes machinery, vehicles, buildings, furniture, and other forms of capital, but excludes land.

7. Dollar amounts are calculated at the average 1996 exchange rate.

Table 2 describes the borrowing patterns of the sample firms. The first three columns report total debt for all firms, as well as by firm size. Firm size categories are based on employment quintiles, so the second entry represents the level of debt of the smallest 20 percent of firms. The average firm owes over 1.1 billion pesos (over 80 million pesos at the median). The average ratio of debt to capital stock is 2.14, and the median is 0.48. Although the amount borrowed increases with firm size, the ratio of debt to capital stock does not: the smallest and the largest firms have the highest average ratios. One possible explanation for this pattern is that smaller firms have a higher demand for funds, and small firms that manage to obtain loans get large amounts relative to their capital stocks. At the other end of the distribution, larger firms are offered more loans, and they borrow more from banks despite their ability to raise funds from different sources. An alternative explanation is that our matching procedure induces mismeasurement of the debt-capital ratios and that these errors are larger for smaller firms. The median ratio of debt to capital is hump-shaped. This median should be more robust to our measurement problems.

The table also reports our measures of firm closeness to its creditors. Columns seven and eight report the number of banks that lend to each firm in the sample.[8] On average, sample firms have a lending relationship with about 2.9 banks. At the median, firms borrow from 2.0 banks. The number of related banks strongly increases with firm size. The smallest 20 percent of firms have, on average, slightly less than two lenders (one lender at the median), whereas the largest 20 percent of firms borrow on average from over 5.1 banks (4.0 at the median).

A second measure of closeness to a bank is credit concentration. The firm-specific Herfindahl index we report was calculated using the shares of total debt borrowed from each of the banks that actually lend to the firm. This measure also shows that bank lending is highly concentrated, and that concentration decreases as firm size increases.

Our final measure of firm-bank closeness is the duration of the relationship. Table 3 presents four alternative measures of our loan tenure variable. Each measure is designed to capture different assumptions about the information on borrowers that banks share.

8. In 1990, there were forty-one banks in business in Chile. In 1999, there were twenty-nine banks. The number of banks declined steadily over the sample period through mergers and acquisitions.

Table 1. Sample Characteristics

Category of firms	No. firms	No. observations	Employment Mean	Employment Median	Employment St. dev.	Sales (millions 1996 pesos) Mean	Sales Median	Sales St. dev.	Capital (millions 1996 pesos) Mean	Capital Median	Capital St. dev.	Profits (millions 1996 pesos) Mean	Profits Median	Profits St. dev.
All firms	2063	12913	149	56	322	4623	449	30700	2,890	195	19,000	1,403	73	11,900
Subsector[a]														
311	567	3,052	146	39	293	3,848	373	21,600	2,274	99	11,000	1,153	66	8,991
312	40	217	238	106	377	15,800	796	64,500	4,695	911	10,700	5,684	59	26,900
313	58	361	228	151	322	6,792	559	19,300	5,553	1,528	13,300	2,608	42	10,000
314	3	9	628	681	274	85,900	895	133,000	37,500	30,000	26,800	61,600	−3,176	110,000
321	202	1,231	134	57	263	2,693	584	8,395	969	191	2,698	867	132	4,024
322	146	831	135	56	352	3,424	487	15,500	546	78	3,267	1,216	116	8,662
323	34	190	100	54	136	3,941	605	13,500	732	241	1,872	1,037	158	4,612
324	64	377	186	56	317	1,543	343	3,943	723	122	1,834	274	60	2,101
331	120	668	100	40	174	3,125	422	11,400	1,196	126	4,920	1,247	81	6,726
332	49	285	134	43	241	2,205	390	6,910	740	130	2,322	478	73	3,019
341	37	210	272	100	442	7,871	1,105	22,400	29,400	838	102,000	2,715	147	12,000
342	101	590	126	37	272	3,308	328	15,700	1,911	162	7,992	905	58	7,690
351	40	182	113	56	136	5,018	562	12,300	4,976	463	12,400	1,414	108	4,911
352	112	714	183	125	221	7,589	652	41,200	2,430	1,015	5,665	2,142	1	13,700
353	3	12	546	648	231	164,000	16,000	233,000	205,000	177,000	162,000	39,100	−132	73,200
354	11	72	92	57	113	4,250	246	11,500	2,258	317	4,499	1,384	−26	5,533
355	26	164	113	40	191	2,824	441	9,477	1,503	246	5,121	678	74	4,736
356	109	598	127	73	143	4,204	532	32,500	1,675	366	4,461	1,331	85	12,500
361	4	28	150	198	94	639	201	970	1,444	385	2,296	−53	−1	565
362	17	110	186	93	224	5,428	646	10,800	6,681	381	19,000	2,042	156	5,196
369	60	365	123	55	152	4,491	354	13,100	4,458	133	15,200	1,585	88	6,928
371	21	100	382	136	817	6,791	214	29,800	6,197	858	14,800	821	−196	11,700
372	17	97	871	281	1,805	25,000	643	94,000	32,800	5,828	54,600	−617	−294	26,600
381	224	1,270	111	59	125	2,227	476	5,813	1317	207	3,736	624	64	2,714
382	91	478	128	51	458	8,982	461	97,000	3,089	165	27,500	2,884	66	35,000

Table 1. (continued)

			Employment			*Sales (millions 1996 pesos)*			*Capital (millions 1996 pesos)*			*Profits (millions 1996 pesos)*		
Category of firms	*No. firms*	*No. observations*	*Mean*	*Median*	*St. dev.*	*Mean*	*Median*	*St. dev.*	*Mean*	*Median*	*St. dev.*	*Mean*	*Median*	*St. dev.*
383	30	190	149	102	142	6,068	719	21,900	1,984	554	4,665	2,230	143	10,300
384	45	249	143	55	169	5,338	398	25,700	1,367	191	2,667	1,108	38	6,269
385	13	76	66	49	50	1,857	403	4,158	447	115	735	515	85	2,135
390	36	187	67	45	73	4,309	479	23,200	270	111	573	2,226	123	14,700

Source: ENIA and SBIF dataset.
a. Three-digit ISIC manufacturing subsector.

Table 2. Bank Borrowing

	Debt (millions of 1996 pesos)			*Debt/capital*			*Number of banks*		*Herfindahl index*	
Category of firms	*Mean*	*Median*	*St. dev.*	*Mean*	*Median*	*St. dev.*	*Mean*	*Median*	*Mean*	*Median*
All firms	1,163	81	4,338	2.1	0.5	21.8	2.9	2.0	0.71	0.74
By number of employees										
10–24	99	12	1,323	2.8	0.4	19.3	1.7	1.0	0.85	1.00
25–41	157	34	1,435	1.9	0.5	6.3	2.0	2.0	0.79	0.97
42–77	375	84	2,110	1.4	0.6	3.7	2.4	2.0	0.72	0.74
78–181	714	259	1,809	2.7	0.5	42.4	3.1	2.0	0.65	0.61
182–8580	4,490	1,456	8,289	1.8	0.5	12.2	5.1	4.0	0.52	0.45

Source: SBIF data set and ENIA.

The first two columns of the table show the number of years the firm has been borrowing from the banking system starting in 1989. On average, firms have been servicing loans for at least 5.3 years (or 5.0 years at the median). The second measure takes the age of the newest loan currently being served as a proxy of the strength of the relationship, whereas the other two proxies take the age of the oldest outstanding loan and the weighted average of the loans' ages, using debt size as weights.[9] Clearly, all these variables are a censored measure of the actual age of the loans anytime a firm was already borrowing in 1989. However, if the firm was either created or got its first loan later on in our sample period, then the relationship's length is properly measured. Except for the newest loan, there is an increasing relationship between the measures of firm-bank ties and the size of the firm at the mean. This is consistent with the notion that smaller firms tend to be younger and with the fact that censoring of the duration variable might have a larger effect on big firms.

The distribution of debt-capital ratios is highly skewed. Figure 1 and table 4 present these distributions.[10] Not only are the means and medians quite different, but also the distribution contains extremely

Table 3. Relationship Length

	With system		*Current min*		*Current max*		*Weighted average*	
Category of firms	*Mean*	*Median*	*Mean*	*Median*	*Mean*	*Median*	*Mean*	*Median*
All firms	5.3	5.0	3.3	2.0	5.0	5.0	4.4	4.0
By number of employees								
10–24	5.1	5.0	3.6	3.0	4.7	4.0	4.2	4.0
25–41	5.1	5.0	3.5	3.0	4.7	4.0	4.2	4.0
42–77	5.3	5.0	3.3	3.0	4.9	5.0	4.3	4.0
78–181	5.6	5.0	3.2	2.0	5.3	5.0	4.6	4.0
182–8580	5.6	5.0	2.8	2.0	5.4	5.0	4.6	4.2

Source: SBIF data set and ENIA.

9. These measures are highly correlated. The lowest correlation coefficient is equal to 0.48 (between the age of the newest loan and the age of the relationship with the system), and the highest is 0.9 (between the age of the oldest loan and of the relationship with the system).

10. For illustration purposes only, the distribution was truncated at the top in figure 1.

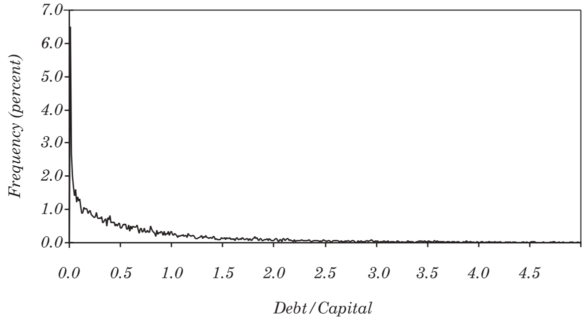
high and low values. Possibly, a number of these extreme observations are due to our matching procedure. Since the median, unlike the mean, is less affected by these extreme observations, the regression analysis below is based on least absolute deviations (LAD) methods and not on ordinary least squares (OLS).[11]

Table 4. Distribution of Debt-Capital Ratios

Percentile	*Debt/capital*
1	0.00001
5	0.00450
10	0.02414
25	0.13996
50	0.47993
75	1.27614
90	3.02296
95	5.25120
99	22.1050
Summary statistic	
Mean	2.137
Standard deviation	21.836
Minimum	0.00000
Maximum	1,954.50
No. observations	12,913

Source: SBIF data set and ENIA.

Figure 1. Density of Debt-Capital Ratios



Source: SBIF data set and ENIA.

11. See Amemiya (1985) for a derivation of the estimator and a proof of its consistency. See the appendix for a description of the method.

3. Relationships, Concentration, and Firm Borrowing Patterns

As mentioned in section 2, the closeness of firm-bank relationships theoretically has an ambiguous effect on the availability of funds. First, lengthy relationships allow banks to learn more about the firm, its projects and its managers, thereby alleviating information asymmetries. However, if (positive) information on a firm cannot be easily conveyed to the rest of the banking system, then lengthy relationships may lead to information monopolies: if a firm requests a loan from a nonconnected bank, it may signal that the related bank is not willing to lend. This hold-up problem is more relevant for firms with closer ties. Key for interpreting our findings below is the fact that banks do not share all the information they gather on borrowers as they lend. Commercial banks in Chile have access to information on the total amount borrowed by each firm (with respect to the complete banking system) and whether firms have loans overdue. They know the total amount that is overdue and the lending institutions involved, although not the exact distribution among creditors. The SBIF provides this information to each bank on a monthly basis.

Concentration measures also have an ambiguous effect on lending volume. On the one hand, bank concentration may be cost efficient. On the other, concentration can lead to monopoly pricing and to information monopolies. In this and the next section, we empirically estimate the effects of the length of firm-bank relationships on the availability of funds.

3.1 Benchmark Estimates

Our benchmark econometric model includes three sets of variables. The first includes variables that capture the effects of firm-bank relationships on lending: the age of the oldest loan, the firm-specific Herfindahl index, and the number of lending banks. The second set is designed to control for firm characteristics, such as size (measured by the natural log of sales and the number of employee), profitability (measured by the ratio of current profits over sales), and quality (measured by firm age and an indicator of credit history). Finally, we add time dummies to control for aggregate shocks that affect all firms, sectoral dummies at the three-digit ISIC level, and regional dummies to account for differences across locations.[12]

The length of the relationship and the age of the firm are correlated. Older firms have been producing for a longer time. If a firm's age is a proxy for firm quality, then older firms are more likely to be able to borrow. Furthermore, a selection bias owing to exit can lead to a positive effect of age on the amount borrowed. To distinguish the age effect from the relationship duration effect, we add controls for the age of the firm. We do not directly observe the date in which the firm was created, but RUTs are assigned chronologically by the Internal Revenue Service; that is, a younger firm has a larger RUT number than an older firm. These identification numbers are assigned within ownership categories. For instance, individuals are given RUT numbers ranging between 0 and 48 million, limited liability corporations have RUT numbers between 77 million and 80 million, and publicly listed companies have RUTs between 90 million and 97 million. Since we are not allowed to directly observe the RUTs, Central Bank statisticians created a variable we label rank RUT. This variable is an ordering from larger to smaller RUT (so the lowest number is assigned to the youngest firm) within ownership categories. There are eleven categories in our dataset, although over 90 percent of the sample is made up of individuals, limited-liability corporations and publicly traded companies.

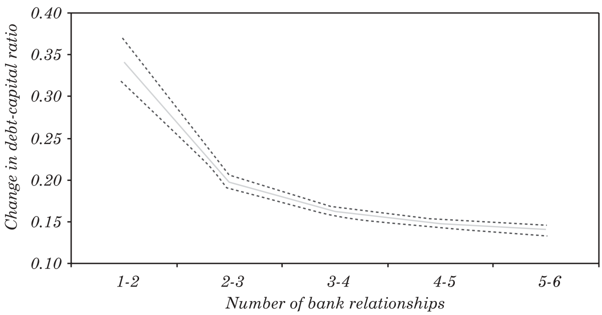
The first four columns of table 5 present our benchmark specification using alternative measures of relationship length. The first column uses the number of years the firm has been borrowing from the banking sector, while the next three columns use the age of the newest outstanding loan, the age of the oldest outstanding loan, and the weighted average of the age of current loans, respectively. Our relationship measures have a positive and significant effect on debt-to-capital ratios in all specifications, that is, firms that have been borrowing for a long period are capable of funding a larger fraction of their capital stock through the banking system. The size of the effect is quite similar across specifications, varying between 0.0103 and 0.0138. These magnitudes are large, as they represent about 2.1 percent to 2.9 percent of the median debt-capital ratio in the sample. Because the regressions already control for the age of the firm, this effect should capture the role of ties between firms and banks. The effect might be overestimated, however, as our duration measures are right-censored.

12. Chile is divided into thirteen administrative regions.

Concentration, as measured by the firm-specific Herfindahl index, has a large and negative effect on the amount borrowed. The number of banks from which firms borrow also has a positive and large effect on loans. The table also shows the estimated effect of increasing the number of banks from which a firm borrows from one to two (assuming equal bank shares) and from two to three. Moving from one to two relationships allows firms to increase their debt-to-capital ratios by about 35 percentage points; moving from two to three banks leads to an increase of about 20 percentage points. Figure 2 plots the estimated effect of increasing the number of relationships (with +/– 2 standard errors), assuming that debt is split equally among banks.[13] The magnitude is always large and significant. As the number of ties increases, the effect of the Herfindahl index tends to disappear, and the total effect converges to the coefficient of the number of related banks.[14]

To allow for a more flexible specification of the effect of concentration on firm borrowing, columns 5 through 8 replace the Herfindahl and the number of banks with a set of dummies that accounts for the number of banks to which the firms is related. All the coefficients turn out to be negative and significant. The estimated effect is decreasing—in absolute terms—in the number of banks; that is, firms

Figure 2. The Effect on Borrowing of Increasing the Number of Relationships



Source: SBIF.

13. Figure 1 is based on the results reported in column 1.

14. Assuming equal bank shares, the Herfindahl index is equal to $1/n$, where n is the number of relationships. Thus the limit of this index as n tends to infinity is 0.

Table 5. The Determinants of Firm Borrowing: Benchmark Estimates[a]

Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Relationship length								
With the banking system	0.0138				0.0107			
	(2.785)**				(2.549)*			
Current min		0.0103				0.0108		
		(3.588)**				(3.776)**		
Current max			0.0103				0.0089	
			(2.784)**				(2.604)**	
Weighted average				0.0137				0.0132
				(4.154)**				(4.359)**
Herfindahl index	–0.4300	–0.4646	–0.4238	–0.4479				
	(14.251)**	(14.602)**	(13.641)**	(14.694)**				
Number of banks	0.1262	0.1268	0.1260	0.1263				
	(32.935)**	(31.352)**	(32.073)**	(32.543)**				
Dummy for no. relationships								
Single relationship					–0.9027	–0.9292	–0.8995	–0.9089
					(70.890)**	(55.019)**	(61.658)**	(64.737)**
Two banks					–0.6488	–0.6582	–0.6471	–0.6519
					(49.081)**	(39.427)**	(43.303)**	(44.071)**
Three banks					–0.4095	–0.4053	–0.4082	–0.4102
					(27.034)**	(21.675)**	(23.883)**	(24.177)**
Loan Overdue 90 days +	–0.0352	–0.0349	–0.0304	–0.0340	–0.0329	–0.0303	–0.0232	–0.0280
	(1.729)	(1.638)	(1.454)	(1.644)	(1.937)	(1.455)	(1.211)	(1.473)
Rank RUT—individuals	–0.00006	–0.00006	–0.00006	–0.00005	–0.00003	–0.00003	–0.00003	–0.00003
	(2.362)*	(2.207)*	(2.219)*	(2.047)*	(1.584)	(1.226)	(1.459)	(1.381)
Rank RUT—limited liability	–0.00004	–0.00004	–0.00004	–0.00004	–0.00004	–0.00004	–0.00004	–0.00004
	(8.594)**	(7.957)**	(8.217)**	(8.280)**	(10.395)**	(8.242)**	(9.225)**	(9.163)**
Rank RUT—publicly traded	0.00000	0.00001	0.00000	0.00000	0.00004	0.00004	0.00004	0.00003
	(0.181)	(0.383)	(0.016)	(0.052)	(1.809)	(1.529)	(1.693)	(1.470)
Ln(sales)	–0.0030	–0.0022	–0.0032	–0.0032	–0.0091	–0.0079	–0.0095	–0.0092
	(0.869)	(0.610)	(0.881)	(0.911)	(3.105)**	(2.194)*	(2.868)**	(2.809)**

Table 5. (continued)

Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Employment	–0.0004	–0.0004	–0.0004	–0.0004	–0.0002	–0.0002	–0.0002	–0.0002
	(18.190)**	(17.327)**	(17.534)**	(18.252)**	(12.872)**	(10.668)**	(11.502)**	(11.616)**
Profit/sales	0.0005	0.0004	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005
	(1.457)	(0.977)	(1.455)	(1.356)	(1.614)	(1.401)	(1.446)	(1.522)
Constant	0.2388	0.4917	0.3146	0.4767	0.9299	1.1568	1.0121	1.5351
	(1.757)	(3.746)**	(2.113)*	(3.751)**	(8.378)**	(9.218)**	(7.580)**	(13.335)**
Summary statistic								
No. observations	12,913	12,913	12,913	12,913	12,913	12,913	12,913	12,913
Pseudo R^2	0.0511	0.0512	0.0511	0.0513	0.0476	0.0478	0.0476	0.0478
Effect of one extra relationship								
From 1 to 2 banks	0.341	0.359	0.338	0.350	0.254	0.271	0.252	0.257
Standard error	(0.012)	(0.013)	(0.013)	(0.013)	(0.012)	(0.015)	(0.013)	(0.013)
From 2 to 3 banks	0.198	0.204	0.197	0.201	0.239	0.253	0.239	0.242
Standard error	(0.003)	(0.004)	(0.003)	(0.003)	(0.015)	(0.018)	(0.017)	(0.017)

a. The dependent variable is the debt-to-capital ratio; t statistics in parentheses.
* Significant at the 10 percent level.
** Significant at the 5 percent level.

with fewer relationships borrow less than firms with more relationships. The bottom panel of the table reestimates the effect of an extra relationship using these specifications. The effect of moving from a single relationship to two is quite similar to the effect of moving from two to three. The effect (about 25 percentage points) is, on average, very close to the effect estimated in the previous set of regressions, so the combined effect of our concentration variables turns out to be robust to alternative functional specifications. The use of the number of relationship dummies does not alter the other regression results materially.

As to the control variables, both firm size variables show that larger firms have lower debt-to-capital ratios. This result may seem counterintuitive, but larger firms have better access to other forms of financing. As firms grow, they probably become increasingly dependent on arm's length financing, rather than on the banking system.[15] The estimation results indicate that if a firm hires 100 more employees (about a third of the standard deviation of employment in the sample), then the debt-capital ratio falls by 4 percentage points. Moreover, a 1 percent increase in the value of sales reduces the ratio by 0.3 percentage points.

The effect of profits is also counterintuitive: as firms become more profitable, they finance a larger fraction of their capital stock through bank loans. These regressions are reduced-form regressions, however, so profitable firms may have better access to funds even though they are in less need of them. If a bank can spot this profitability, it will probably be more interested in lending. According to our regression results, if sales as a fraction of profits increase by one percentage point, the debt-capital ratio increase by 0.05 percentage points.

A lengthier relationship alleviates the information asymmetries between banks and firms. However, firms are only able to get more loans as long as the revealed information is good. The next regression includes a dummy variable equal to 1 if the firm had an overdue loan in the past (during our sample period).[16] We find that negative information on past loans has a negative impact on the availability of

15. This is precisely what Houston and James (1996) find.

16. According to Chilean bank regulation, a loan is classified as past due when an installment of either principal or interest is overdue by 90 days or more. Banks can start legal collection procedures when installment of principal or interest is overdue. They can begin the collection process before 90 days if there is a presumption of a significant deterioration in debtor's quality.

current funds. If a firm was delinquent in the past, it can today finance about 3.4 percentage points less of its capital stock with banking debt.

Finally, our age controls show that older firms finance a smaller share of their capital stock with debt. The effect is significant for individuals and limited liability corporations, but not for publicly traded companies. Within our sample period, twenty-three new individually owned plants, forty-four new limited liability companies, and forty-six new publicly traded companies appear in our dataset.[17] According to the regression estimates, the newest individually owned firm has a debt-capital ratio that is 0.14 percentage points larger than the last firm of this ownership type created in 1990, whereas the newest limited liability firm's ratio is 0.18 percentage points higher. Although the effect on publicly owned companies is not significant in most specifications, the point estimate indicates that the newest firm of this type in the sample has a ratio of almost 0.05 percentage points larger.

In sum, our measures of the closeness of firm-bank relationships have a large impact on the availability of funds. Relationships do matter, and they have a beneficial effect on firms. This result is consistent with the hypothesis that not all information is public and easily verifiable and that close ties between firms and lenders do alleviate informational asymmetries. Furthermore, our results indicate that borrowing concentration makes firms worse off. Economically, the greatest effect occurs when the number of ties is relatively small. In the next subsection, we extend the analysis to alternative assumptions on the statistical behavior of the concentration variables.

3.2 Endogeneity of Concentration Measures

An alternative interpretation of the role of concentration is that the amount borrowed and the number of lending banks are mechanically related: more debt should naturally be supplied by more banks. This is consistent with the large t statistics of the estimated coefficients (see table 5). This need not be the case, however. When they wish to borrow more, firms may choose not to relate to more banks, as there are fixed costs in establishing ties. And even if this is the case, the linear term should capture this effect, and the large effect measured by the Herfindahl index would still be relevant. Alternatively, one

17. These new firms do not necessarily represent start ups. Some of these firms may have increased their hiring over the ENIA sampling threshold or may have borrowed from the banking system for the first time. Most firms in our sample already existed in 1989–90.

could argue that there are legal limits on how much a bank can lend to a single firm. These limits, however, are most likely nonbinding for most of our firms. Finally, if loans are collateralized, firms need to have divisible guarantees in order to borrow from different banks.

To control for these potential problems, we reestimated our regression model through a two step procedure. In the first stage we obtain the ordinary least squares prediction from the regression of the problematic variables (the number of related banks and the Herfindahl index) on the other exogenous variables and a number of instruments. In the second stage we estimate the parameters of the model by a least absolute deviation regression of debt-capital ratios on the projected and exogenous variables.[18]

We use two types of instruments: the number of banks in the locality (*provincia*) and a set of dummies indicating bank mergers.[19] These dummies are equal to one if the firm was borrowing from two banks that merged in that given year, and zero otherwise.[20] We believe that these variables are correlated with the number of banks with which a firm can establish a relationship and with interbank competition (and thus with the lending concentration faced by borrowers). Furthermore, we treat these variables as truly exogenous to individual firms.

Table 6 presents the estimated results. The first column uses the five merger dummies only, whereas the second column uses the complete list of instruments.[21] Both specifications show that the age of the relationship has a positive effect on firm borrowing. However, neither shows a significant effect. Although the sign of the Herfindahl index is reversed, this time we cannot reject the null that the effect of this concentration variable is zero. Even so, the effect of the number of related banks is positive and significant, indicating that the establishment of a new relationship increases the availability of funds

18. This procedure is a modified version of two-stage least squares (2SLS), with a LAD regression (instead of OLS) in the second stage. We provide a description of the general LAD estimation methodology, and of our modified version of it, in the appendix.

19. There are fifty-one *provincias* in Chile.

20. The following are the relevant mergers within our sample period: (1) O'Higgins and Centro Hispano in 1993, (2) O'Higgins and Bank of Hong Kong in 1993, (3) BHIF and Banesto in 1995, (4) Osorno and Santander in 1996, and (5) O'Higgins and Santiago in 1997.

21. The table reports the results using the age of the newest outstanding loan. The LAD procedures using the alternative relationship-length variables did not converge. We believe that these alternative specifications should lead to similar results, given the high correlation among these definitions and the results in table 5.

to firms. We find that an extra relationship increases the debt-capital ratio of the firm by about 20 percentage points. This effect is much larger than the one presented in table 5. The table also repeats our earlier exercise in which we estimated the effect of increasing the number of banks from which a firm borrows, first from one to two and then from two to three. The effect of a second bank is statistically not different from zero, perhaps because the Herfindahl index is not significant. As the number of banks increases, the effect approaches the coefficient of the number of relationship variables, and it becomes large and significant.

Table 6. The Determinants of Firm Borrowing: Instrumented Estimates

Explanatory variable	*(1)*	*(2)*
Relationship length (min)	0.0211	0.0132
	(1.364)	(0.884)
Herfindahl	0.0662	0.3938
	(0.092)	(0.565)
Number of banks	0.1895	0.2105
	(3.206)**	(3.672)**
Loan Overdue 90 days +	–0.0593	–0.0716
	(1.495)	(1.861)
Rank RUT—individuals	–0.00013	–0.00013
	(4.235)**	(4.255)**
Rank RUT—limited liability	–0.00006	–0.00006
	(8.483)**	(8.808)**
Rank RUT—publicly traded	0.00001	–0.00001
	(0.121)	(0.296)
Ln(sales)	–0.0044	–0.0032
	(1.043)	(0.789)
Employment	–0.0006	–0.0006
	(7.849)**	(8.099)**
Profit/sales	–0.0004	–0.0003
	(1.106)	(1.023)
Constant	–0.3982	0.1036
	(0.611)	(0.157)
Summary statistic		
No. observations	12,913	12,913
Pseudo R^2	0.0111	0.0185
Effect of one extra relationship		
From 1 to 2 banks	0.156	0.013
Standard error	(0.304)	(0.295)
From 2 to 3 banks	0.178	0.145
Standard error	(0.066)	(0.064)

a. The dependent variable is the debt-to-capital ratio; *t* statistics in parentheses.
** Significant at the 5 percent level.

The estimated effect of the other control variables is not materially affected, with a slightly larger effect of the payment history of the firm and of the size measures.

Summing up, we have again found that bank lending concentration is harmful for firms in terms of funds availability. This result is consistent with the hypothesis that concentration leads to monopoly pricing and information monopolies. We do not find that lengthy relationships allow firms to borrow more, however.

4. Conclusions and Policy Implications

We have examined the effects of concentration and the length of bank-lender relationships on the volume of bank lending using a sample of Chilean manufacturing firms. After controlling for size, economic sector, (relative) firm age, location, profitability, and credit history, we find that concentration appears to be very important for the volume of bank lending. The results show that the debt-to-capital ratio rises significantly as concentration falls and that this effect is considerably larger when the number of bank-firm relationships is small. For instance, when we control for the linear effect of the number of banks to which a firm is related, increasing the number of relationships from one to two raises the median debt-to-capital ratio from 0.48 to about 0.82, whereas increasing the number of relationships from two to three raises the median debt-to-capital ratio from 0.48 to about 0.68. The length of borrower-lender relationships (measured by the age of the oldest relationship with the banking system) has a positive, though not always significant, effect on the volume of loans. One extra year of relationship increases the debt-to-capital ratio by 2.1 percent to 2.9 percent.

These results motivate two policy implications. First, they show that, on average, a lengthier relationship is convenient for firms. Policymakers, therefore, should not worry if firms persistently choose to do business with the same banks. Second, the evidence is consistent with the idea that enhancing the number of relationships that a particular firm has can increase the volume of credit.

The latter implication has important practical consequences. To begin with, tax policy should avoid lock-in effects that make it difficult for firms to shop around. More significantly, policy should foster multiple relationships. The chief difficulty a typical firm faces with regard to having multiple relationships is the indivisibility of collateral or guarantees. Moving guarantees across banks is a difficult task in Chile. Some people have proposed centralizing the administration of guarantees to facilitate bank shifts. The evidence of this paper shows that this might not be enough. True competition needs firms to relate contemporaneously to more than one bank, and for that purpose firms need divisible collateral. The proposed central agency could provide that service.

Appendix
Estimation Methods

The least absolute deviations (LAD) estimator computes the median of a variable conditional on a number of controls. This method yields results that are more robust than an OLS estimator when errors are heavier tailed than the normal distribution; that is, it is a more robust procedure under the presence of large outliers. This appendix briefly describes the method and its properties. The interested reader may consult the references provided below for a detailed analysis.

Assume the linear model

$$y_i = x_i'\beta_0 + \varepsilon_i \ .$$

If the error terms, ε_i, have a zero median conditional on the controls, x_i, then the true regression coefficient β_0 can be identified by

$$\beta_0 = \arg\min_{\beta} E\left(\left|y_i - x_i'\beta\right| - \left|\varepsilon_i\right|\right) .$$

Given an independent and identically distributed sample of size n, β_0 can be estimated using its sample analog,

$$\hat{\beta} = \arg\min_{\beta} \frac{1}{n}\sum_{i=1}^{n}\left|y_i - x_i'\beta\right| \equiv \arg\min_{\beta} S_n(\beta) \ .$$

The consistency proof of the LAD estimator requires the following assumptions: the data,

$$\left[(y_i, x_i')'\right]_{i=1}^{n} .$$

are independent and identically distributed across i; the regressors have bounded second moments; the error terms are continuously distributed given x_i, with conditional density $f(\varepsilon/x_i)$ satisfying

$$\int_{-\infty}^{0} f(\lambda / x_i)\, d\lambda = \frac{1}{2} \, ;$$

the density of the error terms is positive and finite at zero; and the expectation of $x_i x_i'$ is a positive definite matrix.

Under these conditions, it can be proved that the LAD estimator is consistent, using standard asymptotic arguments for extremum estimators. See Amemiya (1985) for a detailed proof. Note that the assumptions do note require that the moments of either y_i or ε_i exist. This property makes LAD estimator attractive for heavy-tailed error distributions.

The proof of asymptotic normality of the LAD estimator is further complicated by the fact that the criterion function $S(\beta)$ is not continuously differentiable in β, so the usual Taylor expansions used to show consistency are not applicable. Stochastic equicontinuity conditions are used to prove asymptotic normality. See Newey and McFadden (1994) for discussion and a proof.

Given the potential endogeneity of our concentration measures, the assumption of a conditional zero median of the error term may not hold. Hence, we also replace our concentration measures in the LAD procedure for measures that are truly exogenous. To construct such measures, we follow the standard two-stage least squares (2SLS) approach and run regressions for the concentration measures on all exogenous variables of the model and a number of instruments. We then replace the actual concentration variables with their predicted counterparts in the LAD procedure.

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Foreign Bank Entry and Business Volatility: Evidence from U.S. States and Other Countries

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"Foreign banker" once had a nasty ring to it, like "carpetbagger" or "loan shark."[1] In the harshest terms, foreign banks were seen as parasites that were out to drain financial capital from their hosts. In nationalization campaigns, banks were often the first targets, especially when foreign owned. Even after a decade of privatization, governments still own a surprisingly large share of bank assets (La Porta, López-de-Silanes, and Shleifer, 2002). Bank privatization has been held up, in part, by fear of foreign bankers who, in many cases, are the only, or most likely, buyers.

In the United States, banks from other states were long viewed as foreign, and most states strictly forbade entry by banks from other states until the mid-1970s. Even banks from other cities *within* a state were often blocked from opening branches in other cities in the state. Loosely speaking, the hometown bank was local, and banks from anywhere else were foreign.

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1. Carpetbagger was a pejorative term for northerners who flocked to the south after the Civil War in search of opportunity, financial or otherwise.

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Times have changed. In the United States, barriers to entry by out-of-state banks were gradually lowered across the states starting in the late 1970s. The biggest U.S. banks now operate more or less nationally, with banks or branches in many states. Nations around the world have also lowered barriers to foreign bank ownership, and foreign banks have entered aggressively. Foreign bank ownership in Latin America increased dramatically in the second half of the 1990s, with aggressive acquisitions by Spanish banks, in particular. In Chile, the foreign bank share of Chilean bank assets increased from less than 20 percent in 1994 to more than 50 percent in 1999 (Clarke and others, 2001).

Generally speaking, the first-order effects of relaxed bank entry restrictions have been favorable. Relaxed branching restrictions within states in the United States have been associated with increased credit availability, enhanced bank efficiency, and faster economic growth within states (Jayaratne and Strahan, 1996 and 1998). Internationally, the benefits of foreign entry seem to depend on the level of development of the host country. For developing nations, at least, foreign entrants tend to be more efficient than incumbent banks, and the stiffer competition seems to improve overall bank efficiency (Claessens, Demirgüç-Kunt, and Huizinga, 2001). Geert, Harvey, and Lundblad (2002) find that broader financial liberalization—that is, opening equity markets to foreign investors—is associated with faster economic growth.

Interest lately has turned to the second-order, or stability, effects of foreign bank entry, especially in developing nations where recent crises have raised general concern about financial sector stability and specific concern about bank stability. In contrast to the first-order effects—where one might expect mostly benefits from entry—the stability implications of increased entry are less obvious. Several vague concerns have surfaced. Maybe, for instance, fickle foreign banks will cut and run at the first hint of trouble, whereas local banks with long-term ties (or no place to run) will remain stalwart. Foreign bankers may also expedite capital flight in the event of a crisis. During the Asian crises, depositors did shift funds from finance companies and small banks toward large banks, especially foreign ones. What if foreign banks cherry-pick the best borrowers, leaving the local banks with the "lemons" and a risky overall portfolio? Evidence thus far suggests that these concerns are unfounded. Goldberg, Dages, and Kinney (2000) find that lending by foreign banks in Argentina and Mexico during the 1994–95 crises grew faster than did lending by domestic banks, contrary to the cut and run hypothesis. Looking across a wider sample of countries, Levine (1999) finds that the foreign share of bank assets is *negatively* correlated with the probability of crisis.

Our paper investigates whether foreign bank entry is associated with more or less economic volatility, as measured by year-to-year fluctuations in real GDP and investment. Financial crises are the higher profile event, but business cycle fluctuations are much more frequent and may be an important underlying determinant of financial instability. Our empirical strategy employs panel data, allowing us to absorb unobserved heterogeneity across countries with fixed effects. We approach the topic with a mix of theory and evidence from both the U.S. states and countries. Our theory is based on the macroeconomic banking model in Holmstrom and Tirole (1997). Morgan, Rime, and Strahan (2003) use an extended (two-state) version of that model to consider the effect of interstate banking within the United States on business volatility within states. The main result is that integration (entry by out-of-state banks) is a two-edged sword for economic volatility: integration tends to dampen the effect of bank capital shocks on firm investment in a state, but it amplifies the impact of firm collateral shocks. The net effect of integration on business volatility is therefore ambiguous. The empirical effect, however, has been stabilizing in the United States. Morgan, Rime, and Strahan find that volatility within states falls substantially as integration with out-of-state banks increases.

Given the useful parallels between bank integration in the United States in the late 1970s and 1980s, we first review the theory behind Morgan, Rime, and Strahan. We then review and extend their empirical findings for the U.S. states, showing that banking integration across states reduced volatility by weakening the link between the health of local banks and the economy. As we describe in Section 2, the history of U.S. banking deregulation sets up an almost ideal empirical laboratory for testing how banking integration affects the economy, because we can separate out the exogenous changes in bank ownership using regulatory instruments. Section 3 applies a similar set of tests to a panel of about 100 countries during the 1990s, but in the cross-country context regulatory changes are not sufficiently common to allow us to identify the exogenous component of banking integration. Instead, we address the endogeneity problem by constructing instruments that reflect characteristics of groups of countries in the same region, with a common language, or with a similar legal system. The resulting instrumental variables (IV) estimates allow us to avoid the problem that foreign bank entry may reflect, rather than drive, changes in economic performance. In contrast to the results for U.S. states, however, we find no evidence that foreign entry has been stabilizing. If anything, the evidence points tentatively in the other direction.

In our final set of tests, we show that the link between changes in the value of a country's traded equity—a proxy for the value of potential collateral—and its economy becomes stronger with banking integration. Foreign bank entry may make economies more unstable by amplifying the effects of wealth changes; this amplification does not appear to be outweighed by more stable banking. This result contrasts with the U.S. experience, where the dampening of bank capital shocks made integration stabilizing, and suggests that the specific environment in which banking integration occurs may determine its effects.

1. Foreign Banking and Economic Volatility

How are foreign banking and economic volatility related in theory? Ambiguously, we think, at least if the insights from the interstate banking model in Morgan, Rime, and Strahan (2003) apply internationally. Morgan, Rime, and Strahan extend Holmstrom and Tirole's (1997) macroeconomic banking model by adding another (physical) state and then investigating how the impact of various shocks differs under unit banking regime, where bank entry is forbidden, and interstate banking, where bank capital can flow freely between states. The impact of bank capital shocks (on firm investment) is diminished under interstate banking, but the impact of firm capital shocks is amplified. The net effect, in theory, is ambiguous. Because the insights from that model can help in the international context, we review the basic Holmstrom-Tirole model and the Morgan, Rime, and Strahan extension below. At the end of the section, we discuss the applicability of the model to the topic of international bank integration.

The marginal effects arising from integration have to do with how the supply of uninformed capital responds to changes in the supply of informed (that is, bank) capital. The intuition is pretty simple. A banking firm operating in two states (denominated A and B) can import capital from state A to state B if another of its banks in state B has good lending opportunities but no capital. The infusion of informed bank capital also draws extra uninformed capital. That capital shifting immunizes firms in state B from bank capital shocks to some extent. Firms are more exposed to collateral shocks, however. An interstate banking firm will shift lending to state A if firms in state B suffer collateral damage. The loss of informed bank capital also causes capital flight by uninformed lenders, more so than in a unit banking arrangement. Hence, collateral shocks get amplified.

1.1 The Holmstrom-Tirole Model

The Holmstrom-Tirole model is an elegant synthesis of various strands of the macroeconomic and intermediation literature. Banks, or intermediaries generally, matter because their monitoring of firms' activities reduces moral hazard—such as shirking and perquisite consumption—by firm owners. Knowing that intermediaries are monitoring the firms also increases access to capital from uninformed savers. Bankers are prone to moral hazard as well; they will shirk monitoring unless they have sufficient stake in the firm's outcome to justify the monitoring costs. In the end, the level of firm investment spending on projects with given fundamentals depends on the level of bank and firm capital. Negative shocks to either kind of capital are contractionary, naturally, but the contractions are amplified through their effects on the supply of uninformed capital. The reduction in capital that can be invested in the firm by the bank and by the entrepreneur reduce the maximum amount of future income that the firm can pledge to uninformed investors (without distorting the firms' incentives). The decrease in the pledgeable income reduces the supply of uninformed capital available to the firm.

1.2 Interstate Banking

Morgan, Rime, and Strahan extend the Holmstrom-Tirole model by adding another (physical) state. We assume that bank capital is completely mobile across states under interstate banking and completely immobile across states under unit banking. Foreign entry, in other words, is completely prohibited. Even if we relax this restriction, the results remain similar as long as informed capital is relatively less mobile under unit banking. The return on uninformed capital is exogenous and equal across states in either regime. That makes sense in the United States, where savers have access to a national securities market even under unit banking. That assumption is arguable in the international context, but we stick with it for now. The key results from that extended model are stated and discussed below.

Proposition 1: The negative impact of a bank capital crunch in state A on the amount of uninformed and informed capital invested in state A is smaller with interstate banking than with unit banking. A capital crunch in state A, for instance, will attract bank capital from state B, so firm investment in state A falls less than it would under unit banking. Because firm investment falls less, the maximum income they can pledge to informed investors falls by less than under unit banking; hence there is a smaller reduction in the amount of uninformed capital that firms in state A can attract.

Proposition 2: The negative impact of a collateral squeeze on the amount of uninformed and informed capital invested is larger under interstate banking than under unit banking. With interstate banking, for example, the decreased return on bank capital following a collateral squeeze causes bank capital to migrate from state A (where the initial downturn occurred) to state B (which is integrated with state A). The bank capital flight from state A reduces investment by firms in that state, which in turn reduces the maximum pledgeable income firms can credibly promise to uninformed investors. The supply of uninformed capital to firms in state A falls as a result. These amplifying effects are absent under unit banking because bank capital is immobile across states under that regime.

In sum, cross-state banking amplifies the effects of local shocks to entrepreneurial wealth because bank capital chases the highest return. Capital flows in when collateral is high and out when it is low. Integration dampens the impact of variation in bank capital supply. This source of instability becomes less important because entrepreneurs are less dependent on local sources of funding in an integrated market since bank capital can be imported from other states.

1.3 Applying the Holmstrom-Tirole Model Internationally

The intuition from the interstate banking model in Morgan, Rime, and Strahan (2003) is helpful in thinking about how international banking should affect volatility within nations. In fact, the model may fit better internationally. The distinction between informed and uninformed capital seems more germane with the distances involved in international lending than with interstate lending in the United States. The flights of uninformed capital in the model may describe international capital flows in the 1980s and 1990s better than interstate capital flow in the United States in the 1970s.

Eichengreen and Bordo (2002), in their historical study of financial globalization, offer anecdotal evidence consistent with the role of informed capital (bank capital) in allowing leverage using uninformed capital. "That overseas investors appreciated... [this] monitoring is evident in the willingness of Scottish savers to make deposit with British branches of Australian banks, and in the willingness of British investors... to place deposits with Argentine banks" (p. 9). They also note the strict appetite for more monitorable, collateralizable claims by foreign investors. Railways were a favorite, for example, because investors (or their monitors) could easily verify how much track had been laid, and the track was staked down once it was laid.

2. Bank Integration and Business Volatility in U.S. States

The United States once had essentially fifty little banking systems, one per state. The U.S. banking system is now much more national, however, twenty-five years after states began permitting entry by out-of-state banks. Entry by out-of-state banks is not exactly the same as foreign bank entry, but they are not completely different, either. The parallels are close enough to revisit what Morgan, Rime, and Strahan find in their U.S. study before we turn to the international data. To maintain the parallels, the U.S. regressions reported in this section are specified as closely as possible to those estimated with international data. For the United States, we still find a negative correlation between out-of-state bank share and within-state business volatility. Consistent with that result and also with the model, we find that as bank integration increases, the (positive) link between bank capital growth and business gets weaker. We conclude that bank integration, and the resulting immunization from bank capital shocks, has had a stabilizing effect on state business volatility in the United States.

2.1 A Brief History of Interstate Banking in the United States

The Bank Holding Company Act of 1956 essentially gave states the right to block entry by out-of-state banks or bank holding companies.

States also had the right to allow entry, but none did until Maine passed a law in 1978 inviting entry or acquisitions by bank holding companies from other states so long as Maine banks were welcomed into the other states. No states reciprocated until 1982, when Alaska, Massachusetts, and New York passed similar laws.[2] Other states followed suit, and by 1992, all but one state (Hawaii) allowed reciprocal entry.[3] This state-level deregulation was codified at the national level in 1994, with the Reigle-Neal Interstate Banking and Branching Efficiency Act. That act made interstate banking mandatory (that is, states could no longer block entry) and made interstate branching optional (according to state wishes).[4]

Because states did not deregulate all at once, and because the resulting entry proceeded at different rates, integration happened in "waves" across states. The differences across states and across time provide the cross-sectional and temporal variation that we need to identify the effects of integration within states. The deregulatory events make useful instruments for identifying the exogenous component of integration (since actual entry may be endogenous with respect to volatility).[5]

2.2 U.S. Data and Empirical Strategy

Our bank integration measure equals the share of total bank assets in a state that are owned by out-of-state bank holding companies (that is, bank holding companies that also own bank assets in other states or countries). To take a simple example, if a state had one stand-alone bank and one affiliated bank of equal size, bank integration for that state would equal one-half. We compute our integration

2. As part of the Garn-St Germain Depository Institutions Act of 1982, federal legislators amended the Bank Holding Company Act to allow failed banks and thrifts to be acquired by any bank holding company, regardless of state laws (see, for example, Kane, 1996; Kroszner and Strahan, 1999).

3. State-level deregulation of restrictions on branching also occurred widely during the second half of the 1970s and throughout the 1980s.

4. The Reigle-Neal Act permitted states to opt out of interstate branching, but only Texas and Montana chose to do so. Other states, however, protected their banks by forcing entrants to buy their way into the market.

5. While we focus here on interstate banking, Jayaratne and Strahan (1996) report that state-level growth accelerated following branching deregulation; Jayaratne and Strahan (1998) show that branching deregulation led to improved efficiency in banking.

variables using the Reports of Income and Condition (or Call Reports) filed by U.S. banks. Our sample starts in 1976 and ends in 1994.[6]

We measure business volatility using the year-to-year deviations in state *i* employment growth around the expected growth for state *i* (over the 1976–94 period) in year *t*. To estimate expected growth, we first regress employment growth on a set of time fixed effects, a set of state fixed effects, an indicator equal to 1 after interstate deregulation, and our measure of state-level banking concentration (defined below).[7] The residual from this first-stage regression is our measure of the deviation from expected growth for each state and year. We take the square or absolute value of this deviation as our volatility measure.

The mean of our integration measure over all state-years was 0.34, rising from under 0.1 in 1976 to about 0.6 by 1994 (table 1). Employment grew 2.3 percent per year, on average, over the sample of state-years. The squared deviation of employment growth from its mean averaged 0.03 percent. The absolute value of deviations in employment growth averaged 1.3 percent.

Table 1. Summary Statistics for U.S. State-Level Panel Data, 1976 to 1994

Summary statistic	*N*	*Mean*	*Standard deviation*
Share of state bank assets owned by multi-state bank holding companies (banking integration)	931	0.34	0.28
Employment growth	931	0.023	0.023
Squared deviation of employment growth from expected employment growth	931	0.0003	0.0006
Absolute deviation of employment growth from expected employment growth	931	0.013	0.012
Share of state bank assets held by three largest banks (banking concentration)	931	0.376	0.210

6. The Riegle-Neal Interstate Banking and Branching Efficiency Act, passed that year, makes our integration measure incalculable by allowing banks to consolidate their operations within a single bank. We thus lose the ability to keep track of bank assets by state and year after 1994.

7. Business investment would be preferable (in terms of the model), but state-level investment data are not available for the U.S. states (although we do have such data for the international analysis). Our employment series is the best proxy for overall state economic activity, however.

2.3 Other Controls and Instruments

We also use banking sector concentration in our regressions, although it is not an element of the model. Bank-level studies for the United States find that bank risk taking tends to increase as concentration (and the associated rents, or bank charter value) falls.[8] Safer banks may translate into safer—that is, less volatile—economies (albeit slower growing ones; see Jayaratne and Strahan, 1996). Bank concentration will also likely affect the political game determining the barriers to out-of-state (or foreign) banking. The rents and inefficiencies associated with concentration will attract new entrants, but of course, the rents provide incumbents with the incentives and funds to defend barriers.[9] For the United States, Kroszner and Strahan (1999) find that states with more concentrated banking sectors were faster to lower barriers to in-state banks that simply wanted to branch into other cities. Since concentration may matter directly for volatility, as well as indirectly through its effect on deregulation, we use it both as an instrument and as a control (in some cases). Concentration is measured by the share of assets held by the largest three banks (table 1).

The rate of integration could depend, in part, on volatility. For example, banks may be more likely to enter a state after a sharp downturn (when volatility is high) to buy up bank assets cheaply. To exclude this endogenous element of integration, we use two instruments based on regulatory changes: an indicator variable for whether a state has passed an interstate banking agreement with other states; and a continuous variable equal to zero before interstate banking and equal to the log of the number of years that have elapsed since a state entered an interstate banking arrangement with other states. Our third (potential) instrument is banking concentration in each state, although we use that variable selectively (as identified in the table notes).[10] All the specifications include year dummy variables and state dummies.

8. On the relationship between charter value and risk, see Keeley (1990); Demsetz, Saidenberg, and Strahan (1996); Hellman, Murdock, and Stiglitz (2000); and Bergstresser (2001).

9. This may explain why interstate deregulation began in a reciprocal manner: state A would open its borders to state B only if state B reciprocated.

10. Both regulatory instruments have very strong explanatory power in the first-stage models. These regressions are available on request.

2.4 Results

All the coefficients on integration are negative and statistically significant (see table 2). The IV coefficient estimates are much larger than the ordinary least squares (OLS) estimates, implying that the stabilizing influence of integration is larger (if less precisely estimated) when we parcel out the endogenous component of integration.[11] The magnitudes are economically important. For example, the average share of a state's assets held by multi-state bank holding companies rose by about 0.5 between 1976 and 1994. According to our regression coefficients in the OLS model, the 0.5 increase in integration across states was associated with 0.4 percentage point decline in business volatility (table 2, column 5). The exogenous component of the increase in integration—that is, the increase stemming from deregulation—was about 0.25 over the sample.[12] Even with this smaller measure, we would still conclude that integration led to a 0.5 percentage point decline in volatility, a large drop relative to the unconditional mean for business volatility of 1.3 percent.

Our model suggests that the stabilizing effects of integration arise because of better diversification against bank capital shocks. If capital falls in state A, affiliated banks in state B will be happy to supply more to take advantage of good investment opportunities. The link between bank capital growth and business growth within a state should thus weaken as integration increases, which it does (table 3). Bank capital and state employment growth are positively correlated, but the correlation weakens as integration increases. If we take the case of the level of integration at the beginning of our sample (0.1), the coefficients suggest that a one standard deviation increase in bank capital growth (0.084) would be associated with an increase in employment growth of 1.3 percent. In contrast, based on the mean level

11. One might object that interstate banking deregulation itself may be partially determined by the volatility of a state's business cycle. For example, political pressure for opening a state's banking system to out-of-state competition may intensify during economic downturns (when volatility is high). To rule out the possibility that endogenous deregulation drives our IV results, we have also estimated the model after dropping the three years just prior to deregulation as well as the year of deregulation itself. In these specifications, the coefficient increases in magnitude (that is, becomes more negative), and its statistical significance increases across all three measures of volatility.

12. We report a Hausman specification test in table 2 comparing the OLS and IV models. This test fails to reject the hypothesis that the two models differ, although the test has low power given the large number of fixed effects.

Table 2. Panel Regression Relating Volatility of U.S. State-level Employment Growth to Banking Integration, 1976 to 1994[a]

	Dependent variable							
	Squared deviation of growth from expected growth				*Absolute deviation of growth from expected growth*			
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Banking integration	–0.0003*	–0.0013*	–0.0011*	–0.0011*	–0.008*	–0.022*	–0.021*	–0.021*
	(0.0002)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.007)	(0.007)	(0.007)
Banking concentration				0.0004				–0.003
				(0.0004)				
Summary statistic								
Within R^2	0.05	0.01	0.01	0.01	0.07	0.03	0.04	0.04
No. observations	931	931	931	931	931	931	931	931
No. states	49	49	49	49	49	49	49	49
Hausman χ^2 test[b]		8.14	2.05			5.08	0.33	
Estimation technique	OLS	IV	IV*	IV	OLS	IV	IV*	IV*

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a state's bank assets that are owned by multi-state bank holding companies. In the IV models, the instrumental variables are an indicator equal to 1 after a state allows out-of-state bank holding companies to purchase their banks, the log of the number of years that have elapsed since this regulatory change, and the market share of the largest three banks in the state (banking concentration). In the IV* model, we drop concentration from the list of instruments. The sample includes the District of Columbia but not South Dakota or Delaware; the latter two states are dropped because their banking systems are dominated by national credit card banks. Standard errors are in parentheses.

b. The Hausman test compares the model with the one preceding it. For example, the test in column 3 compares the coefficients in column 3 with the coefficients in column 2.

* Statistically significant at the 10 percent level.

of integration at the end of our sample (0.6), a one standard deviation increase in capital would be associated with an increase in employment of just 0.4 percent.[13]

2.5 Thinking Globally

Our analysis of U.S. data suggests quite strongly that bank integration across states had a stabilizing influence on economic activity within states. The regulatory history of state-level deregulation over a relatively long period offers an almost ideal way to explore integration's effects on business cycles, because we can sort out integration stemming from endogenous forces—such as banks' appetite to enter new states when the incumbent banks are weak—from integration

Table 3. Response of U.S. State Employment Growth to Local Bank Capital Shocks, 1976 to 1994[a]

	Dependent variable	
	Employment growth	
Explanatory variable	*(1)*	*(2)*
Growth in state bank capital	0.0578*	0.1718*
	(0.0066)	(0.0141)
Banking integration		–0.0001
		(0.0101)
Growth in state bank capital * banking integration		–0.2127*
		(0.0236)
Summary statistic		
Within R^2	0.5001	0.5435
No. observations	931	931
No. states	49	49
Estimation technique	OLS	IV

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a state's bank assets that are owned by multi-state bank holding companies. In the IV models, the instrumental variables are an indicator equal to 1 after a state allows out-of-state bank holding companies to purchase their banks, and the log of the number of years that have elapsed since this regulatory change. The sample includes the District of Columbia but not South Dakota or Delaware; the latter two states are dropped because their banking systems are dominated by national credit card banks. Standard errors are in parentheses.
* Statistically significant at the 10 percent level.

13. Peek and Rosengren (2000) find that when Japanese banks faced financial difficulties in the 1990s, they reduced their lending in California, leading to a decline in credit availability there. This finding is consistent with our results, although it emphasizes the downside of integration. While integration insulates an economy from shocks to its own banks, it simultaneously exposes an economy to banking shocks from the outside.

stemming from policy changes. We also have accurate and consistent measures of both state-level economic activity and banking integration over a long span of time. This long, balanced panel lets us absorb all sorts of confounding variables by including year and state fixed effects. Even without these fixed effects, of course, confounding omitted variables are much less of a problem when comparing New York and New Mexico than when comparing Chile and China. Cross-country studies also suffer from measurement problems for observable variables, particularly the measure of integration (described below).

But how general are the state-level results? Do the good experiences of U.S. states translate naturally into good experiences when emerging economies open their markets to foreign banks? Clearly, the environments differ substantially. For example, the United States has a well-developed financial market and a legal system that makes contract writing and enforcement relatively easy. In emerging economies, explicit contracting is more difficult. Collateral shocks may therefore matter more outside the United States, where weaker contract enforcement makes lenders insist on higher collateral requirements or, more generally, greater levels of entrepreneurial equity holding per dollar lent (Eichengreen and Bordo, 2002).

The country experience with foreign bank entry also offers some data advantages over the state-level experience. For instance, we can measure both GDP growth and investment growth at the country level, rather than having to rely on employment growth. We are also better able to sort out the effects of different shocks. As the Morgan, Rime, and Strahan (2003) model shows, the effects of banking integration depend on the relative importance of different kinds of financial shocks. In the U.S. states, we showed that the impact of changes in local bank capital declined as states integrated with the rest of the country, but we could not control for shocks to collateral because measures of these shocks are not available at the state level. This omission is potentially serious given that the model predicts that integration will amplify, rather than dampen, the effects of collateral shocks. When looking across countries, however, we can sort out these two kinds of shocks by observing changes in the market value of all traded equity in the stock market (a proxy for changes in the value of collateral or entrepreneurial wealth) and, at the same time, measuring change in the health (capital) of the country's banking system.

3. International Evidence

We now consider how banking integration affects business cycles using countries rather than states. We use a similar empirical specification, although we do exploit data advantages where they exist. The challenges with international data involve cross-country heterogeneity, the accurate measurement of integration, and potential endogeneity between business volatility and foreign bank entry.

3.1 Cross-country Heterogeneity

Our panel data allow us to eliminate much of the cross-country heterogeneity with country-level fixed effects. That is a distinct advantage of our approach over recent papers relating predetermined measures of financial structure and regulation to subsequent economic growth and stability (Demirgüç-Kunt and Levine, 2002; Levine, 1999; Claessens, Demirgüç-Kunt and Huizinga, 2001). We were able to construct a wide, though unbalanced, panel for nearly a hundred countries, albeit within a rather short time period from 1990 to 1997 (see table 4). Many foreign countries began opening their markets to foreign banks during this period, however, so we do have enough time series variation within countries to include country fixed effects.

3.2 Measuring Banking Integration and Volatility

We measure a country's level of integration by the share of bank assets held by banks with at least 50 percent foreign-bank ownership. The series was constructed by Beck, Demirgüç-Kunt, and Levine (2000) using the Fitch IBCA Bankscope database. In contrast to our state measure of integration, foreign-bank ownership share does not fully capture the integration process because it does not include the effects of a country's banks reaching out into new markets. Our measure of state-level integration did incorporate all ownership ties between banks. This was possible with the U.S. data because all banks during our sample operated within a single state, and for each bank we could observe the identity of the banking company controlling it. We were thus able to compute the share of banks in a state controlled by a bank holding company with assets outside the state. In contrast, the best measure of foreign integration—foreign ownership of a country's banks—does not incorporate integration in which banks headquartered in one country own substantial bank assets outside

Table 4. List of Countries by Region

Africa	*Asia*	*Eastern Europe*	*Industrial countries*	*Middle East*	*Western Hemisphere*
Algeria	Bangladesh	Belarus	Australia	Bahrain	Argentina
Benin	Hong Kong	Bulgaria	Austria	Egypt	Bahamas
Botswana	India	Croatia	Belgium	Israel	Bolivia
Cameroon	Indonesia	Cyprus	Canada	Kuwait	Brazil
Congo	Malaysia	Czech Republic	Denmark	Lebanon	Chile
Ivory Coast	Nepal	Estonia	France	Saudi Arabia	Colombia
Kenya	Pakistan	Hungary	Germany	United Arab Emirates	Costa Rica
Lesotho	Papua New Guinea	Kazakhstan	Greece		Dominican Rep.
Madagascar	Philippines	Latvia	Ireland		Ecuador
Mali	Singapore	Lithuania	Italy		El Salvador
Mauritius	Taiwan (China)	Poland	Japan		Guatemala
Morocco	Thailand	Romania	Luxembourg		Guyana
Namibia	Vietnam	Russia	Netherlands		Honduras
Nigeria		Slovak Republic	Norway		Mexico
Rwanda		Slovenia	Portugal		Neth. Antilles
Senegal		Turkey	Spain		Nicaragua
Sierra Leone		Ukraine	Sweden		Panama
South Africa			Switzerland		Paraguay
Swaziland			United Kingdom		Peru
Tanzania			United States		Uruguay
Tunisia					Venezuela
Uganda					
Zambia					
Zimbabwe					

that country. So, for example, a country like Spain, with its largest banks holding significant assets in Latin America, does not appear to be well integrated with the rest of the world. Despite this limitation, foreign ownership is the best measure we have, and it probably represents the bulk of integration for smaller, less developed countries that do not have banks large enough to expand internationally.[14]

Table 5 reports the foreign share data by year and region. The data suggest large increases in banking integration in Asia, Eastern Europe, and the nonindustrialized portion of the Western Hemisphere. In contrast, Africa and Middle Eastern countries experienced little trend in integration during the 1990s.

14. To partially account for this measurement issue, we also estimated our models without the industrial countries listed in table 4. We find similar results to those reported in table 7.

Table 5. Trends in Median Foreign-bank Market Share, by Region, 1990 to 1997[a]
Percent

Year	*Africa*	*Asia*	*Eastern Europe*	*Industrial countries*	*Middle East*	*Western Hemisphere*
1990	18.2	12.4	3.6	3.2	5.5	11.7
1991	11.8	13.4	9.1	4.9	4.8	14.5
1992	23.1	15.0	2.8	4.1	4.9	21.7
1993	28.2	15.6	4.4	3.7	5.5	19.9
1994	23.6	18.4	6.9	3.8	5.6	17.9
1995	29.0	21.2	8.8	3.6	6.2	20.0
1996	22.3	24.1	10.4	3.6	6.3	21.1
1997	20.7	32.9	9.8	2.9	9.1	23.0

a. Medians are based on the percentage of each country's banking assets held by banks controlled by a foreign company, where control means that the foreign company owns at least 50% of the bank's equity.

We measure country volatility on a yearly basis the same as for the U.S. states, except that we consider both overall volatility in real GDP growth and the volatility in growth of real investment spending. For each series, we first construct a measure of unexpected growth by regressing GDP growth (investment growth) on a set of time fixed effects, a set of country fixed effects, our measure of banking integration, and the other control variables (described below). As before, volatility equals the square or absolute value of the residuals from this first-stage growth regression for each country and year. By controlling for banking integration in the first-stage regression, we implicitly allow the growth rate to increase (or decrease) as a country opens itself up to foreign bank entry. This eliminates the possibility of confusing an accelerated growth rate following banking integration with an increase in GDP volatility.[15]

Table 6 reports the summary statistics for our integration and volatility measures across countries and time. For banking integration, the average share of bank assets controlled by foreign banks

15. The models in Aghion, Banerjee, and Picketty (1999) and Caballero and Krishnamurthy (2001) suggest that the severe credit constraints in emerging market countries may slow growth and increase volatility. Their models suggest that foreign bank entry might reduce volatility via an efficiency channel, whereby the increased competition resulting from foreign bank entry relaxes those constraints and thereby causes growth to accelerate and volatility to decline. Our assumption of perfect competition even without foreign entry essentially rules out a reduction in volatility via increased efficiency (Norman Loayza gets credit for this point).

equals 0.192. Real GDP growth averages 2.85 percent per year, with an average squared deviation from the conditional mean growth of 0.43 percent and an average absolute deviation of 4.39 percent. These measures of average volatility are about three-and-a-half times as large as volatility in the U.S. states. Real investment has both a higher mean growth rate and greater volatility than overall GDP growth. Average investment grew by 7.68 percent per year, with volatility of 4.77 percent (squared deviations) and 16.07 percent (absolute deviations).

As in the state-level regressions, we include banking concentration both as an instrument and as a regressor in our model, although we vary the specifications because of the potential endogeneity of concentration. As noted above, an advantage of the country-level analysis over the state-level analysis is that we now can control for real integration (as opposed to financial integration), equal to the trade share of each country, (imports + exports) / GDP. Because the country-level data introduces considerable heterogeneity, we control for the effects of exchange rate volatility by adding the absolute value of

Table 6. Summary Statistics for Cross-country Panel Data, 1990 to 1997[a]

Summary statistic	*N*	*Mean*	*Standard deviation*
Share of a country's bank assets controlled by a foreign bank (banking integration)	498	0.192	0.222
Real GDP growth	498	0.0285	0.0634
Real growth in investment	516	0.0768	0.1877
Squared deviation of GDP growth from expected GDP growth	498	0.0043	0.0141
Absolute deviation of GDP growth from expected GDP growth	498	0.0439	0.0494
Squared deviation of growth in investment from its expected value	516	0.0477	0.0972
Absolute deviation of investment from its expected value	516	0.1607	0.1480
Share of a country's bank assets controlled by largest three bank (banking concentration)	498	0.639	0.216
Total liquid liabilities divided by GDP (financial development)	498	0.525	0.344
Absolute value of percent change in real exchange rate (terms of trade shock)	498	0.070	0.081
Imports + exports divided by GDP (real integration)	498	0.388	0.267

a. Expected growth rates are computed as the predicted value from a regression of GDP growth (capital growth) on a time effect and a country effect.

the change in the real exchange rate for a given country relative to the dollar. We also add a measure of the level of financial development in a country and year (the ratio of total liquid liabilities to GDP), following Levine (2003).[16]

As in the state-level approach, all regressions include both fixed country effects and fixed year effects. The country effects are especially important in the cross-country models because they eliminate many of the unobservable differences in economic conditions, institutions, regulations, taxation, law, corruption, culture, and other factors that may simultaneously affect volatility and foreign entry.

3.3 Potential Endogeneity: Constructing Instruments for Integration

It is perhaps even harder to argue that foreign bank entry is exogenous to economic conditions in a country than it is in the state-level context, so instrumenting becomes even more important than before. Our set of instrumental variables exploits linguistic, institutional, and geographic differences across countries. The idea is simple: a Spanish bank will be more likely to enter countries where Spanish is the primary language; an American bank will be more likely to enter countries in the Western Hemisphere; a British bank will be more likely to enter countries with similar legal and regulatory institutions. Therefore, if American banks are well positioned to enter new markets abroad because, for example, they are well capitalized, then English-speaking countries experience more (exogenous) entry than, say, French-speaking countries.

Accordingly, we first grouped countries along three dimensions: primary language (Arabic, English, French, German, Spanish/Portuguese, and other), legal origin (English, French, German, Scandinavian, and Socialist), and region (see table 4). For each country, we then compute the average of a series of characteristics related to the likelihood that foreign banks enter a country in the group. We exclude the characteristics of the country itself to ensure that these group means are exogenous. The group characteristics include the following: the ratio of bank assets to GDP (a measure of financial depth), the average bank capital-asset ratio (a measure of bank financial strength), and the average share of foreign ownership (a measure

16. Denizer, Iyigun, and Owen (2002) find that GDP volatility and financial development are negatively related.

of how much entry has already occurred within the group). We also include the size of the country's banking system relative to total banking assets held by all countries in the group.

The results from the first-stage regressions of foreign bank share on these group characteristics indicate that we are able to build a good instrument for estimating the effects of integration in an IV model, even controlling for country and time effects. For example, the *p* value testing the joint significance of the set of instruments excluded from the model in the first-stage regressions is less than 0.01. The regional averages turn out to be more powerful predictors of entry than either language or law. Countries in a region where banks are well capitalized, on average, experience significantly more foreign entry than countries in regions where banks are poorly capitalized, on average. Entry is also higher in countries located in regions with large banking systems (relative to GDP) and in countries whose banking system is small relative to the entire region.

3.4 Results

Tables 7 and 8 contain the results for volatility of real GDP growth for all countries and for nonindustrial countries in the Western Hemisphere, respectively, while tables 9 and 10 present the results based on volatility of real investment growth for the same country groups. We report eight specifications in each table, four using the squared deviations of growth to measure volatility and four using the absolute deviations of growth. These four specifications include the fixed-effects OLS and three IV models, one which includes the full set of instruments, one that deletes banking concentration from the instrument set as a possibly endogenous variable, and one that includes concentration as a right-hand-side variable in the model.

In contrast to the U.S. experience, these results are consistent with a zero or positive link between foreign banking (that is, banking integration) and economic volatility. We do not estimate a single negative coefficient on the foreign bank share variable that is significant at the 10 percent level or better in any of thirty-two specifications. In contrast, we find a positive and significant coefficient on foreign banking in fifteen of thirty-two specifications. This positive effect is most evident in table 10, which examines volatility of investment among the nonindustrial Western Hemisphere countries. In all eight of these specifications, the results suggest that greater banking integration is associated with more, not less, volatility.

Table 7. Panel Regressions Relating Volatility of Country Real GDP Growth to Banking Integration, All Countries, 1990 to 1997[a]

	Dependent variable							
	Squared deviation of growth from expected growth				*Absolute deviation of growth from expected growth*			
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Banking integration	0.0083	0.0413	0.0381	0.0388	0.0477*	0.2633*	0.2031*	0.2038*
	(0.0077)	(0.0289)	(0.0323)	(0.0343)	(0.0271)	(0.1063)	(0.1154)	(0.1229)
Real integration	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Financial development	0.017	0.017	0.017	0.018	0.061	0.066	0.065	0.070*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.039)	(0.042)	(0.040)	(0.041)
Terms-of-trade shock	0.024*	0.024*	0.024*	0.024*	0.103*	0.100*	0.101*	0.098*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.024)	(0.026)	(0.025)	(0.025)
Banking concentration				0.0012				(0.0212)
				(0.0073)				(0.0262)
Summary statistic								
Within R^2	0.0747	0.0326	0.0404	0.0404	0.0964	0.0200	0.0222	0.0237
No. observations	498	498	498	498	498	498	498	498
No. countries	87	87	87	87	87	87	87	87
Hausman χ^2 test[b]		1.40	0.05	0.05		4.39	1.00	
Estimation technique	OLS	IV	IV*	IV	OLS	IV	IV*	IV

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a country's bank assets that are owned by foreign banks, where the foreign bank must own at least 50% of the local bank. Real integration equals the ratio of total imports plus exports to GDP. Banking concentration equals the market share of the country's three largest banks. In the IV models, the instrumental variables include the following: banking concentration, the average ratio of bank assets to GDP in countries in the same group (groups defined below), the average bank capital-asset ratio for all countries in the same group, the average share of foreign ownership for all countries in the same group, and the size of the countries banking system relative to the group. For each of these instruments, we construct group averages, where countries are grouped along three dimensions: primary language (Arabic, English, French, German, Spanish/Portuguese, and other), legal origin (English, French, German, Scandinavian, and Socialist), and region (defined in table 4). For each of the averages we do not include the value for the country itself, but rather use only the other countries within the group. In the IV* model, we drop concentration from the list of instruments. Standard errors are in parentheses.

b. The Hausman test compares the model with the one preceding it. For example, the test in column 3 compares the coefficients in column 3 with the coefficients in column 2. The models in columns 3 and 4 (7 and 8) are not nested, so the test is not available.

* Statistically significant at the 10 percent level.

Table 8. Panel Regressions Relating Volatility of Country Real-GDP Growth to Banking Integration, Nonindustrial Western Hemisphere Countries, 1990 to 1997[a]

	Dependent variable							
	Squared deviation of growth from expected growth				*Absolute deviation of growth from expected growth*			
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Banking integration	–0.0213	–0.0279	–0.0286	–0.0253	–0.0013	–0.0226	–0.0195	–0.0309
	(0.0232)	(0.0235)	(0.0235)	(0.0241)	(0.0699)	(0.0706)	(0.0706)	(0.0727)
Real integration	0.0007*	0.0007*	0.0007	0.0006	0.0008	0.0008	0.0008	0.0010
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0012)	(0.0012)	(0.0012)	(0.0013)
Financial development	–0.027	–0.031	–0.032	–0.039	–0.0053	–0.0181	–0.0162	–0.0016
	(0.036)	(0.036)	(0.036)	(0.038)	(0.1093)	(0.1096)	(0.1096)	(0.1145)
Terms-of-trade shock	0.018	0.017	0.017	0.020	0.106	0.104	0.104	0.097
	(0.029)	(0.029)	(0.029)	(0.030)	(0.088)	(0.088)	(0.088)	(0.089)
Banking concentration				–0.0011				0.0266
				(0.0169)				(0.0509)
Summary statistic								
Within R^2	0.1428	0.1420	0.1419	0.1472	0.0999	0.0989	0.0992	0.1011
No. observations	112	112	112	112	112	112	112	112
No. countries	18	18	18	18	18	18	18	18
Hausman χ^2 test[b]		3.78	0.37			4.27	1.73	
Estimation technique	OLS	IV	IV*	IV	OLS	IV	IV*	IV

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a country's bank assets that are owned by foreign banks, where the foreign bank must own at least 50% of the local bank. Real integration equals the ratio of total imports plus exports to GDP. Banking concentration equals the market share of the country's three largest banks. In the IV models, the instrumental variables include the following: banking concentration, the average ratio of bank assets to GDP in countries in the same language group, the average bank capital-asset ratio for all countries in the same language group, the average share of foreign ownership for all countries in the same language group, and the size of the countries banking system relative to the group. We do not construct instruments grouped along either regional or legal origin lines because all countries in these regressions are in the same region, and almost all of the countries in this region have a legal system originating from the French system. In the IV* model, we drop concentration from the list of instruments. Standard errors are in parentheses.

b. The Hausman test compares the model with the one preceding it. For example, the test in column 3 compares the coefficients in column 3 with the coefficients in column 2. The models in columns 3 and 4 (7 and 8) are not nested, so the test is not available.

* Statistically significant at the 10 percent level.

Table 9. Panel Regressions Relating Volatility of Country Real Growth in Investment to Banking Integration, All Countries, 1990 to 1997[a]

	Dependent variable							
	Squared deviation of growth from expected growth				*Absolute deviation of growth from expected growth*			
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Banking integration	0.1795*	0.2428	0.1802	0.1560	0.2548*	0.4812*	0.3039	0.2809
	(0.0505)	(0.1807)	(0.2074)	(0.2178)	(0.0805)	(0.2909)	(0.3310)	(0.3462)
Real integration	0.0004	0.0003	0.0004	0.0005	0.0006	0.0004	0.0005	0.0007
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0010)	(0.0012)	(0.0009)	(0.0013)
Financial development	0.028	0.031	0.028	0.032	0.076	0.085	0.078	0.090
	(0.071)	(0.071)	(0.072)	(0.072)	(0.113)	(0.115)	(0.114)	(0.114)
Terms-of-trade shock	0.1488*	0.1483*	0.1488*	0.1448*	0.2380*	0.2360*	0.2376*	0.2270*
	(0.0446)	(0.0448)	(0.0447)	(0.0450)	(0.0712)	(0.0720)	(0.0713)	(0.0717)
Banking concentration				0.0328				0.0843
				(0.0475)				(0.0756)
Summary statistic								
Within R^2	0.1086	0.1053	0.1086	0.1097	0.1242	0.1075	0.1234	0.1278
No. observations	516	516	516	516	516	516	516	516
No. countries	92	92	92	92	92	92	92	92
Hausman χ^2 test[b]		0.13	0.38			0.66	1.26	
Estimation technique	OLS	IV	IV*	IV	OLS	IV	IV*	IV

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a country's bank assets that are owned by foreign banks, where the foreign bank must own at least 50% of the local bank. Real integration equals the ratio of total imports plus exports to GDP. Banking concentration equals the market share of the country's three largest banks. In the IV models, the instrumental variables include the following: banking concentration, the average ratio of bank assets to GDP in countries in the same group (groups are defined below), the average bank capital-asset ratio for all countries in the same group, the average share of foreign ownership for all countries in the same group, and the size of the countries banking system relative to the group. For each of these instruments, we construct group averages, where countries are grouped along three dimensions: primary language (Arabic, English, French, German, Spanish/Portuguese, and other), legal origin (English, French, German, Scandinavian, and Socialist), and region (defined in table 4). For each of the averages we do not include the value for the country itself, but rather use only the other countries within the group. In the IV* model, we drop concentration from the list of instruments. Standard errors are in parentheses.

b. The Hausman test compares the model with the one preceding it. For example, the test in column 3 compares the coefficients in column 3 with the coefficients in column 2. The models in columns 3 and 4 (7 and 8) are not nested, so the test is not available.

* Statistically significant at the 10 percent level.

Table 10. Panel Regressions Relating Volatility of Country Real Growth in Investment to Banking Integration, Nonindustrial Western Hemisphere Countries, 1990 to 1997[a]

	Dependent variable							
	Squared deviation of growth from expected growth				*Absolute deviation of growth from expected growth*			
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Banking integration	0.2820*	0.2841*	0.2827*	0.2670*	0.4398*	0.4364*	0.4389*	0.4107*
	(0.0869)	(0.0877)	(0.0878)	(0.0901)	(0.1674)	(0.1691)	(0.1692)	(0.1738)
Real integration	0.0012	0.0013	0.0013	0.0016	0.0034	0.0034	0.0034	0.0041
	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0030)	(0.0030)	(0.0030)	(0.0031)
Financial development	0.118	0.119	0.118	0.148	0.0010	–0.0010	0.0005	0.0504
	(0.136)	(0.136)	(0.136)	(0.142)	(0.2620)	(0.2624)	(0.2625)	(0.2739)
Terms-of-trade shock	0.374*	0.374*	0.374*	0.361*	0.6055*	0.6051*	0.6054*	0.5842*
	(0.109)	(0.109)	(0.109)	(0.111)	(0.2107)	(0.2108)	(0.2108)	(0.2136)
Banking concentration				0.0489				0.828
				(0.631)				(0.1217)
Summary statistic								
Within R^2	0.3130	0.3129	0.3130	0.3179	0.2817	0.2817	0.2200	0.2856
No. observations	112	112	112	112	112	112	112	112
No. countries	18	18	18	18	18	18	18	18
Hausman χ^2 test[b]		0.03	0.13			0.02	0.15	
Estimation technique	OLS	IV	IV*	IV	OLS	IV	IV*	IV

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a country's bank assets that are owned by foreign banks, where the foreign bank must own at least 50% of the local bank. Real integration equals the ratio of total imports plus exports to GDP. Banking concentration equals the market share of the country's three largest banks. In the IV models, the instrumental variables include the following: banking concentration, the average ratio of bank assets to GDP in countries in the same language group, the average bank capital-asset ratio for all countries in the same language group, the average share of foreign ownership for all countries in the same language group, and the size of the countries banking system relative to the group. We do not construct instruments grouped along either regional or legal origin lines because all countries in these regressions are in the same region, and almost all of the countries in this region have a legal system originating from the French system. In the IV* model, we drop concentration from the list of instruments. Standard errors are in parentheses.

a. The Hausman test compares the model with the one preceding it. For example, the test in column 3 compares the coefficients in column 3 with the coefficients in column 2. The models in columns 3 and 4 (7 and 8) are not nested, so the test is not available.

* Statistically significant at the 10 percent level.

Tables 7 through 10 report the Hausman specification test that compares coefficients of consistent (but not necessarily efficient) IV models with the more efficient (but not necessarily consistent) OLS model. The test never rejects the consistency of the OLS models. Although the magnitude of the effects of integration do change with the estimation technique, we never observe a change of sign in the coefficient on banking integration in comparing OLS with IV. If we look only at these eight OLS specifications, the coefficient on banking integration is positive in six of eight specifications, with statistical significance at the 10 percent level for five of these cases.

Why are country results so different from the U.S. results? Our model suggests that integration heightens the impact of firm collateral shocks on spending. Perhaps foreign banks respond more elastically to collateral shocks than domestic banks because they are better able to reinvest funds outside the country. To investigate, we regress the real growth of GDP and investment on proxies for shocks to entrepreneurial collateral (the return on the stock market in the country during the preceding year) and shocks to the banking system (the growth rate of bank capital in the country). We then interact these two capital variables with the foreign bank share.

The results (table 11, columns 1 and 4) confirm that the two capital variables are positively correlated with GDP and investment spending growth, as one would expect. More interesting is the positive coefficient on the interaction between collateral and foreign bank share: that positive sign suggests that the impact of firm capital shocks is indeed amplified by the presence of foreign banks. The amplification is much more pronounced in the investment regressions than the overall GDP growth regressions, which seems sensible since lower collateral value has a direct impact of firms' ability to borrow.

4. Conclusions

The theory behind this paper suggests that bank integration is a two-edged sword in terms of business cycle variability. Integration can magnify the impact of firm collateral shocks because integrated banks have the opportunity to shift their capital elsewhere during downturns. Shocks to the banking system itself, however, become less important in an integrated world because the integrated banks can import banking resources from abroad to fund good, local projects.

Table 11. Response of Real GDP Growth and Real Capital Formation Growth to Banking and Collateral Shocks, 1990-1997[a]

	Dependent variable					
	Real GDP growth			*Real growth in investment*		
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Growth in real bank capital	0.0301* (0.0167)	0.0254 (0.0216)	0.0363 (0.0257)	0.0698 (0.0519)	0.0460 (0.0804)	0.0592 (0.0962)
Real return on stock market	0.0242* (0.0118)	0.0124 (0.0146)	–0.0112 (0.0201)	0.1565* (0.0366)	0.0440 (0.0542)	–0.0607 (0.0754)
Banking integration		–0.1272 (0.1845)	0.0130 (0.2479)		0.0857 (0.6865)	–1.6607 (0.9281)
Growth in bank capital*banking integration		0.06607 (0.1036)	–0.0372 (0.1066)		–0.2342 (0.3853)	–0.0157 (0.3995)
Return on stock market*banking integration		0.1712* (0.0895)	0.3290* (0.1262)		0.9394* (0.3331)	1.4923* (0.4730)
Summary statistic						
Within R^2	0.1513	0.2330	0.2472	0.4125	0.4544	0.4739
No. observations	188	175	181	189	176	182
No. countries	30	30	30	31	31	31
Estimation technique	OLS	IV	IV*	OLS	IV	IV*

a. All regressions contain both year and state fixed effects. Banking integration equals the share of a country's bank assets that are owned by foreign banks, where the foreign bank must own at least 50% of the local bank. In the IV models, the instrumental variables include the following: banking concentration, the average ratio of bank assets to GDP in countries in the same group (groups are defined below), the average bank capital-asset ratio for all countries in the same group, the average share of foreign ownership for all countries in the same group, and the size of the countries banking system relative to the group. For each of these instruments, we construct group averages, where countries are grouped along three dimensions: primary language (Arabic, English, French, German, Spanish/Portuguese, and other), legal origin (English, French, German, Scandinavian, and Socialist), and region (defined in table 4). For each of the averages we do not include the value for the country itself, only the other countries within the group are used. In the IV* model, we drop concentration from the list of instruments. Standard errors are in parentheses.
* Statistically significant at the 10 percent level.

Our data suggest that the cutting edge of the sword depends on where one looks. Bank integration across U.S. states over the late 1970s and 1980 appears to have dampened economic volatility within states. That dampening suggests that the benefit of integration in the U.S. has been to diminish the impact of bank capital shocks, and indeed, we find that employment growth and bank capital growth became less correlated with shocks to the local banking sector with integration. Internationally, we find that foreign bank integration is either unrelated to volatility of firm investment spending or positively related. That suggests that the amplifying effect of integration on firm capital shocks dominate, and we do, in fact, find that GDP growth and investment growth became more sensitive to changes in stock market wealth, whereas the effect of shocks to the banking sector did not change significantly.

Even though our model admits conflicting effects from integration, and even though our ancillary regressions (in which we interact integration with bank capital or firm collateral) are consistent with those conflicting effects, we are less confident about our international results than we are about our U.S. analysis. The international data are noisier, for one, and we have less of it (eight years versus eighteen for the United States). Another concern is that our window on the world—the 1990 to 1997 period—is partly obscured by sweeping transitions and episodic financial crises, especially in emerging economies, that may confound the effects of integration, or may even motivate it. Fixed effects and instruments help with those problems to some degree, but not completely.

With those qualifiers, policymakers and central bankers should be aware of the possibility that business spending may become more volatile as they open their banking sectors to foreign entry. The first-order (growth and efficiency) effects of foreign bank entry are almost certainly positive, but the second-order (volatility) effects are less clear.

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Denying Foreign Bank Entry: Implications for Bank Interest Margins

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This paper examines the impact of policies toward foreign bank entry on commercial bank net interest margins. Do countries that impede the entry of foreign banks induce a bigger gap between the interest expense paid to depositors and the interest income received from borrowers after controlling for bank-specific characteristics, macroeconomic conditions, and the structure of the economy's banking industry? In exploring this issue, the paper provides information on the efficiency effects of regulatory restrictions on foreign bank entry.

The paper goes farther, however, and assesses whether there is something special about foreign banks. Regulatory restrictions on foreign bank entry may be highly correlated with regulatory restrictions on domestic bank entry. If this is the case, then information on foreign banks may simply proxy for entry restrictions in general, rather than providing information on foreign banks in particular. To examine the independent impact of restrictions on foreign bank entry, I simultaneously control for restrictions on domestic bank entry.

The paper also distinguishes between impediments to foreign bank entry and the fraction of the domestic banking industry owned by foreign banks. Some researchers focus on the degree of foreign bank ownership (Clarke, Cull, and Martínez Pería, 2001). Others, however, argue that openness to foreign banks is crucial because it makes the domestic market contestable (Demirgüç-Kunt, Levine, and Min, 1998; Claessens, Demirgüç-Kunt, and Huizinga, 2001). From this perspective, the key

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issue is access, not the actual fraction of the domestic banking industry owned by foreign banks (Clarke, Cull, D'Amato, and Molinari, 2000; Clarke, Cull, Martínez Pería, and Sánchez, 2002). To isolate the impact of restricting foreign bank entry from actual foreign bank participation, I simultaneously control for the fraction of domestic banking assets associated with foreign-owned banks.

This is the first paper to study the relationship between net interest margins and the fraction of foreign entry applications denied by the commercial bank supervisory agency when controlling for regulatory restrictions on domestic bank entry and foreign ownership. I use bank-level data on 1165 banks across forty-seven countries. While other studies examine the actual degree of foreign bank participation (Clarke, Cull, and Martínez Pería, 2001), I simultaneously study the rate at which countries reject applications by foreign banks. Furthermore, whereas some studies use information on the number of foreign banks operating in the economy to proxy for the contestability of the market (Claessens, Demirgüç-Kunt, and Huizinga, 2001), I use direct information on the fraction of foreign entry applications denied to gauge the regulatory barriers to foreign bank entry. Finally, other studies do not control for regulatory restrictions on domestic bank entry; this paper, in contrast, controls for the fraction of domestic entry applications that are rejected by the supervisory agency.[1] I thus simultaneously examine the impact of impediments to domestic bank entry, impediments to foreign bank entry, and the degree of foreign bank ownership of the domestic banking industry on net interest margins.

To assess the independent link between foreign banks and commercial bank net interest margins, I control for an array of bank-specific and country-specific characteristics. In particular, I control for bank size, the degree to which banks hold liquid assets, the ratio of equity to total assets, the extent to which banks earn fee income, bank overhead expenditures, and the variability of bank profits. In terms of country-specific variables, I control for inflation and the level of bank concentration in each country. Results on the relationships between interest margins and bank-specific and country-specific factors are valuable. For this paper, however, the purpose of controlling

1. For more on the impact of various supervisory and regulatory policies on bank efficiency, see Demirgüç-Kunt, Laeven, and Levine (2002).

for these factors is to identify the impact of policies toward foreign banks on net interest margins.

The data indicate that impediments to foreign bank entry boost bank net interest margins. Moreover, the paper finds that foreign banks are special. When controlling for impediments to domestic bank entry, restrictions on foreign bank entry continue to explain bank net interest margins. Indeed, while foreign bank entry restrictions enter significantly, domestic bank entry restrictions do not explain bank interest margins. Furthermore, the key factor is impediments to foreign bank entry, not foreign bank ownership per se. The actual fraction of the domestic banking industry controlled by foreign-owned banks does not help account for bank interest margins. The fraction of foreign entry applications denied, however, continues to explain bank interest margins even when controlling for the degree of foreign bank ownership. Contestability by foreign banks is an important determinant of bank interest margins. In sum, the paper finds that regulatory restrictions on foreign bank entry exert an independent impact on bank interest margins after controlling for impediments to domestic bank entry, the actual degree of foreign bank participation, bank-specific factors, macroeconomic stability, and banking sector concentration.

While the positive relationship between the fraction of foreign bank entry applications denied and net interest margins is robust to alterations in the conditioning information set, there may be concerns with the measure of foreign bank entry restrictions. First, the fraction of foreign entry applications rejected by the regulatory agency may not accurately measure excessive regulatory impediments to foreign bank entry. If foreign banks expect that a country is likely to reject foreign bank entry applications, they may be reluctant to apply or may use bribes and other measures prior to submitting an application. Under these conditions, a low rejection rate will not reflect bribes and other obstacles faced by foreign banks. Second, there may be sound prudential reasons for rejecting foreign banks. If foreign banks are not well managed and properly supervised in their home countries, a country may have legitimate reasons for rejecting their entry. Thus, high rejection rates may not suggest excessive entry barriers. These concerns, however, would bias the results *against* finding a relationship between the fraction of foreign entry applications denied and bank margins. Moreover, when I use an instrumental variables estimator and employ different sets of instruments, I continue to find that restricting foreign bank entry boosts net interest margins.

The remainder of the paper is organized as follows. Section 1 discusses the methodology and data; section 2 presents the results; and section 3 concludes.

1. Methods, Data, and Summary Statistics

This paper examines the impact of restrictions on foreign bank entry on net interest margins while controlling for bank-specific effects and country-specific traits. Specifically, I estimate the following regression.

$$\text{Net Interest Margin}_{i,k} = \alpha + \beta_1 F_i + \beta_2 \mathbf{B}_{i,k} + \beta_3 \mathbf{C}_i + \varepsilon_{i,k}\,.$$

In the specification, i indexes country i and k indexes bank k, so that F_i is a measure of restrictions on foreign bank entry in country i; $\mathbf{B}_{i,k}$ is a vector of bank-specific characteristics for bank k in country i; $\mathbf{C}_i$ is a vector of country-specific traits; and $\varepsilon_{i,k}$ is the residual.

The equation is primarily estimated using a generalized least squares estimator with random effects, though I also present the fixed effects estimates on the bank-specific variables. At the end of the paper, I extend the analysis and use a two-stage generalized least squares random effects estimator for this panel-data model.

1.1 Data

This paper uses two primary data sources. First, data for the bank-specific variables are obtained from the BankScope database, which is provided by Fitch-IBCA. The data are for commercial banks and account for 90 percent of all banking assets. Second, data for regulatory restrictions on bank entry are obtained from the Barth, Caprio, and Levine database (Barth, Caprio, and Levine, 2001a, 2001b, 2003). The database is constructed from a survey of national regulatory agencies. The responses to this survey regarding the denial of entry applications primarily cover the period 1997–98.

After combining the datasets, there are data on 1165 banks across forty-seven countries. The country coverage is quite broad, ranging from the richest countries in the world to the poorest and covering all regions of the globe. The sample is as follows: Australia, Austria, Bahrain, Bangladesh, Belgium, Botswana, Burundi, Canada, Chile, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Ghana, Greece, Hungary, Iceland, India, Ireland, Italy, Jamaica, Japan, Latvia, Lebanon, Lithuania, Luxembourg, Malta, Moldova, Namibia, Netherlands, New Zealand, Nigeria, Panama, Peru, Philippines, Poland, Romania, Rwanda, South Africa, Spain, Sweden, Switzerland, Taiwan, Trinidad and Tobago, and the United States. I conduct the analyses on various subsets of countries to assess the robustness of the findings.

1.2 Variable Definitions

This subsection defines the variables used in the regression analyses: namely, net interest margin, several bank-specific control variables, and country-specific variables.

Net Interest Margin

Net interest margin equals interest income minus interest expense divided by interest-bearing assets. The net interest margin measure represents the gap between what the bank pays the providers of funds and what the bank gets from firms and other users of bank credit. Since the net interest margin focuses on the conventional borrowing and lending operations of the bank, I normalize by interest-bearing assets rather than total assets. I compute and examine the net interest margin over two periods. First, I average over the 1995–99 period so that one year does not dominate. The disadvantage of this approach is that the main explanatory variable, denial of foreign bank entry applications, is computed primarily over the 1997–98 period. I do not believe that this is an important disadvantage, however, because Barth, Caprio, and Levine (2001a) and Carkovic and Levine (2002) show that bank supervision and regulation has changed remarkably little. Second, I examine the net interest margin computed in 1999. This alleviates any concerns about the timing of the dependent and independent variables. The disadvantage is that business-cycle phenomena and crises may unduly influence margins in 1999. In any event, the results are the same whether using net interest margins in 1999 or averaging over the 1995 to 1999 period. The results reported below use the net interest margin averaged over the years 1995–99. Table 1 reports great cross-country variability in average net interest margins. Ghana, Burundi, and Moldova have net interest margins of greater than ten percent. In contrast, Finland, the Netherlands, Switzerland, and Luxembourg have net interest margins of less than two percent.

Table 1. Summary Statistics[a]

Variable	*No. observations*	*Mean*	*Standard deviation*	*Min*	*Max*
Interest margin	1,165	3.46	1.94	0.72	12.60
Bank size	1,165	7.14	1.98	1.94	13.49
Bank liquidity	1,165	21.38	16.41	0.23	82.19
Bank equity	1,165	8.55	6.34	–0.77	78.76
Fee income	1,165	0.89	1.44	–6.39	13.80
Bank overhead	1,165	3.00	1.77	0.15	15.72
Fraction foreign denied	47	0.13	0.28	0.00	1.00
Fraction domestic denied	47	0.21	0.31	0.00	1.00
Foreign ownership	38	0.26	0.28	0.00	0.99
Latitude	47	0.40	0.20	0.02	0.72

a. The number of countries is forty-seven. The number of bank observations is 1,165. Interest margin is averaged over the 1995–99 period. The other bank-specific variables are from 1995. Regulatory variables on fraction of foreign and domestic entry applications denied and foreign bank ownership are from the Barth, Caprio, and Levine (2003) dataset.

Since the net interest margin is subject to measurement problems, it is crucial to use a variety of control variables and sensitivity checks to mitigate problems with interpreting the findings. I want to hold a sufficient amount constant to ensure that greater net interest values reflect either operational inefficiency or market power. Confounding issues arise, however. For instance, banks engaging in fee-income-generating activities may have different net interest margins because of cross-subsidization of activities. In this case, cross-bank differences in net interest margins may reflect differences in bank activity, rather than differences in efficiency or competition. Also, bank inefficiencies and market conditions may yield high overhead costs rather than large interest margins. Furthermore, bank margins may reflect different asset allocations and risk tastes of firms, such that the net interest margin may reflect equity premiums. I therefore control for bank equity and bank risk; I also obtain consistent results when controlling for bank profitability and the share of nonperforming loans in the economy. These measurement and interpretational concerns emphasize the need to control for bank-specific characteristics.

Bank-specific control variables

I use bank-specific variables as control variables, since the focus of the paper is on assessing the impact of regulatory restrictions on foreign banks. The following variables are considered in the analysis.

Bank-size equals the logarithm of total bank assets in millions of U.S. dollars in 1995. I use the 1995 figure to reduce potential simultaneity with net interest margins, but the results do not change when using bank-specific control variables averaged over the 1995–99 period. As shown in table 1, there is extraordinary cross-country variation in the average size of banks. Large banks may reduce net interest margins if there are increasing returns to scale. Alternatively, large banks may increase net interest margins if they exert market power.

Bank equity equals the book value of equity divided by total assets in 1995. Some theories suggest that highly capitalized banks face a lower probability of bankruptcy and hence lower funding costs. This will produce larger net interest margins if the interest charged on loans does not drop markedly with more highly capitalized banks.

Bank overhead equals overhead costs divided by total assets in 1995. I use this variable to control for cross-bank differences in organization and operation. Different organizations will choose different business systems, product mixes, and asset allocations, with consequently different overhead cost structures. Large overhead costs may reflect bank inefficiencies or market power in a similar fashion to net interest margins. I thus expect to see a very high, positive correlation between bank overhead and net interest margins. Indeed, overhead costs may be so highly correlated with net interest margin that including bank overhead as a regressor substantively lowers the likelihood of finding that other variables explain net interest margin. I obtain the same results when including or excluding bank overhead.

Fee income equals noninterest operating income divided by total assets in 1995. Banks have different product mixes. Since banks engage in different nonlending activities, these other activities may influence the pricing of loan products owing to cross-subsidization of bank products. I therefore include fee income to control for cross-bank differences in the products offered by banks.

Bank liquidity equals the liquid assets of the bank divided by total assets. Some argue that banks with a high level of liquid assts will receive lower interest income than banks with less liquid assets. This asset allocation, however, does not necessarily reflect greater efficiency. I thus control for bank liquidity in 1995.

Bank risk equals the standard deviation of the rate of return on bank assets over the period 1995–99. Some hold that banks operating in a relatively risky environment will tend toward an equilibrium characterized by a high net interest margin to compensate for this risk. Thus, to assess the independent effect of restrictions on foreign bank entry, it is important to control for individual bank risk.

Country-specific variables

Fraction foreign denied equals the fraction of commercial banking applications from foreign banks that are denied by the regulatory authority. These are based on the Barth, Caprio, and Levine (2001a, 2001b, 2003) survey of bank supervision and regulation. Some countries were completely closed to the entry of foreign banks during this period, such as Burundi, Chile, and Jamaica. Others, such as Austria, South Africa, Canada, and Panama, had denial rates of between five and twenty percent. Still others had denial rates of zero, that is, no foreign bank applications were denied. As shown in table 1, the mean value of fraction foreign denied is 0.13 with a standard deviation of 0.28.

There are problems with the fraction foreign denied variable. If a country does not allow foreign entry, then foreign banks will not apply and there will be no applications. If a country heavily restricts foreign entry, there may be few applications. In this case, those that do apply may use bribes and other measures prior to issuing an application. Denial rates may thus be low even in countries that heavily restrict foreign entry. Similarly, measurement problems may arise in the case of countries that allow a foreign bank to enter by purchasing a domestic bank, because this mode of entry does not require the foreign bank to apply for a commercial banking license. This type of entry is not captured in the survey, which only measures applications. However, it is captured by the change in the fraction of foreign bank ownership. These measurement problems should bias the results against finding a robust link between the fraction of foreign entry applications denied and net interest margin. Nevertheless, I use instrumental variables to mitigate the problem associated with pure measurement error and confirm the results.

Fraction domestic denied equals the fraction of entry applications by domestic entrepreneurs that are denied by the regulatory authority. As with the fraction foreign denied, there is extensive cross-country variation. I examine fraction domestic denied primarily as a control variable. Is fraction foreign denied associated with net interest margin beyond the fraction domestic denied? If so, it would indicate that there is something special about restricting foreign bank entry.

Foreign ownership equals the fraction of banking system assets held by banks that are 50 percent or more foreign owned. These data are from the Barth, Caprio, and Levine survey. In some countries, virtually all of the banking system is foreign owned, as in New Zealand, Botswana, and Luxembourg. In other countries, none of the banking system is foreign owned, as in Nigeria, India, Iceland, and Burundi. I use foreign ownership to assess whether foreign ownership is crucial in explaining bank margins, or whether it is the contestability of the banking market—as proxied by fraction foreign denied—that is crucial for explaining differences in net interest margin.

Inflation equals the log difference of the consumer price index over the 1995–99 period and is taken from the World Bank's *World Development Indicators*. Some work suggests that inflation will expand the wedge between interest income and interest expense. If macroeconomic instability is also associated with restrictions on foreign competition, then impediments to foreign banks may reflect general macroeconomic malaise rather than the independent influence of restrictions on foreign banks on bank margins. I therefore control for inflation in assessing the links between regulatory impediments to foreign bank entry and bank margins.

Concentration equals the fraction of assets held by the three largest commercial banks in each country. Banking system structure may influence net interest margins. Indeed, regulatory restrictions on bank entry may influence net interest margins by increasing concentration and hence the market power of banks. I am interested in examining the impact of entry restrictions on net interest margins. I am less interested here in exploring whether restrictions on foreign bank entry influence concentration and through concentration net interest margins. Thus, I first conduct the analyses without concentration to assess the direct impact of fraction foreign denied on net interest margins; I then control for concentration.

1.3 Correlations

The correlations in table 2 foreshadow key elements of this paper's analyses. Fraction foreign denied is positively and significantly correlated with net interest margins. Fraction domestic denied is also positively and significantly correlated with net interest margins. While fraction foreign denied and fraction domestic denied are positively correlated with each other, the correlation coefficient is only 0.50, which indicates that regulatory restrictions on foreign and domestic banks do not move one-for-one with each other. The correlations also show that foreign bank ownership is not significantly correlated with net interest margins or the denial of bank entry.

Table 2. Simple Cross-country Comparisons[a, b]

Variable	*Interest margin*	*Fraction foreign denied*	*Fraction domestic denied*	*Foreign ownership*
Fraction foreign denied	0.468	1		
	(0.0009)			
	47	*47*		
Fraction domestic denied	0.385	0.5	1	
	(0.0075)	(0.0003)		
	47	*47*	*47*	
Foreign ownership	0.1167	0.0707	0.0795	1
	(0.4852)	(0.6731)	(0.6351)	
	38	*38*	*38*	*38*

a. *P* values in parentheses.
b. Number of observations in italics.

2. Regression Results

As a preliminary step, I ran a panel regression using both random and fixed effects, controlling only for the bank-specific variables. As shown in table 3, the coefficient estimates from the random and fixed effect estimators are very close. Later regressions include country-specific variables and are run using random effects.

The coefficient estimates on the bank-specific variables suggest the following. Unsurprisingly, banks with large overhead costs also have large net interest margins. To the extent that large overhead expenditures and wide margins at least partially reflect bank inefficiency, these bank characteristics will be positively related. The results indicate that big banks tend to have smaller margins. While I do not fit a cost curve, this finding is not inconsistent with arguments of economies of scale in banking. Equity as a fraction of bank assets is not significantly related to net interest margins, although banks that hold more liquid assets tend to have lower margins. This may reflect the lower remuneration on liquid assets. Finally, table 3 demonstrates the negative relationship between fee income and interest margins. Banks that receive more income through non-interest-earning activities have a smaller net interest income as a share of interest-bearing assets than do banks with a lower portion of their income from such activities. While by no means conclusive and also not the focus of the analysis here, this finding is consistent with arguments of cross-subsidization of activities within the bank.

Table 3. Regressions Controlling Only for Bank-specific Factors[a]

Independent variable	*(1)*	*(2)*
Bank overhead	0.537	0.515
	(0.000)	(0.000)
Bank size	–0.107	–0.096
	(0.000)	(0.000)
Bank liquidity	–0.015	–0.016
	(0.000)	(0.000)
Bank equity	0.005	0.007
	(0.319)	(0.224)
Fee income	–0.341	–0.344
	(0.000)	(0.000)
Summary statistic		
R^2 within	0.364	0.365
R^2 between	0.558	0.522
No. observations	1,165	1,165
No. countries	47	47
Estimation	Random effects	Fixed effects

a. Dependent variable is interest margins, which is averaged over the 1995–99 period. The other bank-specific variables (bank overhead, bank size, bank liquidity, bank equity, and fee income) are measured in 1995. The estimation is performed using generalized least squares (GLS) with random or fixed effects, as indicated. A constant term was included, but it is not reported in the table. *P* values are in parentheses.

Table 4. Interest Margins and Restrictions on Foreign-bank Entry[a]

Independent variable	*(1)*	*(2)*	*(3)*	*(4)*
Fraction foreign denied	3.450			3.060
	(0.000)			(0.000)
Foreign ownership		0.680		0.362
		(0.420)		(0.639)
Fraction domestic denied			1.184	0.723
			(0.114)	(0.373)
Summary statistic				
R^2 within	0.364	0.299	0.364	0.299
R^2 between	0.574	0.521	0.591	0.529
No. observations	1,165	900	1,165	900
No. countries	47	38	47	38

a. Dependent variable is interest margins, which is averaged over the 1995–99 period. The regressions include five bank-specific variables (bank overhead, bank size, bank liquidity, bank equity, and fee income) measured in 1995 and a constant term, but these are not reported in the table. The regressions also include measures of the fraction of foreign bank entry applications denied, domestic bank entry applications denied, and foreign bank ownership. The estimation is performed using generalized least squares (GLS) with random effects. *P* values are in parentheses.

2.1 Interest Margins and Foreign Banks

Table 4 presents regressions including all the bank-specific variables and combinations of fraction foreign denied, foreign ownership, and fraction domestic denied. The coefficients on the bank-specific variables are not included in the tables, though they do not vary much from the estimates in table 3. As noted, the regressions are run using generalized least squares with random effects.

The results indicate that greater restrictions on foreign bank entry (as proxied by fraction foreign denied) is positively associated with net interest margins. That is, restricting foreign bank entry boosts the gap between interest received and income paid as a fraction of interest-earning assets. Furthermore, the results suggest that restricting foreign banks from entering is special.

The size of the coefficient is economically large. Consider the coefficient on the final regression in table 4 on fraction foreign denied, which equals 3. This suggests that if Chile had the mean value of fraction foreign denied of 0.13 instead of its value of 1, its net interest margin on banks would be 2.7 percentage points lower (3·0.87) over the estimation period. This would imply a reduction in Chile's net interest margin from 5.0 to 2.3, and it would bring Chile's average net interest margin below the sample mean of 3.5.

The regressions in table 4 also indicate that foreign bank ownership of domestic banking assets and the fraction domestic denied are not significantly correlated with net interest margins. Foreign ownership per se is not crucial, but regulatory restrictions on foreign bank entry do affect net interest margins. These results highlight the importance of the contestability of the market. The results are consistent with the argument that reducing the potential entry of foreign banks allows net interest margins to grow. Furthermore, restricting the entry of domestic banks is not as critical. While restricting foreign bank entry boosts net interest margins, domestic bank entry does not enter the regression significantly.

Finally, when including fraction foreign denied, foreign ownership, and fraction domestic denied simultaneously in the net interest margin regression, I find that only the fraction of foreign denied enters significantly. Even after controlling for regulatory restrictions on domestic bank entry and for the degree of foreign ownership of the domestic banking industry, the results continue to indicate that impediments to foreign bank entry boost net interest margins.

2.2 Sensitivity Analyses

Readers may have concerns over the sample of countries, which includes transition economies, sub-Saharan African countries, and the United States, which has thousands of banks. It is thus important to assess whether the results in table 4 hold on subsets of countries. Table 5 presents the results for four subsets of countries: namely, the full sample less the sub-Saharan African countries, less the formerly socialist countries, less the United States, and less the sub-Saharan African countries, the formerly socialist countries, and the United States.

Even in the subsample that yields the smallest coefficient on fraction foreign denied, the coefficient suggests an economically meaningful magnitude. Specifically, the coefficient in regression 5 suggests that if Chile had the mean value of fraction foreign denied of 0.13 instead of its value of 1, its net interest margin on banks would be 1.4 percentage points lower (1.6·0.87). This would imply a reduction

Table 5. Interest Margins and Restrictions on Foreign Bank Entry: Subsamples[a]

	Subsample of countries				
	Omit sub-Saharan Africa (SSA)	*Omit formerly socialist countries (FS)*	*Omit USA*	*Omit SSA, FS, & USA*	*Omit SSA, FS, & USA*[b]
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
Fraction foreign denied	1.972	3.594	3.401	1.896	1.585
	(0.004)	(0.000)	(0.000)	(0.000)	(0.042)
Foreign ownership					0.107
					(0.832)
Fraction domestic denied					0.587
					(0.379)
Summary statistic					
R^2 within	0.371	0.405	0.368	0.434	0.344
R^2 between	0.681	0.612	0.610	0.815	0.798
No. observations	1,144	1,107	930	851	600
No. countries	41	40	46	33	26

a. Dependent variable is interest margins, which is averaged over the 1995–99 period. The regressions include five bank-specific variables (bank overhead, bank size, bank liquidity, bank equity, and fee income) measured in 1995 and a constant term, but these are not reported in the table. The regressions include measures of the fraction of foreign bank entry applications denied, domestic bank entry applications denied, and foreign bank ownership. The estimation is performed using generalized least squares (GLS) with random effects. P values are in parentheses.

b. In addition to the right-hand-side variables included in regression (4), regression (5) includes fraction domestic denied and foreign ownership.

in Chile's net interest margin from 5.0 to 3.6, and it would bring Chile's average net interest margin close to the sample mean of 3.5. Thus, the robustness check using subsamples of countries confirms the economically large impact o restricting foreign bank entry on net interest margins.

The results in table 5 indicate that the fraction foreign denied enters positively and significantly at the 0.01 level in various subsamples of countries. Thus, the finding that regulatory restrictions on foreign bank entry boost net interest margins is robust to alternations in the sample of countries.

It is also important to control for other country and bank characteristics. For instance, macroeconomic instability may produce large interest margins, and it may also create a political environment that fosters a wary stance toward foreign competition. In this case, the positive relationship between regulatory restrictions on foreign bank entry and bank margins would reflect macroeconomic stability, not an independent relationship between entry restrictions on foreign banks and net interest margins. I thus control for inflation. Similarly, bank risk and the concentration of the banking industry may influence bank net interest margins. If the regressions do not control for these factors, then the results on entry restrictions on foreign banks and bank margins will generate correspondingly lower confidence.

Table 6 indicates that the positive relationship between fraction foreign denied and bank net interest margins is robust to including inflation, the variability of the rate of return on bank assets (bank risk), and the concentration of the banking industry for each country. Inflation enters all of the regressions positively and significantly at the 0.01 level. Bank risk and concentration enter some of the regressions significantly at the 0.10 level. Most pertinent here, regulatory restrictions on foreign bank entry enters all of the regression significantly at the 0.01 level.

2.3 Robustness Check Using Instrumental Variables

This subsection uses a two-stage generalized least squares estimator to assess whether the exogenous component of the fraction of foreign entry applications that are denied is associated with bank net interest margins. As discussed above, there may be problems associated with measuring restrictions on foreign bank entry. I use two different types of instrumental variables in conducting robustness checks.

Table 6. Interest Margins and Restrictions on Foreign-bank Entry: Other Controls

Independent variable	*(1)*	*(2)*	*(3)*	*(4)*
Fraction foreign denied	2.09	2.035	1.902	2.317
	(0.001)	(0.001)	(0.001)	(0.003)
Foreign ownership				0.239
				(0.729)
Fraction domestic denied				–0.409
				(0.584)
Inflation	0.118	0.121	0.115	0.119
	(0.000)	(0.000)	(0.000)	(0.000)
Bank risk		–0.057	–0.056	–0.121
		(0.221)	(0.226)	(0.082)
Concentration			1.371	1.564
			(0.052)	(0.073)
Summary statistic				
R^2 within	0.365	0.365	0.365	0.300
R^2 between	0.738	0.741	0.756	0.727
No. observations	1,137	1,137	1,137	872
No. countries	46	46	46	37

a. Dependent variable is interest margins, which is averaged over the 1995–99 period. The regressions include five bank-specific variables (bank overhead, bank size, bank liquidity, bank equity, and fee income) measured in 1995 and a constant term, but these are not reported in the table. The regressions also include measures of the fraction of foreign bank entry applications denied, domestic bank entry applications denied, and foreign bank ownership. The estimation is performed using generalized least squares (GLS) with random effects. *P* values are in parentheses.

First, as argued by Demirgüç-Kunt, Laeven, and Levine (2002), regulatory impediments on banks reflect broad national institutional characteristics. Thus, I first use the Kaufmann, Kraay, and Zoido-Lobatón (2001) measure of institutional development as an instrument for entry restrictions. Specifically, Kaufmann, Kraay, and Zoido-Lobatón (2001) compile information on voice and accountability, that is, the extent to which citizens can choose their government and enjoy political rights, civil liberties, and an independent press; political stability, that is, a low likelihood that the government will be overthrown by unconstitutional or violent means; government effectiveness, that is, the quality of public service delivery, the competence of civil servants, and the absence of politicization of the civil service; light regulatory burden, that is, a relative absence of government controls on goods markets, government interference in the banking system, excessive bureaucratic controls on starting new businesses, and excessive regulation of private business and international trade; rule of law, that is, protection of persons and property against violence or theft, independent and effective judges, and contract enforcement; and freedom from graft, that is, absence of corruption or the use of public power for private gain. These components have values between zero and two, with larger values implying better institutions. I average these components into an aggregate measure of institutional development for each country. The correlation between this aggregate institutional index and the fraction of entry applications denied is –0.63 and is significant at the 0.05 level.

When using this aggregate institutional index as an instrumental variable, I confirm all of the paper's findings with little change in the coefficient estimates. Thus, the results are robust to pure measurement error. Moreover, these instrumental variable findings provide an economically intuitive story. National institutions and attitudes toward competition are reflected in policies, such as impediments to foreign bank entry, and hence in bank net interest margins.

As a second robustness check, I use an alternative, arguably more exogenous, instrumental variable: namely, the absolute value of the latitude of the country. From an economic perspective, Acemoglu, Johnson, and Robinson (2001) and Engerman and Sokoloff (1997) argue that geographical endowments influenced the formation of long-lasting institutions that continue to shape national policies toward international openness and competition. This argument is based on the following building blocks. First, European colonists adopted different colonization strategies. At one end of the spectrum, the Europeans settled and created institutions to support private property, check the power of the state, and foster open, competitive economies. These "settler colonies" include the United States, Australia, and New Zealand. At the other end of the spectrum, Europeans did not aim to settle and instead sought to extract as much from the colony as possible. In these "extractive states," Europeans did not create institutions to support private property rights and foster internationally open economies; rather, they established institutions that empowered and protected the elite. Examples include Congo, Ivory Coast, and much of Latin America. The second component of Acemoglu, Johnson, and Robinson's theory holds that the type of colonization strategy was heavily influenced by the feasibility of settlement. Europeans tended to create extractive states in inhospitable environments, whereas they tended to form settler colonies in areas where endowments favored settlement (Acemoglu, Johnson, and Robinson, 2001). Third, the institutions created by European colonizers endured after independence. Settler colonies tended to produce postcolonial governments that were more devoted to defending private property rights and promoting competition than extractive colonies. In contrast, since extractive colonies had already constructed institutions for effectively extracting resources, the postcolonial elite frequently assumed power and readily exploited the preexisting extractive institutions. I use the absolute value of latitude to proxy for geographical endowments, albeit imperfectly. This proxy for geographical endowments is particularly problematic for noncolonies, so I confirm all the findings for various subsamples. For more on using latitude to proxy for geographical endowments, see Beck, Demirgüç-Kunt, and Levine (2003) and Easterly and Levine (2003).

Table 7 presents simple, pure cross-country regressions that suggest the appropriateness of using latitude as an instrumental variable for regulatory restrictions on foreign bank entry. In these regressions, net interest margin refers to the simple, unweighted average of net interest margins across the country's banks. The first regression indicates that latitude significantly explains net interest margins. The second regression confirms that fraction foreign denied also explains net interest margins.

The third regression in table 7 indicates that latitude significantly explains cross-country variation in regulatory restrictions on foreign bank entry at the 0.01 significance level. Importantly, the fourth regression presents regression results of net interest margin against

Table 7. Simple Cross-country Regressions[a]

	Dependent variable				
Independent variable	*Interest margin*	*Interest margin*	*Fraction foreign denied*	*Interest margin*	*Interest margin*
Latitude	–5.180		–0.623	–2.919	
	(0.016)		(0.009)	(0.152)	
Fraction foreign denied		4.550		3.638	8.324
		(0.003)		(0.015)	(0.013)
Summary statistic					
No. countries	47	47	47	47	47
R^2	0.143	0.219	0.196	0.255	
Estimation	OLS	OLS	OLS	OLS	2SLS

a. These are cross-country regressions. Interest margin is averaged over the bank in each country over the 1995–99 period. Latitude is the absolute value of the latitude of the country. Fraction foreign denied is the fraction of foreign bank entry applications denied. OLS: ordinary least squares with robust standard errors. 2SLS: Two-stage least squares, where latitude is used as an instrument for fraction foreign denied. *P* values in parentheses.

both latitude and fraction foreign denied. While fraction foreign denied enters significantly, latitude does not. This is consistent with the view that latitude explains net interest margin through its effect on fraction foreign denied. Indeed, the last regression in table 7 uses latitude as an instrumental variable for fraction foreign denied. It indicates that in this pure cross-country context, the exogenous component of fraction foreign denied is positively associated with the average value of net interest margin.

I return now to bank-level data. Table 8 presents two-stage least squares regressions of individual net interest margins on bank-specific characteristics, various country-specific control variables, and fraction foreign denied, where latitude is used as an instrument for fraction foreign denied. As shown, the exogenous component of fraction foreign denied enters all of the regressions positively and significantly. Inflation also enters positively and significantly. Concentration and bank risk, however, do not enter these two-stage generalized least squares significantly. In sum, the finding that regulatory restrictions on foreign bank entry boost bank net interest margins is robust to instrumenting for fraction foreign denied.

Table 8. Interest Margins and Restrictions on Foreign-bank Entry: Instrumental Variables[a]

Independent variable	*(1)*	*(2)*	*(3)*	*(4)*
Fraction foreign denied	8.287	7.047	6.958	6.969
	(0.000)	(0.003)	(0.001)	(0.001)
Inflation		0.081	0.083	0.079
		(0.006)	(0.001)	(0.001)
Bank risk			–0.052	–0.052
			(0.268)	(0.269)
Concentration				0.815
				(0.436)
Summary statistic				
R^2 within	0.364	0.365	0.366	0.366
R^2 between	0.418	0.593	0.598	0.607
No. observations	1,165	1,137	1,137	1,137
No. countries	47	46	46	46

a. Dependent variable is interest margins, which is averaged over the 1995–99 period. The regressions use the absolute value of a country's latitude as an instrument for fraction foreign denied. The regressions include five bank-specific variables (bank overhead, bank size, bank liquidity, bank equity, and fee income) measured in 1995 and a constant term, but these are not reported in the table. The regressions also include measures of the fraction of foreign bank entry applications denied, domestic bank entry applications denied, and foreign bank ownership. The estimation is performed using a two-stage generalized least squares (GLS) with random effects. P values are in parentheses.

3. CONCLUSION

This paper examined the impact of regulatory impediments to foreign bank entry on bank net interest margins. To proxy for restrictions on foreign bank entry, I used the fraction of foreign bank entry applications denied by the regulatory authority of the country. The investigation uses data on 1165 banks across forty-seven countries and controls for numerous bank-specific and country-specific factors.

The paper also isolated the effect of restricting foreign bank entry from restrictions on domestic bank entry and from foreign bank ownership of the domestic banking industry. The paper thus examined the extent to which restricting foreign bank entry is special. To accomplish this, I simultaneously controlled for regulatory restrictions on domestic entry and the fraction of domestic banking system assets held by foreign-owned banks.

The paper concludes that impediments to foreign bank entry exert a positive impact on bank net interest margins. Furthermore, I find that foreign banks are special. When controlling for impediments to domestic bank entry and the extent of foreign bank ownership, restrictions on foreign bank entry continue to explain bank net interest margins. Indeed, while foreign bank entry restrictions enter significantly, neither domestic bank entry restrictions nor foreign bank ownership help explain bank interest margins. Contestability by foreign banks importantly determines bank interest margins. This paper's findings are confirmed when using instrumental variables to proxy for differences in national institutions that yield different policies toward foreign banks. These instrumental variable results increase confidence in the conclusion that restricting foreign bank entry increases bank interest margins, while cautioning that this relationship may reflect deeper institutional traits.

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The Effect of Cross-industry Ownership on Pricing: Evidence of Common Ownership between Banks and Pension Funds in Chile

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The Chilean pension fund system has become a key participant in the domestic capital market. Pension funds accumulate and administer the retirement savings of a large share of the work force. Pension funds have grown substantially since their inception in 1980, accumulating resources amounting to more than 50 percent of domestic GDP in 2002. They thus constitute the second-largest component of the financial industry, after the banking sector.[1] During this same time period, financial conglomerates have gained increasing relevance in Chile, and it is now common to find holding companies controlling a pension fund and a commercial bank, as well as other providers of financial services, such as insurance companies and mutual funds.[2]

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1. For a detailed history of the Chilean pension fund industry, see Salomon Smith Barney (2002).

2. The term financial conglomerate is used only for illustration purposes, since the concept of financial conglomerate is actually missing in the Chilean financial legislation. There is no "consolidated" supervisor, either. These characteristics of Chilean financial regulation make studying the potential interactions that could arise among financial institutions belonging to the same group even more interesting.

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These financial conglomerates are part of prominent domestic- and foreign-owned economic groups that have interests in various industrial sectors.[3]

Banking institutions within these conglomerates arguably may benefit from the association with pension funds, which are the largest providers of funding in the economy, through the generation of competitive advantages in the markets for banking products. Pension funds are, in fact, required by law to invest a fraction of their managed funds in bank deposits. Moreover, a pension fund is allowed to allocate resources to a bank that is part of the same financial conglomerate. Despite the existence of important regulatory restrictions (discussed in detail later), pension funds are extremely large customers of the banks with which they share common ownership. This is clearly indicated if one looks at the holdings of a particular bank's instrument by the pension fund belonging to the same conglomerate (see tables 1 through 3). For instance, AFP Cuprum, the third-largest pension fund, was responsible for 2 percent of Banco de Chile's total deposits in December 1998 (table 3), which represented nearly 16 percent of the bank's capital (table 1); both companies at that time belonged to the domestically owned Penta group. As shown in the tables, the reported figures are not the exception and are certainly nontrivial. Even holdings on the order of 1–2 percent of a bank's capital —among the lowest numbers in table 1— would certainly qualify as representing very large bank customers.

One could speculate that the relationship between the bank and such a large customer would allow for instances of cross-subsidization that would be beneficial to both parties and fulfill the broader interests of the conglomerate. For example, the bank could offer a higher rate of return on the accounts managed by the affiliated pension fund. In exchange, the bank could count on a more stable supply of deposits, which would support a more aggressive lending strategy. Taking on riskier investment projects could generate a higher rate of return on the lending portfolio, together with broader interest margins and higher profitability.

3. LeFort and Walker (2000) document that by 1998, nearly 74 percent of companies listed in the official records of the securities regulatory agency belong to an economic group. They show that percentage is increasing over time, and it underestimates the importance of economic groups in terms of total market capitalization, because it does not consider banks or other financial institutions.

Table 1. Holding of Bank's Instruments by Related Pension Funds as Percentage of Bank's Capital[a]

Bank	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Banco del Estado	1.2	1.4	1.5	3.2	2.4	2.6	
Banco Santander Chile		8.2	11.9	5.8	5.3	4.3	3.2
Banco de Chile	19.3	21.7	35.1	16.3	9.5	8.8	*31.6*
Banco O'Higgins		0.4					
Corpbanca			2.3	3.0	*64.4*	*67.7*	*85.6*
Citibank N A.	13.0	12.3	9.7	13.5	18.2	12.7	16.4
Banco Security	3.6	2.3	14.1				
BBVA Banco BHIF			*25.0*	*42.2*	37.8	27.5	30.1
Banco Santiago	*23.9*	*32.8*	*19.6*	*27.0*	19.4	15.8	12.8

Source: Authors' computations, using Superintendence of Pension Fund Administrators (SAFP) database.
a. Data are for December of each year. Bank's instruments include demand and time deposits, mortgage letters of credit, subordinated bonds, and stocks. Numbers in italics indicate that the pension fund has no common ownership with the bank.

Table 2. Holding of Bank's Issued Instruments by Related Pension Funds as Percentage of Value Administered by the Pension Fund[a]

Bank	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Banco del Estado	3.7	3.6	2.3	4.9	3.1	3.1	
Banco Santander Chile		1.9	1.5	1.1	0.7	0.6	0.5
Banco de Chile	3.4	2.7	4.0	1.8	1.0	0.8	*2.7*
Banco O'Higgins		4.5					
Corpbanca			0.1	0.1	*1.2*	*1.3*	*1.6*
Citibank N A.	0.4	0.4	0.3	0.7	0.9	0.5	0.7
Banco Security	0.1	0.1	0.4				
BBVA Banco BHIF			*0.7*	*1.8*	1.0	0.9	0.9
Banco Santiago	*3.8*	*5.0*	*7.0*	*6.2*	3.6	2.8	2.1

Source: Authors' computations, using SAFP database.
a. Data are for December of each year. Bank's instruments include demand and time deposits, mortgage letters of credit, subordinated bonds, and stocks. Numbers in italics indicate that the pension fund has no common ownership with the bank.

We test this hypothesis using a unique panel of data containing information on new deposits and loans and their corresponding interest rates reported daily by each bank operating in the Chilean financial system. The dataset spans financial observations over a period of more than six years, beginning on 2 May 1995 and ending on 29 June 2001.

Table 3. Deposit from Connected Pension Funds as Percentage of Total Bank Deposits[a]

Bank	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Banco del Estado	0.1	0.1	0.1	0.3	0.2	0.3	
Banco Santander Chile		0.9	1.5	0.7	0.5	0.5	0.3
Banco de Chile	3.1	3.2	5.2	1.9	1.1	0.8	*2.9*
Banco O'Higgins	0.3	0.4	0.1				
Corpbanca	0.5	0.3	0.2	0.3	*8.2*	*7.9*	*10.3*
Citibank N A.	2.0	1.7	1.5	2.8	3.3	2.4	3.2
Banco Security	0.5	0.2	1.5	0.8			
BBVA Banco BHIF			*2.6*	*7.8*	5.6	5.2	4.9
Banco Santiago	*3.3*	*4.6*	*3.0*	*3.6*	2.6	2.1	1.6

Source: Authors' computations, using SAFP database.
a. Bank's deposits include demand and time deposits, mortgage letters of credit, and subordinated bonds. Numbers in italics indicate that the pension fund has no common ownership with the bank.

Controlling for bank-specific fixed effects and for bank and market characteristics, we test whether banks with a pension fund affiliation have different overall pricing strategies and interest margins than nonaffiliated banks. We also look at the behavior of deposits and loan volumes. Finally, we test whether these banks display a different response than the rest of the banking system to monetary policy changes and whether they reacted differently during the liquidity shock suffered by the Chilean economy in 1998.

Our methodology is based on Berger and Hannan (1989) and Hannan and Berger (1991). Deviation from competitive conduct is one of the reasons given in the literature for the existence of conglomerates. Another is the creation and development of internal capital markets (Stein, 1997). Tarziján (1999) argues that internal capital markets might provide a suitable explanation for the rise of conglomerates in emerging markets, because these economies are characterized by a weak institutional framework, an excessive number of regulations, and imperfect capital markets. In the case of Chile, domestic financial regulations require that compulsory pensions have to be channeled exclusively through pension funds and that these funds must be allocated mainly with local investors. This creates an artificial relationship whereby pension funds become natural providers of savings resources. This framework offers clear incentives for bank owners to have access to the administration of pension funds.

The implications of this investigation into patterns of bank deposit and loan pricing within the context of cross-industry ownership are relevant beyond the boundaries of Chilean financial markets. In the United States, for instance, the Gramm-Leach-Bliley Act of 1999 lifted barriers to the consolidation of financial service providers of different industries. Furthermore, these patterns of cross-industry ownership are not uncommon in other Latin American countries that have adopted the model of private pension fund accumulation, where the dynamics of the pension fund industry structure is evolving into more concentrated markets.

The very high frequency of the dataset is especially useful, in that it allows us to track precisely the response of banking institutions to changes in monetary policy. We find evidence consistent with the hypothesis that cross-industry common ownership generates beneficial effects for both banks and pension funds and, in particular, that banks affiliated with pension funds enjoy some form of competitive edge in the market place. Deposit rates are found to be disproportionately higher at such banks, but their interest rate spreads are also higher than average. Controlling for size and other bank-specific characteristics, we find that such banks also have access to a larger deposit base. Finally, the evidence also supports the prior assumption that such banks are able to pursue riskier lending strategies. These results were amplified during the 1998 liquidity shock to the Chilean economy. There is no evidence, however, of a differential response of banks affiliated with pension funds to changes in monetary policy during normal periods. At the same time, the process of deregulation, which has made pension funds less dependent on domestic sources of investment, seems to have reduced the importance for banks of being tied to a pension fund via common ownership.

Section 1 briefly describes some of the relevant pension fund regulations related to portfolio allocation restrictions prevailing during the sample period. Section 2 describes the dataset and the methodology employed. Section 3 presents and discusses the results and also elaborates potential explanations for the findings. Section 4 concludes.

1. The Chilean Pension Fund System

The private pension fund system was created in the early 1980s to replace the state-owned, state-operated pay-as-you-go pension scheme.[4] The private pension system is characterized by the compulsory accumulation of savings in individuals capitalization accounts, managed by the so-called pension fund administrators (*Administradoras de Fondos de Pensiones*, or AFPs). Participants are allowed to choose their fund administrator. To guarantee a sustainable return to the funds, the AFPs are subject to multiple regulations in terms of their portfolio construction. The numerous limitations on the portfolio diversification of the pension fund system are established in Decree Law DL 3500 (Government of Chile, 1980). This legislation created the Risk Classification Committee, an entity that determines the set of instruments subject of investment by the AFPs, although recently a small percentage of their portfolio was opened to the fund administrator's discretion.

The government retained functions and responsibilities within the private pension system. For instance, a government-insured minimum pension is guaranteed, and the government monitors AFPs to ensure that, in a given period, the portfolio's real return during the past thirty-six months falls within the average real return of the system for that same period.[5] In the event of a bankruptcy of an AFP, the state will honor the obligations related to pensions for the disabled and for retirement-aged beneficiaries of deceased employees. The same benefit applies to insurance companies that are paying annuities to employees under a retirement plan.

The restrictions on portfolio diversification established in the law can be divided into limits by instrument and limits by issuer of a particular financial instrument. The limits by instrument have usually been set by the Central Bank at the maximum allowed within these ranges. For instance, the limits on investment in instruments issued by the government or financial institutions, currently set at 50 percent, varies within a range of 35 percent to 50 percent of the

4. The private pension fund system was established in November 1980 under Decree Law 3500 (DL 3500); it then began operations on 1 May 1981. The system replaced a nearly bankrupt, state-owned, and state-operated pay-as-you-go pension system with mandatory retirement savings. Until 1983, individuals entering the labor market had the option of remaining in the former public system. Thereafter, membership in the new system became mandatory for dependent workers.

5. Article 37 of the DL 3500 establishes that every month, the annualized return of the previous thirty-six months of the portfolio administered by AFPs should not be lower than the minimum of: the average return of the pension fund system, or the average return of a particular fund administered less the absolute of the 50 percent of that return.

value of the fund.[6] The range for shares of domestic companies varies between 10 percent and 40 percent, and the limit is currently set at 40 percent. The percentage allocated to variable income instruments has been on a decreasing trend, following the downside behavior of the domestic stock market.[7]

A notable exception to the regulatory pattern of setting limits at their attainable maximum is the treatment of investment in instruments issued in foreign markets. The authorization for pension funds to diversify their portfolio by holding worldwide instruments was the result of a gradual policy followed throughout the 1990s, possibly to avoid a sustained depreciation of the exchange rate with their implications for inflation or to support financial stability. At the beginning of that decade, AFPs were not allowed to invest their administered resources in foreign markets. In January 1992, the first maximum limit on investment in foreign markets was set at 1.5 percent of the value of the fund, and it was raised to 3.0 percent later that year. In January of 1995, the limit on investing abroad was raised to 6.0 percent. It was soon raised again to 9.0 percent of the value of the fund, but this time the regulator established a particular restriction for variable income instruments of 4.5 percent of the total value managed by the pension fund.

Around that period, pension funds were allowed to enter the formal exchange market, which comprises the Central Bank, the financial institutions, and a few exchange houses, in order to manage the transactions with foreign instruments in foreign currencies.

This gradual rise in the limit on the foreign exposure of pension funds continued with the April 1997 increase to 12.0 percent, keeping the restriction of 4.5 percent for variable income instruments. However, the continuing pressure to diversify the portfolio by holding foreign instruments led authorities to raise the maximum limit attainable in these instruments to 20 percent of the fund's value, with a restriction on variable income instruments of 10 percent of the fund's value. Since then, the limit has been gradually increased by

6. These ranges are applied to the "Fondo 1," which is the fund that contains the bulk of all savings of dependent workers compelled by law to save for retirement. There is also a "Fondo 2" that establishes larger maximum limits for fixed income instruments issued by government or financial institutions, and lower maximum limits for positions in variable income instruments, in order to guarantee a safer return for workers near retirement.

7. DL 3500 also prohibits the use of the same name for the bank and the pension fund, and it forbids managers of any financial intermediaries authorized to operate in the local market from assuming board responsibilities with an AFP.

the Central Bank, within the range dictated by the law. A major reform in the pension fund system at the beginning of 2002 set the maximum limit on investing abroad at 20 percent and temporarily removed the faculty given to the Central Bank.[8]

The regulatory restrictions summarized thus far fall within the class of restrictions imposed on broad types of instruments, where the limits are set by the Central Bank as dictated by DL 3500. Restrictions on the type of issuer, however, are directly dictated in the DL 3500; they control the exposure of pension funds to financial institutions and firms affiliated with the controlling group of a given pension fund. In general, article 47 establishes that the exposure of a pension fund to the sum of investments on demand or time deposits, as well as other debt instruments issued or collateralized by a financial institution or a firm affiliated with the bank, cannot be more than the lesser value of the Tier I plus Tier II capital of a bank (adjusted by a risk factor) and 10 percent of the fund's value (adjusted by additional risk factors set by the Central Bank). The same article, in its second paragraph, establishes that the sum of direct and indirect investments of a pension fund in shares, demand and time deposits, as well as any other debt instrument issued or collateralized by a financial institution, cannot represent more than 7 percent of a particular fund.

In particular, article 47 bis of DL 3500 establishes restrictions on the portfolio allocation of a pension fund, based on the affiliation of the pension fund with a particular issuer. For instance, the minimum risk rating for debt instruments issued by connected firms to be eligible for investment is AA. The total sum of investment according to this criterion cannot be more than 5 percent of the fund's value. More importantly, the article commands pension funds to invest a maximum of 1 percent of the fund's value on instruments issued or

8. This reform, Law N° 19795 of February 2002, also increased the limit for investing in variable income instruments; the limit was raised in two steps, first to 13 percent and then to 15 percent of the fund's value, over six months starting in March 2002, and this restriction was finally removed completely in September 2002. Finally, the limit on investing abroad could potentially be set at 30 percent of the fund's value by March 2004. This reform also raised the number of funds administered from two to five funds. These new funds, identified with the capital letters A through E, have different risk profiles owing to different limits on investments in fixed and variable income instruments, with fund A the potentially riskiest. Nonetheless, the percentage of foreign investment by the AFPs has to comply with the overall limit, currently fixed at 25 percent of the total value of the fund.

collateralized by a related firm. Finally, it mandates pension fund administrators to limit to less than 5 percent of the fund's value the sum directly or indirectly invested on instruments issued or collateralized by all firms related to a pension fund. However, if the pension fund administrators should trespass the regulatory limits on portfolio diversification, the adjustment period is thirty-six months. It is therefore not unusual to observe actual portfolio allocation percentages well above those imposed by regulation, as illustrated in tables 1 through 3.

2. Description of the Dataset and Methodology

The analysis is based on panel data with daily observations for deposit and loan interest rates and related quantities for each bank operating in the Chilean financial system over the period from 2 May 1995 to 29 June 2001.[9] There were thirty-five banking institutions at the beginning of the period, but the number of banks decreased to twenty-eight over the sample period as a result of mergers and acquisitions and exit from the market. Pulling all the information together for each bank over the sample period generated a dataset with up to 51,665 observations.

In July 2001, the Central Bank of Chile decided to change the monetary policy rate from UF-denominated to peso-denominated terms. This nominalization of the monetary policy had a sensible impact on UF deposit and loan rates and on the volume of operations. Given the sizeable change in the balance sheet structure of banking institutions, we decided to set this period aside for the purposes of the estimation.[10]

Before we describe the main dependent variables studied in the document, it is worth describing, at least succinctly, the so-called *Unidad de Fomento*, or UF. This is a unit of account indexed to changes in the domestic consumer price index. The UF is calculated daily from the 10th of each month to the 9th of the following month, according to the variation of the previous month on the consumer price index.

9. The information on daily volumes and interest rates is transmitted electronically by commercial banks to the Superintendence and the Central Bank of Chile every day after the closing of bank business.

10. For a detailed description of the nominalization process of the monetary policy and its effects in the Chilean financial system, see Fuentes and others (2003).

The UF was introduced in 1967 by the Superintendence of Banks and Financial Institutions (SBIF), the government agency that supervises legally established banking institutions. It is used mainly on the pricing of financial contracts for real estate transactions, long-term Central Bank instruments, and the lending and deposit operations of banking institutions.[11]

The empirical exercise is based on regressions of the following model specification:

$$y_{it} = \text{CONS} + \alpha \text{BANKS}_i + \beta \mathbf{X}_{it} + \gamma \mathbf{W}_{it} + \delta \mathbf{Z}_{it} + \varepsilon_{it}$$

where y_{it} is either (1) the UF-denominated deposit rate for each bank i on day t, (2) the daily UF loan rate, (3) the rate spread, (4) the daily deposit volume, or (5) the daily loan volume; BANKS_i is a vector of dummy variables capturing bank specific fixed effects; $\mathbf{X}_{it}$ is a vector of market and bank characteristics varying over time; $\mathbf{W}_{it}$ a vector of indicator variables capturing banks' response to changes in monetary policy; and $\mathbf{Z}_{it}$ is a vector of indicator variables capturing the effect of a bank–pension fund affiliation through common ownership. Following is a more precise description of the dependent variables and some of the regressors.

The UF deposit rate variable, DR, for bank i on day t is a volume weighted average of daily UF-based operations from ninety days to one year.[12] Hence, the rate reported on a particular date does not include rates settled previously, but it reflects current market interest rate conditions. The operations included in the computation of this rate are UF-denominated time deposits and other debt instruments issued by commercial banks in that unit of account. The UF loan rate, LR, is also calculated for lending operations from ninety days to one year. Unlike the UF deposit rate, however, it is constructed as a weighted average of all lending operations of a bank, except for interbank operations, including consumer, mortgage, and commercial lending.[13] Correspondingly, the quantity variables are the volume of deposit and lending operations (DV and LV, respectively) denominated in UF accounts for all new operations in which a

11. Only recently did the government decide to issue sovereign debt instruments.

12. Regulatory restrictions on deposit operations preclude contracts in UF-denominated deposits, or any other indexation scheme, with a maturity lower than ninety days.

13. Loan operations in UF represented nearly 50 percent of all lending operations by July 2001.

bank engaged on a given day with their clients. They thus represent the outflow of credit to companies and the inflow of deposits from the public and the institutional investors.

Our market and bank characteristics include the daily interbank rate (IBR), which corresponds to the overnight rate charged among banks during their daily or weekend operations. The Central Bank aims at providing the liquidity in the banking system so that the interbank rate daily approaches the *instancia* rate.[14] Over the sample period, the difference between the interbank rate and the *instancia* rate was no greater than 5 basis points, on average. Another included market variable is the Herfindahl-Hirschman index (HHI) of market concentration, calculated on total bank assets.

The variables capturing bank-specific characteristics included in the model are bank size (SIZE), measured in terms of total assets; profitability (PROFIT), proxied by the monthly operational return, on an annual basis, over total assets; liquidity (LIQ), proxied by the ratio of liquid funds plus fixed income instruments issued by the Central Bank of Chile over total assets; the riskiness of the loan portfolio (RISK), proxied by nonperforming loans over total loans; and a measure of the capital strength of the institutions (CAP), measured by Tier I capital over total bank liabilities. Apart from the interbank rate, the above mentioned controls have monthly rather than daily variation.

A dummy variable controls for whether the bank is foreign or domestically owned (FOREIGN); it takes the value of 1 if the bank is a foreign bank and 0 otherwise. Another dummy variable controls for episodes of merger or acquisition of a bank (FUSION); it takes the value of 1 for a bank that maintains control after the merger and 0 if the bank has not been involved in a merger. Additional control variables are introduced and described in the following section.

3. Results

Table 4 presents the results of a set of regressions in which the dependent variables are the deposit rate, the loan rate, the rate spread, the deposit quantities, and the loan quantities. All regressions were run including bank fixed effects, although their coefficient estimates

14. The *instancia* rate is the objective policy interest rate defined by the Central Bank to conduct the monetary policy, in order to achieve an inflation target schedule.

are not reported. The first group of regressors includes the interbank rate, also at daily frequency, and a set of dummy variables for each day of the week (the excluded category was Friday), days before a holiday (HOLIDAY) and days before a long weekend (WEEK). These variables attempt to control for time-specific events and time regularities in a bank's daily activity.

The Herfindahl-Hirschman index is positive and significant in both price regressions, but it is negative in the spread regression. This suggests that market concentration in Chile is the result of a dynamic evolution during which the relatively efficient firms have grown and gained market share. This improvement in overall market efficiency is reflected in the higher deposit rates offered to customers and the overall narrower spreads corresponding to periods of higher market concentration. Nonetheless, for a given level of concentration, larger banks and those with higher measures of profitability still exhibit higher spreads than smaller banks. This finding is consistent with the hypothesis of the existence of dominant firms in the market, which are able to exercise some degree of market power. This result does not necessarily contradict that suggested by the estimated coefficient of the Herfindahl index: this latter result may be capturing the evolution of the industry over time, thus indicating that markets exhibit more competitive conditions in periods of higher concentration. The coefficient of size and profitability instead provides cross-bank information on industry conduct, so that at any given time some banks may be exercising more market power than others. Also, foreign banks have lower prices and lower-than-average spreads vis-à-vis domestic banks. This may be due to the fact that many of the foreign banks are actually relatively smaller than domestic ones (the median foreign bank is about 20 percent the size of the median domestic bank).

Next, we focus on the potential role played by the possibility for banks to be affiliated to pension fund companies through common ownership. We tracked the history of common ownership between banks and pension funds and generated a corresponding bank-specific indicator variable, PF. This variable takes a value of 1 if a bank and an AFP share common ownership, 0 otherwise. Over the entire sample period, ten out of the thirty-five banks had, continuously or for a limited time, a common ownership relationship with a pension fund.

As the regression results in columns 4 and 5 of table 4 show, banks with a pension fund affiliation display a broader deposit and loan base, as indicated by the positive and significant coefficients of

Table 4. Panel Estimation of Bank Prices and Related Quantities to Bank-Specific and Market Variables, with Pension Fund Affiliation[a]

Explanatory variable	*(1) DR*	*(2) LR*	*(3) Spread*	*(4) DV*	*(5) LV*
IBR	0.140***	0.115***	–0.034***	0.022***	0.001
	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)
Monday	0.633***	0.270***	0.086**	1.687***	0.253***
	(0.028)	(0.042)	(0.043)	(0.046)	(0.021)
Tuesday	0.457***	0.238***	0.006	1.086***	1.182***
	(0.028)	(0.041)	(0.043)	(0.046)	(0.021)
Wednesday	0.363***	0.167***	–0.033	0.558***	0.116***
	(0.028)	(0.041)	(0.043)	(0.046)	(0.021)
Thursday	0.315***	0.115***	–0.071*	0.222***	0.117***
	(0.028)	(0.041)	(0.043)	(0.046)	(0.021)
HOLIDAY	–0.305***	–0.119***	0.062	–0.851***	0.241***
	(0.064)	(0.095)	(0.098)	(0.107)	(0.049)
WEEK	0.248***	0.264**	0.252*	0.651***	–0.108***
	(0.087)	(0.130)	(0.135)	(0.145)	(0.067)
HHI	0.011***	0.005***	–0.005***	0.004***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	0.076***	0.134***	0.087***	1.138***	0.506***
	(0.021)	(0.033)	(0.031)	(0.035)	(0.016)
PROFIT	–8.836***	–13.713***	17.037**	–0.425	–0.134
	(2.564)	(4.413)	(6.716)	(4.272)	(1.979)
RISK	–11.109***	2.973**	6.275***	–0.467	–4.745***
	(0.851)	(1.424)	(2.025)	(1.417)	(0.656)
CAP	0.070***	0.075***	0.075***	0.012	0.008**
	(0.005)	(0.007)	(0.008)	(0.008)	(0.004)
FOREING	–0.644***	–1.190***	–0.305***	0.738***	0.044
	(0.068)	(0.102)	(0.094)	(0.112)	(0.052)
FUSION	–0.118*	0.392***	0.461***	1.582***	0.662***
	(0.063)	(0.096)	(0.089)	(0.105)	(0.049)
PF	1.271***	1.184***	0.267**	1.668**	0.743***
	(0.080)	(0.123)	(0.118)	(0.132)	(0.061)
DEREG	–0.063***	–0.067***	0.018***	–0.011**	–0.009***
	(0.003)	(0.005)	(0.005)	(0.005)	(0.002)
DEREG·PF	–0.083***	–0.087	–0.040***	–0.099***	–0.044***
	(0.007)	(0.010)	(0.010)	(0.011)	(0.005)
Estimation method	Fixed effects	Fixed effects	Fixed effects	Random effects	Random effects
No. observations	51,665	49,456	38,098	51,665	51,665
R^2	0.21	0.07	0.02	0.62	0.47

a. Breush-Pagan LM and Hausmann specification tests were used to select the model estimation technique for each dependent variable. Banks' fixed effects are included in fixed-effects regressions, but coefficient estimates are not reported. Standard errors are in parentheses.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

the PF dummy in the quantity regressions. This is true, once again, even after controlling for measures of size, risk, and profitability of the individual banks. This result is consistent with the hypothesis formulated in the introduction, namely, that banks enjoying a common ownership relationship with a pension fund can count on a broader, more stable supply of funds, which can be translated into a higher volume of loans. Moreover, as indicated in the first two columns of the same table, the banks with a pension fund affiliation also appear to offer higher deposit rates and charge higher loan rates. Finally, the evidence in column 3 indicates that such banks also enjoy higher spreads. This is all consistent with the original hypothesis that common ownership can give rise to cross-subsidization from which both parties can benefit.[15]

We also added an indicator variable tracking the history of deregulation of pension funds, which, as discussed earlier, have experienced a gradual relaxation of restrictions on investing abroad. The variable, DEREG, thus captures the evolution of the percentage allowed for foreign investment by AFPs. Gaining increasing access to an additional venue for portfolio diversification should imply that pension funds become progressively less dependent on bank deposits. All else equal, the potential tie between banks and affiliated pension funds may have gradually loosened over time. As the quantity regressions in table 4 show, banks —in particular, banks affiliated with a pension fund, DEREF*PF— reduced their deposit and loan base as a consequence of pension fund deregulation. In addition, the spread for those banks became narrower as a result of deregulation, thus somewhat reverting the direction of the basic results embedded in the pension fund indicator variable. The regression results seem to be consistent with this hypothesis and therefore reinforce the assertion that common ownership with pension funds may generate competitive advantages for banks, but that the importance of this edge has fallen as deregulation has allowed pension funds to allocate more resources abroad.

Next, we analyze the response of banks to changes in monetary policy rates and the response around a period of extraordinary changes

15. We have also run regressions to test the corollary statement that banks affiliated with pension funds could take advantage of a more stable deposit base to undertake risky lending strategies. The dependent variable in these regressions was two alternative measures of nonperforming loans. In all cases, the results (not reported in the paper) strongly indicate that banks with a pension fund affiliation display a much riskier lending portfolio than banks without such an affiliation.

in policy rates while the country experienced significant economic turmoil. Financial fragility experienced in some Asian countries in 1997, deriving from their deteriorated international liquidity position, generated pressures over the exchange rate in the domestic markets of Latin American countries. Chile could not isolate itself from the misalignment of the exchange rate, but the Central Bank's efforts to stand by the Chilean peso and the 1998 inflation rate target led to a dramatic increase in the interbank rate in 1998 and to a subsequent liquidity shock. Other international events, possibly part of the aftermath of the Asian crisis (the Russian moratorium and the depreciation of the Brazilian currency), are also deemed responsible for the domestic shock, which further affected the level of capital inflows and the terms of trade.[16]

We look at changes in policy rates during normal periods to explore the response of banks to increases and decreases in the policy rates separately. As suggested in Hannan and Berger (1991), an asymmetric bank response may be an indication of less-than-competitive conduct. The first three columns of tables 5 and 6 present the results of regressions in which we added indicator variables capturing banks' responses to increases and decreases in the policy rate with a delay of one, two, three, and four weeks. In these regressions, we excluded the period of extraordinary changes in policy rates (the shock period). With the shock period thus excluded, the mean decrease in the policy rate was about 30 basis points, while the mean increase was 40 basis points.

There is no evidence that banks affiliated with a pension fund display any difference in behavior relative to other banks in instances of either increasing or decreasing policy rates. Hence, this exercise does not offer additional evidence on the effects on competitive conduct of common ownership among banks and pension funds. There is, however, some evidence of asymmetric behavior common across *all* banks, at least with regard to the market for deposits. As indicated in the first column of table 5, banks respond with a two-week delay to increases in policy rates (the indicator variable is only positive and significant for weeks three and four). In contrast, deposit rates are lowered immediately after a decline in the policy rate, and they continue to be low for at least four weeks after the event.

16. For further details on the facts of the 1998 adjustment of the Chilean economy, see Morandé and Tapia (2002).

Table 5. Panel Estimation of Bank Rates and Spread Sensitivity to Changes in Monetary Policy[a]

Explanatory variable	*(1)* *DR*	*(2)* *LR*	*(3)* *Spread*	*(4)* *DR*	*(5)* *LR*	*(6)* *Spread*
PF	0.660***	0.600***	0.509***	1.023***	0.772***	0.112
	(0.070)	(0.115)	(0.114)	(0.077)	(0.122)	(0.118)
DEREG	–0.041***	–0.042***	0.008	–0.0073***	–0.071***	0.025***
	(0.003)	(0.005)	(0.005)	(0.003)	(0.005)	(0.005)
DEREG·PF	–0.044***	–0.049***	–0.054	–0.078***	–0.091***	–0.049***
	(0.006)	(0.010)	(0.009)	(0.006)	(0.010)	(0.009)
Up1week	–0.084	–0.107	–0.144			
	(0.057)	(0.090)	(0.099)			
Up2week	0.023	0.168*	–0.088			
	(0.057)	(0.091)	(0.099)			
Up3week	0.163***	0.160*	–0.128			
	(0.059)	(0.095)	(0.101)			
Up4week	0.245***	0.048	–0.302			
	(0.059)	(0.094)	(0.102)***			
Up1·PF	0.156	–0.137	–0.166			
	(0.134)	(0.208)	(0.204)			
Up2·PF	0.196	–0.067	0.002			
	(0.134)	(0.209)	(0.205)			
Up3·PF	0.079	0.115	0.223			
	(0.134)	(0.209)	(0.205)			
Up4·PF	0.169	0.336	0.233			
	(0.139)	(0.218)	(0.212)			
Down1week	–0.201***	–0.125***	0.085			
	(0.037)	(0.060)	(0.064)			
Down2week	–0.260***	–0.058***	0.089			
	(0.037)	(0.060)	(0.064)			

Table 5. (continued)

Explanatory variable	*(1)* *DR*	*(2)* *LR*	*(3)* *Spread*	*(4)* *DR*	*(5)* *LR*	*(6)* *Spread*
Down3week	–0.122***	–0.073	0.006			
	(0.036)	(0.059)	(0.063)			
Down4week	–0.116***	–0.028	0.123			
	(0.036)	(0.058)	(0.062)**			
Down1·PF	–0.080	–0.020	–0.015			
	(0.084)	(0.133)	(0.127)			
Down2·PF	0.041	–0.154	–0.083			
	(0.084)	(0.133)	(0.127)			
Down3·PF	–0.101	–0.079	0.064			
	(0.084)	(0.133)	(0.127)			
Down4·PF	–0.068	–0.166	–0.113			
	(0.083)	(0.132)	(0.126)			
Shock				1.656**	–1.185***	–0.480
				(0.030)	(0.045)	(0.050)
Shock·PF				0.755***	2.062***	0.286***
				(0.060)	(0.090)	(0.087)
Estimation Method	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Fixed effects
No. observations	43,812	41,521	32,069	51,665	49,456	38,098
R^2	0.12	0.03	0.02	0.27	0.10	0.02

a. Breush-Pagan LM and Hausmann specification tests were used to select the model estimation technique for each dependent variable. Banks' fixed effects are included in fixed-effects regressions, but coefficient estimates are not reported. The market and bank-specific variables displayed in table 1 are included in all regressions, but coefficient estimates are not reported. Standard errors are in parentheses.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Table 6. Panel Estimation of the Response of Bank Activity and Size to Changes in Monetary Policy[a]

Explanatory variable	*(1)* *DV*	*(2)* *LV*	*(3)* *DV*	*(4)* *LV*	*(5)* *Size*
PF	0.355***	0.666***	1.390***	0.714***	–1.306***
	(0.127)	(0.063)	(0.133)	(0.062)	(0.016)
DEREG	0.003	–0.005**	–0.008*	–0.009***	0.061***
	(0.005)	(0.002)	(0.005)	(0.002)	(0.001)
DEREG·PF	–0.073***	–0.044***	–0.105***	–0.045***	0.158***
	(0.011)	(0.005)	(0.011)	(0.005)	(0.001)
Up1week	0.014	0.118**			
	(0.108)	(0.052)			
Up2week	–0.181*	0.058			
	(0.108)	(0.052)			
Up3week	0.506***	0.113**			
	(0.112)	(0.054)			
Up4week	0.305**	–0.010			
	(0.110)	(0.053)			
Up1·PF	–0.131	–0.008			
	(0.252)	(0.121)			
Up2·PF	–0.921***	–0.144			
	(0.252)	(0.121)			
Up3·PF	–0.097	0.032			
	(0.252)	(0.121)			
Up4·PF	0.336	0.565			
	(0.262)	(0.126)			
Down1week	0.036	–0.063*			
	(0.069)	(0.033)			
Down2week	–0.195***	–0.018			
	(0.069)	(0.033)			

Table 6. (continued)

Explanatory variable	*(1)* *DV*	*(2)* *LV*	*(3)* *DV*	*(4)* *LV*	*(5)* *Size*
Down3week	–0.053	0.076**			
	(0.068)	(0.033)			
Down4week	0.209***	0.015			
	(0.068)	(0.033)			
Down1·PF	0.159	0.069			
	(0.157)	(0.076)			
Down2·PF	0.090	0.042			
	(0.158)	(0.076)			
Down3·PF	0.086	0.116			
	(0.157)	(0.076)			
Down4·PF	0.096	–0.043			
	(0.157)	(0.075)			
Shock			0.097*	0.056**	–0.007
			(0.052)	(0.024)	(0.007)
Shock·PF			1.74***	0.160***	0.147***
			(0.104)	(0.049)	(0.013)
Estimation Method	Random effects	Random effects	Random effects	Random effects	Random effects
No. observations	43,708	43,708	51,665	51,665	51,665
R^2	0.56	0.0842	0.58	0.46	0.47

a. Breush-Pagan LM and Hausmann specification tests were used to select the model estimation technique for each dependent variable. Banks' fixed effects are included in fixed-effects regressions, but coefficient estimates are not reported. The market and bank-specific variables displayed in table 1 are included in all regressions, but coefficient estimates are not reported. Standard errors are in parentheses.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

On the loan side, rates seem to adjust up and down more or less symmetrically (in the second week for increases, in the first week for decreases), although the magnitude of the response seems to be lower than average in either direction. The regression in the third column indicates, although the evidence is not very strong, a narrowing of the rate spread during periods of rate increases and a broadening during periods of decreases.

Finally, we specifically examine the response of banks during the shock period. Banks' rates exhibit an expected strong reaction during the shock period.[17] Interestingly, banks with a pension fund affiliation seem to have experienced rate changes of larger magnitude, as indicated in columns 4 and 5 of table 5. Also, while nonaffiliated banks experienced a reduction in the rate spreads, affiliated banks document an increase in the spread as a result of the shock. This last group of banks also registered a large increase in their deposit base and an increase of lower magnitude of the loan base. This evidence is still consistent with the argument that the affiliation with a pension fund may at least partially insulate banks from market events. Such banks seem to have attracted a relatively larger share of funds at the expense of the other banks, perhaps because they are recognized in the market as less exposed to the effect of the economic shock. To confirm this, a final regression (column 5 in table 6), in which the dependent variable was bank size and the regressors were the interbank rate, the market Herfindahl, the measure of profitability, the foreign or domestic ownership dummy, the merger and acquisition dummy and the different pension fund indicators, shows that banks affiliated with a pension fund increased their size substantially during the shock period.

4. Conclusions

This paper has used a unique dataset containing daily frequency information over a seven-year period on deposits and loan prices and related quantities for each individual bank operating in Chile. The level of detail of the dataset has allowed a first exploration of some basic relationships between market and bank characteristics and prices and quantities settings. It has also allowed us to focus on the response of

17. The mean increase in the policy rate during the shock period was 350 basis points, while the mean decrease was more than 100 basis points.

banks to monetary policy action at a frequency level typically unattainable with more customary datasets. An additional and innovative aspect of the analysis has been the focus on the common ownership between some banks and pension fund companies. Given the significant role played by pension funds as among the largest customers of banks, we have explored whether banks affiliated with pension funds through common ownership experience some form of insulation from market forces, with a consequent manifestation of competitive advantages.

The results of the econometric analysis seem to support the argument that banks benefit from such ties. In particular, affiliated banks exhibit a substantially larger deposit base and enjoy higher spreads overall than unaffiliated banks. Also, during the economic shock of February 1998 to March 1999, such banks experienced a marked increase in size and higher spreads, while the other banks' spreads narrowed. There is no evidence, however, of a differential response of affiliated banks to normal changes in monetary policy. Nonetheless, the regression results have highlighted a generalized asymmetric response on the part of banks to increases or decreases in the policy rate. Banks appear to adjust deposit rates quickly and with consistent magnitude in the case of decreases in the policy rate, while they are slower in circumstances of policy rate increases. The overall effect associated with common ownership has been reduced in magnitude as pension funds have gradually been allowed to expand their portfolio allocation opportunities to include international markets, thus loosening their ties with domestic banking institutions.

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Alternative Approaches to Taxing the Financial Sector: Which Is Best and Where Does Chile Stand?

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Proposals for financial sector tax reform typically come from one of two powerful perspectives. Reformers are either enthusiasts for a big simplification—usually some form of flat tax, such as a value-added tax (VAT) on financial services, zero taxation on capital income, or a universal transactions tax—or advocates of subtle corrective taxation designed to offset some of the many market failures that affect the financial sector or to achieve other targeted objectives. In practice, the two perspectives can clash rather severely, just like the perennial conflict between simplicity in tax administration and the economic efficiency of tax rates. The information and control requirements of much of corrective taxation tend to be poorly accommodated by the big simplifications. As this tension remains unresolved over the years, elements of each approach become embodied in both the explicit and implicit taxation of the sector. At the same time, the ever-pressing demands of revenue intrude as a further influence on policy design. The tax systems in most countries often end up as a complex mixture defying any straightforward rationalization. The big flat-tax ideas are diluted and modified; the corrective taxes may misfire by conflicting with others introduced for different reasons.

Meanwhile, even as simplification and correction continue their tug-of-war, policy design can all too often neglect the two distinctive traps into which financial sector taxation can fall, namely, the sector's unique capacity for arbitrage and its sensitivity to inflation and thus

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to nonindexed taxes. This paper argues that the practical design of financial sector taxation should be governed by a defensive approach in which proposed taxes are assessed relative to their ability to resist arbitrage and their degree of inherent indexation. Although the defensive approach does not provide an adjudication between simplification and correction, it will protect against many of the worst distortions that have been observed.

Chile's tax regime is no exception to this general observation in that its financial sector taxation represents an accretion of ideas and measures over many years. This paper looks at how the most conspicuous features if its financial sector taxation, notably the stamp duties, may be positioned in the spectrum of tax types and tax burdens observed worldwide and evaluates the stamp duties against the proposed defensive criteria. A key finding is that the rates of stamp tax are rather high, and while they score better than some alternatives on the defensive criteria proposed, there may be a case for Chile moving toward a more VAT-like alternative.

1. The Big Reform Ideas (Flat Tax)

One general approach to financial sector taxation is to attempt a great simplification, based on the theory that low rates and a wide base with few exemptions is likely to generate relatively low distortions. This approach holds out the prospect not only of minimizing the incentive for complex schemes of financial engineering designed to avoid tax, but also of making such schemes relatively difficult to develop.

The three main handles for taxation—income, expenditure, and transactions—have each been the subject of prominent and extensively discussed grand and simple schemes. These are the proposition that capital income should not be taxed at all; the proposal that value-added by the financial services industry should be subject to a uniform tax; and the idea that a tax on all financial transactions at a very low rate could generate very large revenues with negligible distortion. This section considers these one by one.

1.1 Taxing Capital Income

The underlying basis for the argument that it might be optimal not to tax capital income at all is the insight that this involves a form of double taxation on future consumption. By shifting the perspective from the statutory base of the tax—capital income—to a variable more closely relevant to economic policy—namely, utility based on household consumption—this economic analysis of capital taxation shows that a constant nominal or statutory tax rate on capital income implies an effective rate on consumption that may increase without bound for consumption far into the future. Because future consumption depends on the reinvestment of after-tax capital income, the effective tax rate increases as the date of future consumption grows more remote—and this effective tax rate may increase without bound. Optimal tax policy can improve on a situation with infinitely high effective tax rates; this reasoning accordingly points to the optimality of capital income taxation converging to zero (see Boadway and Keen, 2003).

Many subtle qualifications can be made to the implicit models of utility, income, and consumption that underlie this analysis. The precise prescription for zero taxation is not very robust, yet it retains some force and serves as an important counterweight to proposals for high rates of capital income taxation designed to achieve other goals. One such goal is that of ensuring the socially optimal rate of national saving (since private markets cannot generally be relied on to do this and may result in oversaving). Another is redistribution. Yet even if households differ in their wage-earning capacity and tax policy is being used for redistributional goals, these can best be achieved by a tax on wage income alone—at least in simple models of intertemporal preferences. Once again, the use of capital income taxation would be suboptimal because of the compound interest effect.

If income from capital is not to be taxed, then it might seem to follow that the income of financial intermediaries ought not to be taxed, either. In practice, however, some corporate income—perhaps a large portion—represents pure profit or economic rent. Pure profit is neglected in the models that generate the no-capital-income-tax result, although it can be taxed without distortion. It could be an empirically important factor where financial markets are uncompetitive, and the scale economies that are involved in parts of finance make it relevant, especially in financially closed economies.[1]

1. Caminal (2003) explores the implications for tax incidence of market power in banking. As he and others have noted, though, leaving banks with some untaxed economic rent (or franchise value, as it tends to be called in the banking literature) can reduce the potentially strong propensity among insured banks to assume socially excessive risks (Stiglitz, 1994; Caprio and Summers, 1996).

A stronger line of attack on the no-capital-income-tax proposition comes from practical issues of enforcement and informational deficiencies. If capital income goes completely untaxed, this may provide an easy loophole for high-earning households to camouflage their earnings by transforming or laundering them into capital income. A tax on capital income may be an important practical expedient to close such loopholes.[2] If so, withholding the tax at source or taxing corporate income as a form of implicit withholding may further help to overcome the tax authorities' informational disadvantage and administrative collection costs.

The elegant simplicity of the theoretical argument against capital income tax thus ultimately fails, though it points to a need to justify such taxation—and the taxation of the income of financial and other companies—on grounds other than those of simple consistency with taxation of wage income.

1.2 Taxing Financial Services: Can a VAT Work?

About 70 percent of the world's population lives in countries with a VAT, and the tax is a key source of government revenue in more than 120 nations (Ebrill and others, 2001).[3] If a VAT is the way forward for the bulk of (indirect) taxation on expenditure, to what extent should it also be the model for financial services?

In practice, most financial services are "exempt" in virtually all countries employing a VAT. This does not mean that these financial services wholly escape the VAT, however, since their exempt status does not allow financial service providers to recover VAT paid by their taxable suppliers and built into the price of their inputs. Indeed, taxable firms who use financial services as inputs cannot recover the VAT paid by the suppliers of financial service firms either, with the result that there is so-called tax cascading. But value that has been added by the exempt financial sector firms is not captured in the tax. Whether aggregate tax receipts would increase or fall if the exemption were removed is an unresolved empirical issue that depends not

2. Differentiating the rate of withholding tax on income from high-risk (equity) and low-risk (debt, deposits) assets could help achieve progressivity even in the absence of information on the income of the recipients, assuming diminishing risk aversion with wealth (Gordon, 2000).

3. The largest countries, by population, without a VAT are India, the United States, Iran, Ethiopia, Democratic Republic of the Congo, Myanmar, Afghanistan, North Korea, Iraq, and Malaysia.

only on the degree to which financial services are used by tax-liable firms, but also on the different rates of VAT that may be in effect.

The exemption of most financial services from VAT appears to be a historical inheritance without much political or economic rationale. The main reason adduced is the practical difficulty of deciding how much credit taxable firms that use financial services would be entitled to claim, seeing that the charge for many financial services is an implicit one bundled with others in, for example, the spread between deposit and lending rates. Determining how much of the spread should be attributed to depositor services and how much to borrower services is not straightforward. Thus it is not obvious how much credit each should receive for VAT already paid on inputs.

Yet it is not impossible to devise simple rules of thumb that can provide a reasonable approximation. For example, the cash flow method in which VAT is paid on all net cash receipts (including capital amounts) could be adequate in a static environment. However, start-up problems and treatment of risk may not be adequately resolved by this method, and changing tax rates also present difficulties for the approach. A variant of the cash-flow method that uses suspense accounts and an accounting rate of interest to bring transactions at different dates to a common standard could help ease the transition problems; detailed pilot studies in the European Union have shown this method to be workable (Poddar, 2003).

The lack of any clear potential revenue gain and fears about the practical complexity and possible hidden distortions or loopholes have inhibited any significant move to bringing financial services into the VAT net.[4] The resulting distortions are quite serious in some cases. First, there is a clear incentive to self-supply inputs. Second, there are distortions at the margin: financial services such as factoring, which can represent a particularly low-cost, low-risk form of lending to small and medium-sized enterprises (SMEs), become severely tax-disadvantaged because they fall within the VAT net in many jurisdictions for which other forms of lending are exempt.

The grand simplification offered by the VAT is thus illusory, not for theoretical reasons, but because of administrative and practical difficulties or uncertainties. Nevertheless, it does point in the direction of what might be desirable for substitute indirect taxes.

4. A few countries have introduced substitute taxes based on applying a rate to the estimated value-added of banks, obtained by summing the wage and profits.

1.3 Transactions Taxes: Panacea or Pandora's Box?

Because of their loose connection with consumption and utility and their potential for generating significant distortions in the organization of production and distribution, transactions taxes (including trade taxes) have lost favor as a tool of general tax policy relative to income and expenditure taxes. However, the vast scale of financial sector transactions has presented itself to some scholars and governments as a convenient base for rapidly generating substantial revenue.

There is a paradox here, in that critics of transactions taxes point to the potentially seriously distortions that they cause, while advocates argue that, because of the large base, very sizable revenues can be realized with low nominal tax rates. To the extent that the deadweight cost of a tax is often supposed to be proportional to the *square* of the tax rate, introducing a low-rate financial transactions tax in order to allow a reduction in the much higher rates of labor income or other taxes might be supposed to reduce total deadweight in the tax system as a whole.

At the extreme, a recent proposal suggests that what seems at first sight to be an administratively trivial and quantitatively tiny 0.15 percent rate of tax on all automated payments could raise enough revenue (in the United States) to replace the entire existing tax system (Feige, 2000). Feige shows that existing automated payments in 1996 amounted to somewhere in the region of US$300 trillion to US$500 trillion, or about fifty times the value of gross domestic product (GDP). How, he asks, could anyone argue that a tax rate of 0.15 percent, even applied to such a large base, is seriously distorting in comparison with the existing tax regime?

Analysis of the payments that would be affected reveal that about 85 percent relate to financial transactions (purchase or sale of stocks, bonds, and foreign exchange and other money changing transactions). To a large extent, then, the initial burden of a universal payments tax would fall on the financial sector. As in the case of the capital income tax, a shift in perspective from the statutory or nominal base to the more economically relevant concept of consumption reveals that the average good or service in the typical consumption bundle would be 'hit' by the tax not once, but dozens of times, as it works its way through financing, design, production, and distribution.

Criticisms of this proposal fall into two main groups. First, the tax would not collect as much revenue as claimed owing to the sizable elasticities involved.[5] Financial sector transactions, in particular, would be arbitraged in such a way as to drastically reduce the number of recorded transactions. What are now sequences of linked transactions carried out for little more than book-keeping convenience at negligible cost would be collapsed into a single, more complex transaction. Portfolio readjustments would be made with reduced frequency without substantially altering expected return and risk. Reliable estimates of these effects are not yet available, since few microeconomic studies address the precise mechanisms that are at work to generate gross transactions of such a high multiple of GDP in wholesale financial markets (but see Lyons, 2001, for the foreign exchange market). Furthermore, the scope for avoiding such a tax through offshore financial transactions has to be taken seriously.

Second, even if the tax did collect the expected revenue, the distortion costs would not necessarily be any smaller than with the existing system. This objection relies either on the observation that the financial system would bear the main brunt, such that the tax would be more concentrated, not less, or on the observation that, in terms of final consumption, the tax would effectively cascade to cumulative rates comparable to those observed at present.

No country has seriously considered replacing its tax system with a universal payments tax, but there are numerous examples of partial transactions taxes applied, for example, to bank debits or securities transactions.[6] Bank debit taxes introduced in half a dozen Latin American countries in the past fifteen years in a bid to raise revenue have been successful in that goal—at least for a while—with revenues ranging from about 0.5 percent of GDP to as much as 3.5 percent in one case for one year. It is fair to say that revenue from these taxes held up unexpectedly well over three to four years. Many predicted that revenue would fall off after the first year, and it did, on average, though the effect did not prove to be statistically significant in a regression of the available data. Nevertheless, many of the schemes had to be adapted administratively in the course of their

5. This consideration needs to be kept in mind by those who would see the proposal as socially progressive, in that the affected transactions likely represent a much higher multiple of the income of prosperous people than of the poor. After all, if such a tax did not raise the hoped-for revenue, the consequence might have to be cutbacks in public services, which disproportionately benefit the poor.

6. Tobin taxes are much more focused and do not typically have revenue as the main objective, but instead are seen as corrective taxes intended to reduce volatile speculative capital flows. They have generated an enormous literature, and I am not going to add to that here.

operation, to exempt some transactions that would otherwise have been too distorting (and probably also to capture others that had escaped the net). The distortions of these and of securities transactions taxes have been discussed in the literature: they certainly are distorting, but they have been less distorting than many observers expected when applied in moderation (Coelho, Ebrill, and Summers, 2001).

Thus, despite expectations that they would not only distort financial markets and drive out capital, but also quickly lose their revenue-raising ability, such transactions taxes have been surprisingly resilient. They are far from being a panacea, however, and indeed have little to recommend them beyond their ability to deliver revenue speedily and with low direct administrative costs.

2. Corrective Taxes

Taxation is not the only force distorting financial markets. Information deficiencies, monopoly power, and other factors push most financial markets away from the ideal of the atomistic market with fully informed participants competing on a level basis. Under these circumstances, the nonrevenue side effects of taxes and tax-like measures can be turned to advantage and form part of the corrective policy structure in this area.

Many measures of this type may have regulation and market efficiency as their primary objective, with revenue seen as a side effect.[7] The effectiveness of many such measures in their supposedly corrective role has been challenged and remains controversial, however.

2.1 Deposit Insurance

The most complex and contentious of these debated corrective quasi-taxes is deposit insurance. That it is a tax is fairly clear from the contributions or levies that are generally imposed on participating banks, especially given that these are typically compulsory and that the tax rate usually bears at best an imperfect relation to the "fair premium." Indeed, the anticipated gross revenue from the levy is typically small and in many cases is calculated to be insufficient to

7. The revenues are not always explicitly accounted for, as when unremunerated reserve requirements augment the central bank's net revenue but are nowhere accounted for explicitly as a revenue source.

cover even the expected pay-out costs as calculated using option-pricing formulas (Laeven, 2002). Furthermore the probability distribution of net payout costs is severely skewed: systemic banking crises entailing fiscal costs of up to 50 percent of a year's GDP are never matched by a corresponding deposit insurance fund accumulation in lucky, crisis-free countries.[8]

For many advocates, the perceived corrective role of deposit insurance is essentially one of reducing the likelihood of a depositor panic. They argue that protecting depositors against the risk that their deposits will be unpaid if a bank proves to be insolvent may prevent a self-fulfilling panic, including contagion to other banks triggered by the insolvency of one bank.[9] On the other hand, by lowering the vigilance of potentially informed depositors, deposit insurance may increase the moral hazard of heightened risk-taking by bankers who are not subject to market discipline, which could, in theory, result in heightened risk to the system as a whole.

Although early deposit insurance schemes entailed a uniform insurance premium per dollar of deposit, several countries now differentiate the premium rate in accordance with some measure of the perceived riskiness of the participating bank's portfolio. This dimension of such taxes is designed to reduce the moral hazard potential, but it depends to some extent on the information available to the deposit insurer on the accuracy of the ex ante risk assessment (Honohan and Stiglitz, 2001). About a quarter of existing schemes have some risk-differentiation, but the differentials are small and are not always systematically imposed (Demirgüç-Kunt and Sobaci, 2001).[10]

Econometric estimates of how financial system performance varies across countries with the existence and characteristics of deposit

8. Even the relatively much smaller fiscal costs of the U.S. banking crises of the 1980s were more than enough to empty the insurance funds.

9. Protection of the small depositor is another goal. This is quite a distinct role, of course, since runs by small depositors alone do not threaten systemic liquidity.

10. For example, the U.S. premiums currently vary according to two criteria (capitalization and supervisory assessment) from zero for a well-capitalized bank that is highly rated by the supervisors to 0.27 percent of deposits for an undercapitalized bank that is seen by supervisors as posing a substantial probability of loss to the insurer unless corrective action is taken. Argentina has charged a basic rate of 0.36 percent, which may be doubled for banks that are paying high interest rates for deposits. Cameroon and other francophone African countries impose 0.15 percent plus 0.5 percent of net nonperforming loans. Other risk-based formulations, including ex post assessments, are levied in other countries.

insurance systems suggest that countries whose socio-political institutions are generally rated as strong need not fear that the moral hazard side effect will outweigh other beneficial effects. Although deposit insurance weakens market discipline even in such countries, the effects seem to be offset by better official oversight. However, for countries with less well-developed institutions (along the dimensions of rule of law, governance, and corruption), the establishment of a formal deposit insurance scheme does appear to present a heightened risk of crisis (Demirgüç-Kunt and Kane, 2002) and does not even promote deposit growth (Cull, Senbet, and Sorge, 2002).[11] Having risk-based deposit insurance premiums does not appear to mitigate the systemic risk, so the potential for introducing a corrective structure of the deposit insurance tax may be limited.

Deposit insurance, with or without risk-based premiums, may not be a very effective corrective mechanism. It clearly needs to be supplemented in this role by strong administrative or other controls, including supervision of minimum capitalization ratios. Moreover, it may interact with other taxes. For instance, a tax on bank gross receipts (such as has been employed in several countries) will reduce the expected after-tax return to a risky investment, though Brock (2003) shows that this effect is offset in that the government (deposit insurer) coinsures the risk to a greater extent in the presence of such a tax. Brock also shows that a marginal reserve requirement (see below) could be more likely to reduce the moral hazard effect on bank risk-taking behavior. All in all, though, the uncertain strength and reliability of such effects argue for blunter, more reliable instruments in restraining bank risk-taking, a matter that lies beyond the scope of the present exercise.

2.2 Provisioning and Capital Adequacy

The amount of loan-loss provisioning that is allowable to banks as a deduction against income for tax purposes can be a very significant factor in arriving at the net tax liability, and it is often sufficient to shelter the entire tax bill. By the same token, this can be a matter of considerable revenue significance for the authorities. It has long been acknowledged, however, that the treatment of loan-loss provisions can potentially play a corrective role. This argument hinges on

11. This is the case despite the consideration that a degree of implicit protection may be assumed by depositors even when no formal scheme exists.

the inevitably arbitrary process of arriving at a reasonable provision that would result in the banks' accounts representing a true and fair picture of the business. If the fiscal rules have the effect of biasing company accounting, it could damage the transparency of the financial system and negatively influence decisions on risk management. Recent accounting scandals have focused attention on the difficulty of seeing through valuation procedures used in nonfinancial company reporting procedures; bank accounts can arguably be even less clear-cut, especially in times of economic turbulence or change.

To the extent that equity capital represents a cushion protecting depositors and other claimants against the consequences of a decline in the value of the bank's loan portfolio and other assets, the equity holders of a lightly capitalized bank at risk of failure (and the bank's directors, to the extent that they are acting as the equity holders' agents) will have an incentive to minimize the amount of their capital that is truly at risk (thereby transferring risk to other claimants), provided they can do this without inducing an increase in the required return on their other liabilities. If the fiscal authority disallows the deductibility of reasonable loan-loss provisions, that reinforces the incentive to understate provisions and thereby to overstate capital, potentially misleading regulators and the market. On the other hand, a well-capitalized bank may be more attracted by the advantages of advancing tax deductibility. It may use the range of uncertainty to increase loan-loss provisioning, thereby reducing revenue.

Different countries have adopted different rules to balance the pressures of revenue needs with the risk of losing transparency (Laurin and others, 2002). The preferred goal appears to encompass a move away from mechanical rules (such as disallowing general provisions but allowing specific provisions) toward a more realistic, forward-looking accounting that allows predictable but not yet identified losses to be adequately provisioned, so long as these are accepted by the institutional regulator.

2.3 Promoting Saving

A very widespread explicit goal of corrective tax measures affecting the financial sector is the promotion of saving. The goal is driven partly by fiscal needs (namely, the need to ease the financing of government deficits), partly by a perception that aggregate economic growth is, in the long-run, driven by national saving (this perception is colored by an earlier generation of macroeconomic theories and is no longer generally accepted by economists as a result of new research findings), and partly by a desire to ensure that households do not undersave.

In practice, such measures tend not to affect all savings media equally. They can thus have a substantial impact on the structure and performance of the financial system, which, in some cases at least, can far outweigh the policy's net impact on the goal of increasing household saving (OECD, 1994; Honohan, 1997).

Measures that operate by modifying income tax schedules tend to be relevant only in middle-income countries, or at least in countries that have achieved a certain minimum level of effectiveness in their income tax system.

2.4 Other Dimensions of Corrective Financial Taxation

In other cases, supposedly corrective financial sector taxation comes in the form of a vague and unthinking encouragement of what are seen as social goods. This is not unique to the financial sector: finance ministers are typically bombarded with proposals to exempt from taxation items or activities thought to be meritorious. The ministers are usually advised to resist such special pleading unless tax relief appears to be the most effective way of correcting some market distortion that is resulting in an undersupply of the item or activity in question. Nonetheless, lobbying of this type appears to be notably successful in finance. For example, most countries feel that their financial system is unduly dominated by banks, and this perception generates a constant advocacy of tax concessions targeted at companies with a stock exchange listing. This is at best a crude instrument, especially if the underlying reason for the underdevelopment of the stock exchange lies in an insufficiently developed information and legal infrastructure, as is often the case. A much better solution would be to direct policy attention to correcting these infrastructural deficiencies.

Another much used quasi-tax often thought of as corrective is the unremunerated reserve requirement. This measure is considered corrective in the sense that it provides a lever on which monetary policy can operate. Authorities on monetary policy now acknowledge, however, that the perceived need for unremunerated reserve requirements was based on a misconception. Monetary policy does not require unremunerated reserve requirements or any other quasi-tax for its effectiveness (see Brock, 2003).

3. Vulnerability to Arbitrage and Inflation

If there are two key features of the financial sector that distinguish it from other sectors when it comes to designing taxation, these must surely be the system's capacity for arbitrage and its sensitivity to inflation and thus to nonindexed taxes.

3.1 The System's Capacity for Arbitrage

Whether mainly flat or mainly corrective, the impact of most financial sector taxes, in practice, depends crucially on the extent to which they have been constructed to be insulated from the high elasticities that prevail in the sector. Arbitrage among functionally equivalent contracts or institutional forms bedevils tax design in this area.

Incidence Shifting of Bank Taxes

Because of substitutability and the possibility of arbitrage and near-arbitrage, the full incidence of taxation imposed on one component of the intermediation process (deposits, loans, intermediary profits) may very well be fully shifted to another component. Ramon Caminal has recently used a formal model of intermediation, including the provision of liquidity and intermediation services by banks, to examine the influence of various bank taxes on volumes and cost of intermediation services provided to depositors by banks. Caminal obtains several striking results. For instance, the ability of at least some borrowers to substitute alternative sources of funding implies a tendency for the imposition of a VAT on banking services to be passed back to depositors.[12] Furthermore, the conditions under which a tax on bank loans falls not on the cost of funds, but on the return to bank shareholders are also plausible, including a range of assumptions on competitive conditions. (However, if regulatory capital requirements are likely to be binding in the sense that banks hold more capital than they would freely choose to, then a tax on banks' profits may fall wholly on lending interest rates). In contrast to general models of production, then, substitutability in banking involves such high elasticities that models plausibly predict the incidence of a tax falling wholly on a class of agents not directly the subject of the

12. At least under the plausible assumption that the marginal borrower is VAT-liable while the marginal depositor is not (see Caminal, 2003).

taxation. On the other hand, the services provided to savers by investment funds may be highly substitutable for some of the services obtained from bank deposits, and Caminal shows how, under reasonable circumstances, the presence of untaxed investment funds implies that taxation of deposits will affect only the provision of monitoring and transaction services by banks, and not the provision of liquidity.

These contrasting cases suggest the heightened risks involved in imposing taxes under the assumption that the taxpayer who is liable will be the one incurring the incidence of the tax. Just what the incidence will be can be worked out in theoretical cases (to a greater extent than is the case for taxes on nonfinancial sectors). The task of matching these theoretical cases to the real world, however, represents a striking challenge for the empirical policy analyst given the difficulty of estimating many of the relevant behavioral relationships, as is evident from their relative absence from the literature, even for industrial countries.

The shifted incidence may be accompanied by a very large behavioral effect. This may not be socially costly in equilibrium (if the substitute truly is functionally equivalent), but short-term disruption and the costly incurring of new sunk capital to support the substitute activity could be quite severe.

New Financial Instruments

At the heart of financial innovation is, in the words of Boadway and Keen (2003), the creation of new instruments by repackaging the cash flows generated by others. Arbitrage is here the mechanism, not just an outcome. This repackaging serves to achieve a better alignment of the instruments with the liquidity and maturity preferences of different classes of investors and to shift particular risks among investors who have different appetites for them, whether based on information or on correlations with the remainder of their portfolio. If the rebundled instruments are treated differently by taxation, this can block the repackaging and inhibit the risk-sharing that is involved.[13] Furthermore, of course, differential tax treatment (for example, of debt and equity or of income and capital) can be a powerful driver of innovation designed for no better reason than to repackage cash flows into a less heavily taxed form.

13. For example, the existence of withholding taxes on gross interest receipts can stifle the market in interest rate swaps.

Boadway and Keen note that many of these issues have been dealt with on a piecemeal and ad hoc basis by tax authorities in advanced economies. Theoreticians have been exploring ways of rationalizing the taxation of new financial instruments, both by devising unambiguous decompositions of the instruments into fundamental components and by determining the timing at which the taxable amounts are crystallized (accrual versus realization). But no general agreement has yet emerged among theoreticians, let alone among practitioners in advanced economies. This rules out, for the present, the possibility of developing country tax authorities' piggy-backing on a prepackaged solution. For market participants, the tax situation is even less satisfactory in developing countries, where the likely tax treatment of new instruments is often undetermined or disputed.

3.2 Sensitivity to Inflation

Inflation has pervasive effects throughout the economy and, in particular, has been shown to be negatively correlated with growth at sufficiently high rates. Nonetheless, banking and other parts of the financial sector that extensively employ nominal financial contracts can be more directly and deeply affected than most. High and variable rates of inflation induce significant substitution away from non-interest-bearing monetary assets in favor of assets offering higher real returns and inflation hedges. This can, on the one hand, shrink the size of the banking system's intermediation, but, on the other, the financial system's capacity to provide the instruments to insulate economic agents from the inflation will tend to expand this side of its activities. Indeed, empirically, the balance-sheet size of the banking system is found to shrink with inflation, whereas inflation is found to be positively associated with profitability and the value-added of the banking system (Honohan, 2003).

Inflation also has a strong influence on the government's finances. The term inflation tax is well chosen, even though there is no perfect correspondence between the implicit inflation tax rate as measured by the opportunity cost of holding interest-free base money (which will be related to the expected inflation rate) and the flow of financing to the budget from money creation (Honohan, 1996).

The interaction between inflation and a nonindexed tax system can have sizable and unexpected effects even in a country with single digit inflation (Feldstein, 1983, 1999). As inflation increases, the double distortions of inflation and taxation can be multiplicative rather than additive, with severe consequences. The impact of inflation on the scale and activity of financial services firms needs to be considered alongside its impact on their tax-inclusive cost structures. The effective tax rate of several commonly employed financial sector taxes, such as taxes on gross interest receipts of banks, or unremunerated reserve requirements rise almost in proportion to the rate of inflation. In the case of nominal interest rate ceilings, the effective tax rate rises faster than the inflation rate. This degree of sensitivity to inflation in the effective rate of tax is generally quite undesirable, given that inflation rates can be high, volatile, and unplanned (Honohan, 2003).

4. Calibrating Different Types of Tax

Where these defensive aspects have been neglected, poorly constructed tax systems—whether the consequence of a drive for revenue or of misdirected sophistication—have often had sizable unexpected side effects. Part of the problem in many difficult cases has been that the financial sector taxes and implicit or quasi-taxes have not been seen for what they are. Very high effective tax rates have thus emerged in cases in which legislators would not have conceived of imposing comparable nominal tax rates. On the other hand, lobbyists are prone to finding ways of exaggerating the tax burden on financial intermediaries by adding up taxes that touch the sector only slightly and expressing these as a percentage of the sector's profits.

Is there some simple way of approximating the burden of a given tax or improving the impact of reform in a particular tax? This section addresses this question with regard to the main types of tax or quasi-tax that most often raise such issues. The relevant taxes include the following: unremunerated reserve requirements; tax on intermediary interest receipts; withholding tax on interest payments by intermediaries; stamp tax on bank debits; and stamp tax on bank loans.

One practical approach to calibrating these taxes and judging their appropriateness is to map each tax into its closest nonfinancial analog. One thus decides whether the tax is more nearly an income or a sales tax. If an income tax, is it more a tax on the intermediary's shareholders or on the intermediary's fund-providing customers? If a sales tax, what is the product that is being taxed and what is its net-of-tax price? As with most issues of incidence, these questions cannot always be easily answered. Nevertheless, even an approximate answer can clarify the issues significantly.

Market power and substitution possibilities are central. In many countries, the market power of banks is being eroded, both by international competition for depositor services and from alternative sources of industrial funding and by liberalization of entry. Taxes and quasi-taxes that might hitherto have been assumed to fall on bank shareholders in a manner analogous to an income tax may now be more likely to be passed on to those customers who have few alternatives, notably small borrowers whose creditworthiness is costly to determine.[14]

Under such conditions, the taxes described fall into three groups: those that are best seen as taxes on lending services; taxes on transactions services; and income taxes on suppliers of funds. The first group includes both unremunerated reserve requirements imposed on banks and special taxes on interest receipts of banks, as well as sales taxes on the provision of lending services to small borrowers (for example, credit appraisal and monitoring). The effective tax rate can be approximated by comparing the tax paid per dollar lent (or, in the case of unremunerated reserve requirements, the opportunity cost of the reserved funds) to the net-of-tax cost of the service.[15] High effective tax rates often result. Official estimates for Brazil in 2001 can be read, in this perspective, as implying an 85 percent effective tax rate, on average, for lending (Cardoso, 2003). Furthermore, because the tax base—the cost of intermediation services—is not sensitive to the nominal rate of interest, whereas the tax paid is, the resulting effective rate can be very sensitive to the nominal interest rate and thus to the inflation rate (Honohan, 2003).

The stamp duty on bank loans, which is typically proportional to the loan size but not to its maturity, can be analyzed in much the same way, as demonstrated in the next section. In this case the effective tax rate may increase sharply as maturities shorten, wherein lies the obvious technical deficiency of such a tax.[16]

14. Caminal (2003) models these issues in some detail; Cardoso (2003) presents interesting evidence that pass-through has been very high in Brazil.

15. This applies to reserves remunerated below market rate as well as to unremunerated reserves. A very simple break-even calculation implies that an addition of λ to the loan interest rate will be required to recover an interest penalty of ϕ applied to reserve requirements of θ, where $\lambda = \phi\theta/(1 - \theta)$. More sophisticated calculations are also possible, but they make no material difference at low interest rates.

16. In Egypt, the application of a constant stamp tax independent of loan maturity hampered the development of short-term bridging finance.

Transactions taxes and the stamp tax on checks likely fall mainly on the user of the transactions involved. The relevant tax rate is thus computed as if it were a sales tax on the relevant service.

Judging the appropriate treatment of the withholding of income tax on deposit interest requires careful consideration of the effectiveness of the remainder of income tax. If income tax on the revenue from competing capital assets is collected effectively, then the fact that tax due on deposit interest is withheld at source can best be thought of as chiefly an administrative convenience, rather than as an additional imposition affecting the withholding intermediaries and their other customers. The empirical judgment here will often depend on the degree of international capital mobility (see Huizinga and Nicodeme, 2001).

5. The Chilean Stamp Tax and Its Impact on the Credit Market[17]

The stamp tax imposed on credit operations is the most distinctive feature of the tax arrangements affecting the financial sector in Chile.[18] "Easily raised, widely diffused, pressing little on any particular class, especially the lower orders of society, and producing a revenue safely and expeditiously collected at a small expense"—that was British Prime Minister William Pitt's assessment of the stamp tax in 1797, and accordingly he doubled its rate. Given what I have stated about different types of financial sector tax, are these appropriate sentiments to apply to the controversial Chilean stamp tax today?

5.1 Nature of the Stamp Tax

There are three main elements to the stamp tax as it applies to the financial sector. Of these, the element applied to credit is the most onerous, and its potential impact on the efficient functioning of

17. This section was prepared with the assistance of Verónica Mies.

18. The more famous and widely discussed tax on capital inflows will not be treated here. In light of the discussion above of the tax aspects of deposit insurance, note that Chile's deposit insurance system is distinctive in that it does not involve a levy on banks. There is no fund, and payout would be financed by the fiscal authority. (Demand deposits are covered in an unlimited amount; time deposits to an amount equivalent to about nine months' mean per capita income.)

the financial system deserves scrutiny. The other two elements are a fixed tax of Ch$132 on checks and other payments instruments and a tax on protested checks at 1 percent of the face value.

Tax on Check-type Payment Instruments

The tax on checks is negligible for large payments, but it would have a material effect on the use of checks for small transactions. Moreover, the Ch$132 (equivalent at the time of writing to US$0.19) is high relative to the gross hourly wage of the average industrial worker, which is currently about Ch$1,227.

If the typical (marginal) bank processing charge per check of between Ch$120 and Ch$135 for retail customers represents an approximation of the value-added involved in making a check payment, then a good way of thinking about the wedge created by the tax is as a VAT-rate equivalent, in this case about 100 percent—well above the standard VAT rate in Chile, which of course does not apply to most financial services.[19] Untaxed substitutes for checks include the use of credit cards for payment; these have a low unit-processing cost for the banks, with the result that their net price is quite low.

Tax revenue from the stamp tax on checks in 2001 was Ch$44.4 billion.

Tax on Protested Checks

The rationale for the tax on protested checks is not very clear, as the revenue from this cannot be very high (in 2001 it was just Ch$7.4 billion). Perhaps it is an attempt to discourage the use of post-dated checks as a credit instrument, thereby evading the stamp tax on credit instruments. In many countries, post-dated checks are used to strengthen the position of the creditor (because of the potential application of criminal sanctions) where enforcement of standard credit instruments is problematic. They are not used for this purpose in Chile, however, where the practice is instead to pay a check whenever presented, provided only it is before the check's expiry date.

19. Fixed-rate stamp duties on checks have a long history in British taxation, and they still exist in countries following that tradition (though not in the United Kingdom itself). The rate per check in Ireland is currently less than half of that in Chile.

Tax on Credit Instruments

The stamp tax on credit instruments was introduced in 1980. Three main features are worth noting. First, the tax is very comprehensive, covering not only bank loans, but all loan operations of financial institutions, including credit cards from banks and commercial stores.[20] The main exemption is the renegotiation of outstanding or delayed mortgage loans used for the acquisition, remodeling, or construction of a house or apartment, granted to natural persons for up to UF3,000 (equivalent to about Ch$50 million, or about US$70,000).[21] During the first half of 2002, this exemption did not apply to loans secured offshore, inasmuch as the obligation to pay the tax falls on domestic providers of credit and not on borrowers; there is a proposal to permanently restore this particular exemption.

Second, the tax is imposed not on the interest paid, but on the capital sum. This has implications for the relative burden on borrowers of different degrees of credit-worthiness and also on intertemporal stability of the effective tax rate, whereas an interest or value-added base tax does not. I return to this point below.

Third, the tax applies only to the first twelve months of the loan. Specifically, the tax is imposed at a rate of 0.134 percent of the nominal value of the loan per month up to twelve months.[22] For maturities in excess of twelve months, the total tax rate is 1.608 percent (equivalent to twelve months at the monthly rate). If expressed as a percentage of interest paid, for example, operations of terms under one year are imposed a proportionally larger tax than are medium- to

20. The most important types of document subject to this tax are specified in regulations as "bills of exchange, drafts, promissory notes, simple or documentary loans, and any other document containing a credit or money operation. Also included are the transfer of invoices or receivables in collection to banks and financial institutions; the delivery of interest-bearing currency, except when the depository is a Bank; currency mutuums (consumption loans); loans and other currency credit operations performed with bills or promissory notes by banks and financial institutions registered in the Central Bank of Chile in case of foreign operations, and drafts discounted at banks; bank loans granted in a special account, with or without documentary collateral; and issued bonds and debentures of any nature."

21. For larger loans, the tax is applied on the amount in excess of UF3,000. The UF is used as a unit of account for financial transactions. It is calculated on the tenth day of each month, to vary by a linear amount each day. Thus, by the ninth day of the next month it will have changed in value by as much as the CPI changed two months before. On 13 June 2002, the UF was valued at Ch$16,345.

22. The tax rate was constant at 0.1 percent per month through January 2002, when the current rate of 0.134 percent was introduced.

long-term operations. This may imply an incentive to have longer-term loans.

In the case of sight or overdraft accounts or credit with no specified maturity date, the rate imposed is 0.67 percent (or five months' equivalent of the monthly rate). In any case, the maximum tax rate applicable with respect to the same principal does not exceed 1.608 percent.[23]

5.2 Comparing the Stamp Tax with an Interest or Value-added-based Tax

Comparing the stamp tax with alternative forms of tax on lending can provide a basis for judging whether the annual rate of 1.608 percent on the capital value of short-term loans should be considered high. The most interesting comparison is with a value-added tax, as discussed above. The stamp tax on short-term loans can be expressed as a percentage of value-added in lending, using the interest spread from International Financial Statistics (IFS) to approximate value-added.[24] The average spread of the lending rate over the money market rate between 2000 and 2002 was 4.66 percent; this implies that the 1.608 percent stamp tax was 34.5 percent of value-added—rather high for a VAT rate. Given that banks cannot deduct VAT on inputs since they are not VAT registered, the total effective rate of VAT on lending-related activities is higher by the amount that would otherwise be deductible.

Of course, the equivalent VAT rate would be lower for higher-risk lending operations and operations involving a higher spread than those reflected in IFS. The same would be the case for loans with a longer maturity, with the effective tax rates halving for two-year loans, halving again for four-year loans, and so forth.

Another useful comparison can be made with a gross receipts tax imposed at a fixed percentage rate on the interest received by the lender, a formerly common type of tax that is no longer widespread

23. To determine the maximum amount, the tax amount actually paid over the original operation and successive renewals or extensions is taken into account, with certain protections to ensure that such renewals or extensions are genuine and do not represent a new loan.

24. Actually, taking IFS rates is not ideal here. They are representative rates, but not necessarily close to average rates. On the other hand, using net interest margins, which are averages, from bank annual accounts, will not necessarily correspond exactly to value-added in the lending business either, given the other bundled services that are involved.

(but is still in effect in China). The gross receipts tax rate equivalent to the 1.608 percent stamp tax rate depends, of course, on the lending interest rate. Chile's mean nominal interest rate on loans, as calculated from the monthly data in IFS, was 14.37 percent for the period 1997 to mid-2002. To generate the same revenue, on average, as the stamp tax, a gross receipts tax would have had to be imposed at the rate of 11.19 percent over the period (the figure corresponding to the old stamp tax rate of 1.2 percent would be 8.35 percent). Compare this with the much-criticized gross receipts tax rate of 7 percent in effect in China.

A third comparison can be made with an unremunerated reserve requirement. Based on the mean nominal money market rate of 7.64 percent over the same period used in the last example, the stamp tax can be considered equivalent to an unremunerated reserve requirement of at least 21 percent on deposits.

A favorable consequence of anchoring the rate to the capital value of the loan and not to the interest rate is that it helps insulate the effective tax rate from surges in nominal interest rates, such as can occur in times of high inflation or during a currency or other confidence scare. Chilean nominal interest rates have experienced very sharp spikes in recent years (see figure 1). A tax whose effective rate varies with interest rates (as is the case with unremunerated reserve requirements or a gross receipts tax) would have resulted in highly volatile effective tax rates on value-added. This is clear from figure 2, which compares the equivalent VAT rates of a constant gross receipts tax, of a constant unremunerated reserve requirement, and of the actual stamp taxes in effect.[25] In each case, the value-added is taken as an eight-quarter moving average of the spread between lending and (wholesale) deposit rates, as quoted in IFS. The equivalent VAT rate is clearly much more volatile for the two interest-rate-based taxes than for the capital-based stamp tax.

Finally, the tax is more or less neutral with respect to currency of denomination. This stands in contrast to taxes based on interest rates, which would have implied a much lower VAT-equivalent rate for foreign currency loans, given that foreign currency (U.S. dollar) lending rates have consistently been much lower than local currency rates (about half: 7.9 percent compared with 16.8 percent, on average, during the 1993–2002 period; see figure 1).

25. The constant hypothetical rates of the gross receipts tax and the unremunerated reserve requirement are chosen to be revenue neutral with the actual stamp duty over 1997-2001.

Figure 1. Chile: Bank Lending Rates, 1993 to 2002

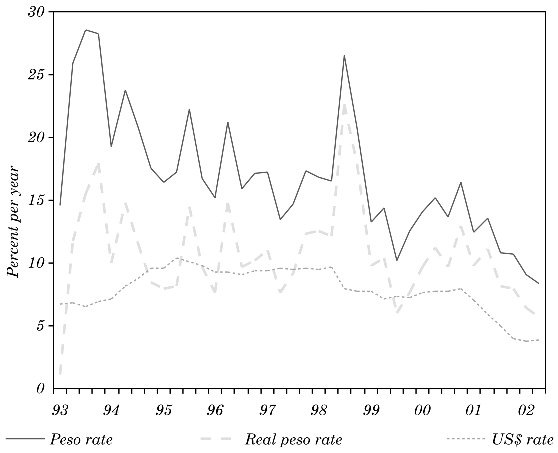
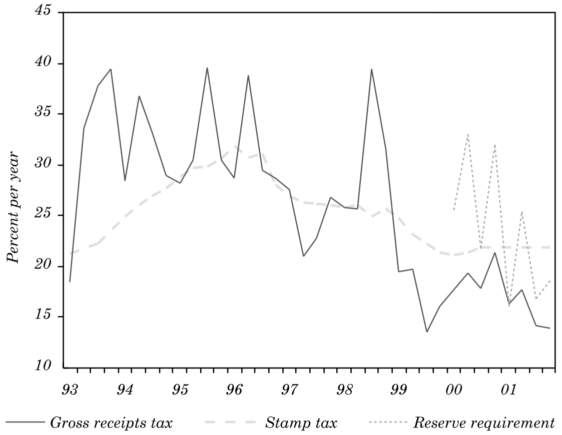


Figure 2. Chile: Equivalent VAT Rate, 1993 to 2001



5.3 Defensive Aspects

Defensive inflation proofing should be one of the central goals of financial sector tax policy design. Inflation has been low and declining in Chile over the past decade or more, but inflation rates of between 20 and 30 percent per year were frequently observed during the 1980s, and there was an episode of very high inflation in the mid-1970s. It is not altogether irrelevant, then, to look at the degree of inflation proofing built into the stamp tax. Two measures that have been proposed to capture the degree of indexation of a financial sector tax are (a) the increase in the tax, expressed as a proportion of the relevant value-added, as inflation increases from zero to 10 percent and (b) the limiting elasticity of this effective tax rate as inflation tends to infinity (Honohan, 2003). In fact, the stamp tax is almost fully inflation proof, with a value of each measure of indexation close, if not equal, to the "perfect score" of zero. In contrast to some similar financial sector taxes, the stamp tax is well insulated from inflation.

The second defensive requirement is limiting the possibility for large-scale tax arbitrage through the use of parallel and equivalent financial channels. Restricting tax arbitrage requires a fair amount of market information, but it seems that the domestic financial system has no obvious loopholes for avoiding the stamp tax, which is not, for example, confined to a narrowly specified range of credit providers. Offshore finance could be employed for this purpose, but this does not appear practical for most borrowers.

5.4 Likely Impact of the Tax

What is the likely impact of the stamp tax? Where is its incidence likely to fall, and which markets will be most affected? The model developed by Caminal (2003) provides some answers. Under the separability and competitiveness assumptions that he presents as a benchmark case, a tax on bank loans is mainly absorbed by the borrowers. Gross loan rates are increased by the amount of the tax, which induces some borrowers to switch to untaxed sources of funding (for example, offshore financing and equities). Bank monitoring decreases, possibly imposing externalities on securities markets or other providers of funds. Bank deposits are unaltered, with the implication that the banks switch a portion of their asset portfolio into untaxed investments.

The assumption of a perfectly competitive banking sector may not be fully realistic. Caminal shows, however, that this makes no difference to the cut-off point for the quality of projects that will be funded by bank loans. The tax will lower the cut-off point to exactly the same extent as in the competitive position. In the case of a monopoly bank, the gross interest rate charged to any borrower is unaffected by the tax. Only those borrowers who are newly shut out of borrowing by the tax feel any effect, and the tax paid simply acts to reduce bank profits.

The movement of interest rates around the time of the doubling of the stamp tax in early 2002 provides an indication of which of these cases most reflects Chilean empirical realities. The amplitude of real and nominal interest rate movements over the past several years—and even in 2001–02—is more than double the increase in the tax rate of about 40 basis points (for a one-year loan). This makes it unlikely that a very evident change will be detectable in the data on interest rates. Figures 3 and 4 show the relevant interest rate movements.

An important fact for interpreting these data is that the stamp tax is not paid by the bank, but is separately invoiced to the borrower.[26]

Figure 3. Chile: Interest Rates, 2001 to 2002

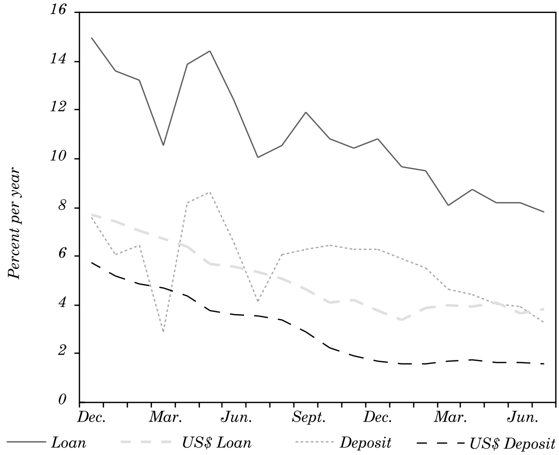
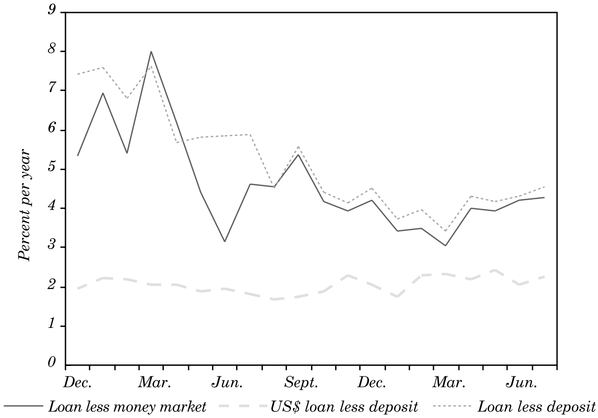


Figure 4. Chile: Interest Spreads, 2001 to 2002



26. It is paid by the borrower before a public notary when the related deed is being signed.

Even though borrowers do not think of the tax as part of the interest to be paid, equilibrium behavior will naturally take account of the tax level. If the monopolistic assumption held, then (according to the theory) the interest rate charged would have fallen by the amount of the tax (inasmuch as the stamp duty is payable by the borrower). If the competitive assumption held, no change in the interest rate would have been observed. In fact, the local currency spreads dip in the period January to March 2002, consistent with the monopolistic model. (The subsequent rise in spreads might be attributable to some other factor, but I know of no econometric model of the determination of interest rate spreads in Chile that fits well enough to help either confirm or deny this effect). The dollar rates do not show the same evidence of a fall in the first quarter of 2002, and in fact there are some indications of the opposite effect, with an upward tendency in the spreads starting in February. A degree of monopoly in the local currency loan market, combined with greater competition in the foreign exchange loan market, would be consistent with the observed pattern. It also fits well with common sense, though this is not, of course, clear evidence.

The scorecard on Chile's stamp tax on credit is thus mixed. The tax does well on the defensive aims of inflation proofing and limiting severe arbitrage. It scores lower on the arbitrary bias toward longer-term credits, except to the slight extent that such a bias may be considered corrective (given the damaging tendency toward short-term financing in Korea in the run-up to the 1997–98 crisis). The overall rate is rather high (perhaps the equivalent of double the standard 18 percent VAT), and even if the incidence is partly on bank profits, the tax still surely discourages loan financing at the margin.[27]

5.5 Possible Additional Impact of Reserve Requirements

An additional quasi-tax that probably has an impact on the cost of credit in Chile is the implicit tax in the form of reserve requirements remunerated at a rate equivalent to just 50 percent of the inflation rate. This is well below the money market rate and can thus be considered the opportunity cost of funds. Of course, this tax is largely

27. There might again be a corrective element here in adjusting for the familiar anti-equity bias of the income tax code, which applies in Chile as elsewhere.

passed on to customers, most likely the small and medium-sized borrowers with limited alternative sources of funds. The rate of reserve requirements is not very high: 9 percent on demand deposits and 3.6 percent on time deposits. Conventional calculations suggest that the effect is rather small (see note 15). A loan funded by time deposits would have had to earn an additional 25 basis points to pay for the mean reserve penalty of about 700 basis points during 2000–02 on the 3.6 percent reserves.[28] If the loan were fully funded by demand deposits, the figure would be 68 basis points, but in practice time deposits account for about 86 percent of all deposits.

6. Concluding Remarks

Chile's stamp taxes on checks and loans seem rather high relative to the natural comparator, namely, a VAT applied systematically to financial services at the standard rate. Efficiency gains would be expected from a reduction in these taxes. On the other hand, the stamp tax on loans does seem to satisfy key defensive criteria, in that it appears relatively insulated from fluctuations in inflation and from arbitrage. Nevertheless, in keeping with Chile's tradition of scientifically based policy innovation in the financial area, the relevant authorities should consider replacing it with a comprehensive application of the VAT to the financial sector. If this proved technically feasible, it would give the lie to the frequent assertions (not wholly convincing to this author) that such a comprehensive "big idea" reform must pose insuperable practical difficulties.

28. The reserve requirement for foreign currency deposits was, until May 2003, 10 percentage points higher, but the remuneration penalty was still smaller because of the lower opportunity cost of U.S. dollar reserves.

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Deposit Insurance: Handle with Care

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During the last two decades, systemic banking crises have afflicted developed and developing countries alike. A systemic crisis occurs when widespread depositor runs reveal that most or all of the accounting capital in a country's banking system is illusory. Systemic crisis have hit ninety-three countries, and borderline crises have afflicted forty-six countries. Numerous countries have suffered several crises.

Banking crises are costly and disruptive. As measured by the increased debt generated in the crisis year, fiscal costs incurred in 1997–98 crises exceeded 30 percent of gross domestic product (GDP) in Thailand and Korea and 50 percent in Indonesia. The true cost of a crisis, however, far exceeds its immediate fiscal cost. Severe banking crises may derail macroeconomic stabilization programs, slow future growth, and increase poverty. During a crisis, depositors typically lose the use of their balances, and would-be borrowers and equity issuers find that financial markets have dried up. Working-class and retired households may be forced into a hand-to-mouth existence, and good borrowers and sound banks may lose access to credit and be forced into bankruptcy. Diminished confidence in domestic financial

This essay is based on a previously published paper, which provides an extensive review of the research results; see Demirgüç-Kunt and Kane (2002). We would like to thank Klaus Schmidt-Hebbel and Iván Araya for useful comments and discussion. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

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institutions may fuel a panicky flight of foreign and domestic capital and a severe currency crisis.

To control these costs, policymakers erect a financial safety net. The net seeks both to make a systemic financial breakdown less likely and to limit the damage done when one occurs. Deposit insurance is a critical component of such safety nets. Establishing explicit deposit insurance guarantees has come to be seen as one of the pillars on which any truly modern financial system must be built. Indeed, the number of countries offering explicit deposit insurance has almost tripled during the last decades. Today, most OECD countries and an increasing number of developing countries feature explicit depositor protection.

The popularity of explicit deposit insurance may give the misleading impression that designing and operating an efficient system is easy. Quite to the contrary, safety-net managers are assigned conflicting objectives that make their task very difficult. They are asked not only to protect against financial crises and related economic shocks, but also to avoid subsidizing bank risk-taking lest they foster inefficient bank risk-taking and other imprudent banking practices. The central challenge safety-net managers face is to strike an appropriate balance between preventing crises and at the same time controlling bank risk-taking.

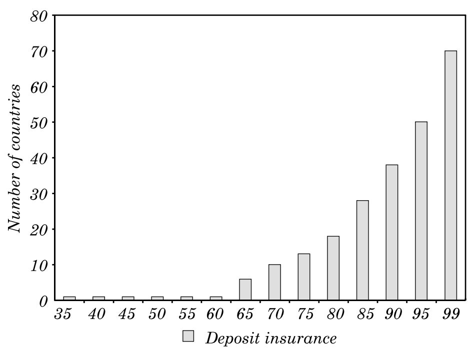
Given the difficulties involved in designing and operating a safety net, policymakers often seek expert advice on how best to design an explicit deposit insurance system. Expert advice needs to be grounded in carefully interpreted cross-country empirical evidence. A recent World Bank research project developed such a database for researchers worldwide and answered questions about how explicit deposit insurance affects four items: financial stability, how markets discipline bank risk-taking, the development of the overall financial system, and crisis management. This paper, which is based on Demirgüç-Kunt and Kane (2002), provides a synthesis of this research effort. The next section characterizes the dataset and uses it to summarize the extent of cross-country differences in deposit insurance design. Section 2 then summarizes the empirical evidence on the impact of deposit insurance. Section 3 combines a short description of the Chilean deposit insurance system with a list of features that cross-country research suggests that Chile should keep or alter. Section 4 concludes by restating our policy implications as principles.

1. The Rise of Deposit Insurance around the World

Deposit insurance can be explicit or merely implicit. Implicit insurance exists to the extent that the political incentives that shape a government's reaction to crisis make a taxpayer bailout of insolvent banks seem inevitable. Explicit deposit insurance has spread rapidly in recent years. The number of countries offering explicit deposit guarantees surged from twelve in 1974 to seventy-one in 1999 (see figure 1). Establishing explicit deposit insurance has become a principal feature of policy advice on financial architecture that outside experts give to countries undergoing reform (Folkerts-Landau and Lindgren, 1998; García, 1999).

It is not hard to see why deposit insurance appeals to policymakers. In the short run, government accountants can book income from periodic insurance premiums without acknowledging the parallel buildup of formal obligations that guarantees create. Such one-sided accounting paints deposit insurance as a costless way of reducing the threat of bank runs. Other attractions include protecting small depositors and improving opportunities for small domestic banks to compete with larger national and foreign institutions. In programs of privatization or post-crisis restructuring, explicit deposit insurance is sometimes adopted to curtail the size of implicit guarantees. When banks were previously either government-owned or given blanket guarantees, limiting the maximum size of balances covered by deposit insurance is an important goal.

Figure 1. Deposit Insurance around the World, 1935 to 1999



Source: Demirgüç-Kunt and Sobaci 2001.

A cross-country database developed as part of the World Bank research program characterizes deposit insurance arrangements in 178 countries (Demirgüç-Kunt and Sobaci, 2001). This database documents how widely deposit insurance design varies across countries. For example, account coverage varies from unlimited guarantees to tight coverage limits. Japan, Mexico, and Turkey promise 100 percent depositor coverage, whereas countries like Chile, Switzerland, and the United Kingdom cover individual deposits up to an amount that is actually less than their per capita GDP. Also, although many countries cover deposits denominated in foreign currency, most schemes exclude interbank deposits. Besides setting a maximum level of coverage, some countries insist that accountholders coinsure a proportion of their deposit balances. Coinsurance provisions are still relatively rare, but they are increasingly frequent in recently adopted schemes.

Deposit insurance obligations are typically advance-funded, most commonly from a blend of government and bank sources. To allow the insurer to build and maintain an appropriate fund of reserves against its loss exposures, such countries generally assess their banks an annual premium that is based entirely or in large part on the amount of insured deposits. Efforts to make these annual premiums sensitive to bank risk exposure have begun in recent years.

Insurance schemes are typically managed in a government agency or in a public-private partnership. A few countries, such as Argentina, Germany, and Switzerland, manage their schemes privately. Finally, membership is compulsory for chartered banks in almost all countries; the most notable exception is Switzerland.

Table 1 lists countries that either established or extensively revised their deposit insurance scheme during the second half of the 1990s. A number of countries adopted or expanded their deposit insurance scheme as a crisis-management measure. For example, Korea, Malaysia, and Thailand moved to blanket coverage in response to their recent crises. The 1990s saw a rapid spread in transitional countries—perhaps partly motivated by their long-term interest in joining the European Union—and in some African countries. Countries that adopted deposit insurance in 1999 are Ecuador, El Salvador, and members of the Central African Currency Union, namely, Cameroon, Central African Republic, Chad, Equatorial Guinea, Gabon, and Republic of Congo. Most of these new schemes show generous coverage levels. For example, Central African Republic and Chad offer coverage ratios that lie between 13 and 15 times their per capita GDP.

Table 1. Recent Establishment of Deposit Insurance Schemes

Year adopted	*Countries that have established an explicit scheme*
1999	Cameroon, Central African Republic, Chad, Ecuador, El Salvador, Equatorial Guinea, Gabon, Republic of Congo
1998	Estonia, Gibraltar, Indonesia[a], Jamaica, Latvia, Malaysia[a], Ukraine
1997	Croatia, Thailand[a]
1996	Korea, Lithuania, Macedonia, Romania, Slovak Republic, Sweden
1995	Brazil, Bulgaria, Oman, Poland

Source: Demirgüç-Kunt and Sobaci (2001).
a. Blanket coverage.

Precisely because the range of design features is so extensive, this dataset can permit analysts to compare and contrast how well different features work in different circumstances. In the next section, we summarize the implications of research that uses this database to make inferences about key deposit insurance issues.

2. Deposit Insurance: Empirical Evidence

An extensive theoretical literature analyzes the benefits and costs of deposit insurance and explores the challenge of balancing these benefits and costs to produce an optimal deposit insurance system. This literature has been summarized by Kane (2000), Calomiris (1996), and others.

Cross-country empirical evidence on the efficiency of real-world deposit insurance systems is harder to come by. We begin this section by posing four empirical questions whose answers indicate how effective an individual country's deposit insurance system happens to be. Specifically, how does deposit insurance affect bank stability? How does deposit insurance affect market discipline? How does deposit insurance impact financial development? What role does deposit insurance play in managing crises?

2.1 Deposit Insurance and Bank Stability

Economic theory offers a mixed message on how deposit insurance affects banking stability. On the one hand, credible deposit insurance contributes to financial stability by making depositor runs less likely. On the other hand, unless insured institutions' capital positions and risk-taking are supervised carefully, the insurer will accrue loss exposures that undermine bank stability in the long run. Economists label insurance-induced risk-taking as moral hazard. Moral hazard occurs because sheltering risk-takers from the negative consequences of their behavior increases their appetite for risk. The need to control moral hazard in banking has been emphasized by academics, but dismissed or denigrated by many policymakers.

Demirgüç-Kunt and Detragiache (2003) are the first to use the cross-county database to study the link between deposit insurance and financial crises. They use data from sixty-one countries for the period 1980–97 to estimate a model of banking crisis. After controlling for other determinants, they find that the presence of poorly designed explicit deposit insurance tends to increase the likelihood that a country will experience a banking crisis; they show that this result does not appear to be driven by reverse causality.[1] On investigating individual design features, Demirgüç-Kunt and Detragiache also show that deposit insurance causes the most trouble in countries where coverage is extensive, where authorities amass a large fund of explicit reserves and earmark it for insolvency resolution, and where the scheme is administered by government officials rather than the private sector. Finally, they also show that the contribution of deposit insurance to bank fragility is significant in countries where the institutional environment is underdeveloped, but it is not significant in countries whose environment is strong. These findings support the hypothesis that where the contracting environment controls incentive conflict, effective prudential regulation and supervision can offset the adverse incentives created by deposit insurance so that moral hazard need not be worrisome.

2.2 Deposit Insurance and Market Discipline

In environments characterized by a high degree of transparency, depositors can discipline banks that engage in excessive risk-taking

1. The countries that introduce deposit insurance as a result of a crisis do not drive these results, because observations for the crisis period are dropped from the sample. As further evidence on this point, the authors go on to estimate a two-stage model where they first estimate the probability of adopting explicit deposit insurance and employ this estimated variable in a second-stage crisis equation. The first-stage results indicate that countries in the sample decide to adopt deposit insurance because other countries adopt it, as it becomes perceived to be best practice. In the second stage, deposit insurance variables become even more significant, indicating that allowing for potential endogeneity does not alter the results.

by demanding higher deposit interest rates or by withdrawing their deposits. However, to the extent that deposit insurance reduces the stake that depositors have in monitoring and policing bank capital and loss exposures, it shifts responsibility for controlling bank risk-taking to the regulatory system. Bank performance is undermined wherever deposit insurance managers displace more discipline than they exert.

Demirgüç-Kunt and Huizinga (2003) build a bank-level dataset covering forty-three countries over 1990–97, which they use to study depositor discipline by looking at interest rates and deposit growth. The evidence shows that explicit insurance lowers banks' interest expenses and makes interest payments less sensitive to bank liquidity. However, regardless of the character of a country's safety net, some market discipline survives. Demirgüç-Kunt and Huizinga also focus on how variation in design characteristics affect market discipline. They find that market discipline is stronger in countries with higher levels of institutional development. Nevertheless, badly designed deposit insurance curtails market discipline even in countries whose institutional development is strong. Setting higher coverage limits, extending coverage to interbank deposits, establishing an ex ante fund of reserves, funding reserves from government sources, and insisting on public management each displaces market discipline. On the other hand, market discipline is enhanced by coinsurance provisions, covering foreign currency deposits, and establishing private or joint management of the insurance enterprise.

Such individual-bank data provide direct evidence of the way in which deposit insurance design can affect bank risk-taking incentives. Although deposit insurance displaces market discipline even in advanced countries, the net effect may be improved by strong regulation and supervision. These findings reinforce the evidence on deposit insurance and banking crises and accord with cross-country variation in the risk-shifting incentives that one can infer from bank stock prices (Hovakimian, Kane, and Laeven, 2003). Countries with poor contracting environments are apt to suffer adverse consequences from deposit insurance.

2.3 Deposit Insurance and Financial Development

Countries adopt deposit insurance for different reasons. One common goal, however, is to augment the flow of bank credit by increasing the confidence that the general public has in the formal banking system and to do this without having to explicitly set aside or expend current fiscal resources. To the extent that deposit insurance bolsters depositors' faith in the stability of the banking system, it may mobilize household savings for use by the financial system. Earlier research shows that financial development supports improved patterns of real investment and leads to sustainably higher aggregate economic growth (Levine, 1997).

Recent adopters of deposit insurance include African and Latin American countries with low levels of financial development. To investigate whether and how explicit deposit insurance contributes to financial development, Cull, Senbet, and Sorge (2003) examine time-series data for fifty-eight countries. These authors find that explicit deposit insurance has a favorable impact on the level of financial activity and its volatility only in the presence of strong institutional development. In institutionally weak environments, deposit insurance appears to distort the pattern of real investment and to retard, rather than promote, financial development.

2.4 Deposit Insurance and Crisis Management

It is common practice to issue blanket guarantees to arrest a banking crisis. Countries that have adopted this strategy include Sweden (1992), Japan (1996), Thailand (1997), Korea (1997), Malaysia (1998), and Indonesia (1998). More recently, Turkey tried to halt its financial panic by guaranteeing not just bank depositors, but all domestic and foreign nondeposit creditors of Turkish banks. Advocates of using blanket guarantees to halt a systemic crisis argue that sweeping guarantees can be helpful, even essential, in halting depositors' flight to quality. However, because blanket guarantees create an expectation of their future use in similar circumstances, they undermine market discipline and may prove greatly destabilizing over longer periods. Although some countries have managed to scale back formal insurance coverage once a crisis has receded, it is very difficult to scale back informal coverage in a credible manner.

Honohan and Klingebiel (2003) analyze the impact of blanket guarantees and other crisis-management strategies on the ultimate fiscal cost of resolving banking-system distress. Data covering forty crises around the world indicate that unlimited depositor guarantees, open-ended liquidity support, and regulatory forbearance significantly increase the ultimate fiscal cost of resolving a banking crisis. Moreover, these authors find no trade-off between fiscal costs and the speed of economic recovery. In their sample, depositor guarantees and regulatory forbearance failed to significantly reduce either crisis duration or the crisis-induced decline in aggregate real output. Providing liquidity support for insolvent institutions appears to prolong a crisis by destabilizing bank-lending incentives so extensively that healthy adjustments are delayed and additional output loss is generated.

3. Lessons for Chile

Deposit insurance was established in Chile in 1986. The system does not have a permanent fund in place. The Central Bank of Chile will honor 100 percent of demand deposits, conditional on a favorable report from the Superintendence regarding the justification for submission of payout proposals to the insolvent bank. Additionally, the Chilean government guarantees 90 percent of household savings and time deposits up to UF120 per individual. To limit the Central Bank's exposure, banks with demand deposits in excess of 2.5 times the capital reserves are required to maintain 100 percent reserves at the Central Bank in short-term central bank or government securities. Foreign exchange deposits are covered, but coverage excludes interbank deposits. Membership is compulsory for all banks, and the scheme is publicly administered.

Two features of the Chilean economy must be highlighted before we can discuss the implications of our research for Chile. First, within the universe of developing countries, Chile has a highly advanced level of institutional development. For example, on a six-point scale measuring adherence to the rule of law, Chile scores a five. This means that Chile's citizens trust its legal system. On an index measuring the protection of property rights, Chile obtains the highest possible score of five. Government corruption is among the lowest in the developing world: Chile scores a four on a six-point scale in which higher scores indicate an absence of corruption.[2] This profile makes it reasonable to rate the Chilean institutional environment as strong enough to support an explicit deposit insurance system whose design can keep moral hazard in check.

2. The U.S. corruption index is also four. Indices for corruption and rule of law are produced by International Country Risk Guide (ICRG), and the index for property rights is produced by the Heritage Foundation.

Second, Chile has a very concentrated banking system. Its top five banks hold 71 percent of domestic banking assets. Concentrated banking systems experience fewer systemic banking crises (Beck, Demirgüç-Kunt, and Levine, 2003) and almost always generate a high level of implicit insurance coverage, partly because of “too big to fail” pressures. Not surprisingly, empirical evidence confirms that incremental exposure to moral hazard from introducing an explicit insurance system is limited in highly concentrated environments.

Taken together, Chile’s institutional development and banking concentration promise to limit any adverse impact that explicit deposit insurance might have on the Chilean economy. Still, the better the design, the more efficiently the country’s scarce savings will be allocated.

Research on the design of deposit insurance has some clear implications for Chile. First, with regard to coverage, it is important to set enforceable limits so as to provide depositors and other creditors with strong incentives to monitor bank risk-taking. For this reason, Chile is to be complimented for keeping the coverage of term deposits low (coverage is currently less than per capita GDP), for imposing coinsurance so that each depositor is responsible for losses on the first 10 percent of its deposits, and for denying coverage to interbank deposits. These features strengthen private monitoring. The system would be even stronger, however, if demand deposits were not fully covered. Although the Central Bank limits its loss exposure on these deposits by imposing 100 percent reserve requirements above a specified size limit, a massive shift from time deposits to demand deposits could occur in the event of a financial crisis. Such a shift would effectively transmit full coverage to all depositors. Given that only 30 percent of total deposits is currently covered by insurance, sudden shifts could generate large increases in coverage at the worst possible time. A potential solution would be to impose a strict coverage limit on demand deposits.

A second positive feature is that the insurer has no explicit reserve fund. Research indicates that earmarking large amounts of funds for insolvency resolution distorts the incentives of market participants. However, making the Central Bank of Chile the only party responsible for covering losses from insolvencies is a dangerous feature. Unless the insured banks truly expect to pay for their mistakes, they have very little incentive either to curb their own excessive risk taking or to monitor one another. If, instead, authorities made it clear that funds to cover bank losses would come from surviving banks, Chilean banks could monitor one another effectively, since the banking system is concentrated and the quality and quantity of information are very high. This is a second improvement that could be introduced into the system.

Third, the Chilean system wisely insists on compulsory membership. Compulsory membership is advisable since it allows risk pooling and prevents stronger members from abandoning the scheme.

Finally, Chile has opted to let government officials run the deposit insurance system. Research indicates, however, that enlisting some layers of private management promises to improve system performance. Private parties tend to be better at monitoring loss exposures and initiating loss-control efforts in a timely manner.

4. Conclusions

Cross-country evidence is disturbing because, unlike Chile, many of the countries that have recently installed explicit insurance have poor contracting environments. What makes this research timely is that 60 percent of the countries in the world still have not adopted explicit deposit insurance. In Africa, for example, where the institutional environment is the least developed, only nine of the continent's more than fifty countries offer explicit insurance.

Cross-country empirical research indicates that, for now, officials in many countries would do well to resist the siren call of explicit deposit insurance. Explicit insurance must be handled with care because it reduces the incentive for depositors to monitor the riskiness of their banks. Studies show that in institutionally weak environments, deposit insurance design is apt to be defective, intensifying rather than reducing the probability and depth of future crises. Unless the insurer can effectively replace the monitoring that its guarantees displace, formal guarantees tend to encourage excessive risk-taking. Banks can raise funds from depositors at interest rates that are much lower than the yields at which their high-risk loan portfolios deserve to be funded. Depositors are apt to tolerate aggressive bank lending as long as they remain secure in the knowledge that whether or not bank loans pay off, their claims to repayment are protected by credible deposit insurance.

Explicit insurance can only help develop a robust financial system when the insurance scheme is well designed and when the local contracting environment embodies reliable institutions of loss control. The difficulty is one of sequencing. In a country with weak controls, explicit deposit insurance can, at best, spur financial development only in the very short run. Formal guarantees undermine longstanding patterns of bank bonding and depositor discipline. Over longer periods, the loss of private discipline is likely to reduce bank solvency, destroy real economic capital, increase financial fragility, and deter financial development.

For countries that have already installed or are in the process of designing an explicit deposit insurance scheme, cross-country empirical research identifies four principles of good design. No government can afford to neglect these principles. No matter how strong a country's institutional environment might be, weaknesses in deposit insurance design fuel financial fragility by undermining the discipline that banks receive from private parties. The following four design features have proved useful in controlling and offsetting these effects.

The most straightforward of these principles of good design entails setting enforceable coverage limits. The goal is to ensure that private monitoring complements official supervision: to convince large depositors, subordinated debt holders, and correspondent banks that their funds are truly and inescapably at risk. Providing strong incentives for private parties to bond and police bank risk exposures is critically important in contracting environments in which government policing threatens to be deficient.

A second principle is to make membership in the deposit insurance system compulsory. This increases the size of the insurance pool and prevents strong institutions from selecting out of the system when it needs to be recapitalized.

A third principle supported by cross-country evidence is to make the public and private sectors jointly responsible for overseeing the scheme. A public-private partnership establishes checks and balances that improve management performance.

The fourth and final principle is to limit the fund's ability to shift its losses to the general taxpayer. Regardless of whether the insurer holds a formal fund of reserves, it must be made clear that funds to cover bank losses will come principally from surviving banks, except in the most extreme circumstances. Taxpayer assistance should be expected only in the special case of a profound crisis.

Deposit insurance is neither always good nor always bad. Depending on its design, it can be a useful part of a country's overall system of bank regulation and financial markets. Cross-country research by no means implies that every country with an explicit system should close it down at the first opportunity. Rather, the research stresses the importance of identifying and fostering informative accounting standards and reliable procedures for contract enforcement before adopting deposit insurance. It also underscores the importance of planning to intelligently re-adapt the insurer's loss-control system to close loopholes opened by financial innovation. Like any strong medicine, users must ensure that the side effects of the prescription are not worse than the course of the disease they intend to treat.

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Banking Concentration: Implications for Systemic Risk and Safety-net Design

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The 1990s saw a global trend toward increased banking concentration. Given that this emergence of larger financial institutions seems to be a permanent change, understanding the implications of the trend is a highly relevant exercise, in particular for small countries like Chile. This paper analyzes safety net issues for a highly concentrated banking system in which, in addition, the total number of players (banks) is low. The safety net is commonly understood as the set of institutions created to guarantee the proper functioning of the financial system (financial institutions and markets) in the economy. It is typically considered to serve the following functions: regulation and supervision, lender of last resort, and deposit insurance. Regulation includes mechanisms for bank closure. One point of this paper is that the importance of these functions and the way they have to be designed or executed is not independent of either the level of concentration or the total number of banks in the system. Recommendations of best practices, then, have to take these considerations into account.

This paper analyzes two dimensions of the impact of concentration on the banking safety net. The first is deposit insurance. In recent years, important efforts in understanding deposit insurance and deriving best practices for it has been made (see Demirgüç-Kunt and Detragiache, 1999; Demirgüç-Kunt and Huizinga, 2000; Financial

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Stability Forum, 2001). This paper contributes to this literature by exploring the implications of concentration for deposit insurance design. One conclusion of the paper is that deposit insurance design cannot be thought of as a stand-alone instrument, but rather must be understood as an element of the intervention and resolution policy.

The second issue refers to systemic risk. I use the Eisenberg and Noe (2001) approach to model a banking network to assess the impact of banking concentration on systemic risk. A working metric of the "too big to fail" situation can be derived in the model. The model also allows testing measures that can contain systemic risk.

The organization of the paper is straightforward. Section 1 discusses deposit insurance. Section 2 presents the model and explores the relation between systemic risk and concentration. A final section summarizes the main results.

1. Deposit Insurance, Resolution Methods, and Banking Concentration

This section discusses the essential characteristics of a deposit insurance system in the case of a highly concentrated banking system featuring a low number of banks. The section starts by considering the role of deposit insurance as an element of the financial system's safety net. It then describes the design of such a system for a country like Chile. Finally, the current situation of the deposit insurance scheme in Chile is analyzed in the light of the previous discussion.

1.1 The Role of Deposit Insurance in the Safety Net

Deposit insurance is one of the most visible elements of the safety net for the public—maybe even the only visible element. Conventional wisdom typically considers the prevention of bank runs as the main role of deposit insurance. Understanding the extent to which a bank run can happen is crucial for designing an efficient deposit insurance system and setting realistic goals for it. In addition to this role, deposit insurance protects small depositors. While this may sound less grandiose, it may, in fact, be the more realistic objective.

The argument linking deposit insurance and bank runs was first formally presented by Diamond and Dybvig (1983), who hold that runs can be a self-fulfilling equilibrium. This idea has been influential in safety net design and has contributed to the view that financial markets are essentially unstable and prone to crises not necessarily backed by fundamentals. Their paper shows that a certain level of deposit insurance can make the “no run” strategy the dominant one, thus eliminating the equilibria with runs. They acknowledge that lender-of-last-resort functions can have the same effect, although they do not explore it formally.

Two elements have to be considered for policy design, however. First, empirical evidence indicates that historically, bank runs have not necessarily been the expression of unfounded panics, but rather have usually occurred in a context of real bank insolvency (Calomiris and Mason, 1997; Gorton, 1988; Kaufman, 1994). Moreover, solvent banks apparently have not suffered from contagion in these events—that is, depositors have discriminated, and there have not been runs on solvent banks. Second, if panics were a high probability event, the only deterrent would be a back-up fund equal to total deposits. In the absence of such a fund, rational depositors would know that the deposit insurance fund was limited, and they would have incentives to run if they believe that others would run. The panic hypothesis thus has clear predictions about the type of deposit insurance that should be in place.

In this context, an alternative to deposit insurance is lending by the central bank. If there is a run on a bank not based on fundamentals, the central bank can step in and provide the required liquidity against good collateral—as per the classical recommendation by Bagehot (1873). If the run is based on fundamentals, then it is optimal to close the bank. Moreover, if this is the case, the bank will have been closed promptly and no run will ever have taken place. There is hardly any reason to believe that the public will know about a bank’s insolvency before the regulator.

The latter argument is incomplete, though, in that it leaves out a case that points to a role for deposit insurance. This case arises when a bank is weak and the regulator cannot fully discern whether the bank is viable. A run is a possible response here, this time granted by fundamentals. The central bank will have to make a decision about whether to lend to this bank when it may not have full information. It would risk losses if it lends and the bank is not solvent. On the other hand, if the central bank does not lend, the economy may experience efficiency losses when projects with a positive net present value are shut down. The need for a possibly inefficient decision can be avoided with deposit insurance, which can contain the run on the bank. What is needed to contain the run is a credible promise that deposits will be repaid. The promise is credible as long as the deposit insurance system has—or has credible access to—sufficient funds to cover insured deposits. In this context, credibility implies that the deposit insurance system should have sufficient funds to pay the deposits of weak banks and not of the entire system.

A corollary of this line of reasoning is that the type of crisis for which the deposit insurance system could be useful is determined by the amount of funds that the deposit insurance can credibly offer. If policymakers expect the deposit insurance system to help in situations of widespread weakening of the banking system, then it should have credible access to enough funds to cover all deposits in the system. This would likely be a very large amount, which is why most deposit insurance systems in the world are not expected to be useful in cases of systemic crisis, but rather are used to deal with isolated bank failures.[1]

An alternative approach leads to a similar conclusion. Dewatripont and Tirole (1994) develop a theory of banking regulation based on what they call the representation hypothesis. By this they mean that regulation is necessary to represent a large number of small depositors who may find it costly to monitor a bank individually, in particular if their deposits are small. Regulation and supervision will restore adequate incentives for good corporate governance of a bank in the presence of an atomized principal. Deposit insurance arises in this context to protect small depositors by minimizing their losses in case of bank failure.

In reality, most deposit insurance systems seem closer to the second approach than to the first. The first approach calls for protection for those most likely to run—arguably, large depositors. The second is consistent with limits on protection per depositor.

1.2 Deposit Insurance in a Highly Concentrated System

The key message of the previous section is that a deposit insurance system should be designed to deal with isolated bank failures. In contrast, deposit insurance should not be counted on in the face of systemic problems, that is, when a substantial fraction of the banking system is in trouble. This has two implications for highly concentrated

1. A recent report by the Financial Stability Forum (2001) explicitly recommends that deposit insurance systems should not be expected to deal with systemic crises.

systems with a low number of institutions. First, such systems are likely to be characterized by the presence of so-called systemic banks—that is, banks that control a significant fraction of the systems assets. The large size of these banks implies that the deposit insurance fund necessary to cover the potential losses generated in paying the deposit insurance guarantee is too big. Moreover, the systemic importance of a large bank may be such that authorities would decide not to close it even in the face of insolvency, and the bank's problems would have to be addressed in a way that does not imply depositor repayments. This implies that the liabilities generated by the deposit insurance should not be expected to be paid in the case of large banks. Second, in the case of systems with a low number of banks, the system will basically be relevant for only a few banks. Since failure is an unusual event from an individual bank's perspective, the deposit insurance guarantee should not need to be executed too often.

To illustrate this point, I compare the deposit insurance system in the United States (the Federal Deposit Insurance Corporation, or FDIC) with a hypothetical deposit insurance system in Chile. The Chilean banking system contains far fewer banks than the United States, with 25 and 8,505, respectively. The Chilean system is also much more concentrated, as shown in table 1.

For the case of Chile, I consider the current structure of coverage, under which all demand deposits are covered in full, while term deposits of natural persons are covered up to UF108 (approximately US$2,600 at the current exchange rate). For simplicity, I assume that all depositors qualify for insurance, that is, I make no distinction between natural and legal persons. I leave comments on this coverage structure and room for improvement for the next section.

Table 1. Chile and the United States: Concentration Measured as Share of Total Loans
Percent

	Share of total loans	
Size group	*Chile 2002*	*United States 1999*
Largest single bank	26	8
Largest five banks	74	27
Largest ten banks	92	37
Largest fifteen banks	99	43

Source: SBIF (Sept. 2002); Group of Ten (2001).

Next, I assume that the Chilean system follows a similar rule to that of the United States, namely, that its target fund is 1.25 percent of covered deposits. This gives an approximation of the effective protection that the deposit insurance system is prepared to give for failures in the system. An alternative metric would be obtained by considering effective premiums charged by deposit insurance systems around the world. The data in the Demirgüç-Kunt and Sobaci (2000) world database on deposit insurance shows that 58 out of the 68 countries with explicit deposit insurance charge premiums (the others rely on ex post funding from surviving institutions or government funding). The average maximum rate is 0.36 percent of deposits while the median maximum rate is 0.24 percent. The problem is that it is not possible to know from the database whether countries target a fund of a determined size. However, a deposit insurance scheme charging the median rate will reach a target similar to that of the United States in five years. Considering that the fund is, in fact, used to pay out the guarantee, the United States target seems a reasonable order of magnitude for the funds that real deposit insurance systems should have in their steady states.

Table 2 compares the extent of protection under a concentrated versus a decentralized system. In the case of Chile, coverage is determined from data on distribution of deposits by size. Coverage limits are more generous in the United States, implying that the fraction of deposits covered is more than twice that of Chile under the current limits. The comparison is startling, however, when based on banks that are effectively protected, that is, those whose insured deposits are less than or equal to the deposit insurance fund. In the United States the fund is relevant for almost eight thousand banks, whereas

Table 2. Protection in Chile and in the United States

		Chile	
Measure of protection	*United States (FDIC)*	*Current limits*	*Proposed limits*
Insured deposits as percent of total	67.2	28.7	28.1
Banks that are effectively covered[a]	7,888[b]	14	14
Banks in the deposit insurance system	7,966	25	25
Ratio (expressed as percent)	99	56	56
Total deposits in effectively covered banks as percent of total	33.8[b]	8.6	8.6

Source: FDIC (2002); SBIF (2002).
a. Banks whose insured deposits are equal to or lower than the deposit insurance system fund, estimated as 1.25% of covered deposits.
b. At least.

in Chile it would be relevant for only 14. These effectively protected banks hold at least 34 percent of total deposits in the United States, while that figure would be only 8.6 percent in Chile.

This analysis implies that the question of how to design and organize a deposit insurance system becomes less relevant in the case of a highly concentrated system. This question has received a lot of attention from multilateral institutions in recent years, and sets of recommendations and best practices have been produced (García, 1999; IMF, 1998; Financial Stability Forum, 2001). However, the necessary elements for a country's decision on whether to have deposit insurance and what to expect from it typically are not part of the discussion.

Deposit insurance policy must be seen as an element of a broader policy encompassing the optimal intervention and resolution of distressed banks. The design of the specific elements of the deposit insurance should be carried out as part of this broader context. While the challenges of intervention and resolution policy in a highly concentrated system are beyond the scope of this paper, some elements to be considered are that the likelihood of banks being closed or liquidated is low and that bank resolution will most likely come in the form of purchase and assumption (P&A) operations. To minimize the cost of these operations, regulation should stress early intervention. The focus of the deposit guarantee management switches toward this type of issues.

I now revisit three questions: Does deposit insurance make sense in a highly concentrated system? If yes, should the deposit insurance system have a fund? And finally, should the public sector participate in the funding of the deposit insurance system? The answer to the first question is yes. The two arguments put forward in support of an explicit guarantee (Dewatripont and Tirole's representation hypothesis and the prevention of a run when it is difficult to discern the solvency of a distressed bank) remain valid. In addition, depositors can rationally anticipate that the likelihood of a large bank being liquidated is lower than that of a small bank being liquidated, and they may therefore prefer the large bank. This implies that an explicit deposit guarantee would correct a bias against small banks and become a force against concentration.

The answer to the second question is also yes, but with a limit. As explained before, a fund will definitely be used for depositors' repayment less in a concentrated than in a decentralized system. A fund will also be needed, however, to cover potential losses in P&A operations. In either case, the frequency of these operations will be low, which raises the question of whether the cost of maintaining a contingency fund is justified. The alternative would be to raise funds from the industry (and maybe from the government, as well, as discussed later) to cover the losses derived from the guarantee in the case of a bank failure. This may be seen as unfair, however, as long as the failed banks that caused the losses do not pay. The highly concentrated case thus calls for maintaining a fund, but at a lower level than in a less concentrated system.

With regard to the third question, the answer depends on the rationale that supports the existence of the deposit insurance. If it is only expected to protect small depositors, then the deposit insurance should be funded by the industry. Protecting small depositors will attract them as customers, which benefits the industry. If the deposit insurance is expected to give the regulator the necessary time to discern the viability of a bank, then a case can be made for partially funding the deposit insurance through the public sector. Such a fund would allow the authority to avoid the risk of acting as lender of last resort to a bank that is potentially insolvent. At the same time, it avoids the risk of closing a solvent bank, which would lead to efficiency losses if projects with a positive net present value are cancelled.

1.3 Comments on the Current Deposit Insurance Guarantee in Chile

The main facts of deposit insurance in Chile were described in the previous section. Demand deposits are covered in full, while term deposits are covered with a low limit (approximately US$2,600) and for natural persons only. Table 2 shows the coverage implied by the size distribution of deposits.

The main criticism of this structure is that protection to demand deposits is unlimited. Depositors facing a situation of distress could move from term to demand deposits massively, in search of full protection. The effective guarantee that the central bank is giving to the public can thus be multiplied several times in a short period. In the extreme case, all deposits could be moved to demand deposits, with the effective coverage being multiplied by a factor of 3.5.

The logic of protecting demand deposits in full is that they are deemed key for not generating disruptions in payments in the economy in the case of a bank failure. This seems rather limited as a measure for containing the systemic implications of such an event. Presumably, a current account holder would also have term deposits.

Protecting current account deposits only does not mean that all expected payments by this holder in the future will be fulfilled.

This criticism notwithstanding, the real problem with the full guarantee is the potential increase in the cost of closing a bank as a result of shifting deposits.[2] The logical solution is to limit the coverage of demand deposits. A second issue is the low limit on term deposits, which makes the threat of closing a bank less credible since it would be politically difficult to implement.

A sensitive scheme would raise the protection of term deposits and reduce that of demand deposits. The last column in table 2 shows the effective protection granted when the limit on both types of deposit is set at 500 UF (approximately US$12,000). The size of the guarantee is similar to that of the previous case, so the total protection granted to the system is similar. A key difference, though, is that a major channel through which exposure could be artificially inflated has been eliminated.

2. Systemic Risk and Banking Concentration

This section is concerned with the relation between banking concentration and systemic risk. Despite the lack of a specific definition, systemic risk is the most common single argument used to justify the regulation of the financial sector in general and the banking system in particular. Explicitly or implicitly, systemic risk is usually understood as the failure or risk of failure of a significant part of the financial system.

Although systemic risk is widely employed as a primordial justification for banking regulation, efforts to model it explicitly and consider it explicitly in regulation design and evaluation are surprisingly recent. The consensus view on banking was largely associated with liquidity transformation as the main rationale for the existence of banks and, from there, as the key characteristic determining their risks. A seminal and largely influential paper in this tradition is Diamond and Dybvig (1983). Their approach, however, does not leave any room for a systemic analysis.

2. The extent to which this is a real possibility can be verified in Japan, where term deposits shifted to demand deposits when it was announced that the full guarantee on deposits would be eliminated for term deposits but maintained for

Dow (2000) proposes a simple classification of the different forms that systemic risk can take. Dow distinguishes four forms for thinking about systemic risk: contagion à la Diamond and Dybvig, in which problems in one bank can generate a change in expectations and thus produce runs on solvent banks; direct linkages, in which direct exposures via interbank lending, deposits and derivatives contracts can cause the transmission of problems in or the failure of one bank to otherwise healthy banks; endogenous prices, in which problems in one bank or group of banks can lead to changes in asset prices, which, in turn, can cause problems in previously unaffected banks; and common shocks, in which a large fraction of the banking sector can be weakened if they face similar risks.

The discussion in the previous section showed that pure expectations contagion (case 1) does not seem to be found in the historical evidence. Efforts should therefore focus on the other three cases. In this paper, I use a simple model that incorporates the second form of systemic risk, in order to assess the impact that banking concentration can have on that risk. In addition, the model aims at deriving possible regulatory measures that could be used to reduce systemic risks. Future work should add cases 3 and 4 into the analysis.

2.1 Relevant Literature for this Paper

Theoretical models for analyzing banking systems have recently been put forward by Rochet and Tirole (1996), Freixas, Parigi, and Rochet (2000), and Allen and Gale (2000). Important results from these works include the importance of a diversified set of linkages among banks to increase the system's resilience to shocks and the importance of unsecured direct linkages to promote cross-monitoring and market discipline among banks.

Applied studies of the systemic risk implicit in interbank markets have appeared in recent years applied to different countries. Furfine (1999) for the United States, Upper and Worms (2001) for Germany, Elsinger, Lehar, and Summer (2002) for Austria, and Wells (2002) for the United Kingdom all use a framework described in Eisenberg and Noe (2001) to assess this risk. Findings typically show that the probabilities of systemic crises are low. Also, the systemic importance of different banks can be determined.

This paper is related to this literature, but its goals are different. Specifically, I am not interested in assessing the extent of systemic risk implied by the current bilateral exposures of the Chilean banking system, but rather examine whether the tendency toward concentration has fundamentally affected the fragility of the system.

2.2 The Model

The interbank structure can be described by the following $N \times N$ matrix:

$$\mathbf{X} = \begin{bmatrix} x_{1,1} & \dots & x_{1,j} & \dots & x_{1,N} \\ \vdots & & \vdots & & \vdots \\ x_{i,1} & \dots & x_{i,j} & \dots & x_{i,N} \\ \vdots & & \vdots & & \vdots \\ x_{N,1} & \dots & x_{N,j} & \dots & x_{N,N} \end{bmatrix}$$

Matrix **X** summarizes interbank cross-exposures, with x_{ij} representing the loans that bank i has made to bank j. Summing horizontally I obtain the total liabilities of bank i, while the vertical sum gives us all the interbank assets of bank j:

$$a_k = \sum_i x_{i,k}$$

$$l_k = \sum_j x_{k,j}$$

In addition, elements on the diagonal have to be zero; otherwise, it would mean that banks are lending to themselves:

$$x_{i,i} = 0 \quad \forall i$$

Eisenberg and Noe (2001) provide crucial elements for using this model to assess the stability of a banking system in the context of a payments problem. Specifically, they are interested in finding the clearing vector for a system of nodes that hold liabilities among each other, that is, the vector of payments from each node to the rest of the system that clears the system. The clearing vector is what banks actually pay in equilibrium. If a bank defaults, its payments would be ex post lower than its original liabilities. Using a fixed-point argument, the authors prove that a clearing vector always exists and that it is unique under mild conditions. This is important given the cyclical interdependence of the model. Because the solution is unique, it is independent of the procedure taken to find the solution.

In the Eisenberg and Noe setup, payments are modeled in accordance with bankruptcy law. If the node (bank) has not defaulted payments are made in full. If the node has defaulted, the remaining value of the node is distributed among claim holders in proportion to their claims, that is, liquidation rules assume limited liability.

In addition to the proof of existence and uniqueness, a useful outcome of Eisenberg and Noe's paper is the algorithm they use to find the clearing vector, which they call the fictitious default algorithm. This algorithm starts by assuming that all payments are fulfilled. If no node has total income below payments, then total payments made by each node form the unique clearing vector that solves the system, and the algorithm stops. If a bank defaults, a new round is run, in which liabilities by the failed node are distributed proportionally among the creditor nodes. After this, it is checked whether other nodes fail and so on. This algorithm is iterated until no bank fails. Eisenberg and Noe's procedure for finding a clearing vector in a network of bilateral exposures thus becomes a natural procedure for measuring the systemic risk imposed by a given bank.

To measure the systemic importance of each bank and, more generally, the stability of a certain banking structure, I allow banks to fail one at a time. In each failure, I assume that a certain fraction, θ, of the value of the failing bank is lost, and this amount constitutes the loss that the failed bank's creditors experience (that is, the loss-given-default ratio). I assume that each bank has a certain amount of capital and that a bank fails when its total losses from failed banks are larger than its capital.

The sequential nature of the algorithm gives us important information about the stability of the system, such as the extent to which failures are caused by contagion rather than direct exposures, the number of rounds of failures that the failure of a large bank can generate, and so on.

2.3 Simulations

The object of study of this paper is the concentration of banks in Chile. This is approximated by the distribution of Tier 1 capital among banks. This concentration structure is compared with other structures with varying degrees of concentration. The objective is to determine the extent to which the systemic risk implied by a system's members varies with the level of concentration.

Two scenarios are run in the simulations. In the first scenario, limits to interbank borrowing and lending are purposely kept high in order to generate many different possible scenarios for interbank linkages. Allowing high levels of interbank exposure makes contagion more likely. These scenarios are generated randomly, as explained below. The objective of this step is to test different metrics to measure systemic risk in a given system of interbank linkages. The second scenario simulates the Chilean banking system more realistically. In particular, limits to interbank lending are set at levels corresponding with current regulation in Chile.

2.4 Parameters

This subsection presents the parameters chosen for the model in order for it to reasonably resemble the case of Chile. In some cases, data for the Chilean banking system are available. When data are not available, Chilean regulation is used to define the limits within which random draws are obtained for simulation.

Capital Structure

The base case is the effective capital structure in September 2002. The alternative scenarios are generated following a simple rule: I sequentially reduce the rate of growth of bank sizes by a factor of 0.2 of the original size distribution. The scenarios generated are summarized in table 3.

Table 3. Capital Structures Used in Simulations
Percent share

Size group	*Baseline*	*Case b*	*Case c*	*Case d*	*Case e*	*Case f*
Largest single bank	23.7	19.4	14.8	10.8	7.3	4.0
Largest five banks	65.0	58.7	48.7	40.0	29.3	20.0
Largest ten banks	84.7	80.6	71.3	64.6	53.7	40.0
Largest fifteen banks	95.4	92.9	87.8	81.5	75.6	60.0
Summary statistic						
Herfindahl index	1,157	937	702	556	458	400
No. banks	25	25	25	25	25	25

Source: FDIC (2002); SBIF (2002).
a. Banks whose insured deposits are equal to or lower than the deposit insurance system fund, estimated as 1.25% of covered deposits.
b. At least.

Limits to Interbank Lending

Current regulation imposes limits to interbank credit on both the borrowing and lending side. On the lending side, Chilean banking law establishes that interbank lending to a single bank cannot exceed 30 percent of the Tier 2 capital of the lender. Because Tier 2 capital can be up to 50 percent larger than Tier 1 capital, this limit implies that lending to a single bank can be as much as 45 percent of Tier 1 capital. These limits refer to lending and not to total exposure. Exposure can be larger than lending as a result of deposits and derivative contracts. There is no limit to overall interbank exposure.

On the borrowing side, overall interbank term (as opposed to demand) liabilities with residual maturity of less than one year cannot exceed 10 percent of assets. In addition, term liabilities with a specific bank cannot exceed 3 percent of the assets of either the borrower or the lender, whichever is the largest. In a concentrated banking system, this limit becomes less relevant, since it is determined by the size of the largest bank in a credit relationship. In particular, medium and small banks can have large exposures to a big bank. Finally, liabilities payable on demand or with a residual maturity of over a year are not subject to any limit.

Limits to interbank exposures thus are not very restrictive on either side of the balance sheet. On the lending side, total lending is not limited and individual exposure can be increased by means other than lending. On the liabilities side, limits can be exceeded via long-term borrowing. Long-term interbank lending can be high in some countries: Upper and Worms (2001) report that in Germany as of December 1998, 36 percent of all interbank liabilities have a maturity of four years or more.

For the first scenario I assume a limit of 30 percent on interbank assets and liabilities. For the second scenario, I impose a 10 percent limit to interbank assets and liabilities.

Interbank Linkages

In the first scenario, interbank lending is generated randomly. I assume that the ratios of overall interbank assets and liabilities to total assets are random variables for each bank, distributed uniformly between 0 and the defined upper limit. This implies that the interbank assets and liabilities of a given bank are not related in a predictable way—that is, that the level of a bank's interbank assets does not say anything about the level of its liabilities. This may not be true for certain banks that typically operate on either the lending or borrowing side of the market (money center banks, for example), but it is a reasonable assumption for most banks.

From the two ratios obtained for each bank, total interbank assets and liabilities for each bank are obtained using the level of the bank's total assets. The next step is to generate the matrix **X**, which will tell us how the interbank connections are. Since assets and liabilities are generated randomly, an adjustment has to be made to ensure that they add up to the same amount.

Banks can be connected to each other in a number of ways. According to Allen and Gale (2000), the more diversified are the links of each bank, the more resilient is the system to shocks. I generate interconnections through an algorithm that generates maximum diversification or "connectedness" of the structure *given the total assets and liabilities that each bank wishes to hold*.

The algorithm starts by randomly determining a vector of total interbank assets (vector **a** of elements a_k) and one of total interbank liabilities (vector **l** of elements l_k). They represent, respectively, the total interbank assets and liabilities that a bank wishes to hold. From them, I would like to generate matrix **X**. This may not be possible, since it amounts to solving N x (N – 1) unknowns with 2N equations.

Given this, I follow an algorithm to build a matrix **X** that is as consistent as possible with vectors **a** and **l**. Each element of vector **a** is distributed as liabilities of the other banks (that is, in a column of matrix **X**) in proportion to vector **l**. In the next step, allocated liabilities are summed for each recipient bank (horizontal sum in matrix **X**) and compared to the desired liabilities indicated by vector **l**. Allocated and desired liabilities may differ. When the allocated liabilities of a recipient bank are larger than its desired liabilities, the excess is subtracted proportionally from each creditor bank and the desired liabilities for the recipient bank are set to zero for the next round. The assets allocated in excess are marked as pending for each creditor bank. Should the allocated liabilities be less than desired liabilities, this difference will be the desired liabilities for the next round.

In the next round, a similar allocation takes place where the pending assets of each creditor bank are distributed among recipient banks in proportion to their remaining desired liabilities. Excesses are determined and a new round is run until either all assets are allocated or all desired liabilities are fulfilled. Whichever happens first will determine the total size of the interbank market. The algorithm allocates assets in a few rounds.

Note that the algorithm as described generates total interbank assets and liabilities independently of each other, and it stops when the lower of the two is allocated. It thus biases randomly generated interbank relations to the conservative side, which is assuming a low level of interconnectivity among banks.

Loss-given-default Ratio

Simulations are run considering loss ratios between 10 percent and 50 percent. James (1991) calculates loss ratios in bank failures at 40 percent. The latter is a standard value for calibrated models in this literature. This is a conservative value, in the sense that it calculates the final loss after a long period during which assets are liquidated. The stress imposed on a creditor bank at the time of the bank failure can be a lot larger.

Total Assets

Total assets are generated from capital assuming the regulatory ratio of Tier 1 capital to assets of 3 percent.

2.5 Results

As mentioned earlier, results are obtained in two stages. In the first, constraints on interbank borrowing are relaxed in order to generate a large number of banking failures and contagion. This stage attempts to test the accuracy of different metrics for systemic risk. The second stage explores the Chilean system more realistically and uses the results of the first stage to explore measures to contain systemic risk.

First Simulations

The objective of the first simulations is to explore the dynamics of the model and to determine metrics for measuring the systemic risk implicit in a given system. Table 4 provides a summary of some of the findings. For each possible capital structure, I simulate a hundred different interbank markets. The resilience of each case of interbank market is determined through the fictitious default algorithm. If at least one bank in this algorithm generates the failure of at least

Table 4. Systemic Risk

	Capital structure				
System indicator	*Baseline*	*Case b*	*Case c*	*Case d*	*Case e*
Average interbank assets over total assets (percent)	15.2	15.0	15.0	14.9	14.8
Cases of contagion out of 100	70	42	14	0	0
Average no. banks affected given contagion[a]	15.8	15.0	15.8	0	0
Average assets affected given contagion (percent)[a]	52.1	51.3	59.6	0	0
Assets failed in worst contagion case (percent)	79.8	80.1	76.5	0	0

a. The baseline capital structure generates six cases in which two banks can generate contagion for a given interbank matrix; the worst case was taken for the table.

one other bank, the whole interbank structure is marked as capable of generating contagion.

Table 4 reports the average size of the interbank market generated in each case, which is similar across capital structures. The second line shows that systemic risk differs considerably across structures. For the baseline capital structure, in 70 out of 100 scenarios there is at least one bank whose failure can lead to the failure of a second bank. The next line shows that the total number of banks affected in each case is large, as is the average level of assets damaged when contagion exists.

The incidence of contagion drops considerably as the capital structures become less concentrated. Beginning with structure d, in which the largest bank accounts for about 11 percent of the system, there are no more cases of contagion under the parameters of this exercise. However, while reducing concentration lowers the incidence of contagion considerably, when contagion does occur (structures b and c), it causes a similar level of damage as measured by number of banks and assets affected. In fact, the damage increases slightly, suggesting that the worst contagion cases are the last to disappear.

Next, I run regressions based on the data generated in the simulations to determine possible metrics for assessing the systemic risk embedded in a given system of interbank linkages. I define the dependent variable as the worst loss in total assets that can occur in a certain system of interbank linkages. I try different metrics as potential explanatory variables, focusing on variables that could be constructed from balance sheet data by a regulator.

Two metrics seem to give interesting information. One is an attempt to measure interconnectedness; it is defined as the standard deviation of the exposure of each bank to each other bank as a percentage of its capital. In practical terms, it consists of dividing each row i of matrix **X** by the capital stock of the i^{th} bank and taking the standard deviation of this matrix without considering elements in the diagonal. A better-connected (that is, more diversified) system will have a lower standard deviation of exposures, so I expect a positive relation between this metric and the dependent variable. The second variable captures the risk imposed on the system by the bank that causes the worst systemic crisis when it fails. I define this measure of "risk imposed" as the total liabilities of a bank (the column sum of matrix **X**) over the combined capital stock of all the other banks. Again, the higher the risk imposed by a bank, the higher the potential damage, so I again expect a positive coefficient.

Table 5 shows the results of the regressions. Each regression is run a second time with dummy variables for the type of capital structure. The first metric (standard deviation of exposure) is significant and gives a relatively good account of systemic risk when combined with the total size of the interbank market. R squared increases when dummy variables are included. This is due to cases d and e, in which failures never occur. The "risk imposed" variable has an even better explanatory power. As it turns out, including other variables in this specification does not help. This finding is useful for policy purposes, as discussed in the next section.

Second Simulations

The second set of simulations assesses the risks of the current structure of concentration in Chile in a more meaningful way. Measures of both bank failures and damaged assets are reported. Damaged assets are defined as the assets of banks that suffer a capital loss of at least 50 percent but less than 100 percent. The idea is to measure not only absolute failures, but also banks that have been substantially weakened. In these situations, the supervisor will most likely have to take some corrective action.

Interbank assets and liabilities are limited to 10 percent, and I assume that banks are close to that number. This assumption may seem extreme, but it is in the extreme scenarios that resilience is tested. Moreover, as reported above, interbank assets and liabilities can be higher than 10 percent of assets according to current regulation in Chile.

Table 5. Key Determinants of Asset Loss[a]

	(1)	(2)	(3)	(4)
Explanatory variable	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Constant	–0.842	–1.134	–0.282	–0.340
	(–14.7)	(–12.6)	(–17.7)	(–9.5)
Interbank/total assets	2.459	2.708		
	(7.5)	(8.4)		
Std. dev. of exposure	0.416	0.550		
	(23.3)	(16.3)		
Risk imposed			0.401	0.448
			(28.7)	(21.4)
Dummy *b*		–0.002**		0.028**
		(–0.1)		(–1.3)
Dummy *c*		0.031**		0.027**
		(1.0)		(–1.1)
Dummy *d*		0.088*		0.008**
		(2.5)		(0.3)
Dummy *e*		0.191		0.09
		(4.7)		(3.2)
Summary statistic				
R^2	0.54	0.58	0.62	0.65
Adjusted R^2	0.54	0.57	0.62	0.64
Standard error	0.17	0.16	0.15	0.15
No. observations	500	500	500	500

All variables significant at 1 percent unless otherwise noted.
a. The dependent variable is the fraction of total assets failed to total assets in the worst-case scenario of a given system of interbank linkages. The explanatory variables are as follows: Interbank/total assets is the standard deviation of the exposure of each bank to each other bank as a percentage of its capital; risk imposed is the total liabilities of a bank (the row sum of matrix **X**) over the combined capital stock of all the other banks.
* Significant at 2 percent.
** Not significant at 10 percent.
t statistics in parentheses.

In these simulations, I also explore the impact of different structures of interconnections. In particular, I study the impact of varying the number of counterparties with which banks interact. I analyze cases for a number of counterparties ranging from three to twenty. These need not to be the same on the borrowing and lending side. Nor do they form closed sets, in the sense that the counterparties of a given bank do not have the same counterparties as that bank. Limiting the number of counterparties adds realism to the exercise, in that it does not seem plausible that banks have relations with all existing banks.

For a given number of counterparties, the interbank matrix can take many possible forms. In other words, there are many ways to pick C counterparties from $N-1$ banks, when C is lower than $(N-1)$.

I thus randomly generate 1,000 interbank matrices for each number of desired counterparties. I focus on symmetric cases only. That is, if bank 1 has interbank liabilities with, say, banks 4 and 5, then bank 2 has interbank liabilities with banks 5 and 6. This ensures that all banks have the same systemic importance in terms of their connections, and they only differ in their size.

Results are presented in figures 1 to 9. First, I present the effect of different capital structures on systemic risk, measured as both damaged assets (as defined earlier) and the assets of failed banks. I then present the effect on systemic risk of limiting the risk that banks can impose on the rest of the system under the current capital structure of banks in Chile. In all cases, the average of the fraction of damaged or failed assets across the 1,000 cases is presented, as well as the tenth and ninetieth percentiles.

Figures 1 and 2 present the results for the cases of loss-given-default ratios (θ) of 20 percent and 30 percent, respectively. At these levels of θ, there are no failures by contagion. The figures show the fraction of damaged assets for three cases of the capital structure (the baseline case, case *c*, and case *e*) and for a number of counterparties ranging from three to twenty. The most important result is that systemic damage increases with the concentration of the banking system. In the less concentrated system (case *e*), damage is low and it appears only in cases of a small number of counterparties (less than 6). This implies that concentration increases systemic damage in the event of failure.

Figure 1. Damaged Assets under Different Levels of Concentration, θ = 0.2

Average, 10th percentile, and 90th percentile

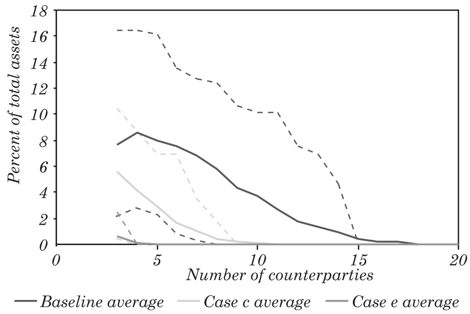
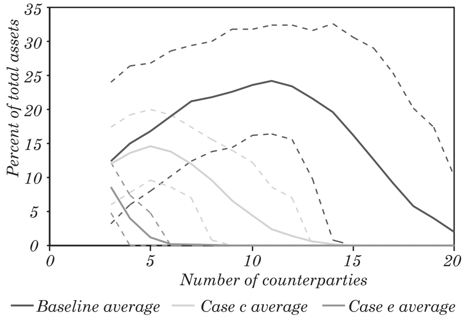


Figure 2. Damaged Assets under Different Levels of Concentration, θ = 0.3

Average, 10th percentile, and 90th percentile



The second interesting result is that for the more concentrated banking systems, the relation between total damage and the number of counterparties is not monotonic. Figure 3, in particular, shows that for the baseline case, increasing the number of counterparties from the lowest figure (three) increases the damage caused in the system by the failure of a bank; this continues until 11 counterparties are reached, after which systemic damage falls. This result is contrary to the conventional wisdom that a better-connected system is always safer than a less connected one. Here, the increase in interconnections—rather than spreading the shock of the initial failure over a larger number of counterparties and thereby making it more difficult for the event to lead other banks into default—is dominated by the effect of more interconnections increasing the number of banks that can be affected by the initial bank failure. This result is more likely to occur with greater heterogeneity of bank sizes. This is confirmed by the fact that the inverted-U shape disappears when the concentration in the banking system is reduced.

Figures 3 and 4 report cases with θ equal to 40 percent and 50 percent, respectively. These figures report the assets of failed banks as a proportion of total assets. Results are analogous to those shown in figures 1 and 2. Damage is higher the higher the concentration of banks for a given number of counterparties in almost all the cases.[3]

3. The only exceptions are the cases of θ = 0.5 with three and four counterparties.

Figure 3. Failed Assets under Different Levels of Concentration, θ = 0.4

Average, 10th percentile, and 90th percentile

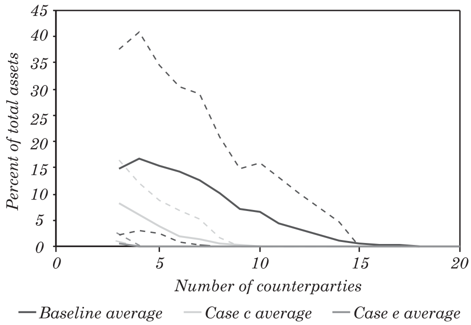
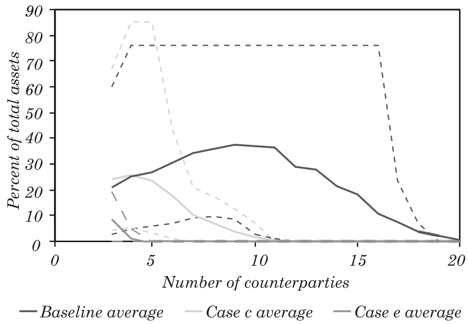


Figure 4. Failed Assets under Different Levels of Concentration, θ = 0.5

Average, 10th percentile, and 90th percentile



The relation between damage and the number of counterparties has an inverted-U shape that disappears as concentration is reduced. Finally, note that going from the base structure to case *c* involves larger benefits than going from case *c* to case *e*. Gains in moving from the base structure to case *c* can be large. The case θ = 0.4 shows that case *c* has no systemic failures in up to 90 percent of the cases with eight counterparties. Reaching this level of stability under the baseline structure requires increasing the number of counterparties to fifteen.

Results from the first set of simulations showed that "risk imposed" was a key determinant of systemic risk. Consequently, systemic risk can be contained by limiting the level of risk imposed on the rest of the system. I searched through the simulations to find the largest value for the "risk imposed" variable that generates no failures by contagion in 95 percent of the cases given θ = 40 percent and ten counterparties. It turns out that this number is 0.25. This is the maximum ratio of liabilities in the interbank market to the combined capital of all other banks in the system. This number can be translated into a maximum ratio of interbank liabilities to total assets as a function of the fraction of capital that a given bank represents in the total. The latter representation is easier to interpret intuitively than the former.

Figure 5 shows the rule of the maximum liabilities as a function of the ratio of a bank's capital to total system capital. A 10 percent maximum is exogenously imposed. The rule implies that banks whose capital represents more than 7.5 percent of total capital should have a limit on total interbank liabilities below 10 percent of their assets. A bank whose capital represents 20 percent of the system, for example, should not have more than 3.7 percent of its assets as interbank liabilities.

The effect of the rule is shown in figures 6 through 9, which can be directly compared with figures 1 through 4. The rule effectively reduces systemic damage in all cases. Failures by contagion virtually disappear in all cases with ten or more counterparties, even in the case of θ = 50 percent. This contrasts sharply with the case of the base structure of concentration.

The rule leaves the system with a measure of potential systemic damage lower than that achieved under concentration structure *c*, in some cases by a large amount. Incidentally, it has an analogous effect on reducing concentration in eliminating the inverted-U shape of the impact of increasing connections over systemic damage.

Figure 5. Maximum Interbank Liabilities

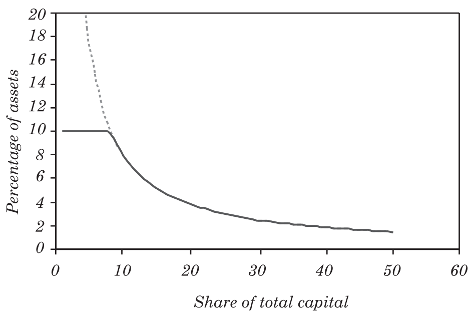


Figure 6. Damaged Assets, with and without Rule, θ = 0.2

Average, 10th percentile, and 90th percentile

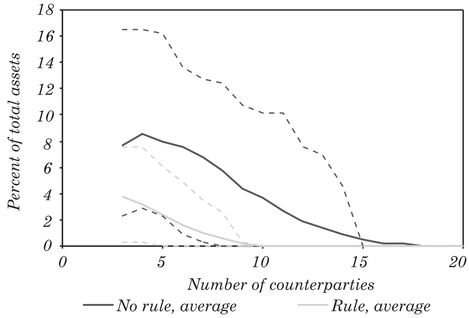


Figure 7. Damaged Assets with and without Rule, θ = 0.3

Average, 10th percentile, and 90th percentile

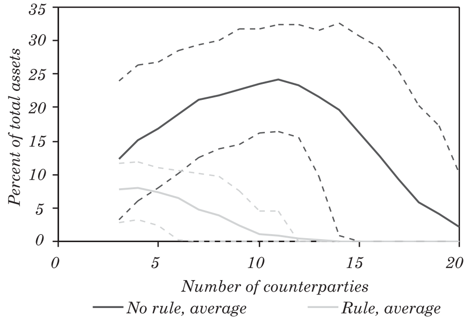


Figure 8. Failed Assets with and without Rule, θ = 0.4

Average, 10th percentile, and 90th percentile

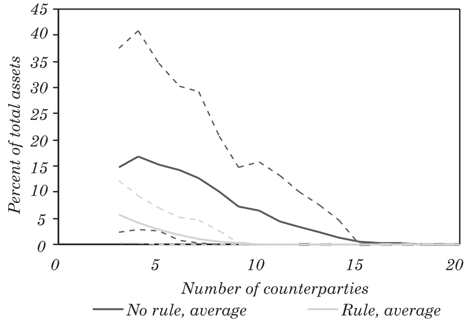
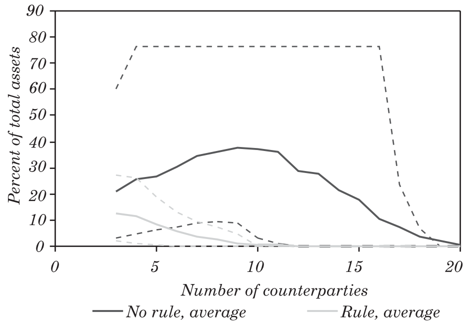


Figure 9. Failed Assets with and without Rule, θ = 0.5

Average, 10th percentile, and 90th percentile



3. Final Remarks

This paper has analyzed the key characteristics of a safety net for a financial system characterized by high concentration and a low total number of banks. The first section discussed the role of deposit insurance, highlighting the diminished importance of deposit insurance in the case of a system with a low number of banks. The design of a deposit insurance system should therefore be embedded in a more general policy of intervention and resolution.

A second message from the first section is that the issue of systemic risk becomes crucial in a highly concentrated banking system. The second section thus analyzed systemic risk in the case of the Chilean banking system and proposed regulatory measures to help contain it. Specifically, this section showed how the risk of idiosyncratic shocks spreading through the system are substantially higher in concentrated systems than in decentralized ones. It then described a specific regulatory measure that can reduce this risk.

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