U.S. Monetary Spillovers to Latin America: The Role of Long-term Interest Rates

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The economic situation in emerging markets has deteriorated in recent years. Perhaps the single most important event, especially for Latin America, has been the end of the so called commodity supercycle, which intensified with the collapse in oil prices in late 2014. But the trend of weaker currencies and rising inflation can, in many cases, be traced back at least a year earlier to the taper talk episode in May 2013. This event was a stark reminder of the interdependence of monetary conditions in small countries with core financial centers, the fickle nature of global liquidity, and the consequences of its evaporation for developing economies.

Since that episode, the U.S. Federal Reserve's actual liftoff date has been on the short list of concerns of virtually every central bank in Latin America—and for good reasons. There is now plenty of evidence showing a link between global liquidity push factors and their consequences on key variables in emerging market economies.[1] The central narrative in this literature is that lax monetary conditions in

The views in this paper are those of the authors and do not represent the views of the Central Bank of Chile. We thank Constantino Hevia for helpful comments and Stefano Banfi for excellent research assistance.

1. See Rey (2015), Bruno and Shin (2015), Ahmed and Zlate (2014), and Obstfeld (2015).

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core zones, such as the United States and the euro area, incentivize more risk taking in the form of maturity extension within the risk-free yield curve (indeed, this is the explicit mechanism by which quantitative easing is supposed to work),[2] or through portfolio rebalancing of fixed-income assets with different default risk, such as a substitution from treasuries to investment-grade bonds, mortgages, or even emerging fixed-income and equity markets. The obvious concern is that this mechanism works in reverse, too, and a Fed tightening might produce a further depreciation of exchange rates when most countries in the region are already deviating from their explicit inflation targets.

This paper contributes to the literature by studying spillovers from monetary conditions in the United States to the five largest economies in Latin America (with reliable economic indicators): namely, Brazil, Chile, Colombia, Mexico, and Peru. One way to go about this question is through a country-by-country analysis. However, this approach makes it hard to convey a coherent narrative for the region without falling into idiosyncrasies of each economy. It also misses the potentially rich interactions between different countries in the region—a potentially important omission, given the close trade and financial ties between them.

To tackle these issues we propose a restricted factor-augmented vector autoregressive (FAVAR) approach that includes an exogenous block of information. Under this approach, we first compute a set of factors that are representative of Latin America's performance on different dimensions. We include here an unemployment factor as a measure of real activity, an inflation factor, an exchange rate factor, and a stock market factor. We then model the dynamics of the estimated factors in a vector autoregressive framework including an exogenous block that contains information about U.S. interest rates. This framework allows us to describe the effects of shocks to interest rates in the United States on a particular variable in a specific Latin America country by tracing the dynamics of the associated factor. This is a suitable methodology for our purposes, as it allows us to assess spillovers from U.S. monetary conditions to the region in a parsimonious way, while at the same time controlling the dimensionality of the problem.

We find that for our sample period (2003–15), there are significant spillovers from U.S. monetary conditions into Latin America.

2. See Hanson and Stein (2015), Greenwood and Vayanos (2014), and Krishnamurthy and Vissing-Jorgensen (2011).

Specifically, an unexpected increase in U.S. ten-year yields is associated with higher unemployment, higher inflation, a fall (depreciation) of local currencies vis-à-vis the U.S. dollar, and a drop in stock markets. These effects hold for most Latin American countries. Mexico is an important exception, probably due to its much closer trade ties and proximity to the United States.

One shortcoming of the data is the lack of systematic interest rate information for Latin America in the earlier part of the sample. To assess the spillover effects into monetary conditions in Latin America, we proceed in two parts. First, we estimate an alternative FAVAR using a shorter subsample beginning in January 2009, after which long-term (ten-year) interest rate data are available for all countries. In this exercise, we find significant spillover effects of long-term interest rates in the United States to those in Latin America, but the effects on the other factors are generally insignificant. One possibility is that economic fundamentals in the region—affected by the commodity super-cycle, among other forces—largely diverged from the United States after the global financial crisis, which could explain why interest rate similarities at the long end of the yield curve might not show up elsewhere.[3]

Second, we focus on two specific countries with a long data series on the yield curve: namely, Chile and Mexico. In this exercise, we study U.S. interest rate spillovers using weekly data from financial variables, including exchange rates, stock returns, and bond yields. Moreover, we decompose long-term rates into a risk neutral component that captures the future evolution of short-term interest rates and a term premium component that reflects compensation for risk.[4] We carry out the same exercise using two subsamples, one before the zero lower bound (ZLB) period (2003–08) and during the ZLB (2009–15). The results confirm that U.S. interest rate spillovers after the ZLB—that is, in the period associated with the global financial crisis—are concentrated on bond yields, particularly on the term premium component. The effects on exchange rates are much smaller in the post-crisis period than in the earlier subsample, while the impact on stock returns is not statistically significant.

3. This result is consistent with Gilchrist, Yue, and Zakrajsek (2015), who show that the impact of U.S. monetary policy shocks on exchange rates in emerging market economies largely diminishes after 2009.

4. We perform the term structure decomposition following the methodology described in Adrian, Crump, and Moench (2013).

There is a growing literature exploring the transmission of global liquidity conditions to emerging market economies, including the papers cited above. A number of papers on fixed-income and yield curve modeling quantitatively evaluate the effect of different monetary policy measures in core economies (typically the U.S. Federal Reserve's conventional and unconventional monetary policy measures) on domestic interest rates at different maturities, as well as the international spillover of these measures into interest rates abroad.[5] Our contribution to this literature is twofold. First, we focus specifically on Latin America, which shares similarities with other emerging market economies but also displays important differences in economic structure, in particular the reliance on commodities. Second, we rely on an identification approach (the FAVAR model) that allows us to trace the effects of U.S. interest rate spillovers on several variables (including activity, prices, and financial markets) while keeping the dimensionality of the system in check. One potentially important result is that while U.S. interest rates have generated large spillovers into long-term rates in Latin America, the effects on other financial and real variables are weaker in the post-2009 sample.

The rest of the paper is structured as follows. In section 1, we document a significant degree of comovement within Latin America on a number of dimensions and construct our set of factors. Section 2 describes the proposed restricted FAVAR model, together with its estimation, and reports the main results regarding the spillover effects of U.S. interest rate shocks under different specifications and sample periods. In section 3, we perform the individual case studies of Chile and Mexico with VAR models, at a weekly frequency, based on financial variables only. Section 5 concludes.

1. Comovements in Latin American Economies

Latin American countries have strong commercial ties not only with the U.S. economy, but also with each other. Imbs (2004) and Ductor and Leiva-León (2016) show that trade is a key driver of the comovement among the major world economies, and Latin American countries are

5. See Gagnon and others (2011), Christensen and Rudebusch (2012), Hellerstein (2011), Bauer and Rudebusch (2014), Gilchrist, Yue, and Zakrajsek (2015), Hoffman and Takáts (2015), BIS (2015), Miyajima, Mohanty, and Yetman (2014), and Albagli and others (2015).

not the exception. Our analysis focuses on the largest economies of Latin America: namely, Brazil, Chile, Colombia, Mexico, and Peru. We exclude Argentina from the sample due to the unreliability of official figures, particularly for inflation, the exchange rate, and output data.[6]

This section focuses on comovements among countries along four dimensions of economic fundamentals. First, we use the unemployment rate as a measure of the business cycle, which has the advantages of being available at a monthly frequency and displaying less volatility than industrial production. Second, as a measure of inflation dynamics, we use the year-on-year growth rate of the consumer price index (CPI). Third, we use the nominal exchange rate with respect to the U.S. dollar (in levels). Fourth, we include information about the evolution of financial markets by using monthly stock returns. To abstract from hyperinflation and highly volatile periods, we focus on a sample of data that extends from January 2003 until August 2015.

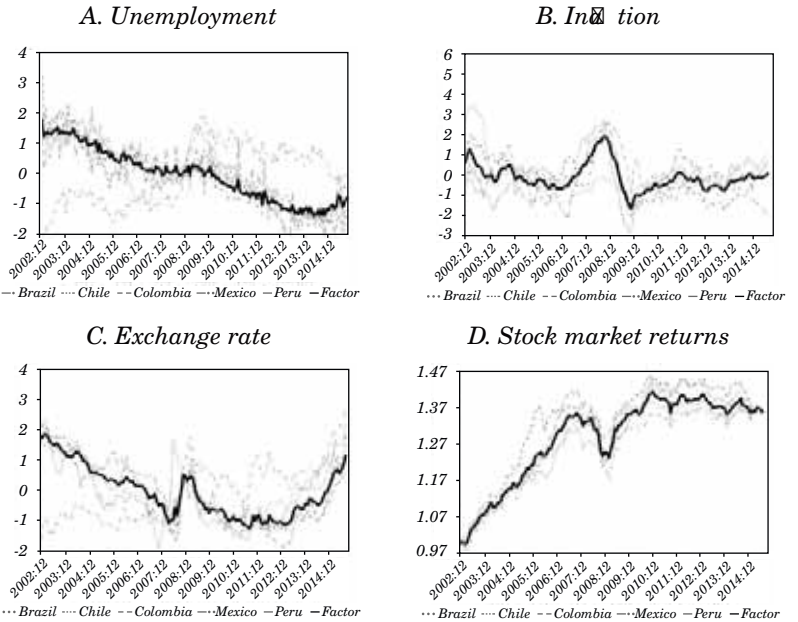
To assess the degree of comovement in unemployment rates, denoted by $u_{i,t}$, for i= Brazil, Chile, Colombia, Mexico, and Peru, we rely on factor analysis and extract the first principal component, f_t^u, such that country-specific unemployment rates can be decomposed into common and an idiosyncratic components:

$$u_{i,t} = \lambda_i^u f_t^u + \varepsilon_{i,t}, \tag{1}$$

where λ_i^u are the estimated factor loadings, and the common component, f_t^u, can be interpreted as a measure of Latin American unemployment. Panel A of figure 1 plots the country-specific unemployment rates, along with the Latin American unemployment. All the data in figure 1 have been standardized to facilitate comparison. The figure shows a strong comovement between Brazil, Chile, Colombia, and Peru, following a decreasing trend from the early 2000s through 2014, with a moderate increase in the last year of the sample. The only significant exception is Mexico, which experienced an important increase in the level of unemployment rate in 2009. This increase is not hard to rationalize due to the close commercial ties with the U.S. economy and the recession that took place at that time.

6. In fact, the IMF took the unprecedented step in February 2013 of censuring this member, encouraging the country to improve its efforts to meet the IMF standards for inflation and GDP data.

Figure 1. Comovement in Economic Fundamentals in Latin America



The same procedure is used to extract the common component among inflation rates, $\pi_{i,t}$, to obtain a measure of Latin American inflation, f_t^{π} (panel B of figure 1). Inflation across countries has remained relatively stable, with the exception of the 2008–09 period, when inflationary pressures increased temporarily. In the more recent period, inflation has started to pick up, related in most cases to the strong currency depreciation. Again, an important exception is Mexico, where recent inflation has receded even below their expected target.[7]

Panel C shows the country-specific exchange rates with respect to the dollar, $\chi_{i,t}$, along with a Latin American exchange rate measure, f_t^{χ}. Similar to the case of unemployment, exchange rates demonstrate a

7. According to the Bank of Mexico's latest (June) inflation report (Bank of Mexico, 2015), inflation remains low mostly due to the lack of wage pressures in the context of a relatively weak labor market, despite the exchange rate pass-through pressures due to the recent depreciation of the currency.

significant degree of comovement, with a continuous increase starting in 2013 in response to the U.S. Federal Reserve's taper talk and the global strengthening of the U.S. dollar. Finally, although we extract the common factor of monthly stock market returns across countries, $p_{i,t}$, we recover the level of stock market data to facilitate interpretation and plot it along with the Latin American index of stock markets, f_t^p, in in Panel D. The chart shows that the continuous growth of Latin American stock returns until 2007, followed by a significant downturn in 2008–09, associated with the recession in United States. This is followed by a quick recovery up to 2011, after which the stock market factor has been relatively flat, with some deterioration in the las few months of the series.

We performed a variance decomposition analysis to identify the share of each country's economic variables that is explained by the respective economic factor. The results are reported in table 1. For example, the first column of the table reports the share of unemployment rate volatility in each country that is explained by the unemployment factor alone. The unemployment and exchange rate factors explain a largest share of the country-specific series in most cases (with the exception of Mexico). There is somewhat less comovement for inflation, although the common factor is still significant in some cases.

Overall, this section provides evidence of strong comovement in Latin American economic fundamentals. Brazil, Chile, Colombia, and Peru experience similar fluctuations in the unemployment rate, inflation, exchange rates, and stock returns. Mexico, on the other hand, shows some important differences, in particular in unemployment and inflation, which can be attributed to its proximity to and strong integration with the U.S. economy.

Table 1. Fraction of Country-Speci□c □ariables E□plained by Common Factors

Country	*Unemployment*	*Inflation*	*Exchange rate*	*Stock market returns*
Brazil	0.93	0.16	0.79	0.73
Chile	0.74	0.53	0.83	0.58
Colombia	0.82	0.64	0.96	0.52
Mexico	0.44	0.35	0.08	0.71
Peru	0.82	0.58	0.84	0.64

2. Assessing International Spillovers

We now study the spillover effects of monetary conditions in the United States to Latin American countries. As highlighted in the introduction, several recent papers study the implications for emerging market economies of global liquidity conditions more generally and interest rate spillovers specifically. Our central contribution relies on the sample choice (namely, Latin America) and the identification strategy based on the FAVAR approach. Several papers base their identification on event study analysis.[8] However, a VAR-based approach identifies U.S. interest rate shocks from the data by recovering the structural innovations in U.S. interest rates. The FAVAR approach, in particular, allows us to study different Latin American countries jointly, with potentially important interaction effects, while at the same time keeping the dimensionality of the problem under control. Also, as documented in the previous section, the degree of comovement between most Latin American countries is significant along most economic dimensions considered (with the exception of Mexico), which makes the chosen methodology particularly informative.

2.1 The Model

We use FAVAR models, initially proposed by Bernanke, Boivin, and Eliasz (2005), to assess the responsiveness of the country-specific economic fundamentals to shocks in U.S. interest rates. This econometric framework allows us to tackle the high dimensionality of the problem and to elegantly relate the two blocks of information: namely, Latin American economic developments and U.S. monetary conditions. In doing so, we also need to deal with the exogeneity of the U.S. block to ensure identification of the spillover effects. We therefore impose some restrictions in the coefficients of the model, in line with Canova (2005).

The proposed FAVAR model with an exogenous block is defined as follows:

$$\begin{bmatrix} X_t \\ r^h_{US,t} \end{bmatrix} = \begin{bmatrix} \Lambda^f & \Lambda^r \\ 0 & I \end{bmatrix} \begin{bmatrix} F_t \\ r^h_{US,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ 0 \end{bmatrix}, \varepsilon_t : N(0, \Omega) \tag{2}$$

8. See Hanson and Stein (2015) for U.S. monetary policy spillovers into U.S. long-term yields; and Gilchrist, Yue, and Zakrajsek (2015), and Albagli and others (2015) for the case of emerging market economies.

and

$$\begin{bmatrix} F_t \\ r^h_{US,t} \end{bmatrix} = \begin{bmatrix} \Psi_f(L) & \Psi_{f,US}(L) \\ 0 & \Psi_{US}(L) \end{bmatrix} \begin{bmatrix} F_{t-1} \\ r^h_{US,t-1} \end{bmatrix} + \begin{bmatrix} e_{f,t} \\ e_{US,t} \end{bmatrix}, e_t : N(0, \Sigma), \tag{3}$$

where the first block of information consists in the economic fundamentals of Latin American economies contained in $\boxtimes_t = (Y_{BRA,t}, Y_{CHI,t}, Y_{COL,t}, Y_{ME\boxtimes,t}, Y_{PER,t})'$. Accordingly, each element of $\boxtimes_t$ is given by $Y_{i,t}\boxtimes(u_{i,t}, \pi_{i,t}, \chi_{i,t}, p_{i,t})'$. The information contained in $\boxtimes_t$ can be appropriately summarized in a small set of factors collected in $F_t=(f_t^u, f_t^\pi, f_t^\chi, f_t^p)'$. We use the factors obtained earlier, which provides two main advantages with respect to unobserved factor models. First, assuming that the factors are observed reduces the estimation uncertainty of the model substantially. Second, this modeling strategy allows us to provide identification and a clear interpretation of what each factor represents. This is usually not well achieved when several factors are extracted from a set of data without imposing any identification restriction.

The second block of information, $r^h_{US,t}$, captures the U.S. monetary conditions, proxied by the U.S. bond yield at horizon h. To ensure proper identification of the U.S. interest rate shocks, we impose some constraints on the coefficients of the VAR in equation (3). Specifically, current emerging market dynamics depend on their lagged values and past U.S. developments, while current U.S. dynamics depend only on their lagged values. We also assume a variance-covariance matrix of the VAR disturbances with a block diagonal structure, Σ = blockdiag $\{\Sigma_f, \Sigma_{US}\}$, as in Canova (2005).

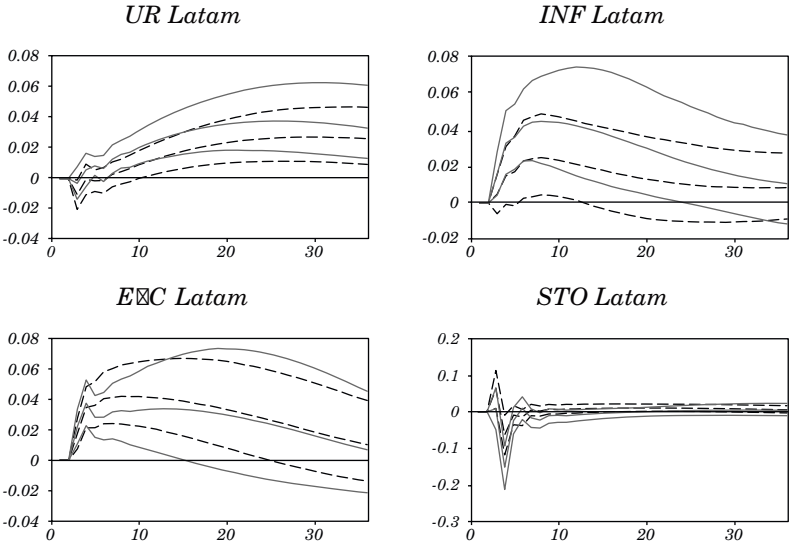
The model is identified with a recursive (Cholesky) structure. We adopt the following ordering for the variables in F_t : the unemployment rate factor, followed by the inflation rate factor, the exchange rate factor, and finally the stock market return factor. This ordering is consistent with a criteria of placing slow moving variables first (that is, activity and goods prices) and letting the fast-moving (financial) variables be affected by the previous ones contemporaneously.

The estimation of the model is based on Bayesian methods to provide robust inferences on the parameter estimates. We use the Gibbs sampler to compute draws of the parameter estimates of the FAVAR model and simulate their posterior distribution of parameters and impulse responses. For further details on the estimation method, see Bernanke, Boivin, and Eliasz (2005).

2.2 U.S. Monetary Spillovers: The Effects of Interest Rate Shocks

We now quantify and compare the effect of shocks in short- and long-term U.S. bond yields on Latin American economies. We use two FAVAR models with different information on the United States. One model includes only information about the one-year bond yield, $r_{US,t}^{h=1}$, in the U.S. block, while the second model includes only information on the ten-year bond yield, $r_{US,t}^{h=10}$, in the same block. Figure 2 reports the responses of each of the factors to a 25-basis-point shock in the short- and long-term rates. Because we have standardized all the series in the factor analysis, the unit of measure on the y axis is the number of standard deviations from the mean.

Figure 2. Effect of a Shocö to öbse rved U.S. Short- and Long-term Bond Yields on Latin American Factors



The dashed (solid) lines plot the responses to a shock in the one-year (ten-year) observed bond yield. In all figures, the central line corresponds to the response according to the median draw of the simulation, while the lower and upper lines correspond to the tenth and ninetieth percentile, respectively.

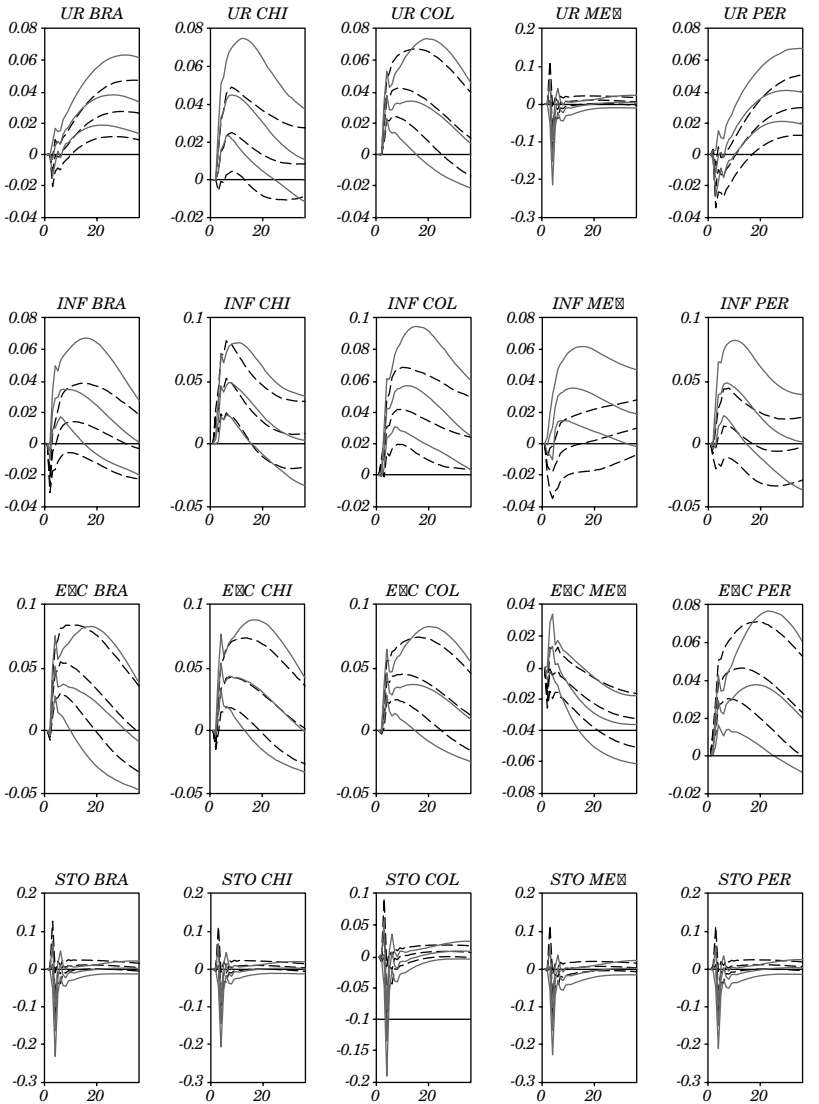
The figure shows that a shock in U.S. short-term rates has a rather small impact on the unemployment factor, the inflation factor, and the stock market factor. The long-term rate, on the other hand, has a significant impact on all factors, in the direction one would expect: higher unemployment, a more depreciated exchange rate, higher inflation, and lower stock market returns.

Figure 3 complements the analysis by showing the response of these variables for each individual country, according to the factor loadings estimated in equation (2). Consistent with figure 2, we find that short-term rate shocks almost always have a negligible effect on Latin American economies. However, these economies are highly affected by long-term rate shocks. Specifically, an increase in the long-term U.S. rate increases unemployment rates, inflation, and exchange rates and decreases stock returns in Brazil, Chile, Colombia, and Peru. Indeed, the direction and magnitude of the responses across countries reflect the high degree of comovement in Latin American economies, as documented above. Mexico exhibits a clearly different pattern of responses in some key variables. As mentioned before, this economy experienced a break that is mainly associated with the global financial crisis and the economy's sensitivity to U.S. economic conditions.

2.3 Spillovers at the Zero Lower Bound

We now present a related exercise by estimating a similar FAVAR model but for a period starting in January 2009. This exercise has two main motivations. First, the conduit of monetary policy and the level of interest rates have truly been exceptional in the period after the global financial crisis, so 2009 seems like a natural break point to test for differential effects. Second, beginning in 2009 we have systematic, reliable data on long-term interest rates for our complete set of Latin American economies, which allows us to enlarge our previous FAVAR model by including information about interest rates and to extract the corresponding factor into the otherwise unchanged specification (equations 1–3). In our baseline specification, the interest rate factor, which is plotted in figure 4, comes in last among the Latin American factors in equation (3). Figure 5 reports the responses of each of the factors to a 25-basis-point shock in the long-term rate for the post-2009 sample, while figure 6 plots the responses on each individual country.

Figure 3. Effect to a Shoc to bserved U.S. Short- and Long-Term Bond Yields on Latin American Factors by Country



The dashed (solid) lines plot the responses to a shock in observed one-year (ten-year) bond yields. In all figures, the central line corresponds to the response according to the median draw of the simulation, while the lower and upper lines correspond to the tenth and ninetieth percentile, respectively.

Figure 4. Long-Term Interest Rates in Latin America

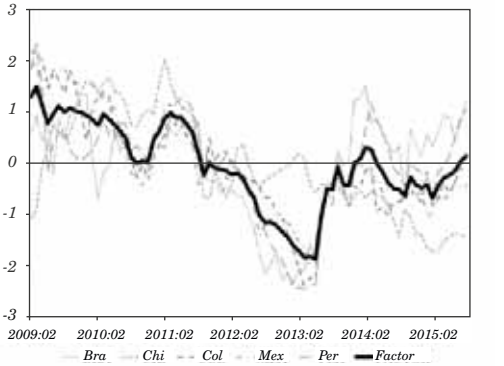
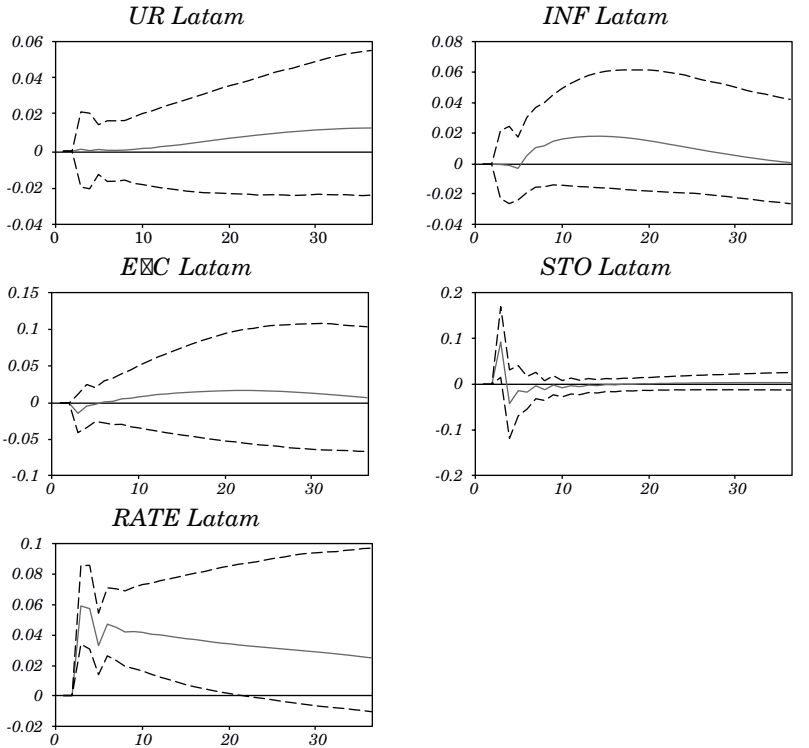
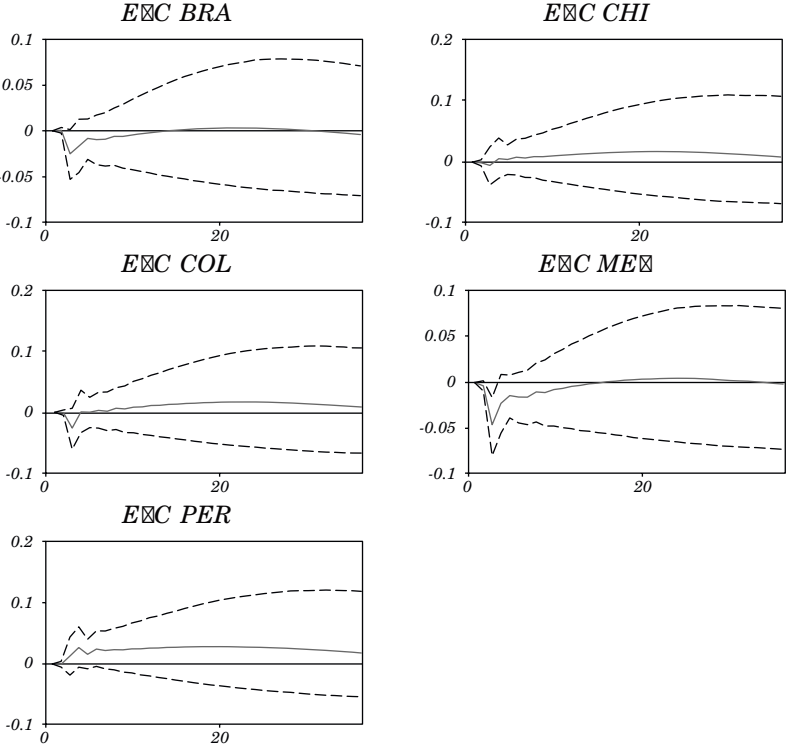


Figure 5. Effect of a Shock to Observed U.S. Ten-Year Bond Yields on Latin American Factors at the Zero Lower Bound



The lines plot the responses to a shock in the observed ten-year bond yield during the zero lower bound. In all figures, the central lines corresponds to the response according to the median draw of the simulation, while the lower and upper lines correspond to the tenth and ninetieth percentile, respectively.

Figure 6. Effect of a Shocö to öbse rved U.S. Ten-Year Bond Yields on Latin American Factors at the öero Loö er Bound



The lines plot the responses to a shock in the observed ten-year bond yield during the zero lower bound. In all figures, the central lines corresponds to the response according to the median draw of the simulation, while the lower and upper lines correspond to the tenth and ninetieth percentile, respectively.

These figures reveal interesting patterns. First and foremost, U.S. interest rate shocks appear to have little to no significant effects on unemployment, inflation, and exchange rates, as compared to the full-sample specification. Based on the median draw of response simulations, the effect has the intuitive sign, but they are generally not significant at the confidence intervals considered. Second, the impact of U.S. long-term interest rates is in general highly significant, both for the Latin American interest rate factor and for individual interest rates in each country. Even Mexico responds in the same direction, breaking the orthogonal behavior displayed on other dimensions with respect to Latin America.

3. Spillovers through Financial Markets

The above analysis suggests that U.S. interest rates have played a role in activity, prices, and financial variables in Latin America over the past 12 years. Moreover, our results indicate that in the post-2009 period, U.S. long-term interest rate shocks have a significant impact on Latin American long-term rates, but a generally insignificant impact on other variables over this shorter subsample. One potential objection to our identification strategy, however, is that it might be too restrictive to assume dynamics associated with lags of one month or more when it comes to financial variables. Moreover, the sample size in monthly frequency after 2009 is rather limited, which could also cast doubt on our results.

To deal with these issues, we perform a country-specific analysis for the cases of Chile and Mexico, where good yield curve information exists for a long sample. In these case studies, we focus on high-frequency data, namely, weekly interest rates, exchange rates, and stock market returns. More specifically, for each country we run a VAR that includes an exogenous bloc for the U.S. interest rate, as before. Among the endogenous domestic variables, we include the level of the nominal exchange rate, the weekly stock return, and a measure of interest rates, in that order. We are thus estimating the restricted VAR specified in equation (3) with new data. The availability of high-frequency data allows us to enlarge the information set in our sample size and also reduces concerns about results being driven by a particular ordering.

We also dig deeper into the specific channels that drive interest rate spillovers from the United States into these countries. Specifically, we perform a decomposition of overall domestic yields into a risk-neutral component, which captures the expected evolution of short-term rates, and a term-premium component. Hence, we run three separate VAR models, using the respective measure of interest rates (one with overall yields, one with the risk-neutral component, and one with the term-premium component). In all cases, the U.S. interest rate variable corresponds to the observed ten-year Treasury yield.

The litter contains a few different approaches for decomposing yields into expected rates and compensation for risk. We follow the methodology advocated by Adrian, Crump, and Moench (2013), which relies only on yield curve data for its estimation, making it suitable for constructing high-frequency variables. Their methodology exploits the log excess holding return predictability showed in empirical

studies, such as Cochrane and Piazzesi (2005).[9] Based on that idea, Adrian, Crump, and Moench (2013) propose a simple methodology to construct market prices of risk into an affine model consistent with the predictability of excess bond returns.[10]

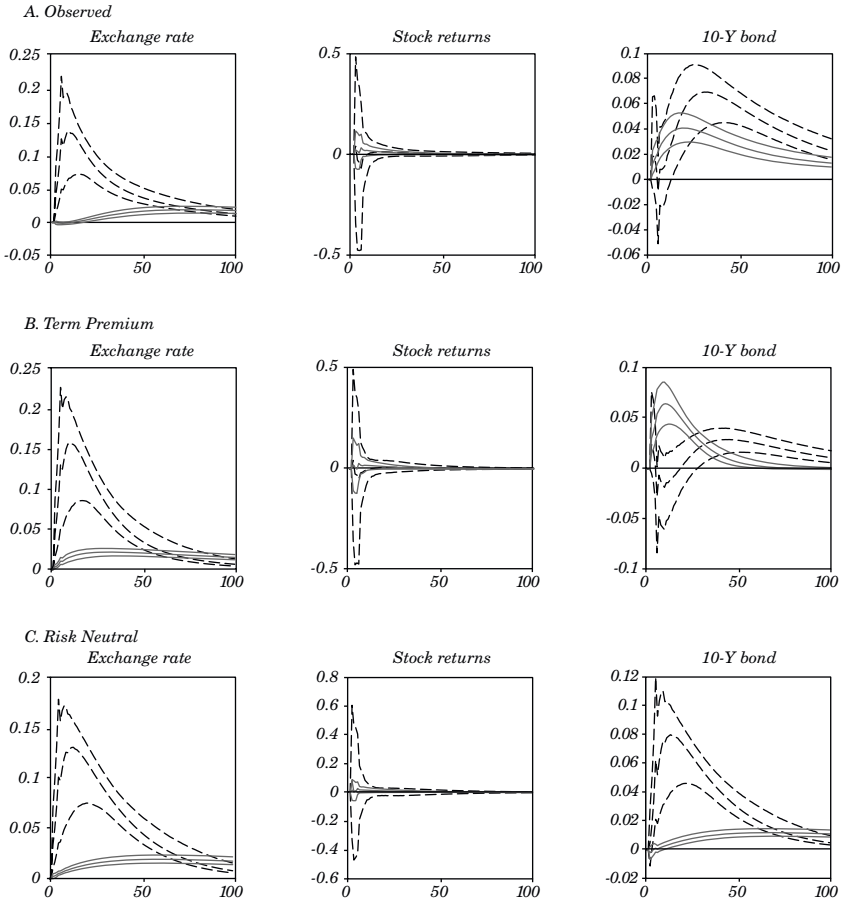
3.1 Country-Specific Analysis

Figure 7 plots the impulse response functions to a 25-basis-point increase in U.S. long-term rates for the case of Chile for both the first half of the sample (prior to 2009) and the sample after 2009. The figure includes the results of the VAR for overall yields as a measure of interest rates in Chile, as well as the term-premium component and risk-neutral component. The figure largely confirms our previous results. First, interest-rate shocks have a relatively large impact on exchange rates prior to 2009 (an increase in rates induces a depreciation of the Chilean peso), but a smaller (though still significant) impact during the ZLB period. The impact on stock markets, however, is insignificant in both samples. This result is somewhat consistent with Gilchrist, Yue, and Zakrajsek (2015), who document a significant spillover effect of U.S. interest rates on stock markets before, but not during, the ZLB period.

Second, the impact on Chilean long-term rates is significant in both samples, although in the ZLB period the spillover seems to be acting faster. Moreover, the effect is largely concentrated in the term-premium component after 2009, whereas the bulk of the response is due to the risk-neutral component in the earlier period. This result is consistent with Albagli and others (2015), who use an identification strategy based on event studies to show that spillovers from U.S. monetary policy are concentrated in the term-premium component for a larger sample of emerging countries post-2009. This result probably reflects the fact that activity and monetary policy decisions in Chile have been largely decoupled from the United States after the global financial crisis, so changes in U.S. interest rates are unlikely to affect expectations for future short-term rates (the signaling channel) in Chile. On the other hand, as documented in the papers cited above, there is mounting evidence that U.S. monetary conditions are strongly associated with global liquidity factors, which in turn affect the flow of capital into emerging market economies. The evidence presented here for the case of Chile seems to confirm this notion.

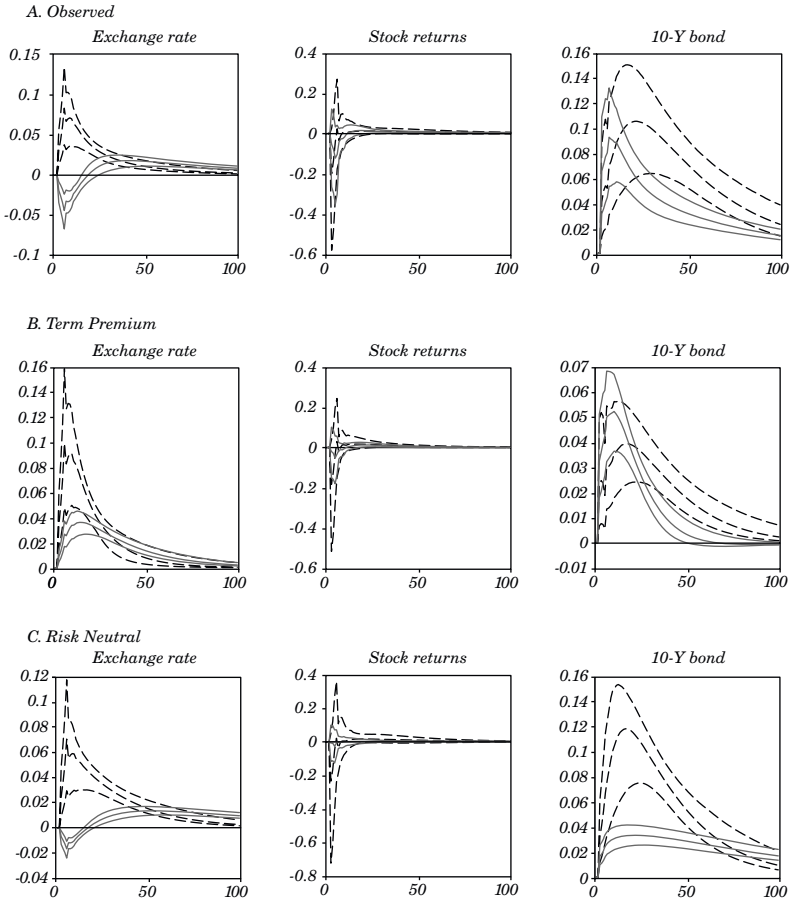
9. See Gürkaynak and Wright (2012) for a comprehensive review of this literature.
10. For more details on the methodology, see Adrian, Crump, and Moench (2013).

Figure 7. Effect of a Shoc to bserved U.S. Ten-Year Bond Yields Before and at the ero Lo er Bound in Chile ee ly Fre uency



The dashed (solid) lines plot the responses to a shock before (at) the zero lower bound.

Figure 8. Effect of a Shoc to bserved U.S. Ten-Year Bond Yields Before and at the ero Lo er Bound in Me ico ee ly Fre uency



The dashed (solid) lines plot the responses to a shock before (at) the zero lower bound.

Figure 8 plots the impulse response functions for the case of Mexico. The effects on the exchange rate change sign between the two subsamples. An increase in U.S. interest rates is associated with a depreciation of the Mexican peso before the ZLB and an appreciation during the ZLB episode. One possible explanation for this phenomenon is that economic activity in Mexico is strongly linked to the United States, particularly after the global financial crisis. It is plausible then that an increase in U.S. yields caused by expectations of stronger economic activity in that country could also reflect good news for the Mexican economy, thus appreciating the currency. On the other hand, as was the case for Chile, there is no significant impact of U.S. interest rates on the Mexican stock market in either period.

With regard to the spillover of U.S. interest rates into Mexican long-term rates, the figure reveals that these spillovers are significantly larger than in the case of Chile, which is intuitive given Mexico's much closer economic interaction with the U.S. economy. Indeed, spillovers are of similar magnitude in both subsamples. However, as was the case with Chile, the spillover effect also seems to be more biased toward the term-premium component during the ZLB, while the risk-neutral component seems to dominate in the earlier part of the sample.

To get a better understanding of the magnitudes of U.S. interest rates spillovers, table 2 computes the pass-through coefficients. These are calculated as the ratio between the cumulative response in domestic bond yields (and the risk-neutral and term-premium components) divided by the cumulative response of the U.S. long-term interest rate. The cumulative pass-through to Chile is close to 0.5 in both samples at a one-year horizon, but at two years the pass-through increases to between 0.8 and 1.0. The component-level analysis shows that, as expected, the pass-through to risk-neutral rates falls drastically during the ZLB subsample, while the pass through to the term premium increases substantially.

In the case of Mexico, the pass-through to overall yields is larger than for Chile at all horizons. Consistent with figure 8, the pass-through to the risk-neutral component is significantly diminished after 2009, while for the term premium it increases somewhat, especially for a one-year horizon.

Overall, the evidence presented in this section corroborates the analysis presented above. We find significant spillover effects of U.S. interest rates to domestic bond yields, which extend for a considerable period of time and which are larger in the case of Mexico. Moreover, we see a more significant role of the term-premium channel during

the ZLB episode and a more muted response of risk-neutral rates. This evidence supports the view that spillovers to emerging market economies via the risk-taking channel have been more prevalent in the environment of exceptionally low interest rates that has characterized fixed-income markets after the global financial crisis.

Table 2. Pass-through of U.S. Interest □ ates to Bond Yields□ by Component

Type of rate and period	*Chile*	*Mexico*
Observed		
1 year before ZLB	0.56	1.05
2 years before ZLB	1.01	1.55
1 year at ZLB	0.56	0.96
2 year at ZLB	0.81	1.34
Risk neutral		
1 year before ZLB	0.64	1.02
2 years before ZLB	0.8	1.3
1 year at ZLB	0.12	0.5
2 year at ZLB	0.28	0.82
Term premium		
1 year before ZLB	0.13	0.36
2 years before ZLB	0.36	0.45
1 year at ZLB	0.57	0.46
2 year at ZLB	0.58	0.46

. Concluding Remarks

This paper assesses the spillover effects of unexpected increases in U.S. bonds interest rates on the economic fundamentals of Latin American economies. Four main results arise from the analysis. First, we find evidence of strong comovement in the economic fundamentals of Brazil, Chile, Colombia, and Peru. Mexico shows some important differences, which can be attributed to its proximity to and strong integration with the U.S. economy.

Second, we find that short-term rate shocks usually have a negligible effect on Latin American economies. However, these economies are highly affected by long-term rate shocks. Specifically, an unexpected increase in the U.S. long-term rate increases unemployment, inflation, and exchange rates and decreases stock market returns in most of Latin American economies. Mexico exhibits a clearly different pattern of responses in some key variables.

Third, when focusing on the zero lower bound period, we find significant spillover effects of long-term interest rates in the United States to those in Latin America, but also find generally insignificant effects on the other factors. One explanation for this is that after the global financial crisis, economic fundamentals in the region have largely diverged from those in the United States.

Finally, our analysis points to significant spillover effects of U.S. interest rates to domestic bond yields. Moreover, the term premium seems to play a key role during the zero lower bound period, while risk-neutral rates show a more muted response. This evidence supports the view that spillovers to emerging economies via the risk-taking channel have been more prevalent in the environment of exceptionally low interest rates that has characterized fixed-income markets after the global financial crisis.

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