Monetary Policy Rules and Transmission Mechanisms under Inflation Targeting in Israel

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Disinflation in Israel has been a relatively slow process. It took more than a decade for the annual rate of inflation to fall from about 18 percent in the late 1980s to less than 4 percent in the late 1990s. For 2000 and 2001 the government has set an inflation target range of 3 to 4 percent. Whether low inflation will be a permanent feature of the Israeli economy remains to be seen. Some important aspects of the economy—such as the principles guiding monetary policy and asset market allocations—have adjusted themselves to the new, single-digit-inflation conditions. Yet many key transmission mechanisms that were introduced in the era of double- and triple-digit inflation remain in place. Leading examples are widespread indexation of wages and financial assets to the consumer price index (CPI), as well as a relatively rapid pass-through from changes in nominal exchange rates to changes in prices. Nevertheless, Israel's experience suggests that it has been possible to disinflate and to conduct monetary policy as it is conducted in most inflation targeting countries. Underlying these successes has been a virtuous circle in the interaction between

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disinflation and economic institutions. As disinflation became more credible over the years, an increasing number of transmission mechanisms were adapted to these conditions; the latter, in turn, contributed to making disinflation more credible and to increasing the efficacy of monetary policy.

Under these conditions, however, the conduct of monetary policy has faced numerous difficulties. First, there has not been a wide consensus on the need to bring about a convergence of domestic inflation to rates in the industrial countries. This lack of consensus has created ambiguity about the nature and role of inflation targets, about the conduct of monetary policy, and about the role of fiscal policy in achieving the inflation target. In fact, the mid-1990s saw a considerable overburdening of monetary policy, which had to offset, at least partially, the potential impacts of fiscal expansion on the rate of inflation (Bufman and Leiderman, 1998). Some politicians have disputed the stance adopted by monetary policy, to the point of proposing legislative changes that would effectively reduce central bank autonomy.[1] There is no doubt that lack of full support from fiscal policy and ambiguity about nominal targets have damaged the credibility of the disinflation process and have increased the difficulties encountered by monetary policy. To effectively reduce the rate of inflation, the central bank has had to maintain a more conservative stance than otherwise, and to take on what has become in part an educational role. That is, it has had to explain to other policymakers and to the public at large the importance of having inflation in Israel converge gradually to the level prevailing in the leading countries in a globalized world economy. Second, most of the time inflation targeting has coexisted with targeting of the nominal exchange rate, further raising ambiguity about the guiding principles and priorities for monetary policy. Over the years it has become increasingly clear that the inflation target is the key objective of monetary policy, and the nominal exchange rate is seen more and more as an indicator variable set primarily by the market.

In addition, Israel has had to develop a well-specified forecasting scheme for conducting policy under inflation targeting. It turns out that the econometric relationships that seemed to work well in the high-inflation period (before mid-1985) were subject to structural breaks due to frequent regime changes in the poststabilization period.

1. See Frenkel (1999) on the role of central bank independence in achieving price stability.

In particular, it is likely that the extent of exchange rate pass-through to prices will be reduced over time as inflation targets become more credible and as the flexibility of the exchange rate regime is enhanced. Inflation forecast targeting requires the policymaker to continuously monitor comparisons of inflation forecasts against the inflation target, and discrepancies between these two serve as a trigger for potential monetary policy action. Thus the inflation forecast is a key building block of the policy paradigm under inflation targeting. In the case of Israel, some of the difficulties were overcome by using market-based inflation expectations as one important (yet imperfect) indicator for the market's assessment of the inflation outlook into the future.

These challenges are not unique to Israel. They are shared not only by numerous emerging market countries but also by industrial countries.[2] For example, when New Zealand adopted inflation targets in 1989, it did so in the context of broad structural and policy reforms, most of which rendered previously estimated models quite obsolete. And when the United Kingdom adopted explicit targets in the fall of 1992, it did so after a period of nominal exchange rate targeting within which the transmission mechanism was quite different from that of inflation targeting coupled with flexible exchange rates. Moreover, in all cases the initial stages of inflation targeting suffered from lack of credibility and from substantial ambiguities, resulting in a time path for inflation expectations well above that of the actual rate of inflation.

In spite of these cross-country similarities, a striking difference between Israel and the industrial countries is that in Israel, a country with a relatively recent history of high inflation, political and public support for inflation targeting and for inflation reduction has been relatively weak. Not long ago, officials from the finance ministry and other official entities publicly criticized inflation targeting. Thus ambiguity and a lack of initial credibility, together with a nonsupportive role of fiscal policy for disinflation, created at some point in the past conditions less than favorable for the success of inflation targeting. Even so, substantial disinflation has occurred in recent years under inflation targeting, and monetary policy in Israel continues to be conducted within a framework very similar to that in industrial countries.

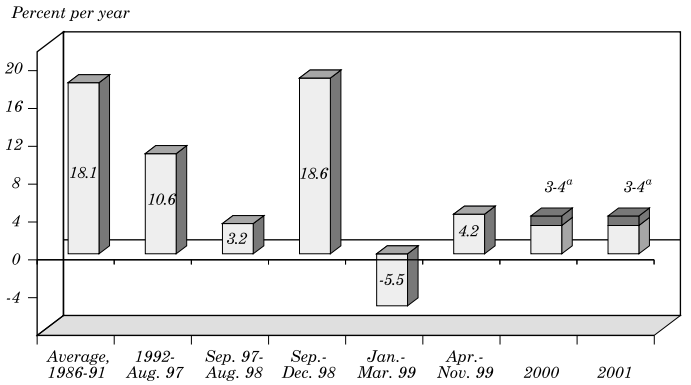
2. See, for example, Leiderman and Svensson (1995) and Morandé and Schmidt-Hebbel (1999).

In this paper we analyze Israel's inflation targeting policies since 1992, with an eye toward those characteristics that may well apply to other countries. Section 1 lays out the main stylized facts about recent disinflation and details about the inflation targeting scheme. Then section 2 discusses the transmission mechanism in the inflation process and reports new estimates of equations for determinants of the rate of inflation. Special attention is given to the changing nature of the pass-through from exchange rates to prices and its dependence on the state of the business cycle and the magnitude of exchange rate fluctuations. Section 3 estimates a representation of the Bank of Israel's policy rule, and section 4 concludes.

1. Inflation Targeting And The Inflation Process: The Facts

Starting at the beginning of the 1980s, the rate of inflation in Israel rose persistently and at an increasing rate, reaching well into triple-digit territory. This continued until mid-1985, when the Economic Stabilization Program was introduced. Figure 1 depicts the major developments in inflation since then. From 1986 to 1991 average inflation was 18 percent per year, not so much as a result of an explicit policy decision (such as an inflation target) but more as a residual consequence of the targeting of other variables, such as the

Figure 1. Evolution of the Rate of Inflation in Israel



Source: Bank of Israel.
a. Official target 2000-2001.

nominal exchange rate and international reserves. The rate of inflation was then sharply reduced to an average of 10 percent per year in the period from 1992 to 1996. Lately there has been a further reduction in inflation, to 7 percent in 1997, and year-over-year inflation to mid-1998 was a bit below 4 percent. However, the drop in the rate of inflation was interrupted by marked increases in consumer prices in the last third of 1998. These were associated with a sharp depreciation of the shekel in a context of crisis and volatility in world financial markets, mainly related to the financial crisis in Russia and the failure of the hedge fund LTCM in the United States. Nevertheless, thanks to a tightening of monetary policy and the help of other factors, these price increases were reversed in early 1999, and current forecasts are for a rate of inflation in 1999 of less than 1.5 percent, well below the official target of 4 percent (see Bank of Israel, 1999a and b).

An inflation target was first introduced in Israel in the context of the shift to a crawling exchange rate band in late 1991. The inflation target came in through the back door, as it were. It first appeared only as an input in setting the exchange rate's rate of crawl, specified in a forward-looking manner as the difference between the inflation target and a forecast of foreign inflation.[3] Both the exchange rate regime and the inflation target are set by the government (mainly following the recommendation of the finance minister) upon consultation with the Bank of Israel, which by law has instrument independence. As a result, there has been considerable ambiguity about the nature and operational meaning of inflation targets as a precommitment device for monetary policy and for fiscal policy as well. This ambiguity was especially strong in the initial years of inflation targeting but has decreased substantially over time, as the central bank has credibly made the inflation target the key objective of monetary policy.

Table 1 summarizes the history of inflation targeting in Israel. In some years targets were set in terms of a range and in others as a point target. In all cases the overall CPI was used in specifying the target, which seems especially appropriate in an economy subject to extensive indexation of wages and financial assets to the overall CPI. In general, targets for a given year have been set only a few months before the end of the preceding year, and rarely have there been explicit multiyear targets. A salient characteristic of the setting of inflation targets in Israel is the generally "adaptive" behavior on the part of the authorities: the target for the next year has typically been set at a

3. See Bufman, Leiderman, and Sokoler (1995).

rate very close to the observed, year-over-year, rate of inflation at the time. In practice, this has meant that progress toward disinflation has typically preceded further reductions in the level of the inflation target. The inflation target for 1999 is 4 percent, and the target for 2000 and 2001 has been set as a range of 3 to 4 percent (see also Sokoler, 1997).

Table 1 indicates that, although there have been deviations of inflation from target in some years, from a multiyear perspective the targets have been achieved on average. From 1992 to 1998 inflation averaged 9.9 percent per year, very close to the average of the yearly targets at 9.7 percent. Figure 2 shows several episodes of marked intrayear deviations from target both of actual inflation in the previous twelve months and of twelve-months-ahead expected inflation. (Market-based expected inflation in figure 2 is derived from the yields on indexed and nonindexed bonds traded in the local capital market.) Major episodes of inflation acceleration well above target occurred in 1994, in the first half of 1996, and in the first half of 1999. In all these cases the credibility of the regime was put to a very serious test: inflation expectations escalated to about 15 percent in the first two episodes and to about 10 percent in the third. On the other hand, the rate of inflation was well below the annual target in the first two-thirds of 1998 and in the last quarter of 1999.

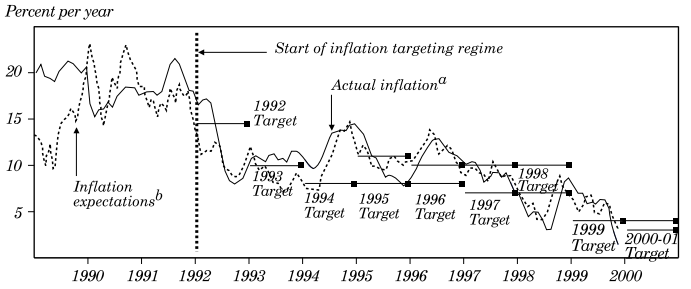
As already discussed, inflation targets in Israel coexist with another nominal policy commitment, namely, the crawling exchange

Table 1. Inflation Targets and Inflation Performance in Israel[a]
Percent per year

Year	*Inflation target*	*Actual inflation*
1992	Up to 14-15	9.4
1993	10	11.2
1994	8	14.5
1995	8-11	8.1
1996	8-10	10.6
1997	7-10	7.0
1998	7-10	8.6
Average, 1992–98	9.7	9.9
1999	4	1.5[b]
2000-01	3-4	n.a.

Source: Bank of Israel.
a. Inflation is measured by the change in the consumer price index.
b. Forecast.

Figure 2. Actual Inflation, Inflation Targets, and Inflation Expectations in Israel

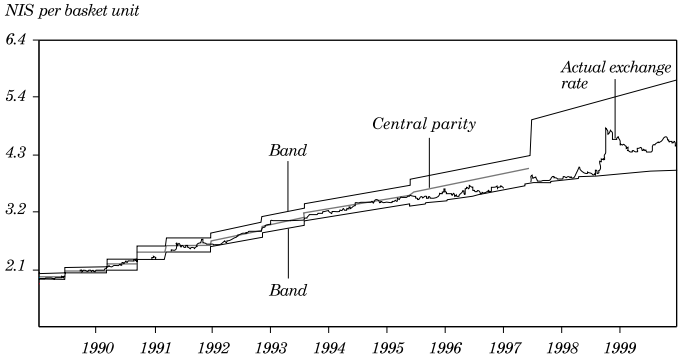


Source: Authors' calculations.
a. Year-over-year change in the consumer price index.
b. Derived from capital market data on indexed and nonindexed bonds.

rate band for the new Israeli shekel (NIS) against a basket of foreign currencies. The NIS exchange rate and its band are depicted in figure 3. Over the years there has been a substantial shift in the direction of liberalization of foreign exchange transactions, including capital flows, together with a gradual move toward increased flexibility of the nominal exchange rate regime. Less than five years ago the exchange rate band was relatively narrow, and the authorities engaged in considerable intramarginal, sterilized intervention in the foreign exchange market. Today, in contrast, daily exchange rates are set primarily by private market forces with no central bank intervention and in the context of a very wide currency band (see Leiderman and Bufman, 1996). In fact, since mid-June 1997 there has been a gradual (daily) widening of the currency band, whose width will be about 40 percent of the central parity by the end of 1999.

Israel's experience in the last five years illustrates that, under conditions of high capital mobility, the coexistence of an exchange rate band and inflation targeting may make the role of monetary policy more difficult than otherwise. Using only one instrument (the monthly setting of the central bank interest rate on repurchase agreements, or repos), the monetary authority is expected to achieve both these targets simultaneously. On several occasions (for example, in the first half of 1997), the level of the repo rate required to achieve the inflation target exceeded that consistent with lack of pressure on the exchange rate band. This situation was associated with considerable capital inflows and sizable sterilized

Figure 3. Path of Exchange Rate against the Currency Basket in Israel



Source: Bank of Israel.

intervention in the foreign exchange market to defend the lower (that is, most appreciated) limit of the band. Over the years the authorities have dealt with these policy dilemmas by increasing the emphasis of monetary policymaking on inflation targeting while increasing the degree of exchange rate flexibility.

2. The Monetary Policy Transmission Mechanism

In principle, the channels for the potential effects of monetary policy on key macroeconomic variables in a small, open economy are well known. A change in the monetary policy stance—as captured, for example, by a change in the central bank's overnight rate—may have a short-run impact on the level and composition of aggregate demand, especially through its impact on short- and long-term real interest rates, on the real exchange rate, and on the liquidity available to consumers and investors. Changes in monetary policy can also influence forward-looking inflation expectations and the nominal exchange rate, which in turn affect the wage- and price-setting mechanism (for example, through changes in domestic pricing of tradable goods and services). Clearly, financial markets and the impact of monetary policy changes on economic agents' balance sheets are key components of the transmission mechanism.

The analysis of these interdependent and simultaneous effects requires the formulation of a model in which each channel of the transmission mechanism and its feedback effects from and to the other channels is properly specified. Accordingly, relatively small-scale macroeconomic models have been formulated and estimated in various central banks in recent years. These typically consist of an aggregate demand equation, a price-setting equation that takes into account (among other things) the impact of the output gap on price pressures, a money demand equation, a wage-setting equation, a real exchange rate equation, a term structure of interest rates (relating short and long rates), an interest rate parity condition, a specification of inflation expectations, and a monetary policy reaction function. Under certain conditions these models can be accurately estimated, and the resulting parameters can be used to assess the quantitative importance of the various transmission channels as well as to simulate the impact of monetary policy shocks.

In Israel, the specification and estimation of such small-scale macroeconomic models faces the methodological difficulties arising from relatively frequent structural breaks due to regime changes. In spite of this, there are current efforts under way at the Bank of Israel to deal with these issues (see, for example, Azoulay and Elkayam, 1997; Djivre and Ribon, 1999; Kahn, Kandel, and Sarig, 1998; and the research papers by various authors in Leiderman, 1999). At the same time, efforts have been devoted to estimating some of the individual components of the overall macroeconomic model, such as money demand and the Phillips curve, with satisfactory results.

We focus here on models for analyzing and forecasting movements in the rate of inflation in Israel, which can play a key role in the inflation targeting scheme. To a large extent, monetary policy consists of what Svensson (1999) has termed "inflation forecast targeting" (see Bufman and Leiderman, 1998). That is, monetary policy decisions mainly depend on an assessment of whether, in the absence of policy changes, it is highly likely that the inflation target will be met. For example, to the extent that the inflation forecast is above the inflation target, a tightening of monetary conditions is called for. Although the existence of market-based data on inflation expectations can be exploited in this forecasting and policy exercise, as implied by the analysis in Bernanke and Woodford (1997), the proper conduct of monetary policy requires reliance on other indicators and forecasts of the inflation outlook as well.

2.1 Estimates of a Quarterly Inflation Equation

Most existing quarterly econometric models of the price-setting equation in Israel relate quarterly movements in the rate of inflation to a set of explanatory variables that includes measures of monetary conditions such as the ex ante central bank real interest rate (which, in turn, makes use of market-based inflation expectations) and the nominal exchange rate; indicators of "imported" inflation (such as foreign prices); measures of the level of economic activity such as the output gap or the rate of unemployment; and others (for a review of research by various authors, see Leiderman, 1999). Although estimation of these models has yielded reasonable results, within-sample simulations suggest that, to a large extent, these models are not able to economically account for a sizable part of observed key turning points in the disinflation process, such as from the end of 1991 to mid 1992 and from late 1997 until mid-1998 (see Bar-Or, 1999). Therefore default dummy values are often added to capture the fall in the rate of inflation and to enable a more precise estimation of the parameters. It seems plausible that, to a large extent, these dummies capture the effects of one-time shifts in the stance of fiscal policy with respect to the inflation process. Although quarter-to-quarter impacts of fiscal policy variables on the evolution of the rate of inflation have been difficult to detect, research by Dahan and Strawczynski (1997) has shown that salient changes in the evolution of inflation in the 1970-96 period were preceded by substantial and persistent changes in the same direction in the fiscal policy regime, as reflected in changes in the structural public sector deficit and in the public debt.

Our work relies on a reduced-form representation of the quarterly rate of inflation, which differs from most previous work mainly in the specification of the pass-through mechanism from exchange rates to prices. Specifically, in the proposed model the contemporaneous and lagged pass-through is from the nominal exchange rate to prices of all goods, not just tradables. Because of Israel's high-inflation history, there exist even today, in spite of lower inflation, various formal and informal indexation mechanisms linking domestic prices and wages to the nominal exchange rate, beyond the impact of the latter on domestic prices of traded goods and services. Hence nominal exchange rates and foreign prices are entered separately in the inflation equation. In addition, the proposed model of the pass-through coefficient allows for this coefficient to vary with time, depending on the state of the economy over the business cycle (see

Bufman and Leiderman, 1998, and Bar-Or, 1999); that is, the extent of pass-through is larger in booms than in downturns. We also examine the extent to which the exchange rate pass-through coefficients depend on the size of the underlying exchange rate change, that is, whether exchange rate movements beyond a given threshold level give rise to a stronger or quicker pass-through than do milder exchange rate changes. Concretely, we estimate an equation of the form

$$\pi_t = \beta_0 + \beta_1 D2 + \beta_2 DPOIL_t + \beta_3 \pi f_{t-2} + \beta_4 r_t + \beta_5 r_{t-2} + \beta_6 u_t + (\beta_7 + \beta_8 u_t)\varepsilon_t + \beta_9 \varepsilon_{t-1} + \eta_t , \quad (1)$$

where π denotes the quarterly rate of change in the consumer price index excluding fruits and vegetables. The fruits and vegetables price index (whose weight in the CPI is only 3.5 percent) is seasonal and extremely volatile, and was strongly affected in the sample period by the existence or lack thereof of a closure of the borders with the territories, which prevented the entry of Palestinian workers. *D*2 is a dummy variable for the second quarter of each year. *DPOIL* is the rate of change of fuel prices in Israel. The variable πf is the rate of change of the price index for imported consumer goods. Variable r denotes the real ex ante interest rate, calculated using the nominal interest rate set by the central bank and market-based inflation expectations. Variable u is the rate of unemployment (seasonally adjusted), and ε is the quarterly rate of change of the NIS-U.S. dollar exchange rate. We allow for the coefficients on exchange rate depreciation—both contemporaneous and lagged—to depend, through dummy variables, on the size of the exchange rate change. We added to equation (1) coefficients β_{10} and β_{11} on these dummies, which correspond to the period 1998Q4-1999Q1. Estimating this equation by the least squares method, correcting for heteroskedasticity, on a sample of data from 1990Q1 to 1999Q3 yields the results in table 2.[4]

For an economy as historically volatile as that of Israel, the results are quite satisfactory in terms of both the estimated individual coefficients (table 2) and the overall within-sample fit of the equation (figure 4). In addition, their broad features conform to those of earlier work. In particular, if we disentangle the nominal interest rate and the ex ante market-based measure of inflation expectations,

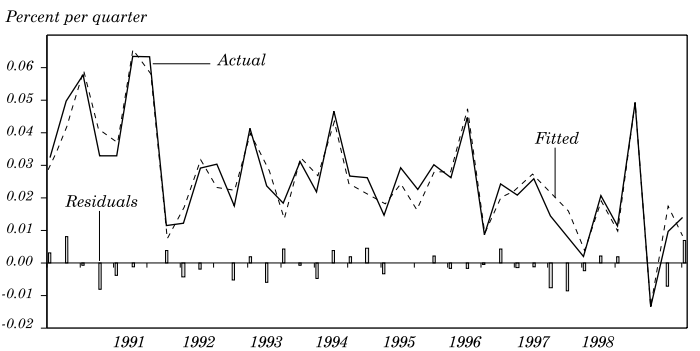
4. Stability tests of equation (1) support the notion that no structural breaks occurred within the sample.

Table 2. Regression Estimates for the Quarterly Inflation Equation

Parameter in equation (1)	*Coefficient*	*Standar error*
β_0	0.038	0.005
β_1	0.009	0.002
β_2	0.016	0.006
β_3	0.149	0.039
β_4	–0.263	0.051
β_5	–0.170	0.042
β_6	–0.130	0.041
β_7	0.620	0.151
β_8	–4.325	1.304
β_9	0.205	0.040
β_{10}	0.093	0.045
β_{11}	–0.229	0.045
R^2		0.926
Adjusted R^2		0.896
Standar error of regression		0.005
DW		1.877

Source: Authors' calculations.

Figure 4. Actual and Fitted Inflation and Residuals[a]



Source: Authors' calculations.
a. Fitted inflation is that calculated from equation (1).

the coefficients on both these terms, when entered separately, are quite similar, thus providing support for the present specification. An innovative feature of the results is the finding that the pass-through coefficients depend on the state of the business cycle and on the size of the exchange rate change, as discussed further below.

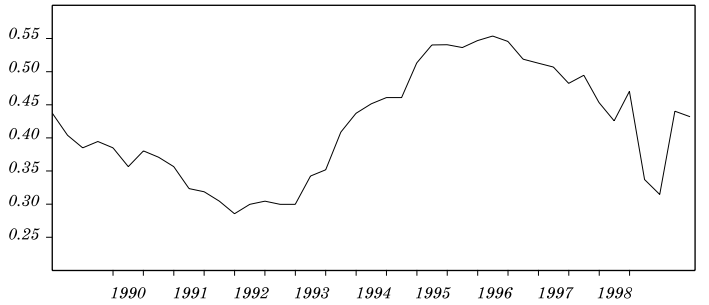
To interpret the estimated parameters for the transmission mechanism in the inflation process, we discuss now some of the implied "partial derivatives" of inflation with respect to various factors, each of which is treated separately from the others. Our estimates imply that, other things equal, a depreciation of 1 percent per quarter of the NIS against the dollar in a given year would result in a 2.1-percentage-point rise in the rate of inflation, mostly in the same year. This calculation assumes that there is no output gap, that is, that the rate of unemployment is about 6.5 percent. However, if the economy were in a slowdown, with a rate of unemployment close to 9 percent, inflation would accelerate by only 1.6 percentage points in response to the same exchange rate shock. In other words, the overall (current and lagged) pass-through from exchange rates to prices is estimated at about 0.5 under full employment and 0.4 in a downturn. Further, the pass-through is spread almost equally over the current and previous quarter in a slowdown, but is faster under full employment (with a coefficient of 0.3 on the contemporaneous term and 0.2 on the one-quarter lag).

To examine whether the size of exchange rate fluctuations matters for the pass-through, we attached, as mentioned above, dummy variables to the direct exchange rate pass-through for the last quarter of 1998 and the first quarter of 1999—a period of sharp exchange rate turbulence. We found that, relative to the earlier sample estimates, in this specification all of the pass-through effects shifted to the contemporaneous term. This indicates that, when exchange rate shifts are sizable, prices respond more quickly.[5]

Figure 5 depicts the implied within-sample, time-varying, overall pass-through coefficient from the NIS-dollar exchange rate to the CPI.

5. We also explored additional specifications of equation (1). First, we checked whether the pass-through associated with the foreign inflation variable varies with the business cycle, as specified for the exchange rate variable. Second, we explored whether the size of the fluctuation in the rate of unemployment has an impact, per se, on the pass-through coefficient. Third, we tested for whether there was a difference between the pass-through effects arising from currency depreciations and those arising from appreciations. Fourth, the effects of the ex ante real interest rate on the rate of inflation were allowed to depend on the state of the economy. We found no evidence in support of any of these alternative specifications.

Figure 5. Time-Varying Overall Pass-through Coefficient from the Nis-Dollar Exchange Rate to the CPI



Source: Authors' calculations.

The dependence of the pass-through on the state of economic activity is quite evident. In the early 1990s the overall pass-through plunged from 0.45 to almost 0.25 at the end of 1991 and the beginning of 1992, a period during which unemployment surged. This was mainly the result of an influx of immigrants, which greatly increased labor supply. On the other hand, the marked recovery in economic activity thereafter got translated into a rise in the pass-through coefficient, which reached a peak of almost 0.55 in mid-1996. The slowdown in the most recent period has led to a decline in the degree of pass-through.

As for the direct effects of monetary policy changes, we find that a rise of 1 percentage point in the ex ante real interest rate from the previous year's level is associated with a decrease in the rate of inflation of 1.7 percentage points (about 1.4 in the same year and 0.3 in the subsequent year). A rise in prices abroad of 1 percent per quarter during the year would lead to a rise of 0.6 percentage point in the rate of inflation, which would be spread evenly over two years. Further, a rise in the rate of unemployment by 1 percent from the previous year's level would be associated with a reduction of 0.7 percentage point in the rate of inflation in that year. Of that, 0.52 percentage point would be due to the direct effect on inflation, and the rest due to the moderating effect on the pass-through from exchange rates to prices.[6]

6. No dummy variable was introduced for the interaction term between the rate of unemployment and exchange rate depreciation because of insufficient degrees of freedom.

Before we move on to further applications of the parameter estimates, it is well to discuss some of their potential limitations and ways to overcome these limitations. Although in principle an equation such as (1) may be subject to simultaneity (that is, the regressors may be correlated with the error term), more detailed analysis suggests that this issue may not be very relevant for the present application. First, when Granger causality tests are run for the variables in the sample, in monthly terms for lags of one and two months, we find no evidence for significant causality from the rate of inflation to the rate of depreciation, or to the real interest rate (for detailed results, see Bar-Or, 1999). Yet we do find significant causality from the real interest rate and the rate of depreciation to the rate of inflation.[7] Second, if equation (1) is estimated using two-stage least squares, the resulting coefficients are very similar to those reported in the table but are less precisely estimated.

Moreover, the following empirical considerations hold. First, the rate of unemployment is typically a lagging indicator for macroeconomic conditions in Israel and is not related to the contemporaneous rate of inflation. Second, for a large part of the sample period there was nominal exchange rate targeting, using foreign exchange market intervention, and thus there was very limited exchange rate adjustment in response to shocks; that is, the path of the nominal exchange rate was predetermined to a large degree. Also, in many macroeconomic models, financial markets clear faster than goods markets. Finally, as far as the real interest rate variable is concerned, the central bank's setting of nominal interest rates probably reacts more to lagged values of inflation expectations and of inflation shocks than to their current values, and market-based inflation expectations are known to be largely adaptive. The combination of these characteristics reduces the scope for simultaneity.[8]

2.2 Quantifying the Role of Various Factors in the 1997-98 Disinflation

As indicated, an important drawback of previous empirical models is that they could not account well for important turning points

7. As is well known, it is not possible to determine the direction of contemporaneous causality by means of Granger tests.

8. As far as the potential for multicollinearity is concerned, contemporaneous cross-correlations among the various explanatory variables are quite small and not statistically significant.

in the process of inflation as measured by quarterly data. Consequently, they had to rely on dummy variables to prevent these turning points from causing imprecise parameter estimates. Here we illustrate how the present inflation equation is able to account well, within the sample, for the marked reduction in the rate of inflation in the period from 1997Q4 to 1998Q3. Inflation in that period fell to about 4.2 percent per year, compared with 8.8 percent per year in the period 1996Q4 to 1997Q3. The relevant data for this task are provided in table 3; see also Bar-Or (1999). The data are organized in the form suggested by taking first differences in equation (1) and measuring by $\Delta\pi$ the drop (of 4.6 percentage points) in the rate of inflation to be accounted for.

Table 3 shows that the estimated equation captures the reduction in the rate of inflation quite well.[9] A tightening of monetary conditions, as captured both by a higher ex ante real central bank interest rate and by a contemporaneous slower rate of depreciation of the NIS against the dollar, was quantitatively the key factor accounting for the reduction in inflation. In addition, the economic slowdown (as captured by a higher rate of unemployment) and the marked fall in fuel prices abroad helped lower inflation in the period under discussion.

Table 3. Contributors to Inflation Performance in the 1997-98 Disinflation[a]
Percent

	1996Q4–1997Q3	*1997Q4–1998Q3*	*Estimated contribution*
Inflation rate	8.8	4.2	4.6
"Explained" inflation rate	9.2	4.6	4.6
Foreign inflation	–5.1	–4.7	–0.1
Oil price change	–9.2	–31.4	0.4
Depreciation of NIS against the dollar	11.5	5.9	1.7
Ex ante real interest rate	4.1	5.2	2.0
Unemployment rate	7.6	8.5	0.6

Source: Authors' calculations.
a. Raw data are the source for the first two columns. The third column is derived by applying first differences to equation (1), using the estimated parameter values. "Explained" inflation is the one corresponding to the basic equation underlying this analysis.

9. In addition, as shown in Bar-Or (1999), the estimated equation yields satisfactory results in out-of-sample forecasts. Using actual values of the right-hand-side variables, estimates of equation (1) up to 1997Q3 predict a reduction of 4.5 percentage points in the rate of inflation, compared with an actual reduction of 4.6 percentage points. Also, the contribution of the explanatory variables to the disinflation is very similar to that found within the sample, as shown in table 3.

2.3 Inflation Forecasting

We now turn to the potential use of equation (1) to forecast inflation. Doing so requires formulating forecasts for the right-hand-side variables, such as the rate of currency depreciation, foreign-price inflation, the rate of unemployment, and so on. Although forecasts of the external variables can probably be taken from foreign sources, a proper derivation of forecasts of the internal variables would require working with a fully simultaneous macroeconomic model within which interdependencies among various forecasts could be taken into account. As indicated above, work in developing overall macroeconomic models for the Israeli economy is under way at the Bank of Israel, and further research is needed before a relatively satisfactory small-scale macroeconomic model will be available to derive macro forecasts. Because of this constraint, we focus here on a relatively limited use of equation (1) in forecasting inflation, based on various assumptions about the evolution of the right-hand-side variables.

Consider the forecasting of inflation for the four quarters from 1997Q4 to 1998Q3 based on information and other forecasts that were available as of the third quarter of 1997 and based on the parameter estimates of equation (1) obtained up until 1997Q3. On the basis of forecasts by the International Monetary Fund at that time, we assumed that the rate of change in world fuel prices would be 0.4 percent in the first of the four quarters and –1.6 percent in the remaining three quarters. We further assumed that prices of Israel's imports would fall at a rate of –0.4 percent per quarter. In addition, on the basis of a small-scale macroeconomic model of the real side of the economy developed at the Research Department of the Bank of Israel, we assumed that the rate of unemployment for the relevant four quarters would be 7.9 percent in the first quarter and 8.1 percent in the next three quarters.

The next task is to specify the path of the exchange rate. As is well known, typically there are no satisfactory models for predicting exchange rate fluctuations on a monthly or even a quarterly basis, whether in Israel or in the industrial countries. Much of what appears to move foreign exchange markets is "news," which by definition is hard to predict. What we can do at this stage, however, is derive various forecasts for the rate of inflation based on several alternatives for the rate of currency depreciation in the pertinent future. However, to be specific, consider the forecasts based on what was a relatively plausible assumption at that time about the path of

the exchange rate, namely, appreciations of 0.4 percent and 0.1 percent in the first two quarters of the forecast horizon, and depreciations of 1.6 percent in each of the following two quarters.

It remains to forecast the ex ante real interest rate on central bank funds. In the very short run this can be treated as a policy variable, and as such it should be compatible with achieving the inflation target. Using an ex ante real interest rate of 5 percent, in line with rates observed since mid-1996, we derived an inflation forecast of 5 percent for the four-quarter horizon; this was lower than the inflation target range of 7 to 10 percent.

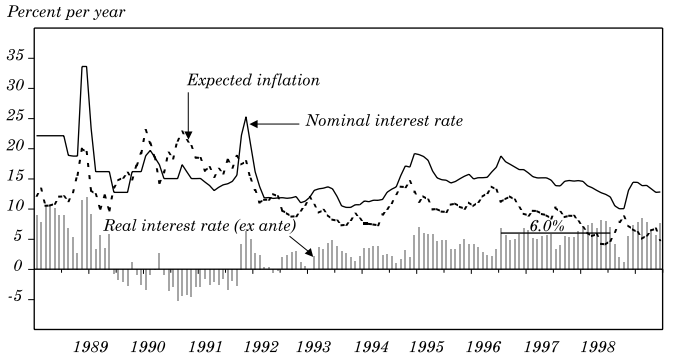
Again, one could derive alternative forecasts based on differing assumptions about the evolution of the exchange rate and of the ex ante real interest rate. We believe that more work exploring the forecasting properties of an equation such as (1), and comparing it with the forecasts of other models, is an important avenue for useful research in this area, as is the development of a fully specified, small-scale, simultaneous-equation macroeconometric framework.

3. Assessing Monetary Policy Rules

Here we attempt to formalize some aspects of monetary policy determination. Clearly, no simple mathematical rule can truly describe a process that involves frequent sharp, unexpected changes in economic circumstances, for example from an LTCM-type default or crisis in another country. With these caveats in mind, it is still instructive to explore the performance of various monetary policy rules, such as those estimated by Taylor (1993) and by Clarida, Galí, and Gertler (1998) for monetary policy of the main industrial economies, using data for Israel.

Figure 6 shows the path of the nominal interest rate as well as of market-based inflation expectations and the implied expected real interest rate for the period from 1988 to the present. It can be seen that, together with the gradual decrease in inflation expectations, especially after 1996, there has been a move toward a more uniform range of ex ante real interest rates than in the early 1990s, to levels of about 5 to 7 percent in annual terms. To a large extent, throughout the 1990s monetary policy evolved from a main emphasis on nominal exchange rate targeting in the early 1990s to inflation targeting and enhanced exchange rate flexibility in recent years. It is for these reasons—that is, possible changes in the monetary policy rule within the sample—that we perform our analysis here on monthly data

Figure 6. Effective Nominal and Real Interest Rates and Expected Inflation in Israel[a]



Source: Authors' calculations.
a. Nominal interest rates are those on liquid resources of the central bank.

(which is the periodicity of interest rate decisions) for the relatively more uniform period from 1994 onward.[10]

3.1 Interest Rate Changes and the Role of Inflation Expectations

The existence of reliable data on market-based inflation expectations is very useful in an inflation targeting context like that of Israel. In fact, substantial changes in these expectations have typically triggered sharp monetary policy responses. For example, the episodes of late 1994 and early 1995, the second half of 1996, and late 1998 (figure 6) illustrate marked increases in central bank rates in the face of sharp increases in inflation expectations. In the first two cases the rise in expected inflation was mainly due to a fiscal expansion together with overheating of the domestic economy, all of which led to a buildup of price pressures. In late 1998 the rise in the interest rate was associated with increased inflation risks due to very rapid depreciation of the NIS during world financial crises.

Tables 4, 5, and 6 report statistical and historical information on interest rate changes by the Israeli central bank, as well as on the main characteristics of fluctuations in the rate of inflation.

10. Interestingly, most of the applied research on monetary policy rules for industrial countries uses quarterly data, in spite of the fact that monetary policy decisions are made much more frequently.

Table 4. Statistical Characteristics of the Bank of Israel's Official Interest Rate
Percent per year except where indicated otherwise

	January 1994 to July 1999	*January 1994 to June 1996*	*July 1996 to July 1999*
Simple average	13.41	13.72	13.17
Standard deviation	1.82	1.95	1.68
Normalized standard deviation	0.14	0.14	0.13
Maximum	17.00	17.00	17.00
Minimum	9.50	10.50	9.50
Average increase	0.97	0.78	1.55
Average decrease	0.54	0.72	0.49
Standard deviation of increases	0.65	0.46	0.88[a]
Standard deviation of decreases	0.29	0.42	0.22
No. of months	67	30	37
Frequency of changes (months)	1.6	1.7	1.5
Frequency of turning points (months)	7.4	7.5	7.4
No. of increases	16	12	4
No. of decreases	26	6	20

Source: Authors' calculations.
a. The figure is 0.4 if November is excluded.

Table 5. Statistical Characteristics of the Inflation Rate in Israel
Percent per year except where indicated otherwise

	January 1994 to July 1999	*January 1994 to June 1996*	*July 1996 to July 1999*
Average	9.31	11.18	7.79
Standard deviation	2.89	2.09	2.54
Normalized standard deviation	0.31	0.19	0.33
Maximum	14.45	14.45	12.93
Minimum	3.03	7.75	3.03
No. of months in period	67	30	37

Source: Authors' calculations.

Table 6. Bank of Israel Interest Rate Changes

Date of announcement	*Change in interest rate (percentage points)*	*Level of interest rate after change (percent per year)*
December 28, 1993		10.50
May 9, 1994	0.42	10.92
May 23, 1994	0.60	11.52
June 27, 1994	0.54	12.06
July 26, 1994	0.44	12.50
August 29, 1994	1.50	14.00
September 25, 1994	1.50	15.50
November 28, 1994	1.50	17.00
February 21, 1995	–0.70	16.30
March 19, 1995	–1.50	14.80
April 24, 1995	–0.80	14.00
May 29, 1995	–0.50	13.50
July 24, 1995	–0.30	13.20
September 21, 1995	0.50	13.70
October 23, 1995	0.50	14.20
December 25, 1995	–0.50	13.70
January 29, 1996	0.30	14.00
April 21, 1996	0.80	14.80
May 27, 1996	0.70	15.50
June 24, 1996	1.50	17.00
July 29, 1996	–0.70	16.30
August 26, 1996	–0.50	15.80
September 24, 1996	–0.30	15.50
October 28, 1996	–0.30	15.20
December 23, 1996	–0.50	14.70
January 27, 1997	–0.50	14.20
February 24, 1997	–0.30	13.90
June 18, 1997	–1.20	12.70
August 25, 1997	0.70	13.40
January 26, 1998	–0.50	12.90
February 23, 1998	–0.30	12.60
March 23, 1998	–0.40	12.20
April 27, 1998	–0.30	11.90
May 25, 1998	–0.30	11.60
June 22, 1998	–0.30	11.30
July 27, 1998	–0.30	11.00
August 6, 1998	–1.50	9.50
October 26, 1998	2.00	11.50
November 12, 1998	2.00	13.50
February 22, 1999	–0.50	13.00
March 29, 1999	–0.50	12.50
April 26, 1999	–0.50	12.00
July 25, 1999	–0.50	11.50
November 22, 1999	–0.30	11.20
December 27, 1999	–0.50	10.70

Source: Bank of Israel

The highest value of the nominal interest rate on central bank funds in the period since 1994 was 17 percent per year, in the middle of 1996. The lowest was 9.5 percent per year, in August 1998. It can be seen that, out of the sixty-seven months in our sample, the average frequency of interest rate changes was almost two months. Moreover, turning points in the trend of interest rates—from increases to decreases, and vice versa—have been frequent, occurring every 7.4 months on average. From table 5 it can be seen that the inflation environment during the sample period was relatively volatile; thus it is plausible that the volatility in the fundamentals influencing the inflation process prompted frequent interest rate reactions. Another interesting feature of the results is that, in absolute (percentage point) terms, increases in interest rates were typically larger than decreases in rates. This asymmetric pattern would seem quite plausible in an economy in which there are still forces (from the high-inflation periods in the past) toward inflation bias, and where gradual disinflation is a policy objective. In such a context, there is a stronger interest rate response in the face of rises in inflation than in the face of decreases in inflation.

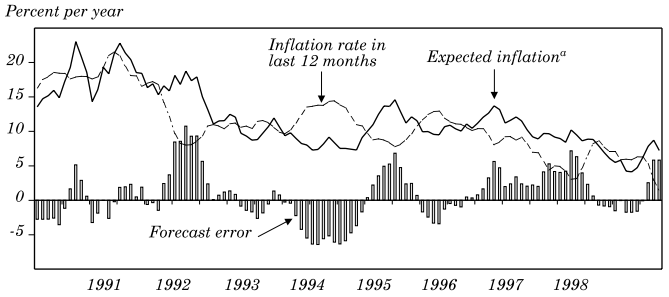
As indicated, market-based inflation expectations are a key variable in the inflation targeting policy regime. That this is the case is quite evident from central bank official statements and reports (see, for example, the Bank of Israel's annual reports and inflation reports) and from typical analysis in the media. In fact, some newspapers report the previous day's market-based measure of inflation expectations. The limitations of this indicator are well known and have been taken into account in the policy process. Moreover, as suggested by the analysis of Bernanke and Woodford (1997), the proper conduct of inflation targeting requires using not only market-based expectations but also the central bank's own forecasts. One key limitation of market-based inflation expectations is the fact that market data on yields on indexed and nonindexed bonds actually measure the sum of expected inflation and the risk premium. Only under the assumption of a constant and zero risk premium is it possible to attribute month-to-month changes in the difference between these yields to changes in expectations of inflation.

A second limitation is that, to a large extent, measured inflation expectations are backward-looking and reflect adaptive behavior by the public; this is evident from figure 2. The level and fluctuations in twelve-months-ahead expected inflation appear to be closely correlated with those of inflation in the last twelve months. Hence a

variable that in principle should contain a strong forward-looking element is largely determined by past performance, although it is well known that for some stochastic processes of the rate of inflation, "adaptive" expectations can be "rational" after all. This means that it would probably be hard to detect expected future turning points in the inflation process solely on the basis of market-based expectations.

A third limitation is that, in a regime where the authorities conduct inflation forecast targeting, with market-based inflation expectations as one of the key indicators, and where there has been gradual learning about the anti-inflation stance of the authorities, it is very difficult to determine the properties of market-based inflation expectations. A sudden rise in expected inflation can trigger a strong interest rate response, which in turn succeeds in stopping the inflationary pressures, so that by, say, the end of the year, inflation is back to the target. Under these conditions, a comparison of expected and actual inflation will lead to a sizable forecast error. Figure 7 depicts twelve-months-ahead expected inflation and actual inflation as recorded twelve months thereafter. It can be seen that there are periods of considerable measured forecast errors and that these errors exhibit relatively strong serial correlation. Again, whether these observations correspond to "irrational" expectations or to rational expectations under frequent changes in fundamentals and gradual learning about the authorities' inflation forecast targeting cannot be determined on the basis of these data alone. In any case, casual observation suggests that, as the 1990s advanced, there indeed was a learning process under inflation targeting by both the authorities and the public at large.

Figure 7. Expected and Actual Inflation in Israel



Source: Authors' calculations.
a. Expected inflation is derived from capital market data on indexed and nonindexed bonds and is shifted twelve months forward.

3.2 Estimating a Forward-Looking Analogue of a Taylor Rule for Israel

As stressed above, no simple formula can summarize the complexity of the interest rate determination process. With this important caveat in mind, recent influential research by Taylor (1993) has developed a relatively simple empirical rule that describes quite well ex post the behavior of the U.S. federal funds rate under the Federal Reserve's policies as a function of the output gap and the rate of inflation. Svensson (1999) developed the conditions under an inflation targeting regime that will lead to policy rules of the type estimated by Taylor. In both these analyses it was assumed that the central bank makes no use of any available market-based measures of inflation expectations. Here we consider estimates of a relatively plausible interest rate rule for Israel, which exploits the existence of market-based inflation expectations. The rule takes the following form:

$$L_t = \alpha_0 + \alpha_1 \left[\alpha_2 \pi_t^e + (1 - \alpha_2) \pi_{t-1} \right] + \alpha_3 \left(y_{t-1} - y_{t-2}^* \right) + \alpha_4 L_{t-1} + \alpha_5 t U H d_t + \xi_t \,. \tag{2}$$

In this equation, $y - y^*$ denotes the gap between the last available annual rate of change in the Bank of Israel's economic activity index and a twelve-month annual average calculated from the preceding month backward, and *trend* is a time trend variable that in part will capture the gradual move to increased monetary tightening over time. The presence of the lagged dependent variable represents the well-known case for partial interest rate smoothing, and the variable

$$\alpha_2 \pi_t^e + (1 - \alpha_2) \pi_{t-1} \,,$$

stands for the inflation "environment." This reflects a combination of a backward-looking element (the last known value of annual inflation) and a potentially forward-looking one (the last known value of expected inflation as of the time of the interest rate decision). Lagged inflation is of importance mainly because of the widespread indexation in Israel of wages and financial assets to the CPI, which works with a lag, and expected inflation enters as a variable that potentially includes forward-looking elements. In this specification an increase in inflation expectations and/or an increase in last known annual

inflation would trigger a rise in interest rates.[11] Although in principle the equation should actually include the gap between the inflation environment and the inflation target, this has no major practical importance here because the latter was relatively unchanged in the sample period (see table 1). As is well known, a linear specification such as equation (2) arises, for example, when the central bank's preference function is quadratic in deviations of the inflation environment from target and in the output gap.

In the econometric implementation, we ensured that the timing of the right-hand-side variables reflected that of the last available information before the policy decision was made. In Israel the CPI for a given month is released on the fifteenth day of the subsequent month. Then, on the last Monday of the month, the central bank announces its decision regarding the interest rate on central bank funds for the subsequent month. For example, the CPI for June 1999 was released on July 15, and the central bank interest rate for August was announced on July 26. Only on rare occasions have there been deviations from this procedure. Thus the lagged inflation term corresponds to two months before the present month. Also, the last known monthly indicator of economic activity is that for a three-month lag, and the last known market-based inflation expectations correspond to the five weeks that precede the interest rate decision. Parameter estimates based on a sample of monthly data from 1994 to the present are given in table 7.

Table 7. Regression Estimates of the Monetary Policy Rule, January 1994 to July 1999

Parameter in Equation (2)	*Coefficient*	*Standard error*
α_0	0.0130	0.050
α_1	0.5000	0.000
α_2	0.7470	0.000
α_3	0.0790	0.005
α_4	0.4970	0.000
α_5	0.0003	0.000
R^2	0.946	
Adjusted R^2	0.942	
DW	1.910	

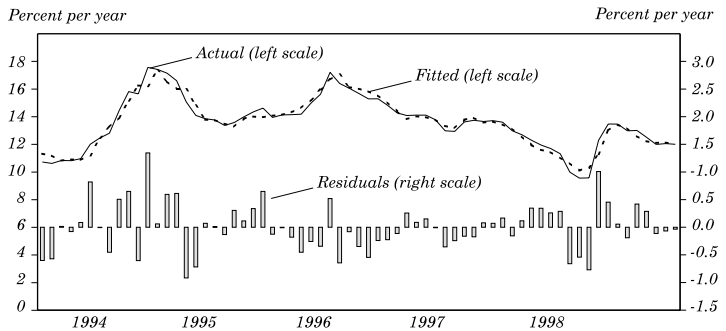
Source: Authors' calculations.

11. Previous work on the Bank of Israel's reaction function appears in Gottlieb and Ribon (1997), Djivre and Ribon (1999), Goldberg (1999), and Levanon (1998).

It can be seen that, on average, a rise in the inflation environment of 1 percentage point in a given month triggers a rise in the central bank rate of 0.5 percentage point. This indicates that in the very short run—say, a month—a rise in expected inflation does trigger a rise in the nominal interest rate, yet the impact coefficient is less than unity, and the implied ex ante real rate partially falls in that month, all else equal. To an important extent, this partial response is consistent with a considerable degree of interest rate smoothing: when conditions require a change in the interest rate, that change appears to be spread over several months. Accordingly, if the same increase in expected inflation does persist over a whole quarter, the overall response of the nominal interest rate will be close to 1.0, which is line with the estimates obtained by Levanon (1998) and Djivre and Ribon (1999).

Within the inflation environment variable, the strongest weight (0.75) is given to market-based inflation expectations. Figure 8 depicts the actual, fitted, and residual values for equation (2). The equation tracks relatively well the evolution of the central bank interest rate within the sample.[12]

Figure 8. Actual and Fitted Interest Rates and Residuals[a]



Source: Authors' calculations.
a. Fitted interest rate is that calculated from equation (2).

12. We have also explored the possible inclusion of foreign interest rates and of the rate of domestic-currency depreciation as additional regressors in equation (2). The results, however, did not support their inclusion. It is plausible that market-based inflation expectations, already included as a regressor in the equation, capture well the potential effects of both these variables on the rate of inflation.

If estimation is conducted for the more recent sample period from July 1997 to July 1999, the coefficients change in a clear-cut pattern (table 8). First, there is now a stronger impact of the inflation environment variable on the central bank rate. Second, within the inflation environment variable there is now a stronger effect of forward-looking inflation expectations, and lagged inflation is no longer a significant explanatory variable beyond these expectations (we captured this by setting $\alpha_2 = 0$). Finally, there is a stronger reaction of contemporaneous interest rates to lagged interest rates. All of these considerations imply that a permanent 1-percentage-point rise in expected inflation would lead to a rise in the ex ante central real bank real interest rate, which is consistent with an inflation-stabilizing role of monetary policy (see Clarida, Galí and Gertler, 1998).

3.3 "Strict" or "Flexible" Inflation Targeting?

An important issue in characterizing central bank policy under inflation targeting is to determine—in Svensson's (1999) terminology—whether targeting is "strict" or "flexible." Strict targeting does not allow for countercyclical monetary policy, in that the output gap does not enter the interest rate rule beyond its impact on inflation forecasts. Flexible targeting does allow for such a countercyclical response. In official statements Bank of Israel officials have made it clear that their current policy is one of strict inflation targeting.

Table 8. Regression Estimates of the Monetary Policy Rule, July 1997 to July 1999

Parameter *Equation (2)*	*Coefficient*	*SE*
α_0	–0.030	0.052
α_1	0.548	0.000
α_3	0.204	0.001
α_4	0.637	0.000
α_5	0.0007	0.000
R^2		0.932
Adjusted R^2		0.920
DW		2.024

Source: Authors' calculations.

A common argument has been that, in an economy with such a high-inflation history, strict targeting is needed in the first stages of disinflation, because of the weak credibility of monetary policy and the need to build the reputation needed for a disinflation to be effective. This argument implies that countercyclical policy would be contemplated if and when monetary policy comes to enjoy strong anti-inflation credibility. However, the fact that there is a significant, nonzero coefficient on the economic activity variable in the interest rate equation would suggest that, in practice, there is a partial countercyclical element to monetary policy. Yet whether or not this is the case cannot be determined with the present information alone. To the extent that the inflation environment variable is only an imperfect proxy for true expected future inflation, and to the extent that the latter does depend on the level of economic activity, the latter can appear in the equation with a nonzero coefficient. By itself this need not be interpreted as a deviation from strict inflation targeting. Thus, further work is needed to attempt to empirically discriminate strict from flexible inflation targeting. These and the other features of the results conform quite well with the findings of Clarida, Galí, and Gertler (1998) for monetary policy in the United States and in other industrial countries.

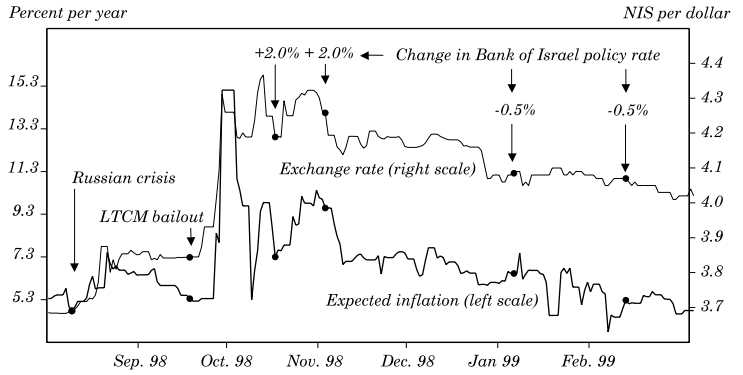
4. Concluding Remarks

To conclude, it is useful to illustrate the strong interactions between the transmission mechanism in the inflation process and monetary policy rules under inflation targeting; the episode immediately following the Russian crisis and the failure of LTCM in the second half of 1998 provides a convenient example. At that time, growing concern on the part of international investors about their investments in emerging countries led them to reduce their positions in those countries. Israel was among them: some foreign positions in the local stock market were liquidated and the funds transferred abroad. These developments led to a strong depreciation of the NIS within the very wide currency band, both against the currency basket and against the dollar, reaching about 15 percent on average from August to October 1998. In fact, in a space of just three days—October 6 to 8, 1999—the NIS fell against both the basket and the dollar by close to 10 percent, a surprising and unusual event in the contemporary Israeli foreign exchange market (see Bank of Israel, 1999b).

Following these dramatic events, during which the foreign exchange market, although not accustomed to shocks of this magnitude, continued to function in orderly fashion, the next policy concern was about their potential implications for inflation acceleration. In the high-inflation past, currency devaluations were typically one-time events that had a strong and permanent impact on prices and on inflation expectations. In an economy with advanced methods of wage and financial indexation, there was a very quick pass-through from changes in the exchange rate to actual and expected changes in the rate of inflation. However, in this episode one might have expected a relatively weaker pass-through because of the increased flexibility in the exchange rate regime, the weaker state of economic activity, and the stronger credibility of anti-inflation policy by the central bank. In other words, there were good reasons to believe that some degree of exchange rate overshooting had occurred and that eventually some degree of appreciation would offset the previous developments.

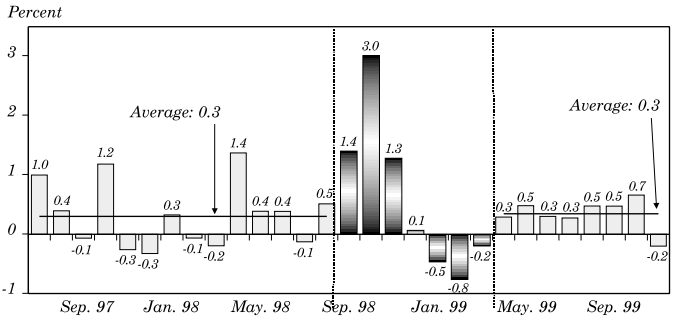
Figure 9 depicts the daily behavior of the U.S. dollar-NIS exchange rate and of twelve-months-ahead inflation expectations during this volatile period. The rapid depreciation was accompanied by a sharp upward shift in inflation expectations. There were also very large increases in consumer prices in September, October, and November 1998. In October alone, consumer prices rose by 3 percent (figure 10). Given the substantial risk of an acceleration of inflation

Figure 9. Exchange Rate and Twelve-month Inflation Expectations in Israel



Source: Bank of Israel.

Figure 10. Monthly Rates of Change in the CPI in Israel[a]



Source: Authors' calculations.

well beyond the official target, the question for monetary policy was how and when to react to these events. And in doing so the authorities had to allow room for the possibility that these events might represent only a one-time jump in the price level and not necessarily an increase in the rate of inflation, as in the high-inflation past.

A first element in the policy dilemma was whether to intervene in the foreign exchange market to smooth out exchange rate fluctuations. Despite many calls for intervention in policy and public discussions, the central bank opted not to intervene, especially given that such intervention might well create additional incentives for capital outflows and for speculation against the central bank's actions. The central bank saw the situation as an opportunity to allow private market forces to fully determine the exchange rate, while internalizing the true extent of exchange rate risk in the new, more flexible regime. Nor did the central bank increase interest rates in September and October, as it believed the episode likely represented more of a one-time price-level jump than a permanent increase in the rate of inflation. Only toward late October, when substantial turbulence in domestic financial markets arose, did the Bank of Israel raise its interest rate by 2 percentage points. However, since this change was not followed by stabilizing trends in the foreign exchange market and in inflation expectations, a "surprise" additional interest rate rise of 2 percentage points followed in early November.

This policy move contributed to a reversal in the previous trend of the nominal exchange rate and in inflation expectations. As figure 10 shows, the rate of inflation soon moved back to its earlier level; this was accompanied by a sizable appreciation of the NIS (about 5 percent from December 1998 to March 1999), and inflation expectations adjusted downward. This opened some room for interest rate reductions in 1999. Our estimates indicate that although the overall pass-through to inflation may have remained unchanged in this episode, there has been an increase in the contemporaneous exchange rate coefficient, and a decrease in the lagged coefficient. One possible explanation is that the exchange rate shifts were so large that they prompted quicker price responses than before.

In sum, we believe these developments provide support for the policy strategy of focusing on the inflation target and allowing for market determination of the nominal exchange rate, with no intervention in the foreign exchange market (unless the market is not operating in an orderly fashion). Four months after the dramatic, 4-percentage-point rise in the central bank rate, the central bank was able to begin reducing interest rates without jeopardizing the inflation target. By mid-1999 there was a common assessment that inflation had returned to about 4 percent per year (although the rate of inflation for 1999 itself was forecast to be well below that figure). This was internalized by the government's decision to set the inflation target for the years 2000 and 2001 in the range of 3 to 4 percent.

It would be desirable in future work to explore analytically and empirically various aspects of inflation targeting that have emerged from Israel's experience. One of these is possible asymmetries in monetary policy actions in the course of a disinflation process, whereby the policy response to deviations of inflation above the target is stronger than those when inflation is below the target. Another is the evolution of the exchange rate pass-through mechanism as it relates to the process of disinflation, to the increased flexibility of the exchange rate regime, to the changing credibility of monetary policy and of the inflation target, and to the effective degree of external openness of the economy. Finally, a third topic for future study is the role of credibility of the inflation target, and of monetary policy, in choosing the degree of fixed versus flexible inflation targeting.

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