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The Transmission of Monetary Policy in Israel

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Abstract

This paper investigates the transmission of Israeli monetary policy since 1990. Two issues are addressed: the extent to which monetary policy exerts real effects, and the relative importance of different transmission channels. The impact of monetary restraints on aggregate industrial production is found to be small, although industrial sectors open to trade appear to suffer to a larger extent than closed sectors. Three transmission channels are analyzed by comparing the empirical evidence to that predicted by theory. While the credit and exchange rate channels may be important mechanisms of transmission, the interest rate channel finds weak support in the data.

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SUMMARY

Since 1994, Israel has experienced a prolonged period of relatively restrictive monetary policy. A current debate concerns whether monetary policy has contributed to the slowdown in real activity, which occurred in 1996 after several years of sustained growth. This paper investigates the transmission of monetary policy to real activity in Israel from January 1990 to April 1997, using the "narrative approach" of Romer and Romer (1989). Two issues are addressed: whether monetary policy significantly influences real activity and the relative importance of different transmission channels from monetary policy to real activity.

The effectiveness of monetary policy is evaluated by selecting three episodes of large monetary shocks aimed at reducing inflation, and by examining the response of industrial production to each shock. The impact on aggregate industrial production is found to be relatively small, particularly when compared with previous results obtained from the United States. At a sectoral level, industrial sectors open to trade appear to suffer from monetary shocks to a larger extent than sectors closed to trade, because of their exposure to the exchange rate channel. Open sectors with a high value added and a low wage share, however, may be able to partially insulate themselves from the exchange rate channel.

The relative importance of three different transmission channels—the interest rate, bank lending, and exchange rate channels—is analyzed by comparing the behavior of key variables to that predicted by theory. The estimated reaction of credit, the exchange rate, and the trade deficit to each shock suggests that the bank lending channel and the exchange rate channel may have been active mechanisms of monetary transmission. On the contrary, the reaction of money, and the overall yield curve only weakly supports the existence of an interest rate channel.

I. INTRODUCTION

Over the last decade, Israel has undergone substantial changes in terms of monetary policy, financial structure, and exchange rate regulation. Since 1985, when the Economic Stabilization Plan reduced annual inflation from three digit values to about 20 percent, price stability has become a main concern. However, different strategies have been implemented in the fight against inflation. During a first phase, the authorities aimed at maintaining inflation around the newly achieved platform by anchoring the nominal exchange rate. At the beginning of the 1990s, however, it became clear that fixing the exchange rate was costly, particularly under an increasingly liberalized financial sector, and that it was an inadequate strategy for the reduction of inflation to single digit values. The second phase aimed at achieving a stepwise reduction to single digit values, by anchoring the inflation rate and by allowing the exchange rate to fluctuate within an upward sloping band. This goal turned out to be difficult to achieve, partially because the large flows of immigrants, which arrived in the early 1990s, and the consequent expansionary fiscal policy generated periods of excess demand. As a result, since 1994, Israel has experienced a prolonged period of relatively strict monetary policy. A current debate is whether the slowdown in real activity, which was felt in 1996 after several years of sustained growth, may be due to the central bank's policy of high interest rates.

This paper originates from this debate and investigates the transmission of monetary policy in Israel by addressing two issues. The first is whether monetary policy has significantly influenced real activity since 1990. The second is what has been the relative role of different transmission channels over that same period.

In a small open economy where the exchange rate is fixed, capital movements are unrestricted and domestic and foreign assets are perfect substitutes, the money supply is outside the control of the monetary authorities. Hence, monetary policy cannot be used to affect real activity. Israel is a small economy open to trade, with an increasingly liberalized financial sector. However, because of restrictions on capital movements and other factors, domestic and foreign assets are not perfect substitutes. Moreover, the exchange rate fluctuates within an upward sloping band, whose slope reflects the differential between the domestic inflation target and the expected level of inflation abroad. These two aspects give the monetary authorities some room to move interest rates and the money supply, to the extent that these movements are consistent with the diagonal exchange rate band. If domestic interest rates rise too much relative to the inflation target and to the slope of the band, the yield gap induces large capital inflows, which cause an appreciation and threaten the exchange rate regime. Whether these features are sufficient to create independence in the conduct of monetary policy is an open question, and is addressed in the first part of the paper by computing the response of industrial production to episodes of restrictive monetary policy.

A related issue is to understand the mechanism through which monetary shocks exert real effects. The second part of the paper provides empirical evidence on the relative importance of three different channels of monetary transmission that might be relevant for Israel, given its

financial structure and its exposure to international trade: the interest rate channel, the bank-lending channel, and the exchange rate channel.[2]

The interest rate channel is emphasized by the so-called "money view." According to this view, there are only two assets in the economy: currency, which is used for transactions, and bonds, which are all other financial assets held as a store of value. The monetary authorities, by raising the official rate, induce a decrease in the amount of banking system reserves, and therefore a contraction in the deposits issued by the banks. Since currency and bonds are the only assets available in the economy, the private sector has to hold less currency and more bonds, requiring higher short-term real rates to clear the asset market. Hence, according to the "money view," monetary policy affects output through a reduction in the real money balances held by the private sector and through a fall in all interest-sensitive expenditures.

Another stream in the literature, often referred to as the "credit view," emphasizes the importance of the bank-lending channel as a transmission mechanism. According to this alternative view, bank loans are considered a third type of asset, in addition to money and bonds. Despite the fact that they are also a store of value, bank loans are not perfect substitutes for bonds. This is because borrowers might face constraints on the bond market, and might then be forced to borrow at a higher rate from the banking sector. When the authorities implement a restrictive monetary policy, the amount of banking system reserves falls, so that the banks' ability to lend is also reduced. Monetary policy affects output to the extent that some borrowers face a credit crunch, thus reducing private expenditure. Notice that the bank-lending channel is independent of the interest rate channel. An increase in the nominal official rate might reduce the amount of reserves without affecting real interest rates (for instance, if currency and bonds are perfect substitutes). In this case the interest rate channel is not active; nonetheless, the bank lending channel is active, to the extent that lower reserves reduce the ability of banks to supply loans.

A third view argues that the exchange rate channel is an additional transmission mechanism by referring to the asset theory of the exchange rate. This latter[3] argues that, when exchange rates are flexible, foreign reserves are fixed and the exchange rate is determined by long-run considerations such as purchasing power parity. Nonetheless, in the short run the exchange rate is determined by asset market equilibrium conditions, as the relative price of two currencies which satisfies their demand and supply. When the exchange rate determined by the asset equilibrium is not consistent with the demand and supply of goods, a current account and a corresponding capital account imbalance occurs. This alters the ratio of domestic to foreign assets, which in turn changes the level of the exchange rate that is consistent with stock market equilibrium. Through this adjustment process, the exchange rate eventually

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[2] See Mishkin (1996) for a discussion of the possible transmission mechanisms from monetary policy to real activity.

[3] See the review by Artis and Lewis (1991).

converges to its long-run value. When the monetary base is reduced by a rise in domestic real interest rates, the supply of the national currency falls and its price relative to the price of foreign currencies rises, which amounts to an appreciation of the exchange rate. This may affect output in tradable sectors, by increasing imports and decreasing exports.

A major difficulty in quantifying the real effects of monetary policy is that, even if one believes that monetary policy affects output, it is hard to distinguish this effect from the influences that real activity has on monetary policy. The same problem arises when different channels of monetary transmission are evaluated; it is hard to disentangle the effects of monetary policy on key variables—such as money, credit, the exchange rate, or the trade deficit—from the reaction of monetary policy to movements in the latter variables. One way to deal with this difficulty is by measuring the effects of monetary policy only in those cases when monetary tightening was a reaction to movements in inflation, not in output. This is the idea underlying the econometric approach used in this paper, often referred to as the "narrative approach." The methodology, pioneered by Friedman and Schwartz (1963) and later extended by Romer and Romer (1989), uses historical records of the monetary authorities' actions to identify episodes of monetary shocks that are independent of developments in real activity. Having selected those episodes, various statistical methods can be used to identify the effects of monetary policy on the variables of interest. The results derived in this paper are obtained from univariate dynamic forecasting analysis. First, the "normal" path of the variable of interest is modeled as an autoregressive process, and is estimated over the entire sample. Then, following each monetary shock, forecasts are obtained on the basis of the estimated relation. While the forecasts approximate the path that would have prevailed in the absence of a monetary shock, cumulative forecast errors provide a measure of the effect of monetary policy on the variable considered, after a certain lapse of time.

The paper is structured as follows. Section II briefly describes monetary policy, the exchange rate regimes, and some major structural shocks the Israeli economy underwent following the Economic Stabilization Plan (ESP) of 1985. Section III discusses the methodology used to evaluate the effects of monetary policy and the channels through which these effects are transmitted. Section III.A identifies the relevant episodes of monetary policy. Section III.B describes the technique used to compute the effects of the contractionary episodes on industrial activity, and discusses the problems related to their identification. Section III.C describes the methodology followed to test the empirical relevance of the interest rate channel, the credit channel, and the exchange rate channel. Section IV reports the computed effects of the selected monetary shocks on real activity, first at an aggregate and then at a sectoral level. Sections V–VII present statistical evidence on the relative importance of the interest rate channel, the credit channel, and the exchange rate channel. Section VIII summarizes the results.

II. Monetary Policy, Exchange Rate Regimes, and Structural Shocks in Israel

As a result of a decade of expansionary fiscal and monetary policy, Israel experienced three-digit inflation rates at the beginning of the 1980s. After annual inflation had reached a level close to 450 percent, the authorities decided in July 1985 to implement the Economic Stabilization Plan (ESP), which combined restrictive monetary and fiscal policies with a fixed exchange rate. The plan was successful in that it achieved a reduction of annual inflation to around 20 percent by the end of 1986, and it signaled a new era in Israeli policy, whose main objective became price stability.

The aim of the authorities, following the step reduction in inflation induced by the ESP, became to maintain inflation at the prevailing rates by using the exchange rate as a nominal anchor. However, commitment to a fixed exchange rate and ongoing foreign-exchange liberalization resulted in a cumulative real appreciation, which eroded competitiveness and fostered speculative attacks. The fear that this could endanger the disinflation process induced the authorities to progressively allow greater flexibility in the exchange rate regime. Initially, they decided to devalue the fixed nominal exchange rate several times. In 1989, the persistent pressure on the central bank reserves led to the introduction of a band that allowed fluctuations of 3 percent around the central parity; despite a temporary release, further appreciation of the exchange rate induced an enlargement of the band width to 5 percent in 1990.

These measures may have caused markets to perceive a lack of commitment of the authorities to the exchange rate regime and to the anti-inflationary policy, inducing sustained inflationary expectations and preventing a reduction of inflation rates to single digit values. Although the authorities had achieved their stability objective, with an average inflation rate around 18 percent over the five years following the ESP, it became clear that the overall strategy was not going to lead to single digit inflation rates. After a further speculative attack, at the end of 1991 the authorities decided to shift to an upward sloping exchange rate band, whose slope was set yearly according to the differential between a newly introduced inflation target and a measure of average inflation rate for Israel's main trading partners. On one hand, this marked a shift from a regime where monetary policy followed exchange rate targeting to the current one, where monetary policy is mainly driven by inflation targeting. On the other hand, since 1991, the presence of a crawling exchange rate band has acted as a constraint on the inflation objective, and in some cases the level of the interest rate necessary to achieve the declared inflation target has not been consistent with the maintenance of the nominal exchange rate within the existing band. Nonetheless, whenever a conflict between inflation targeting and the exchange rate regime has not arisen, the former has driven Israeli monetary policy.[4]

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[4] See Bufman and Leiderman (1997), and Bufman, Leiderman and Sokoler (1995) for a discussion of monetary policy, inflation targeting, and exchange rate regimes in Israel.

While Israel was moving toward a greater degree of exchange rate flexibility, it was also experiencing a gradual process of financial liberalization,[5] which started after the 1985 ESP and continued throughout the first half of the 1990s. Restrictions were removed sequentially, first on the domestic financial market, then on the current account, and finally on the capital account. Although the liberalization process was substantial, some rigidities still persist. For instance, the banking system remains highly concentrated, and the share of banking intermediation in total financial intermediation is still higher than in many other industrialized countries. Moreover, the capital account has been liberalized in an asymmetric way, with a faster removal of restrictions on inward than on outward capital movements. While the increasing degree of exchange rate flexibility suggests that real effects of monetary policy might have increased since the early 1990s, the process of financial liberalization might have counteracted this tendency.

Other events might have affected the transmission of monetary policy to real activity. Over the period considered, Israel was hit by important exogenous shocks that exerted a positive impact on output. This provides an additional difficulty in the identification of the real effects of monetary policy, since these shocks may have acted as exogenous driving forces in the data generating process of output. First of all, the Israeli economy has heavily been affected by the evolution of the peace process with the Palestinians. For instance, a positive confidence shock was induced by the peace agreement achieved in late 1993. The general optimism about the political environment was reflected in an increased ratio of gross fixed nonresidential investment to income, which rose by 1 percentage point from 1993 to 1994, despite the fall of 1.5 percentage points in the ratio of gross national savings to income. Second, Israel experienced massive immigration flows at the end of the 1980s and at the beginning of the 1990s, which required higher rates of capital formation for the increased labor force to be absorbed.

A final aspect that has interacted with monetary policy in affecting output is fiscal policy. In 1991 the government approved a law of diminishing budget deficits, to ensure that the temporary increases in public expenditures needed to face the arrival of immigrants did not translate into permanent and unnecessary increases. Nonetheless, from 1994 to 1996 fiscal policy was expansionary, and the domestic budget deficit rose above the targets both in 1995 and 1996. In particular, the public sector domestic deficit rose from 3.3 percent of GDP in 1994 to 4.4 percent in 1995. Since the economy was also experiencing a fall in unemployment rates toward its natural rate, this resulted in increased demand, so that restrictive monetary policy was required to counteract these inflationary pressures.

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[5] See Clifton (1994) for a description of the financial liberalization measures.

III. THE METHODOLOGY

The major difficulty in providing an empirical evaluation of the real effects of monetary policy lies in the fact that there is no entirely convincing way of disentangling causes and effects of central banks' actions. Monetary authorities react to changes in real activity, as well as in inflation. Hence, it is difficult to distinguish the effects of monetary policy on real activity from the influences that real activity has on monetary variables. A similar problem arises in providing evidence on the transmission mechanism, since monetary policy both affects and is affected by monetary aggregates, by the banks' ability to lend, and by the exchange rate behavior.

Following Sims (1980), the main methodology used in the recent empirical literature on transmission mechanism has been vector autoregression (VAR). The way VARs disentangle causes and effects is by imposing coefficient and/or error covariance restrictions on the parameters of the model. Therefore, the results of the analysis often heavily relies on the restrictions imposed. Moreover, as pointed out by Friedman (1995), there are several reasons why the VAR approach does not solve the problem of the direction of causation. The first relates to Tobin's (1970) "post hoc ergo propter hoc" critique: even when it is found that money precedes output, this does not imply that the former "causes" the latter. As King and Plosser (1984) show, money could increase before output during an expansionary phase of the economy, simply because firms increase their demand for credit. The second criticism is that at best VARs detect only deviations from the usual conduct of central banks, and therefore they might underestimate the real effect of monetary shocks. Suppose that the authorities react to random output fluctuations by persistently trying to smooth them. If they succeed in their intent, then monetary policy has more power in affecting the real side of the economy than it is evident from the data. Third, if the central bank reacts to an unusual event that affects output, the VAR methodology might incorrectly conclude that monetary policy is ineffective. For example, suppose that the central bank reacts to a stock market boom, but that monetary policy only partially offsets the positive impact on real activity. Then a VAR can erroneously find a positive relation between monetary tightening and output.

As a result of these shortcomings, attention in the literature has shifted back to the "narrative approach" used by Friedman and Schwartz (1963). In their pioneering investigation on the real effects of monetary policy in the United States, they argue that records of the U.S. monetary history allow one to select episodes of large and independent monetary shocks. However, by broadly identifying monetary shocks as "unusual" movements in monetary instruments relative to the pattern of real activity, their methodology could also select episodes where real activity is affecting the monetary authorities' decisions, for instance when the central bank reacts to negative shocks to output by decreasing interest rates.
A further development in this direction is the work of Romer and Romer (1989),[6] who use historical records to identify independent monetary shocks, but in a way that overcomes the

[6] Here onwards referred to as R&R.

criticism of Friedman and Schwartz's procedure. Using a much narrower criterion, R&R select only episodes "when the Federal Reserve attempted not to offset perceived or prospective increases in aggregate demand but to actively shift the aggregate demand curve back in response to what it perceived to be excessive inflation." If one believes that inflation does not have real effects, as it is often argued, then the definition solves the causation problem. By limiting the statistical analysis to those shocks which were not provoked by undesired movements in output, it is possible to identify the effects of monetary policy only. The authors then use univariate dynamic analysis to explore how the selected episodes of monetary tightening affected unemployment and industrial production in the United States. They find that industrial production falls and unemployment rises after each episode, compared with what would be in the absence of the monetary shock.[7]

The "narrative approach" solves at least two of the shortcomings of the VAR methodology. First, it allows the use of nonstatistical, qualitative analysis in a quantitative methodology. While the VAR approach lets the data "choose" the episodes of monetary shocks, the "narrative approach" uses historical records as an additional information set, in order to solve the causation problem. Second, by limiting the analysis to those episodes where the monetary authorities have not reacted to movements in output, the effects of monetary policy can be identified even if the central bank often tries to smooth output fluctuations. Another advantage of the "narrative approach" is that it is possible to use univariate analysis. This is preferable to a procedure based on a system of equations, when the sample is limited as in our case.

Nonetheless, there are also limitations that should be kept in mind, when using this approach. One relates to the same univariate analysis, and it recalls the third shortcoming of the VAR methodology. If the authorities implement a restrictive monetary policy when a large exogenous shock is positively affecting output, univariate analysis might underestimate the effect of monetary policy, unless this shock is introduced in the generating process of output. Another limitation relates to personal judgment in the interpretation of the authorities' accounts. Finally, the identification method selects single dates for the monetary shocks, implicitly assuming that they are equal in intensity and duration. Since shocks are treated as being of equal severity, the methodology often groups all episodes together and averages the effects across each single episode.

Given the necessity of accessing and interpreting the monetary authorities' reports, little work has been done along the lines of the "narrative approach". However, episodes of monetary tightening have been identified according to R&R's definition by Tsatsaronis (1993) for Germany, by Ueda (1993) and by Fernandez (1994) for Japan, and by Tsatsaronis (1995) for

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[7] Fair (1989) argues that the estimation of structural models is an alternative to the narrative approach, since it can identify the direction of causation. Using the "structural approach" he analyses the six monetary shocks considered by R&R, and obtains similar results, although the average size and persistence of the effects is found to be smaller.

the United Kingdom. Moreover, Romer and Romer (1990) and Tsatsaronis (1995) also use their identification of monetary shocks and dynamic forecasting analysis to evaluate respectively the behavior of money and of bank loans after the monetary shocks in the United States and in four industrialized countries. This provides a way to assess the relative importance of the interest rate channel and of the credit channel of the transmission mechanism. This paper follows R&R's approach[8] to analyze the transmission of monetary policy in Israel, from January 1990 to April 1997.[9] The relevant episodes of monetary policy are identified according to R&R's definition, using historical records of policy actions.[10] We try to limit the role for judgment in the selection of monetary policy by defining what "excessive" inflation is for the Bank of Israel. Since the authorities have declared an official target for the inflation rate since December 1991, we select monetary shocks as those episodes where the Bank of Israel has reacted to increases in the actual inflation level above the declared target, independently of the real developments in the economy.[11] Also, we distinguish among different episodes' intensity and duration, by using a measure of the Bank of Israel's perceptions of the real interest rate. Since episodes appear to be of different severity, and because of the limited number of shocks identified, we do not average results across different episodes. Dynamic forecasting analysis is then used to assess whether monetary policy has real effects, and to evaluate the relative importance of the different channels of monetary transmission.[12]

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[8] Despite the similarity with the methodology used in Romer and Romer (1989, 1990), differences arise in the variables considered, in the transformation used, and in the lag structure of the regressions.

[9] The sample selection is restricted by the presence of several structural shifts in the data before 1990, in correspondence with the high inflation episode, the financial liberalization reforms, and the period of large immigration flows.

[10] Monetary shocks are selected on the basis of what is reported in the Annual Reports and in the Recent Economic Developments bulletins of the Bank of Israel, and in the Recent Economic Developments reports of the IMF.

[11] Section II.A identifies the first shock in October 1991, while the inflation target was officially introduced in December 1991. Hence, our definition does not apply to the first episode. However, we think that there is little room for judgment errors in the interpretation of the authorities' intent for that particular episode. Inflation increased from 17.6 percent in April 1991 to 21.6 percent in August of the same year, while the inflation target was set at 14–15 percent just three months later.

[12] Throughout the empirical analysis we use seasonally adjusted data, when available. When they are not, a seasonal adjustment is performed according to a multiplicative ratio to moving average method.

A. The Identification of the Monetary Shocks in Israel

Episodes of monetary policy that should be isolated take place when the authorities react to "excessive" inflation, relative to the declared inflation target. In other words, monetary shocks are selected when the inflation target becomes a more important concern than the growth performance, so that the monetary authorities deliberately take steps to reduce the overheating. In order to select the date of the shock we focus on the Bank of Israel's main instrument, the discount rate. Three shocks are identified.

October 1991

The period from January 1990 to April 1991 was characterized by a downward trend in nominal interest rates, as a consequence of the long-term decrease in inflation and of the Bank of Israel's goal of supporting a recovery in investment. Despite the low interest rates, the decline in world interest rates resulted in capital inflows to Israel that brought the exchange rate close to the appreciated limit. In March 1991 the midpoint of the band was unexpectedly devalued. This generated fears of future devaluations, raised doubts in the market about the credibility of the exchange rate system, and fostered speculative action. Beginning in October 1991, after inflation had risen from 17.6 percent in April 1991 to 21.6 percent in August of the same year, the Bank of Israel started increasing the interest rate to signal the authorities' commitment to the exchange rate system and to the inflation objective. This was particularly important, given that the authorities were going to introduce an upward sloping band and an official inflation target in December 1991. The slope was to be set at 9 percent, and the inflation target at 14–15 percent. Hence, the central bank increased the discount rate from 14.3 percent in September, to 21 percent in October, and to 22.4 percent in November 1991. The monetary restriction was steep but short. The discount rate fell to 14.2 percent already in December and remained around 11 percent until the end of 1992.

September 1994

In the second half of 1993, the slowdown of economic activity and of the monthly inflation rates generated a view in the market that a step-reduction in the inflation level, similar to the one observed the preceding year, was being achieved. The decision by the Israeli authorities to set the inflation target for 1994 at 8 percent, from 10 percent in 1993, and to reduce the slope of the exchange rate band from 8 percent to 6 percent, was a sign of the ongoing optimism. As a consequence, the Bank of Israel lowered the short-term interest rate from 12 percent to 9 percent. However, a rise in the price of vegetables from April 1994, and an increase in overall demand caused a rapid acceleration of the inflation rate, which remained around 14 percent until the end of 1994. Against this high inflation rate, fears of further acceleration in the future, and a background of surging demand, the central bank increased its discount rate in September, October, and December by 1.5 percentage points each time.

May 1996

The budget deficit exceeded the target set by the authorities in 1995, reversing the previously declining trend in the ratio of debt to GDP. Following the pressure on domestic demand, the annual inflation level rose from 8.1 percent at the end of 1995 to 12.9 percent in July 1996, against an inflation target set at 8–11 percent in 1995 and 8–10 percent in 1996. Against this acceleration in price growth and inflationary expectations, and against the expansionary fiscal policy, the Bank of Israel implemented a contractionary policy, raising the nominal interest rate by 0.8 percentage point in May, by 0.7 percentage point in June and by 1.5 percentage points in July 1996.

As noted above, R&R's identification procedure does not distinguish among different degrees of monetary tightening, or among different shocks' duration. This might be misleading when comparing the effects of each shock. In order to capture the duration and the intensity of monetary restriction, we use a measure of the real interest rate that reflects the authorities' perception of inflationary expectations. The Bank of Israel uses a market-based measure of inflationary expectations, which is built from prices of CPI-indexed and unindexed bonds of 12-months maturity. Also, the central bank often argues that movements in nominal interest rates affect inflationary expectations, and thus activity, only when they are sizable, or when the expected real interest rate approaches 5 percent. Hence, we represent the severity of each episode by the area below the ex-ante real interest rate, calculated as the discount rate minus market based inflationary expectations.

Figure 1 shows the discount rate and the real ex-ante interest rate, where vertical lines are drawn at the starting date of each shock. Figure 2 plots the area below the ex-ante real interest rate over 11 months following the monetary shock,[13] confirming that the 1991 episode was overall less severe than the successive two. The rise in the real interest rate was initially sharp, but it fell immediately afterwards. It seems that the contractionary shock reflected more a reaction to the speculative attack, and the aim of signaling commitment to the exchange rate regime, rather than a strong anti-inflationary attempt. On the contrary, the 1994 and 1996 episodes were of similar nature and intensity, although it should be kept in mind that the 1996 shock lasted beyond the end of the available sample.

B. Effects on Real Activity

To isolate the real effects of monetary policy, we examine how aggregate industrial production deviates from its "normal" behavior after each monetary shock. Since the effect on aggregate output might result from different behavior in particular sectors, we also analyze the response of production for selected industrial sectors. We use growth rates to account for nonstationarity of the series.

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[13] The comparison is carried over 11 months, since the sample ends 11 months after the shock of May 1996.

The "normal" behavior, or the path that the growth of industrial production would have followed in the absence of a monetary shock, is built in the following way. First, a univariate equation that includes a constant, a trend, and 18 lags of the growth in industrial production is estimated over the entire sample:

$$g_{j,t}=\alpha+\beta\ t+\sum_{i=1}^{18}\ \gamma_i\ g_{j,t-i}+\epsilon_t\ . \qquad (1)$$

Here t is the trend, g is the monthly percentage change in the industrial production index, and j is alternatively aggregate industry or each single industrial sector.[14] The idea is that, over a long horizon, the effects of positive and negative monetary and fiscal shocks cancel out, so that the estimated equation approximate the "normal" behavior of the growth of production. The resulting estimates are then used to build in-sample dynamic forecasts g^f for the growth rate of the industrial production index, for 18 periods after the beginning of the monetary shock. At each time t, the forecast error is given by the difference between the actual and forecasted values of the growth rate, or between the actual value and what the value would have been in the absence of a monetary shock. Therefore, the forecast error can be interpreted as the effect of the monetary shock at that particular period. The overall effect of monetary tightening up to period t is obtained by cumulating all the forecast errors from the date of the monetary shock up to time t,

$$CFE_t^{g_j}=\sum_{i=1}^{t}\ (g_{j,t}-g_{j,t}^f)\ . \qquad (2)$$

Since these are cumulative forecast errors for growth rates, their values give the percentage deviation of the output level from its forecast, t periods after the monetary shock.

There are two possible difficulties with this methodology. The first arises from the changes Israel underwent over the period considered, as described in Section II. On one hand, the shift from exchange rate targeting to inflation targeting could be seen as a regime shift, leading to a change in the authorities' monetary rule. On the other hand, the process of financial liberalization and the increased exchanged rate flexibility might have caused instability in the data generating process for output,[15] as described by equation (1).

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[14] Throughout the econometric analysis it is checked that the inclusion of 18 lags in the regressions is sufficient to eliminate residual correlation.

[15] Recursive estimation of the "normal" path could account for instability of the coefficients. Nonetheless, the relatively short sample would result in poor estimates, particularly over the first years of the sample.

The second difficulty comes from the presence of large exogenous shocks over the period of interest, such as immigration, the peace process, and the behavior of fiscal policy. This would not be a problem for the estimation of equation (1) over a long horizon, since positive and negative shocks would cancel out. However, this is no longer true when the period is short and the shocks are asymmetric. In such a case, when a positive exogenous shock coincides with a restrictive monetary shock, univariate analysis might underestimate the impact of monetary policy on real activity. The shocks could in principle be included in equation (1) by building adequate dummies. In the case of Israel, however, data are at best available on a quarterly basis, and disaggregation into a monthly frequency would be arbitrary. Moreover, the presence of exogenous shocks does not always alter the measurement of the real effects of monetary policy. For instance, despite massive immigration flows were experienced in late 1980s and in the early 1990s, their effects were transmitted to output through a higher rate of capital accumulation, which persisted throughout most of the analyzed sample. The methodology, by first identifying the monetary shock and then computing the deviation of output from trend, is such that an upward shift in the trend does not affect the results. Nonetheless, developments of the peace process exerted a large impact on investment and output in 1994, and fiscal policy was expansionary from 1994 to 1996. Since the positive effect on output due to these events was large and temporary, the forecast errors computed after the 1994 shock might underestimate the real effects exerted by that monetary restraint.

C. The Transmission Mechanism

We analyze the relative importance of the interest rate channel, the bank lending channel, and the exchange rate channel, by quantifying the initial steps of each transmission channel. In order to do so, we compute the changes induced by each monetary shock in key variables, and we relate them to those predicted by the theory. The aim of the analysis is not to conclude that the transmission of monetary policy in Israel is best characterized by a certain channel rather than another. First of all, channels other than those considered in this paper might be active. Second, the channels analyzed are not exclusive; some channels might be important over a certain period but not over others, because of structural changes in the economy. Finally, available data do not allow a complete description of each channel, so that no definite conclusions can be drawn.

In order to assess the role of each channel, we use dynamic forecasting analysis to see how changes in the policy instrument—the discount rate—translate into deviations of key variables from their "normal" behavior, after each tightening episode. The variables considered are real money balances,[15] total credit to the public through the banking system, the domestic and foreign currency components of credit, the nominal exchange rate, the real effective exchange rate, and the trade deficit.

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[15] Real balances are built as the ratio between M1 and the consumer price index.

For the nominal and the real effective exchange rate (Figure 3), data are used in percentage change, so that cumulative forecast errors are built in a similar way as for the growth of production. The "normal" behavior is estimated using the following autoregressive specification

$$e_t=\alpha+\sum_{i=1}^{18} \gamma_i \, e_{t-i}+\epsilon_t \quad , \qquad (3)$$

where e is alternatively the percentage change in the nominal and in the real effective exchange rate. Then, in-sample dynamic forecasts are calculated and forecast errors are computed as the difference between actual and forecasted values of the percentage change. Cumulative forecast errors are given by:

$$CFE_t^{\,e}=\sum_{i=1}^{t} (e_t-e_t^f) \; . \qquad (4)$$

The procedure followed to analyze the behavior of the other variables of interest—M1, total credit to the public through the banking system, the domestic and foreign currency components of credit (Figure 4), and the trade deficit—is slightly different. All these variables are likely to be affected by changes in monetary policy. However, as noted by Romer and Romer (1990), cumulative errors obtained from simple auto-regressive processes cannot separate the cyclical behavior of each variable from the effect of the monetary shock. For instance, after a monetary contraction, money might fall simply as the result of a cyclical downturn. In order to distinguish changes in nominal aggregates induced by monetary shocks from changes induced by output fluctuations, we use two different methodologies.

The first methodology is similar to the one used to analyze the behavior of industrial production. The "normal" path is estimated on the basis of a simple univariate forecasting equation, where t is a trend, and X_t denotes in turn real money balances, total credit to the public through the banking system, its domestic and foreign currency components, and the trade deficit:[16]

$$\Delta \ln X_t=\alpha+\beta \; t+\sum_{i=1}^{18} \gamma_i \, \Delta \ln X_{t-i}+\epsilon_t \; . \qquad (5)$$

We call this Regression I. Forecast errors at each period are given by the difference between the actual and the forecasted difference of the log variable. At each time t, the overall effect of

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[16] Data on trade deficit exclude ships, aircraft and diamonds.

monetary tightening on X is obtained by cumulating the forecast errors from the date of the monetary shock up to t,

$$CFE_t^X=\sum_{i=1}^{t} (\Delta \ln X_t-\Delta^f \ln X_t) . \qquad (6)$$

Since we cumulate the first difference in log values, CFE_t^X gives the percentage deviation of the variable X from its usual behavior, t periods after the beginning of the shock.

The second methodology adjusts for the possible cyclical behavior of the variable X. The "normal" path is now obtained by considering that X_t reacts not only to its own values, but also to output movements. Hence we estimate an equation where the difference in log X_t depends upon a constant, a trend, 18 own lags, and six leads and lags of the difference in the total industrial production index Y_t:

$$\Delta \ln X_t=\alpha+\beta\ t+\sum_{i=1}^{18} \gamma_i \Delta \ln X_{t-i}+\sum_{i=-6}^{6} \Delta\ lnY_{t-i}+\epsilon_t . \qquad (7)$$

We call this Regression II. Leads are added to account for the possibility that X_t reacts to expected movements in output. On the basis of the estimates obtained, we conduct the usual dynamic forecasting exercise[17] and calculate new forecasts (denoted with the superscript f^*). The resulting forecast errors represent the effect of monetary policy on the variable, beyond the effect on it of output movements. Cumulative forecast errors are given by

$$CFE_t^{X^*}=\sum_{i=1}^{t} (\Delta \ln X_t-\Delta^{f^*}\ln X_t) , \qquad (8)$$

and they can be interpreted as the percentage deviation of X_t from what one would expect, given a stable money-output relation and given the effective movements in output. For instance, a negative deviation of real money balances from its forecast values implies that monetary policy affected money beyond the changes caused by movements in production, and that the interest rate channel is an active transmission mechanism in Israel.[18]

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[17] Dynamic forecasts are run for 18 periods after the first two shocks, and for 11 periods after the last shock. The shorter horizon of the last forecast is due to the fact that the last episode is identified in May 1996, and data are available only until April 1997.

[18] Notice that one should pay attention to both Regressions I and II. Regression I suffers from the limitations of univariate models, where it is assumed that a variable can completely be explained by its own past. The advantage of Regression II is that, by including output, one can draw conclusions on which movements in the variables of interest are only due to the monetary shock. However, a problem of endogeneity might arise in the estimation of equation (7), if output in turn reacts to movements in X_t. Therefore results from Regressions I and II should be interpreted in relation to each other.

IV. Does Monetary Policy Have Real Effects in Israel?

Having identified three episodes of restrictive monetary policy aimed at reducing excessive inflation, we now ask whether these actions affected real activity in Israel. Figure 5 shows the log of seasonally adjusted aggregate industrial production.[19] Visual inspection of the plot is not sufficient to detect a sustained slowdown of output growth after the selected contractionary episodes, except after the shock of May 1996. However, the behavior of overall industry might hide different patterns at a sectoral level, given that effects of opposite signs could cancel out. For instance, sectors that are open to trade are likely to be affected by monetary policy through the exchange rate channel, while sectors closed to trade are more likely to be affected through the interest rate or the credit channel. If these channels have a different relative importance as transmission mechanisms, sectoral output would display different reactions to monetary policy.

To test this hypothesis, we build an index of relative exposure to foreign trade for the six industrial sectors with the highest weight in the aggregate industrial production index. The two rows in Table 1 report each sector's weight and index of exposure, as in 1993.[20]

Figures 6 and 7 plot the log of industrial production by sectors, seasonally adjusted, where sectors are grouped in relation to their exposure to trade. Figure 6 shows industrial sectors that are more dependent on domestic demand, while Figure 7 shows those more open to trade. No definite conclusion can be drawn from a casual inspection, but it seems that each group follows a similar behavior after the episodes of monetary policy. The first group shows a slowdown in production relative to trend after the first shock, an acceleration after the second, and a slowdown again after the third. However, the second group shows an oscillating behavior after the first shock, a slight slowdown after the second, and a strong slowdown after the third. The next two sections present formal tests to verify the graphical impression.

A. The Aggregate Industrial Sector

To distinguish between the cyclical downturns in real activity and those induced by a change in monetary policy, we estimate a univariate forecasting equation for the percentage change of the index of aggregate industrial production, according to equation (1). The first three

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[19] Monthly data are available from the Central Bureau of Statistics for the aggregate industrial production index and for each industrial sector's production index.

[20] The index of exposure is calculated as the end of period ratio of each sector's exports to its production. Gross exports by sector are found in the Central Bureau of Statistics. Since data for industrial production are only available as indices, we calculate sectoral output in 1993 by using data from the Statistical Abstract for 1996. Output is given by the average annual product per employee in each sector, multiplied by the months' average number of employees in the same sector.

columns of Table 2 show the cumulative forecast errors. The analysis reveals a deviation of production from its usual behavior after every shock. Over the period considered, however, there seems to have been no stable relation between restrictive monetary policy and real activity. While industrial output growth is on average lower than what it would otherwise have been after the 1991 and 1996 shocks, it is positive after the 1994 episode.

There are two, possibly complementary, explanations for the different behavior after September 1994. One is simply that Israeli monetary policy does not affect output in a systematic way. Another explanation is that restrictive monetary policy reduces production, but that the 1994 episode was characterized by simultaneous positive exogenous shocks to domestic demand. If the positive and negative shocks hit the economy at approximately the same time, then monetary policy might have exerted a more contractionary—or a less expansionary—effect than implied by the cumulative forecasts. As argued in Section II, in 1994 Israel experienced a confidence shock as a consequence of the agreement with the Palestinians, and a sharp increase in domestic deficit as a consequence of an expansionary fiscal policy. Hence, the effects of the monetary restraint on output might not be apparent, because of these counteracting events. This explanation finds support in the visual impression derived from Figures 6 and 7, and from the cumulative forecast errors—reported below—obtained for each industrial sector. Those sectors that are more dependent on domestic demand show an increase in output after the 1994 shock, while those more dependent on world demand show the expected decrease in output.

Even neglecting the 1994 episode, the maximum effect of monetary policy on industrial production appears to be relatively small in Israel. Over seven different episodes of monetary contraction in the United States, Romer and Romer estimate an average largest departure of -14 percent,[21] with the smallest maximum effect in a single episode of -8 percent and the largest of -21 percent. In Israel, the maximum negative effect found is -3.7 percent. While three episodes are not enough to draw general conclusions, a lower absolute value of the departure from normal behavior is consistent with the nature of small open economy of Israel and with the limited room left to the monetary authorities for moving interest rates. In order to verify how robust are the results from this dynamic forecasting analysis, we carry out two exercises. In the first, we ask how the results would change by modifying the specification of the univariate forecasting equation. Hence, we calculate the cumulative forecast errors for the change in the aggregate production index including only 12 lags in equation (1). In the second exercise, we ask how the results would change by identifying the starting date of each shock one month before the actual peak in the discount rate. In fact, if the reaction of output is immediate, setting the starting date when the discount rate has already increased might understate the estimated effects. Results from both exercises are compared to the original results in Table 3, suggesting that the analysis is robust to changes in the dynamic specification and to slight changes in the selection criterion of the shocks' starting date.

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[21] In the text, forecast errors are converted to percent by multiplying the figures reported in the tables by 100.

B. Sectoral Estimates

The remaining columns of Table 2 report the cumulative forecast errors obtained for the percentage change in four sectoral production indices.

The first is *food, tobacco and beverages*, which accounts for 12.7 percent of total industrial production and whose proxy for the ratio of exports to output is 11 percent, the lowest among the four sectors. The effects of monetary policy are very similar to those observed for the industrial sector as a whole, though they are more pronounced. The maximum departure after the first two shocks is -8.5 percent, against -3.3 percent for aggregate production, and the average departure is more pronounced over the first 12 months. After the second and third shock maximum effects are 7.2 percent and -6.6 percent, compared with 6.4 percent and -3.8 percent for aggregate production. The difference is particularly high over the last episode, when the sectoral peak is -6.6 percent against -3.7 percent for aggregate production.

The second sector reported in Table 2 is *basic metal and metal products*, which accounts for 10.4 percent of industrial production and whose proxy for trade openness is also relatively low, 14.6 percent. The effects of monetary policy are very close to the ones obtained for food, tobacco and beverages except for the first episode, when the effects on production remain on average slightly positive for 11 months and then turn negative. Peak departures in the last two episodes are 9.3 percent and -6.9 percent.

The third sector is *chemical, its products and petroleum*, whose weight in industry is 9.9 percent and whose proxy for openness is 52.2 percent. The picture is rather different here. Monetary policy exerts a big negative effect almost immediately, and after each of the three shocks. Moreover, the departure of output from its usual behavior closely reflects movements in the real effective exchange rate, shown in Figure 3. The peak effect following the first shock is -7 percent after four months, reflecting the instantaneous appreciation of the real exchange rate, although the departure from trend becomes positive when competitiveness starts increasing again in April 1992. The second shock is followed by a negative effect on output, the peak being -11 percent after 13 months, in correspondence with a strong deterioration in competitiveness. The departure after the 1996 episode is also stronger than for the other sectors, reaching -11.6 percent after 11 months. Here not only does monetary policy seem to operate through the exchange rate channel, but also the reaction of sectoral output seems to be immediate.

Forecast errors for the *high technology* sector[22] are reported in the last column. The relative weight is 22.4 percent and its proxy for openness is 58.3 percent. The estimated effects of monetary policy are on average more negative than for sectors closed to trade, but to a minor

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[22] The sector aggregates communication, control, medical and scientific equipment, and electronic components, office machines and computers.

extent compared with the chemical sector. This might be due to the fact that prices in this sector are usually quoted in dollars, and that output has a higher value added and a lower wage share than in other sectors open to trade. This might partially insulate the high technology segment from the exchange rate channel. The departure of output from its usual behavior, in fact, tends to fluctuate around zero. Following the 1991 shock, the maximum effect is −3.7 after 9 months. The second episode reaches a peak of 9 percent after 18 months, but until then deviations from trend fluctuate around zero with a maximum of 3–4 percent. The effects after the 1996 shock again are small and fluctuate around zero.

V. The Interest Rate Channel

According to the traditional "money view", the monetary authorities use the liquidity in the system to control the interest rate and therefore to stimulate investment and other components of the aggregate demand. A restrictive monetary policy reduces deposits and the overall liquidity of the system through a decrease in reserve requirements, therefore inducing a rise in the nominal interest rate to restore market equilibrium. If prices are sticky, the real interest rate increases as well and the private sector money balances fall in real terms, so that the cost of borrowing rises, spending is cut and output falls.

Although reserve requirements were an important instrument of monetary policy in Israel until the 1980s, one of the goals of financial liberalization has been to reduce them to international levels, and at present they average around 4 percent. Therefore, over the last decade there has been limited room for an active use of the reserve requirement in the conduct of monetary policy. The main instrument, nowadays, is the interest rate on the central bank's monetary loans to commercial banks. Commercial banks borrow from the central bank in order to fulfill the reserve requirements, at a rate which is set at an auction and which is strongly influenced by the official discount window rate. When the discount rate and the interest rate on monetary loans are increased, the commercial banks' lending and borrowing rates rise almost immediately, and sometimes even in advance, leading to a reduction in the overall liquidity of the system. When there are price rigidities, a restrictive monetary policy translates into an increase in real interest rates and into a decrease of the real quantity of money in the economy. Therefore, the interest rate channel might work in Israel through a reduction in spending, due to the private sector's lower real money balances, or through a reduction in investment, due to an increase in the real cost of borrowing.

We provide evidence on the relevance of the interest rate channel by asking whether monetary shocks reduce deposits and the overall liquidity of the system, in real terms, through increases in the discount rate. Since the monetary aggregate for which there is a stable demand in Israel is M1, we study the dynamic response of real money balances, measured as the ratio of M1 to the consumer price index, after the three shocks.[23]

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[23] Seasonally unadjusted monthly data are available from the International Financial Statistics until November 1996, and from the Monthly Bulletin of Statistics thereafter.

We initially estimate a univariate forecasting equation for the change in log, according to Regression I. The results are shown in the first set of columns in Table 4. Only the second episode seems to induce a drastic reduction in money growth over the entire sample, with a peak effect of -13.3 percent after 7 months. Over the first and third episode, the change in log money falls below its usual behavior only for about 7 months, and to a lesser extent.

In order to account for the cyclical behavior of money, we estimate a money-output relation as in Regression II, and then perform the usual dynamic forecasting exercise. Cumulative forecast errors represent the deviation of money from what one would expect, beyond the changes induced by movements in production, and therefore indicate whether the interest rate channel is active. The effect of monetary policy on money confirms the picture drawn from Regression I. The effect is persistently negative after the second shock. Also, departures from the usual path are on average larger in absolute value. Having accounted for the increase in output experienced in 1994, the effect of the monetary restriction appears more severe. The departure from the usual behavior remains negative throughout the simulation period, with a peak effect of -16 percent after 7 months. After the third episode, departures of real money balances from trend are very small, and only become negative after 3 months. The behavior of real money balances after the 1991 episode changes when we control for cyclical movements in output. Departures from trend become positive, although they remain relatively small. One explanation for this unexpected behavior is that the first monetary restraint was felt by the private sector as a reaction to a speculative attack. Expected real interest rates rose sharply but briefly (as shown in Figure 2), not sufficiently to induce a shift in the private sector's portfolio composition.

A second issue in the analysis of the interest rate channel is whether monetary shocks increase the real cost of investment. In order to answer this question, one would need to quantify the effect of changes in short-term nominal interest rates on short-term expected real interest rates first, and on the long-term real yields afterwards. As argued above, inflationary expectations in Israel are not easily affected by changes in the official discount rate, and they only decrease when short-term expected real interest rate approach 5 percent. Figure 2 shows that increases in official rates bring about increases in short-term expected real interest rates. Determining the effect on the long-term yield curve, which is what matters for investment, is more difficult. As Klein (1997) argues, this analysis for the Israeli case would require considering several factors, like the size of the government's budget deficit, the maturity structure of public debt, its domestic and foreign currency composition, the degree of capital openness, and the fact that government bonds with long-term maturity are linked both to the cost of living and to the exchange rate. Bufman, Leiderman, and Sokoler (1995) provide empirical evidence on the change induced by a movement in the Israeli monetary auction rate on the slope of the term structure of interest rates, defined as the difference between 12 months and 1 month yields to maturity. Their estimates suggest that an increase in the official rate decreases the term structure slope, meaning that the yields of medium-term government bonds rise more and faster than the yields of long-term bonds.

To sum up, there is not a strong evidence supporting the first stages of monetary transmission, as described by the interest rate channel. On one hand, monetary shocks do not always reduce the private sector's real money holdings. The only episode that induced a substantial reduction in real money was one where a severe monetary restriction was used to counteract an expansionary fiscal policy and a positive confidence shock, resulting in an overall increase in output. On the other hand, it seems that changes in official rates immediately translate into changes in nominal and real short-term market interest rates. However, the effect of these changes on the overall yield curve is more ambiguous and certainly weaker, so that the final effect on the cost of investing is not clear. This conclusion is confirmed by the sectoral estimates presented in Section IV.B. Those estimates showed that in sectors relatively close to trade and exposed to domestic demand (and therefore exposed to the interest rate channel) monetary restraints exert low effects on output.

VI. The Bank Lending Channel

According to the "credit view," monetary policy affects not only interest rates, but also the external finance premium.[24] This is defined as the wedge between the cost of raising funds externally, by issuing equities or debt, and the opportunity cost of raising them internally, by retaining earnings. A contractionary monetary policy that raises interest rates will also tend to raise the external finance premium, or to lower the agents' ability to borrow, to an extent that depends upon the imperfections in the credit markets. Hence, monetary policy can exert an additional effect, independent from the effect described by the "money view", on the overall cost of borrowing and thus on real spending.

There are two possible ways in which monetary policy can affect this premium.

(i) The balance sheet channel, according to which the lower the borrower's financial position and creditworthiness, the more acute is the principal-agent problem among lenders and borrowers, and the higher is the external finance premium. When the official rate is raised, borrowers' financial position deteriorates. This effect can be direct, through an increase in interest payments on short-term debt, or indirect, for instance through a fall in consumer spending that, for given fixed costs, lowers firms' revenues and reduces financial liquidity.

(ii) The bank lending channel, which is particularly relevant in countries where banks are the main source of intermediated credit. If monetary policy reduces total availability of credit from the banking sector, some borrowers might be refused bank loans and might incur costs in finding new lenders willing to establish long-term credit relationships. This translates into a rising finance premium, a lower ability to borrow, and a spending reduction.

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[24] See Blinder (1987), Bernanke and Gertler (1995), Bernanke and Blinder (1988), and Romer and Romer (1990) for a discussion of the "credit view."

In Israel, before 1987, commercial banks alone could raise deposits and supply credit to the private sector. However, the set of reforms undertaken in the early 1990s led to some financial liberalization. Institutional investors increased their portfolio of stocks, and started raising funds by issuing stocks and securities, which became an alternative to credit. Also, firms started to raise funds directly and, to a limited extent, to resort to credit from insurance companies and provident funds. Despite these developments, the new sector of institutional intermediation grew more in relation to the stock market and did not compete with the banking system in classical banking activities. Moreover, while the share of banking intermediation in total financial intermediation fell from 82.3 percent in 1990 to 74 percent in 1993, it rose again after the collapse of the stock market in 1994, reaching 79.1 percent in 1995. Given the dominance of the banking sector in the financial system, the bank lending channel might be important in the transmission of monetary policy. For this reason, and because measures of the balance sheet position of firms are not available with high frequency, in what follows we will only address the bank lending channel.

There are two ways by which the central bank can affect the supply of bank loans. The first is by raising reserve requirements. However, as argued above, the monetary authorities in Israel have not actively been using reserve requirements as a policy instrument during recent years. The second way is by conducting open market sales. In a closed economy, where banks cannot easily substitute deposits with other sources of credit, open market sales drain liquidity from the economy. Liberalization of the capital account has allowed inflows of foreign capital, and has enhanced funding with credit in foreign currency. Open market operations have then been used also for sterilizing capital inflows, and might not have fully translated into a lower supply of total credit from the banks.

Nevertheless, there are two reasons why the bank lending channel could be active even if one finds that monetary policy does not immediately affect the total amount of credit supplied to the private sector. First, as pointed out by Bernanke and Gertler (1995), credit aggregates have a countercyclical component, owing to the fact that households and firms might borrow even when the external finance premium is rising, because they wish to smooth the effect of business cycles. This implies that total credit might rise, even when borrowing conditions worsen because of a restrictive monetary policy. Second, the bank lending channel could be more important than what emerges from the reaction of total credit to monetary shocks, because of the movements in the domestic and foreign currency component of credit. Despite the progressive liberalization of the capital account, some asymmetries are still in place. For instance, reserve requirements on deposits in foreign currency are still higher than those in domestic currency. Therefore, a change in the ratio of credit in domestic currency to credit in foreign currency might cause a higher external finance premium even if the total amount of credit is unchanged. Figure 4 suggests that, particularly after 1995, a large change in that ratio has occurred.

We ascertain the presence of a bank lending channel by first asking whether in Israel monetary policy affects total credit to the private sector through the banking system.[25] To verify this, we regress the difference of log total credit according to Regression I. Then we account for the cyclical behavior of credit by estimating Regression II. Cumulative forecast errors are shown in Table 4. Regression I does not show a clear effect of monetary policy. After the first shock, the effect on total credit is positive for five months and then turns negative, with a peak of −5.7 percent after 15 months. After the second shock, the impact effect is again positive for 3 months, and then fluctuates around zero. In the last episode, the effect is very small in absolute value. The picture changes with the results from Regression II. When we account for output movements, the effect of monetary policy on credit is generally negative. In all three cases, the impact effect is slightly positive but soon becomes negative. Peaks are achieved toward the end of the simulation period in all cases, being respectively −7.4 and −7.3 after 15 months, and −1.6 after 4 months.

To see how the change in the ratio of credit in domestic currency to credit in foreign currency is related to shifts in monetary policy, we run Regressions I and II for the log change of credit in domestic and in foreign currency. The results are reported in Table 5. Regression I shows that monetary shocks, by raising the relative cost of funding in domestic currency, exert a strong negative effect on the domestic component of credit and a strong positive effect on the foreign component. Peak departures for credit in domestic currency after the first two shocks are, respectively, −10 percent and −2.9 percent. Credit in foreign currency, on the contrary, rises above trend after the first two episodes by a peak of, respectively, 21.4 percent, and 22.5 percent. The 1996 episode has a different behavior. Although departures are small, credit in domestic currency overall rises above its usual behavior, while credit in foreign currency oscillates around it. In general, the results from Regression II confirm the results obtained from Regression I. Departures from trend show a similar behavior but they are larger in absolute value, showing that both components of credit react to output fluctuations.

Although no general conclusion can be drawn from these results, the analysis suggests that the "credit view" might be relevant for Israel. First of all, the results show that monetary shocks induce a fall in the ratio of credit in domestic currency to credit in foreign currency, which might cause an increase in the external finance premium. Second, monetary policy seems to exert an effect on the total supply of credit from the banking sector. Third, the impact effect of each shock on total credit is slightly positive, which provides support to the countercyclical argument that credit rises immediately after shocks owing to smoothing actions. Finally, the effect is very small at the beginning of the forecasting period, but becomes large at the end, suggesting that the credit response to monetary impulses might be slow. This latter point might provide a further explanation for the positive effect of the second shock on aggregate production. Figure 4 shows an upwards jump in total credit relative to trend from late 1993

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[25] Monthly data are available from the Bank of Israel for total credit to the private sector through the banking system, and for credit to the public through the banking system in domestic and in foreign currency.

to late 1994. If credit reacts countercyclically, and if the response is slow, then the rise in total credit to the public could provide an additional explanation for the positive reaction of output to the 1994 episode.

VII. THE EXCHANGE RATE CHANNEL

The exchange rate is a certainly crucial component for the determination of prices in Israel. One reason is that many industrial sectors are heavily dependent on tradable goods, whose prices reflect movements in the nominal exchange rate. Another reason is that some of the nontradable goods that enter the CPI index, particularly houses, are priced in U.S. dollars. In 1996, exports and imports in goods and services accounted respectively for 31 percent and 47 percent of GDP.[26] This suggests that the exchange rate channel may also be an important mechanism through which monetary policy affects real activity.

In a country with fixed exchange rates the exchange rate channel is not active, because domestic interest rates adjust in such a way as to leave the exchange rate unchanged. In a country with fully flexible rates, the transmission of interest rate movements to the exchange rate and to activity in the tradable goods sector is highest. Although in the long run the exchange rate is determined by factors such as purchasing power parity, its short-run behavior is the result of the asset market equilibrium. When domestic real interest rates rise after a monetary contraction, deposits in domestic currency and credit in foreign currency become more attractive, inducing an appreciation of the exchange rate, reducing net exports, and lowering domestic output.

The presence of an independent exchange rate channel is controversial. Friedman (1980) denies a role of the exchange rate in the transmission of monetary policy, arguing that monetary policy affects output and prices through changes in asset portfolios and in investment decisions; movements in the exchange rates are only a consequence of these effects on output and prices, either domestically or abroad. Even if one is ready to accept the existence of an exchange rate channel, as described by the asset theory of the exchange rate, the issue arises whether this latter is independent from the interest rate channel. In fact, it could be argued that the capital inflows that generate a worsening of the terms of trade and a reduction of net exports are induced by the same increased differential in domestic and foreign interest rates that generates lower investment.

Nonetheless, an independent exchange rate channel might exist in Israel, because of the double goal of targeting inflation and of keeping the exchange rate within the band. When real interest rates rise after a restrictive monetary action, foreign capital starts flowing into the country. If the exchange rate approaches the appreciated limit of the band, the central bank must intervene. Moreover, inflation targeting requires that the increased quantity of money is sterilized. The resulting lower share of credit in domestic currency reduces the domestic

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[26] Source: International Financial Statistics, National Accounts.

component of the total average cost of credit, increasing the size of the interest rate change necessary to attain a certain inflation target. This effect occurs independently from the effects described by the interest rate channel, and it might explain the difficulty the authorities have had in reducing inflation in recent years. The real interest rate plotted in Figure 1 confirms that monetary policy was overall more restrictive since late 1994, rather than before. Nevertheless, the policy mix of high interest rates and sterilization did not translate into a large drop in inflation in the period under review. One possible explanation is that the tight monetary policy was counteracted by a relaxation on the fiscal side. Another explanation is that sterilization, by reducing the domestic currency component of the monetary base, increased the size of the interest rate change necessary to attain a certain inflation reduction.

In what follows, we focus our attention on the asset-theory view of the exchange rate channel. However, it should be noted that inflation targeting and the presence of an exchange rate band in Israel may affect the traditional exchange rate channel in two ways. On one hand, inflation targeting may amplify the effects of the exchange rate channel. If a monetary tightening induces an inflow of foreign capital through higher interest rates, the central bank must sterilize the excess liquidity in order to attain the announced inflation target. To the extent that sterilization feeds back into higher domestic interest rates and in higher capital inflows, the effects described by the exchange rate channel are amplified. On the other hand, a policy of intra-marginal intervention may neutralize the effects that monetary policy exerts on real activity through the exchange rate. If the central bank's intra-marginal intervention is able to reduce the effects of higher interest rates on the nominal *and* the real exchange rate, then the real effects transmitted through the exchange rate channel are smaller.

Table 6 reports cumulative forecast errors for the percentage change of the nominal and real effective exchange rate,[27] calculated according to Regression I. In all three episodes, the nominal exchange rate appreciates compared with the forecast, supporting the first step described by the exchange rate channel. After the first shock, the exchange rate falls substantially below trend for a few months, with a peak effect of -6.3 percent after 3 months. Thereafter, the negative effects decrease, and turn into positive deviations after one year. This behavior is consistent with the change in the ex-ante real interest rate and in the differential between domestic and foreign interest rates after the first shock. The effect following the second episode is deeper and more persistent, reaching a maximum of -8 percent after 10 months. The more severe monetary restriction, reflected in a high real interest rate differential, and the large capital inflow reaching the country are part of the reason. Finally, the third shock has both a smaller and less persistent effect, owing to the closer position of the

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[27]Monthly data are available from the International Financial Statistics for the nominal and the real exchange rate, and from the Central Bureau of Statistics for the trade balance (excluding ships, aircraft and diamonds).

exchange rate to the appreciated limit of the band and to a higher degree of central bank intervention.[28] The deviation reaches -3.9 percent after 4 months and then returns to zero.

Cumulative forecast errors for the change in the real effective exchange rate show that this latter does not always follow movements in the nominal exchange rate. In particular, it seems that nominal appreciation induces real appreciation only when monetary policy is severe, or when the induced increase in ex-ante real interest rates is high enough. The effect of the first monetary shock, which was shorter and overall less severe, is a permanent depreciation. Departures are low at the beginning of the period, but smoothly increase reaching a peak of 9.4 percent after 16 periods. After the second shock, the real exchange rate on average appreciates relative to its usual behavior. Departures are negative for five months, although the effect over the rest of the forecasting period oscillates around zero. Finally, the last shock results in a clear appreciation relative to what it would have otherwise been.

The availability of monthly data on the trade deficit (excluding ships, aircraft and diamonds), allows to go one step further and see how movements in the exchange rate translate into movements in one of the output components. Results are reported in the last two columns of Table 6.[29] Consider first Regression I. The effect of a monetary shock on the trade deficit is not clear. While the trade deficit fluctuates around its normal values after the first shock, it increases substantially above them after the second, and falls below after the third. However, exports and imports also depend on output, through domestic demand. Hence, the trade deficit might increase above trend in the second episode because domestic demand increased, lowering exports and raising imports. The effects resulting from Regression II are in fact different. The first shock seems to lower the trade deficit below trend. This reflects the real exchange rate depreciation experienced after 1991. The departure of the trade deficit after the second shock is positive, though to a lower extent than in Regression I. Finally, when the reduction in output experienced in late 1996 is considered, the departure of the trade deficit becomes positive 4 months after the shock.

Overall, evidence seems to support the exchange rate channel, as described by the asset theory. Monetary shocks are always followed by an appreciation of the nominal exchange rate, although this only translates into a real appreciation after the last two episodes. There are two reasons for the unexpected real depreciation following the 1991 shock. The first is the lower intensity and duration of the first monetary restraint, which only induced a temporary

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[28] From the widening of the band in June 1995 until the subsequent band expansion in mid 1997, the central bank has sharply increased intra-marginal intervention, to counteract the appreciating trend of the nominal exchange rate. While foreign reserves were US$7.4 billion at the end of 1994, they became respectively US$8.7 billion, US$11 billion at the end of the following two years, and US$17 billion during the first half of 1997.

[29] Given the presence of an outlier in the 1993M7, we smooth the series with a moving average which covers three months and is centered on the current observation. X_t in equations (5) and (7) is the transformed series.

nominal appreciation. The second is that in 1991 foreign exchange regulation was preventing from a full adjustment of portfolios composition to the interest rate differential. The limited amount of capital inflow might partially explain the different behavior of the real effective exchange rate. The trade deficit closely reflects movements in the real exchange rate. In fact, it raises above its usual values after the last two monetary shocks, in correspondence with an appreciation of the real exchange rate, and falls below after the 1991 shock. Again, the results are in line with the sectoral estimates presented in Section IV.B. Those estimates showed that, in sectors relatively open to international trade and exposed to the exchange rate channel, monetary restraints exert higher effects on output than in sectors close to trade.

VIII. CONCLUSIONS

The paper addresses two issues regarding the functioning of monetary policy in Israel since 1990.

The first issue is *whether the openness of the Israeli financial market and the current exchange rate system leave enough room for monetary policy to exert real effects.* The results indicate that:

1. Industrial production deviates from its usual behavior after every shock examined. However, while production growth is on average lower than what it would otherwise have been after the 1991 and 1996 shocks, it is positive after the 1994 episode. One plausible explanation for the behavior of output after the 1994 shock is that Israel was hit by two simultaneous exogenous shocks to domestic demand. The first was a positive confidence shock that resulted from the newly achieved agreement with the Palestinians; the second was a sharp increase in domestic deficit that resulted from a relaxation in fiscal policy. Hence, the effects of the second monetary restraint on output might be understated, because of these counteracting events.

2. Overall, the quantitative impact of monetary shock on aggregate production is relatively small, particularly when compared with the results obtained in the literature for the United States. This is consistent with the nature of small open economy of Israel, and with the limited independence of monetary policy.

3. At a sectoral level, homogeneity is found across sectors open to trade and across domestically oriented sectors. In particular, open sectors suffer from monetary shocks to a larger extent than closed sectors. This is because the former are exposed to the effects of the exchange rate channel, in addition to those of the interest rate and credit channels. However, it seems that open sectors with high value added and with a low wage share are partially able to insulate themselves from the exchange rate channel.

The second issue concerns *what is the relative importance of three different transmission mechanisms of monetary policy*. The results can be summarized as follows.

1. There is not a strong evidence supporting the first stages of monetary transmission as described by the interest rate channel. On one hand, monetary shocks do not always reduce the private sector's real money holdings. On the other hand, it seems that changes in official rates immediately translate into changes in nominal and real short-term market interest rates. However, the effect of these changes on the overall yield curve is more ambiguous and certainly weaker, so that the final effect on the cost of investment is not clear.

2. The bank lending channel might be an important channel in Israel. Total credit to the public through the banking sector is found to decline substantially below output fluctuations in all three episodes. Moreover, the analysis suggests that credit in Israel has a countercyclical component, since it rises immediately after the monetary contraction, because agents attempt to smooth over the cycle. The fact that credit rises immediately but decreases permanently thereafter also suggests that the response of credit to monetary policy might be slow. The results also show that monetary shocks induce a fall in the ratio of credit in domestic currency to credit in foreign currency, possibly inducing an increase in the external finance premium.

3. The exchange rate channel also seems to be important. Monetary shocks are always followed by an appreciation of the nominal exchange rate, although this only translates into a real appreciation after the last two episodes. The real depreciation found after the first shock is partially explained by the lower intensity and duration of the 1991 monetary restraint, and by the presence of a restrictive foreign exchange regulation. Moreover, the behavior of the trade deficit is consistent with movements in the real exchange rate, as predicted by the theory. In fact, the trade deficit raises above its usual values after the last two episodes and falls below it after the first one.

Table 1. Main Industrial Sectors

Industrial sectors	Metals 1/	Chemicals 2/	Hi-tech 3/	Food 4/	Textiles 5/	Wood 6/
Weight in industrial production 7/	10.4	9.9	22.4	12.7	5.9	9.9
Proxy for trade openness 8/	14.6	52.2	58.3	11.0	33.3	5.3

Sources: Monthly Bulletin of Statistics (1997), and Statistical Abstract of Israel (1996).

1/ Basic metal and metal products.
2/ Chemicals and refined petroleum.
3/ Communication, control, medical and scientific equipment plus electronic components, office machines, and computers.
4/ Food and beverages.
5/ Textiles, clothes, and leather.
6/ Wood, furniture, paper, and printing.
7/ Weight in the total industrial production index, as in 1994.
8/ The proxy is given by each sector's exports as a percentage of its output.

Table 2. Cumulative Forecast Errors for Industrial Production, by Sectors 1/

Months after the shock	Total industry			Food			Metals			Chemicals			High-technology 2/		
	1991M10	1994M9	1996M5	1991M1	1994M9	1996M5	1991M1	1994M9	1996M5	1991M1	1994M9	1996M5	1991M10	1994M9	1996M5
1	0.013	-0.001	0.000	-0.010	-0.008	-0.024	0.037	0.010	0.010	-0.008	-0.037	0.006	-0.020	0.024	0.010
2	-0.015	-0.013	0.000	-0.059	-0.015	-0.043	-0.012	-0.002	-0.004	-0.067	-0.001	-0.030	-0.035	0.003	0.017
3	-0.003	0.008	-0.003	0.018	0.001	-0.030	-0.003	0.016	-0.027	-0.053	0.010	-0.047	-0.033	0.033	0.009
4	0.000	0.005	0.004	-0.019	0.003	-0.034	0.032	0.034	-0.007	-0.070	0.001	-0.047	0.028	0.000	0.017
5	-0.027	0.019	0.021	-0.024	0.004	-0.022	-0.005	0.032	-0.025	-0.013	-0.035	0.020	-0.008	0.019	0.019
6	0.000	0.008	-0.005	-0.020	0.019	-0.033	0.029	0.030	-0.027	-0.015	-0.061	-0.049	-0.027	0.003	0.020
7	-0.006	0.011	-0.037	-0.033	0.013	-0.060	0.041	0.032	-0.030	-0.011	-0.044	-0.053	-0.033	-0.002	-0.025
8	-0.013	0.030	-0.020	-0.013	0.072	-0.018	0.019	0.049	-0.055	0.029	-0.058	-0.052	-0.030	0.023	-0.019
9	-0.032	0.032	-0.033	-0.059	0.009	-0.016	0.000	0.079	-0.069	0.001	-0.050	-0.020	-0.037	0.011	-0.017
10	0.003	0.026	-0.030	-0.025	0.048	-0.066	0.037	0.036	-0.039	0.035	-0.031	-0.014	-0.010	0.013	-0.002
11	-0.033	0.013	-0.023	-0.085	0.044	-0.063	0.006	0.028	-0.026	-0.004	-0.008	-0.075	-0.035	-0.019	0.073
12	-0.011	0.041	-0.026	-0.006	0.050	-0.047	-0.007	0.093	-0.047	0.025	-0.012	-0.116	-0.031	0.041	-0.023
13	-0.015	0.011		0.010	0.040		-0.037	0.040		0.041	-0.110		-0.027	-0.001	
14	-0.004	0.019		0.013	0.023		-0.011	0.061		0.001	-0.003		-0.023	-0.010	
15	-0.012	0.021		-0.002	0.027		-0.010	0.051		0.067	0.035		0.007	-0.017	
16	-0.015	0.031		0.000	0.013		-0.044	0.020		0.092	0.032		0.007	0.029	
17	-0.004	0.016		0.022	0.020		-0.031	0.049		0.084	0.049		-0.020	-0.031	
18	-0.005	0.064		0.017	0.037		-0.011	0.061		-0.011	0.043		0.022	0.090	

1/ Cumulative deviation of the growth in the industrial production index from its forecasted level.

2/ The high-technology sector includes communication, control, medical and scientific equipment, and electronic components, office machines, and computers.

Table 3. Cumulative Forecast Errors for Aggregate Industrial Production 1/

Months after the shock	Aggregate industry								
	Equation (1)			Equation (1) with 12 lags only			Equation (1), the shocks start one month ahead		
	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M9	1994M8	1996M4
1	0.013	-0.001	0.000	-0.024	-0.008	0.011	-0.008	0.022	-0.017
2	-0.015	-0.013	0.000	-0.012	-0.020	0.006	0.013	0.006	-0.011
3	-0.003	0.008	-0.003	-0.003	0.008	-0.004	-0.014	-0.006	-0.012
4	0.000	0.005	0.004	-0.019	0.004	0.003	0.000	0.016	-0.018
5	-0.027	0.019	0.021	-0.025	0.014	0.025	0.003	0.015	-0.015
6	0.000	0.008	-0.005	-0.027	0.005	-0.006	-0.021	0.023	0.006
7	-0.006	0.011	-0.037	-0.074	0.011	-0.037	0.005	0.015	-0.024
8	-0.013	0.030	-0.020	-0.052	0.026	-0.018	0.000	0.018	-0.058
9	-0.032	0.032	-0.033	-0.040	0.027	-0.029	-0.007	0.040	-0.043
10	0.003	0.026	-0.030	-0.035	0.023	-0.025	-0.024	0.039	-0.056
11	-0.033	0.013	-0.023	-0.032	0.013	-0.017	0.011	0.035	-0.056
12	-0.011	0.041	-0.026	-0.034	0.039	-0.022	-0.025	0.025	-0.053
13	-0.015	0.011		-0.020	0.009		0.000	0.047	-0.056
14	-0.004	0.019		-0.022	0.017		-0.004	0.019	
15	-0.012	0.021		-0.031	0.015		0.011	0.025	
16	-0.015	0.031		-0.028	0.027		0.004	0.024	
17	-0.004	0.016		-0.015	0.014		0.002	0.033	
18	-0.005	0.064		-0.046	0.064		0.014	0.021	

1/ Cumulative deviation of percentage growth in the industrial production index from its forecasted level.

Table 4. Cumulative Forecast Errors 1/

Months after the shock	M1/CPI (regression I)			M1/CPI (regression II)			Total Credit to the Public (regression I)			Total Credit to the Public (regression II)		
	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5
1	0.038	-0.055	-0.018	0.040	-0.025	0.026	0.022	0.029	-0.001	0.027	0.020	0.005
2	-0.069	-0.072	-0.007	-0.032	-0.068	0.007	0.019	0.036	-0.009	0.032	0.020	-0.009
3	-0.020	-0.076	0.013	0.005	-0.074	0.019	0.005	0.013	0.001	0.005	-0.013	-0.012
4	-0.036	-0.089	-0.034	0.021	-0.087	-0.020	0.000	-0.022	-0.001	0.001	-0.062	-0.016
5	0.002	-0.094	-0.038	0.020	-0.113	-0.044	-0.003	-0.007	0.013	-0.007	-0.058	0.003
6	-0.012	-0.106	-0.035	0.035	-0.112	-0.011	-0.006	-0.002	0.011	-0.011	-0.051	0.000
7	-0.002	-0.133	-0.046	0.014	-0.160		-0.013	0.009	0.003	-0.008	-0.048	
8	0.037	-0.090	0.063	0.066	-0.106		-0.013	0.008	0.003	-0.010	-0.059	
9	0.031	-0.102	0.018	0.069	-0.129		-0.013	0.007	0.008	-0.004	-0.066	
10	0.002	-0.115	0.006	0.029	-0.123		-0.015	0.002	0.006	-0.012	-0.068	
11	-0.001	-0.090	-0.006	0.040	-0.096		-0.023	0.005	-0.011	-0.015	-0.063	
12	0.032	-0.078	0.037	0.046	-0.086		-0.025	0.003	-0.014	-0.026	-0.062	
13	0.007	-0.064		0.066	-0.055		-0.014	0.008		-0.017	-0.061	
14	0.067	-0.117		0.103	-0.076		0.010	0.018		-0.008	-0.059	
15	0.033	-0.063		0.053	-0.046		-0.057	-0.003		-0.074	-0.073	
16	0.060	-0.068		0.085	-0.058		-0.042	0.018		-0.056	-0.060	
17	0.012	-0.068		0.046	-0.045		-0.037	0.006		-0.046	-0.062	
18	0.007	-0.051		0.058	-0.050		-0.039	-0.012		-0.050	-0.071	

1/ Cumulative percentage deviation of actual from forecasted differences in log values.

Table 5. Cumulative Forecast Errors 1/

Months after the shock	Credit in domestic currency			Credit in domestic currency			Credit in foreign currency			Credit in foreign currency		
	(regression I)			(regression II)			(regression I)			(regression II)		
	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5
1	-0.001	0.041	0.010	0.016	0.027	0.011	0.123	-0.022	0.028	0.095	0.003	0.003
2	-0.010	0.043	-0.002	0.016	0.024	0.004	0.127	-0.004	0.004	0.125	0.041	-0.048
3	-0.018	0.026	0.007	-0.009	-0.003	0.004	0.098	-0.041	0.010	0.097	-0.003	-0.056
4	-0.032	-0.023	0.010	-0.017	-0.065	0.004	0.135	-0.046	-0.009	0.117	-0.005	-0.074
5	-0.047	-0.013	0.015	-0.035	-0.077	0.014	0.159	0.036	0.029	0.142	0.075	-0.045
6	-0.048	-0.010	0.013	-0.034	-0.084	0.005	0.175	0.113	0.040	0.146	0.149	-0.031
7	-0.061	-0.006	0.019	-0.024	-0.084		0.205	0.138	0.005	0.133	0.157	
8	-0.065	-0.010	0.029	-0.035	-0.100		0.200	0.152	-0.041	0.142	0.175	
9	-0.068	-0.011	0.031	-0.031	-0.114		0.196	0.201	-0.028	0.126	0.206	
10	-0.072	-0.012	0.018	-0.039	-0.118		0.212	0.168	-0.007	0.112	0.192	
11	-0.073	-0.017	-0.012	-0.039	-0.126		0.204	0.187	-0.006	0.104	0.230	
12	-0.079	-0.023	-0.023	-0.055	-0.130		0.212	0.202	-0.004	0.097	0.246	
13	-0.064	-0.015		-0.047	-0.124		0.214	0.193		0.093	0.240	
14	-0.031	-0.004		-0.045	-0.132		0.214	0.200		0.130	0.273	
15	-0.100	-0.029		-0.124	-0.149		0.199	0.225		0.136	0.266	
16	-0.075	-0.012		-0.102	-0.131		0.171	0.212		0.160	0.241	
17	-0.066	-0.026		-0.093	-0.145		0.125	0.219		0.149	0.265	
18	-0.057	-0.029		-0.094	-0.142		0.097	0.195		0.132	0.210	

1/ Cumulative percentage deviation of actual from forecasted differences in log values.

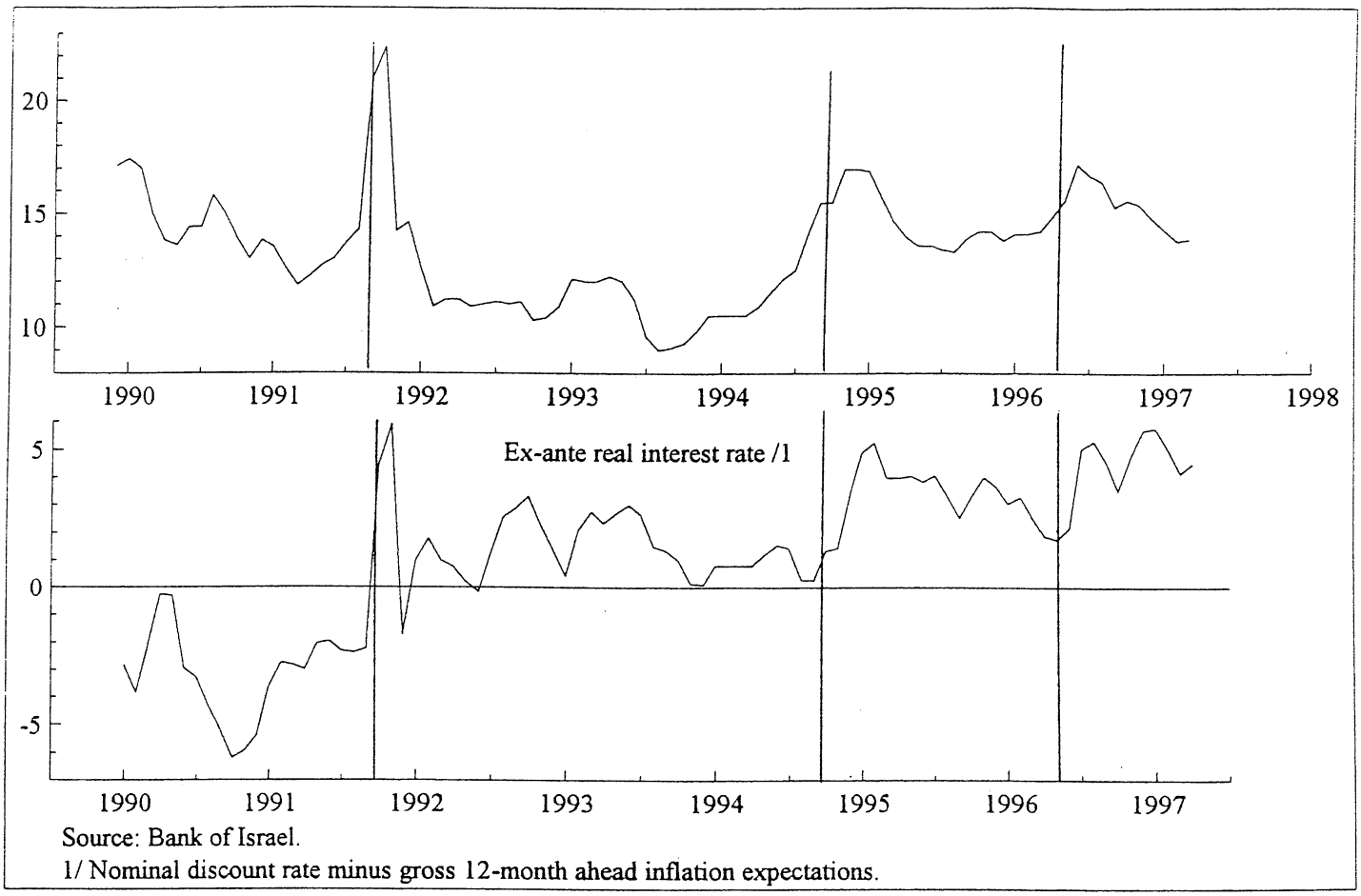
Table 6. Cumulative Forecast Errors

Months after the shock	Nominal exchange rate 1/ (SH/US$)			Real effective exchange rate 1/			Trade deficit excluding ships, aircraft, and diamonds 2/ (regression I)			Trade deficit excluding ships, aircraft, and diamonds 2/ (regression II)		
	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5	1991M10	1994M9	1996M5
1	-0.008	0.003	0.001	0.018	0.009	0.006	-0.020	0.003	0.006	0.012	-0.036	-0.014
2	-0.035	-0.002	-0.016	0.011	-0.010	-0.012	-0.047	0.073	-0.065	-0.010	0.035	-0.003
3	-0.063	-0.008	-0.030	0.005	-0.029	-0.037	-0.005	0.119	-0.111	-0.006	0.050	-0.028
4	-0.058	-0.023	-0.039	0.009	-0.027	-0.033	-0.027	0.206	-0.068	0.000	0.160	0.062
5	-0.037	-0.035	-0.023	0.009	-0.016	-0.033	0.056	0.328	-0.127	-0.130	0.194	0.064
6	-0.027	-0.040	-0.012	0.013	0.002	-0.027	-0.054	0.278	-0.111	0.012	0.154	0.061
7	-0.027	-0.051	-0.019	0.017	0.015	-0.016	0.004	0.301	-0.201	-0.091	0.128	
8	-0.022	-0.062	-0.027	0.040	0.021	-0.031	-0.029	0.266	-0.205	-0.027	0.131	
9	-0.020	-0.056	-0.017	0.057	0.016	-0.055	0.004	0.231	-0.262	-0.083	0.060	
10	-0.020	-0.080	-0.011	0.075	0.007	-0.079	-0.030	0.296	-0.222	-0.032	0.097	
11	-0.037	-0.071	-0.007	0.089	0.000	-0.086	0.019	0.247	-0.239	-0.028	0.067	
12	-0.038	-0.058	0.001	0.090	-0.013	-0.075	0.018	0.329	-0.191	-0.020	0.178	
13	-0.003	-0.079		0.088	-0.009		0.079	0.356		-0.061	0.212	
14	0.047	-0.073		0.088	-0.004		-0.010	0.391		0.003	0.195	
15	0.068	-0.066		0.087	0.007		0.034	0.444		-0.087	0.238	
16	0.066	-0.053		0.094	-0.009		-0.112	0.402		-0.018	0.223	
17	0.070	-0.058		0.082	-0.027		-0.043	0.461		-0.186	0.259	
18	0.053	-0.074		0.081	-0.040		-0.061	0.420		-0.098	0.245	

1/ Cumulative deviation of percentage growth in the exchange rate from its forecasted level. A negative sign indicates an appreciation of the exchange rate relative to its "normal" behaviour.

2/ Cumulative percentage deviation of actual from forecasted differences in log values.

Figure 1. Discount Rate



Source: Bank of Israel.

1/ Nominal discount rate minus gross 12-month ahead inflation expectations.

Figure 2. Expected Real Interest Rate

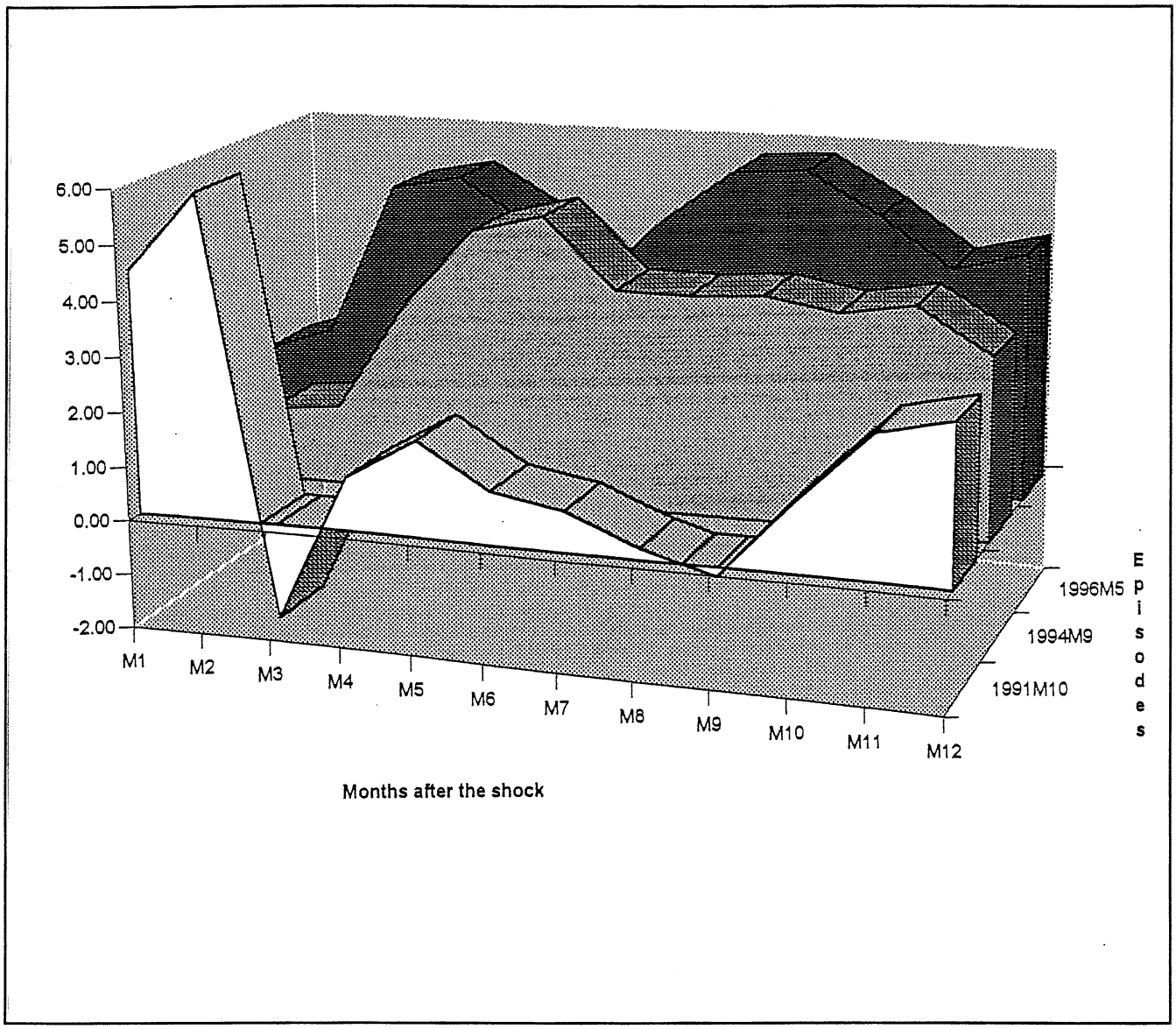


Figure 3. Nominal and Real Effective Exchange Rates

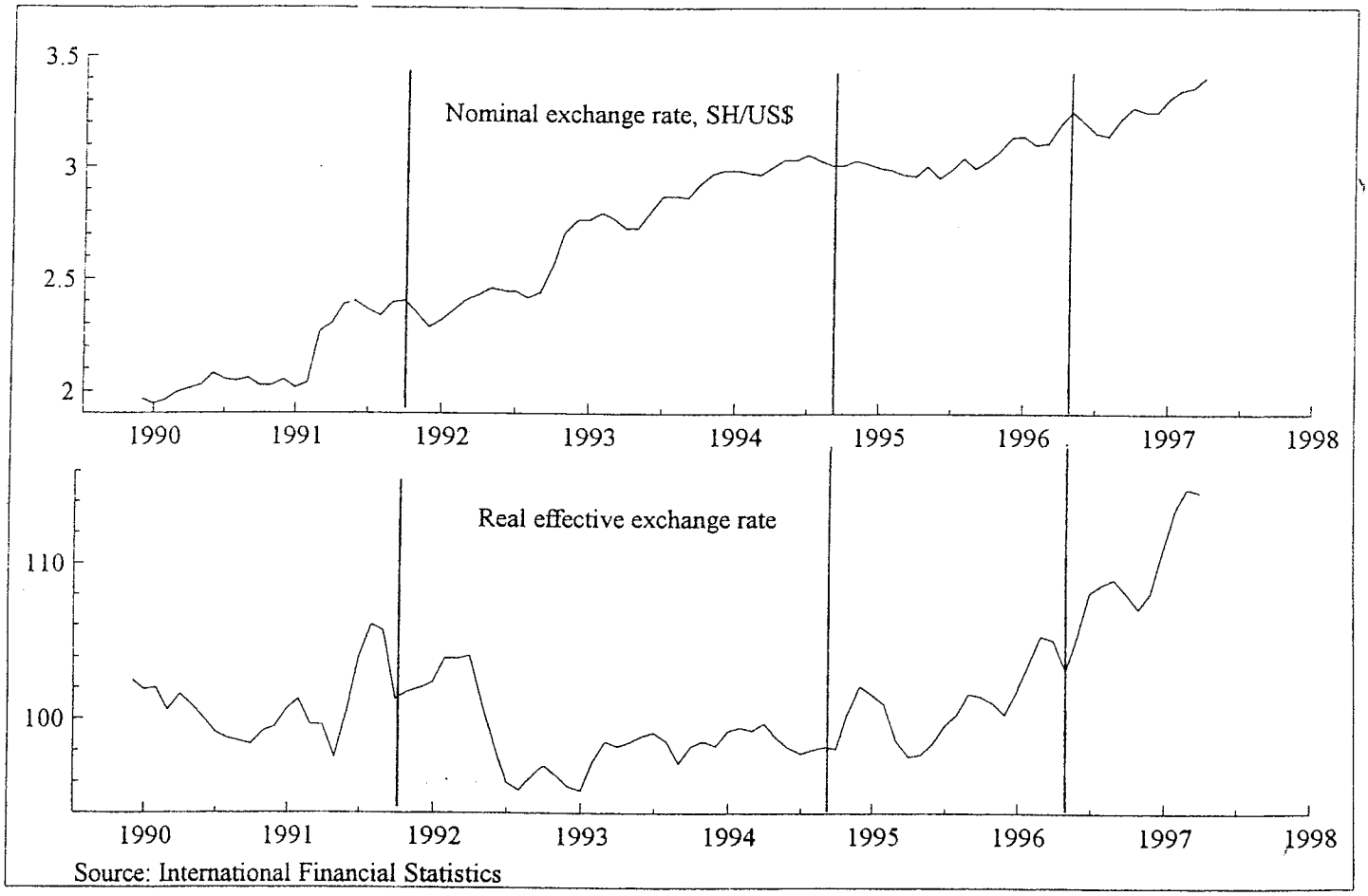


Figure 4. Log of Credit

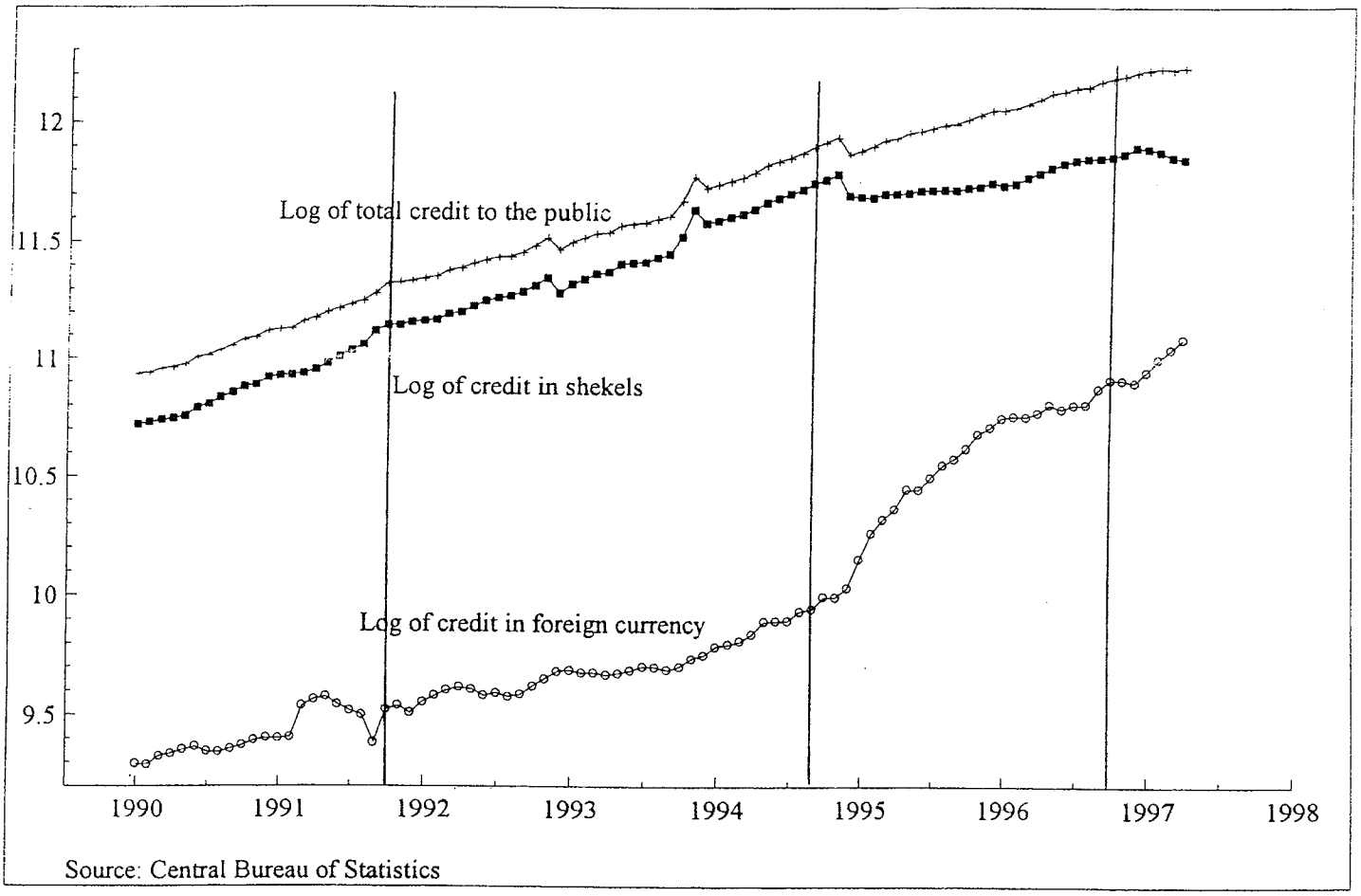
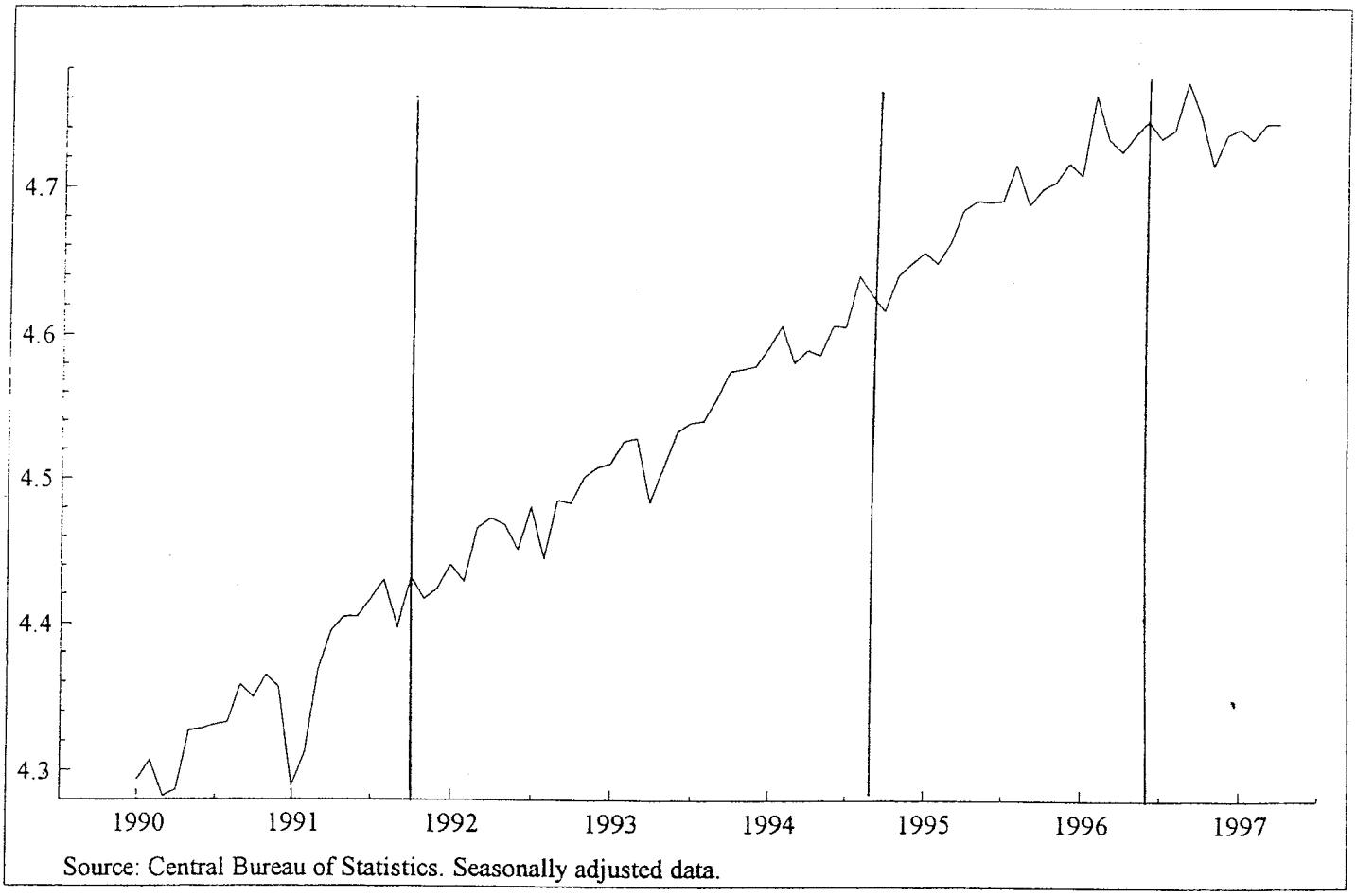
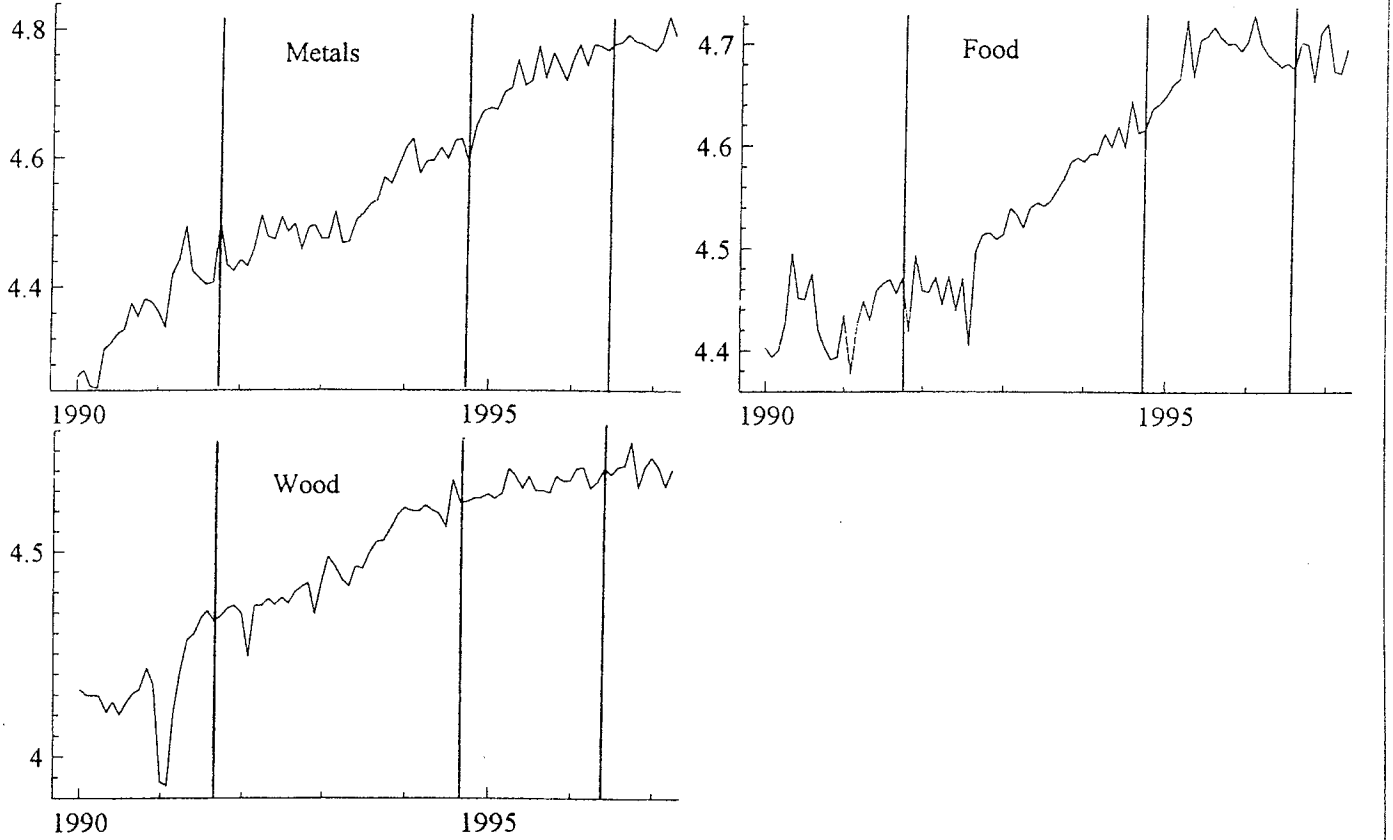


Figure 5. Log of Industrial Production Index



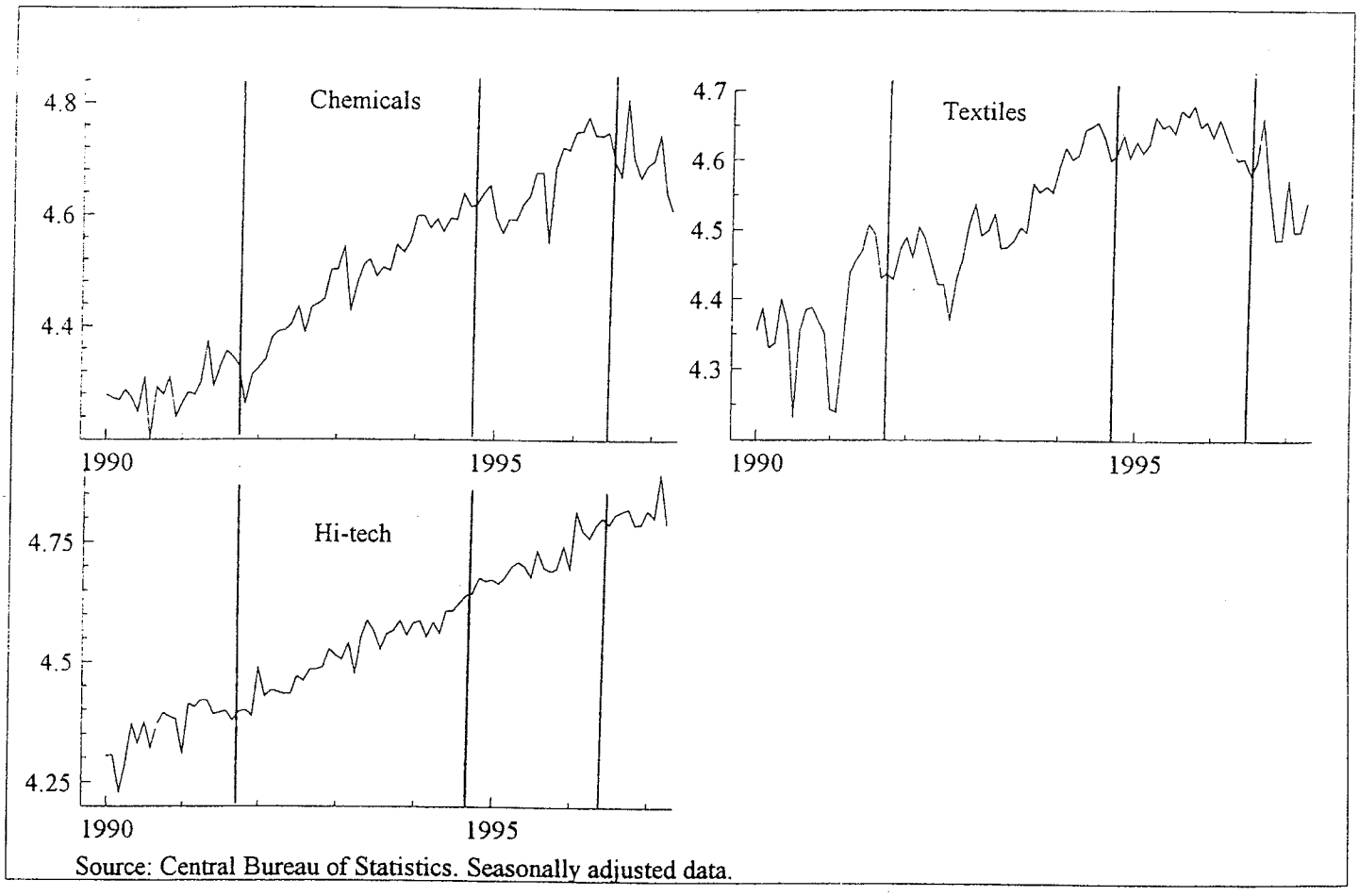
Source: Central Bureau of Statistics. Seasonally adjusted data.

Figure 6. Log of Industrial Production Index, by Sector



Source: Central Bureau of Statistics. Seasonally adjusted data.

Figure 7. Log of Industrial Production Index, by Sector



Source: Central Bureau of Statistics. Seasonally adjusted data.

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