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**The Long Road from Adjustable Peg to Flexible  
Exchange Rate Regimes  
The Case of Israel**

David Elkayam\*

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# **The Long Road from Adjustable Peg to Flexible Exchange Rate Regimes: The Case of Israel<sup>1</sup>**

David Elkayam<sup>2</sup>

## **Summary**

The stabilization of the exchange rate of the shekel against the dollar was a cornerstone of the program for the stabilization of the Israeli economy, adopted in mid-1985. The program led to a drop in the inflation rate from 400 percent during 1984 and at the beginning of 1985 to a level of between 16 and 21 percent during the years 1986-1991. From the onset of the stabilization program and until 1994, policy-makers related to the exchange rate as a key price anchor, while the interest rate served to moderate capital movements.

When the program was launched, it was initially hoped that stabilizing the exchange rate would lower inflation to Western levels and that it would be possible to maintain a fixed exchange rate over time. However, the inflation rate continued to be relatively high and with time, a cumulative real appreciation necessitated exchange rate adjustments. At first, a policy of discreet devaluation was implemented, while a stable exchange rate was maintained between the devaluations. This policy and the liberalization of the money and foreign currency markets during the 1990's led to repeated waves of speculative capital movements, which eventually necessitated an increase in the flexibility of the exchange rate. The process of transition from a fixed exchange rate regime, with occasional devaluations, to a floating exchange rate lasted from 1989 to mid-1997. One reason why the process of increasing exchange rate flexibility was so protracted, was that such a transition required a conceptual change regarding the exchange rate's role as an anchor for the general level of prices. However, the increase in exchange rate flexibility, in itself, appears to have been an inevitable measure resulting from the liberalization of the foreign currency market and the development of high-tech industry, which was reflected *inter alia* by large equity issues abroad from the mid-1990s.

Due to the continuation of double-digit inflation during the years 1986 to 1991 and the upsurge in speculative capital movements, at the beginning of 1992 the Bank of Israel moved to an exchange rate regime that may be described as an upwardly sloping target zone (or crawling band).

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<sup>2</sup> I would like to thank Meir Sokoler and Akiva Offenbacher for their helpful comments. I would also like to thank Eyal Argov and Alex Ilek for their help in processing the data.

The aim was to ensure, as far as possible, that the exchange rate itself would rise along the slope. Concurrently, the Bank of Israel began to announce inflation targets. The objective was to gradually reduce the gradient of the slope and the inflation target with it. In 1994, actual inflation greatly exceeded its targeted level, leading to an assessment that the exchange rate could no longer serve as the sole anchor for prices.

From the last quarter of 1994, the Bank of Israel began to use the interest rate as a tool for attaining the inflation targets. Over time and in several stages, the limits of the exchange rate band were expanded, with the intention of moving to a mobile exchange rate regime. At the beginning of 1996, the Bank of Israel announced that it would no longer intervene in the foreign currency market, unless the exchange rate were to approach the limits of the diagonal band. Since mid-1997, except for several days at the beginning of 1998, the Bank of Israel has refrained completely from intervening in foreign currency trading. The exchange rate has been determined by market forces, and the interest rate has served as the only tool for attaining the inflation target.

Experience in Israel indicates that the stabilization of the exchange rate made a substantial contribution to halting the process of hyperinflation. Yet the attempts to manage the exchange rate over time as a means of anchoring prices were unsuccessful. In a small economy that is open to capital movements, it is very difficult to manage the exchange rate and the public is well aware of this difficulty. In fact, the gradual reduction in the inflation rate during the 1990's and the convergence of this rate in recent years to a level similar to that prevailing in the industrialized countries, was achieved despite (or due to) the increased flexibility of the exchange rate and the move to full mobility since 1997.

It should be noted that on the basis of the findings that will be presented below, the increased flexibility of the exchange rate did not appear to have the effect of reducing the extent of the pass-through from the exchange rate to prices. Moreover, the correlation between the pace of depreciation and inflation increased when the exchange rate became more flexible. In other words, changes in prices became more closely correlated with changes in the exchange rate. Concurrently, the sensitivity of the exchange rate to interest rate adjustments also increased. Accordingly, exchange rate mobility enhanced the effectiveness of the interest rate as a tool for the achievement of price stability. But at the same time, exchange rate and price volatility increased, although the volatility in the exchange rate of the shekel (against the currency basket or the dollar) has not exceeded that in the exchange rates of the pound sterling, the euro and the yen (against the dollar). In addition, the rapid expansion of the derivatives markets in Israel during recent years has enabled the private sector to hedge against exchange rate fluctuations.

## **Contents**

- 1. Introduction - The move from an exchange rate target to an inflation target.**
- 2. The exchange rate regime since the 1985 stabilization program.**
  - 2.1 The stable exchange rate regime with discrete devaluations – 1986 to 1988.**
  - 2.2 The horizontal band limited mobility regime – 1989 to 1991.**
  - 2.3 The diagonal band limited mobility regime - 1992 to 1997.**
  - 2.4 The full mobility regime - from mid-1997.**
- 3. Impact on inflation of changes in the exchange rate regime and interest rate policy.**
  - 3.1 Impact of increased exchange rate flexibility on the extent of the pass-through from the exchange rate to prices.**
  - 3.2 Impact of changes in the exchange rate regime and monetary policy on the nature of the relationship between depreciation, inflation, inflation expectations and the interest rate.**
- 4. Main elements of the liberalization of the foreign currency market.**
- 5. Conclusions and discussion.**

## **1. Introduction - The move from an exchange rate target to an inflation target**

The stabilization of the exchange rate of the shekel against the dollar was a cornerstone of Israel's economic stabilization program (ESP), adopted in mid-1985, that led to a drop in the inflation rate from 400 percent during 1984 and at the beginning of 1985, to a range between 16 and 21 percent during the years 1986-1991. From the onset of the stabilization program and until 1994, policy-makers related to the exchange rate as a central anchor for prices while the interest rate served to moderate capital movements.

When the stabilization program was launched, it was initially hoped that the stabilization of the exchange rate would lower inflation to Western levels and that it would be possible to maintain a fixed exchange rate over time. Although the rate of price increase slowed greatly in comparison with the rate prevailing before the stabilization program, it remained at a double-digit figure and over time a cumulative real appreciation had the effect of slowing economic activity, making exchange rate adjustments necessary. At first, the Bank of Israel chose to adopt a policy of occasional discrete devaluations, retaining a fixed rate between the devaluations.

This policy led to a number of problems. The need for occasional adjustments in the exchange rate implied a major weakening of the exchange rate's ability to serve as a price anchor. Another difficulty was that unexpected discreet devaluations led to the creation of speculative capital movements, which eventually dictated a devaluation even when this was not planned in advance (see the next section for more details).

In order to moderate capital movements, a gradual, if not always consistent, increase in exchange rate flexibility was initiated. At the beginning of 1989, the Bank of Israel initiated an horizontal target zone exchange rate regime, with the actual exchange rate permitted to rise or fall within limits of 3 percent in each direction from the announced midpoint rate. (Subsequently, the limits were expanded to 5 percent in each direction.) This system enabled the exchange rate to be determined mainly by market forces and occasionally, assuming an upturn trend in the exchange rate, to raise the midpoint rate without setting off an immediate actual devaluation. As explained in Section 2.2, this regime could have succeeded in easing the subsequent move to full mobility. However, unexpected devaluations, which necessitated a considerable rise in the actual exchange rate, led to a loss of confidence in the regime and to the onset of large-scale capital movements.

Against this background, at the beginning of 1992, the exchange rate regime was switched to an upward sloping target zone. A theoretical daily rate of increase in the midpoint rate was prescribed (conforming to an annual depreciation of 9 percent), while the actual rate was allowed to fluctuate within  $\pm 5$  percent of the midpoint rate. Concurrently, the Bank of Israel began to

announce inflation targets. At first the aim was to try to move the actual exchange rate as close as possible along the midpoint rate slope, after which the gradient of the slope would be gradually reduced and the inflation target with it. The intention therefore, was that the exchange rate would continue to serve as an anchor for prices, while the local currency rate of price increase was meant to be equal to the rate of increase in the exchange rate plus the price increase in the countries with which Israel trades. This regime was in fact a regression, relative to the previous regime, as regards the intention to increase the flexibility of the exchange rate. Indeed, as will be explained below, the new regime failed to solve the problem of capital movements. In 1994, actual inflation considerably exceeded its targeted level, supporting the assessment that the exchange rate cannot serve as the sole anchor for prices.

From the end of 1994, the Bank of Israel began to use the interest rate as a tool for attaining the inflation targets. Initially, the central bank continued to intervene in the foreign currency market in order to keep the exchange rate along the midpoint slope. The Bank of Israel thereby tried to use, in effect, two tools for holding down inflation, and a new difficulty emerged here. The monetary restraint (rise in the interest rate) that was adopted from the end of 1994 and other factors (see Section 2.3 for more details) led to substantial capital imports during the years 1995 and 1996. Capital imports pushed the exchange rate down towards the lower limit of the band of mobility, forcing the central bank to buy large amounts of foreign currency, and sterilize the derived increase in the money supply (in order to prevent a reduction in interest rates). In addition, the existence of a lower band of mobility prevented a substantial reduction in the exchange rate and a reduction in prices with it. Conditions were thereby created for a considerable decline in inflation, but the existence of the band of mobility prevented these forces from materializing. These developments compelled the central bank to increase the range of exchange rate mobility. The increase was enacted in several stages (see Section 2.3 for details). At the beginning of 1996, the Bank of Israel announced that it would no longer intervene in the foreign currency market unless the exchange rate were to approach the limits. In mid-1997, the limits of the band of mobility were expanded appreciably and except for a number of days at the beginning of 1998, the Bank of Israel completely ceased its intervention in foreign currency trading. Since then, the exchange rate has been determined by market forces, with the interest rate serving as the sole tool for the attainment of the inflation target.

During the years 1986 to 1991, the inflation rate in Israel ranged between 16 and 21 percent. During the years 1992 to 1996, inflation fell to 10 percent, apparently due to the combined impact of supply factors (the wave of immigration from the former Soviet Union), and the slow rate of increase in the exchange rate. Against the background of the severe monetary restraint practiced

during the years 1995 to 1996, the inflation rate fell to 3 percent<sup>3</sup> from mid-1997 (see Table 1 and 2). The fall in the rate of inflation, from 10 percent during the years 1992-1996 to 3 percent from mid-1997, appears to have resulted from the announcement of inflation targets, and from the use of the interest rate for attaining these targets. This assessment suggests that the interest rate is a more effective tool for dealing with inflation than the exchange rate. That is, the reaction of inflation expectations and actual inflation to interest rate adjustments, appears to be more rapid than their reaction to changes in the pace of depreciation. Moreover, flexibility of the exchange rate increases the effectiveness of monetary policy and shortens the period in which monetary restraint is necessary for reducing inflation. (See also the discussion in Section 3 below.)

This of course leads to the question of why a flexible exchange rate regime was not used earlier, if the interest rate is such an effective tool for countering inflation. We believe there are several reasons:

1. The concept prevailing in Israel and worldwide at the end of the 1980's and at the beginning of the 1990's (as reflected, for example, in the IMF's approach in its recommendations for the developing countries) was that in a small open economy, the exchange rate is the most effective anchor for prices. The issue of an inflation target and the use of the interest rate as a tool for the attainment of the inflation target only became accepted worldwide practice in the mid-1990s. Even then, many economists, including economists at the Bank of Israel, were highly skeptical of the effectiveness of the interest rate as a tool for the persistent dampening of inflation.
2. Any change in the parameters of the exchange rate regime in Israel requires government approval. Over the years, both the Treasury and the Bank of Israel feared that exchange rate mobility could increase the volatility of the real exchange rate and harm economic activity (see for example, Ben Bassat [1995]).
3. At the beginning of the 1990's, the foreign currency market and trading in it were not sufficiently developed to permit full mobility of the exchange rate. Such mobility was only possible after the liberalization of the foreign currency market was largely completed (that is, in mid-1997). (It could however be claimed that it might have been possible to speed up the liberalization process). The liberalization facilitated and speeded up the shift to exchange rate mobility, because such mobility led to increased exchange rate risk and

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<sup>3</sup> An examination of the monthly indexes shows that a new low level of inflation emerged from mid-1997. At first glance, this is difficult to discern due to the price increase in October and November 1998 following the large depreciation in October 1998.

thereby moderated the speculative capital imports that had increased as a result of the liberalization.

4. Market forces in fact compelled policy-makers to move to exchange rate mobility. The opening up of the economy to capital movements and the large growth in high-tech industry, which began to raise large amounts of capital abroad, required policy-makers to move to a regime that would make it possible to refrain from intervention in the foreign currency market.

**Table 1 - Inflation, Inflation Target, Depreciation and the Interest Rate, 1986-2002**

Year	Rate of change in prices <sup>4</sup> <b>dp</b>	Inflation target	Rate of change in exchange rate <sup>5</sup> <b>des</b>	Nominal interest rate <sup>6</sup> <b>I</b>	Inflation expectations <sup>7</sup> <b><math>\pi^e</math></b>	Real interest rate <sup>8</sup> <b><math>I - \pi^e</math></b>
1986	19.6		0.0	33.6		11.7
1987	16.1		14.2	31.0		12.4
1988	16.4		1.3	20.4	13.4	7.0
1989	20.7		19.7	14.7	14.0	0.7
1990	17.6		11.1	16.0	19.6	-3.6
1991	18.0		11.6	16.1	17.0	-0.9
1992	9.4	14-15	14.9	12.1	10.9	1.2
1993	11.2	10	8.0	11.4	9.1	2.3
1994	14.5	8	5.4	13.4	10.4	3.0
1995	8.1	8-11	5.8	15.6	10.6	5.0
1996	10.6	8-10	3.0	16.3	11.7	4.7
1997	7.0	7-10	3.7	14.7	9.1	5.6
1998	8.6	7-10	20.6	12.6	6.2	6.4
1999	1.3	4	-2.5	13.0	5.3	7.7
2000	0.0	3-4	-6.3	9.9	2.5	7.4
2001	1.4	2.5-3.5	3.7	7.2	1.6	5.2
2002	6.5	2-3	14.2	6.6	2.0	3.9

<sup>4</sup> Percentage change in consumer price index.

<sup>5</sup> Exchange rate of the shekel against the currency basket. Rate of change, December average compared with December average of previous year.

<sup>6</sup> Interest rate on Bank of Israel monetary tenders to the banks.

<sup>7</sup> Inflation expectations for a year ahead as derived from the capital market.

<sup>8</sup> For the years 1986 and 1987, the ex-post real interest rate; for the other years, the nominal interest rate minus inflation expectations.

**Table 2 - Inflation, Depreciation, the Interest Rate and Foreign Currency Conversions in Different Periods<sup>9</sup>**

<b>periods</b>	<b>Inflation (dep)</b>	<b>Depreciation (des)</b>	<b>Nominal interest rate (I)</b>	<b>Real interest rate (I - <math>\pi^e</math>)</b>	<b>Foreign currency conversions<sup>10</sup></b>
86.01 – 88.12	18.0 (12.3)	7.2 (27.9)	28.0 (7.4)	10.1	200 (272)
89.01 – 91.12	19.4 (13.3)	19.1 (47.1)	15.6 (8.5)	-2.4	288 (427)
92.01 – 97.06	10.9 (6.3)	7.8 (12.4)	13.9 (1.7)	3.5	326 (468)
97.07 – 2003.04	3.8 (8.3)	9.2 (38.4)	10.3 (1.5)	6.1	7 (0)

In Section 2 below, we will describe in greater detail the changes that occurred over the years in the exchange rate regime. As stated, these changes mainly consisted of a gradual increase in the flexibility of the exchange rate until full mobility was reached. In Section 3, we will examine the impact of the changes in the exchange rate regime on the pass-through from the exchange rate to prices, and on the nature of the relationship between the pace of depreciation, inflation, inflation expectations and the interest rate. In Section, 4, we will give a brief description of the main elements of the liberalization of the foreign currency market, that were implemented concurrent with the increase in exchange rate flexibility. Section 5 will be devoted to conclusions and discussion.

## **2. The development of the exchange rate regime since the 1985 stabilization program**

### **2.1 The stable exchange rate regime with discrete devaluations 1986 to 1988**

When the July 1985 economic stabilization program was implemented, the shekel was devalued by 18.8 percent against the dollar, and a decision was taken to stabilize the exchange rate at around

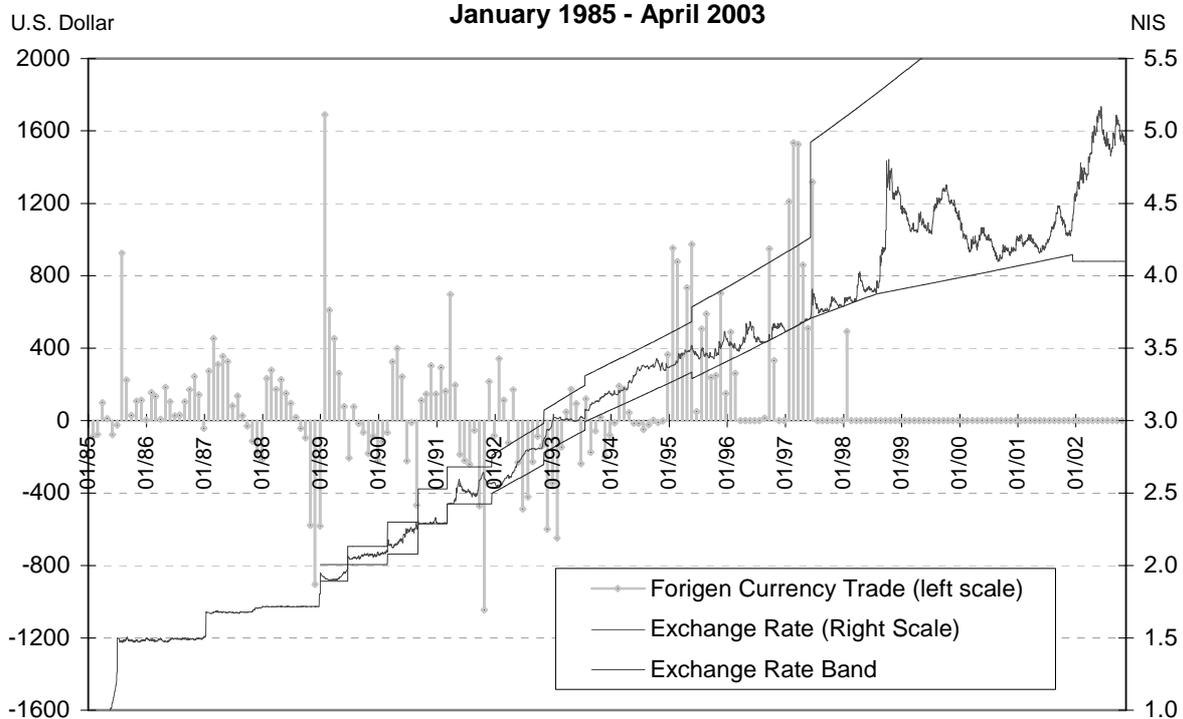
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<sup>9</sup> The numbers in parentheses are the standard deviations of the monthly data in the relevant periods. The standard deviations of the interest rate were calculated relative to the deviations from the trend that was calculated with the Hodrick Prescott method.

<sup>10</sup> At their absolute value. \$ million per month. The standard deviations were calculated on the monthly average of their normal values.

1,500 shekels to the dollar (1.5 new shekels to the dollar). In addition, fluctuations of up to 2 percent in each direction were permitted, although the subsequent fluctuations were much lower than this rate. The freeze in the exchange rate against the dollar was made conditional on future developments and it was announced that if wages in the economy were to rise excessively, the exchange rate would be adjusted as well. However, policy-makers hoped that the stabilization program would lead to price stability, and that it would be possible to maintain a stable exchange rate.

**Diagram 1:**  
**The NIS/Basket Exchange Rate<sup>1</sup> and Forigen Currency Trades<sup>2</sup>**  
**January 1985 - April 2003**



1. The Exchange Rate - Daily Data. Until July 1986 the NIS/Dollar Exchange Rate.  
 2. The Bank of Israel Foreign Currency Repurchase from the Public. Monthly Data.

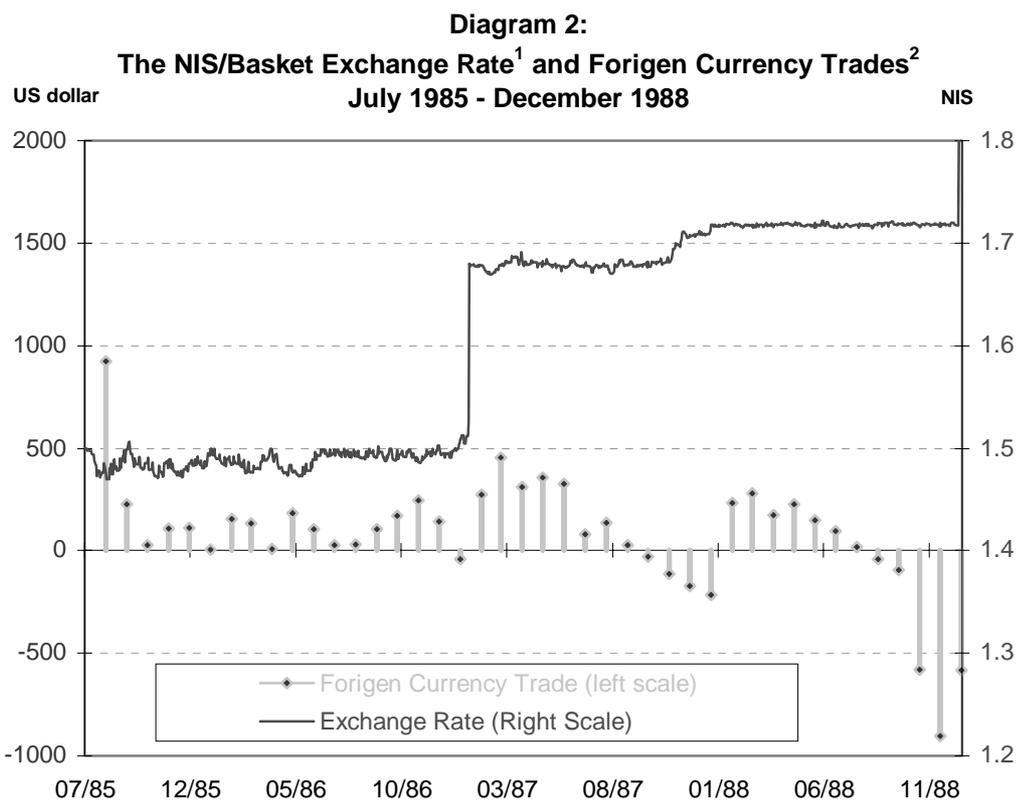
The shekel remained stable against the dollar until July 1986. During the period from July 1985 to July 1986, prices rose by 23.8 percent concurrent with a substantial weakening of the dollar against other currencies. These developments led to fears that indexation to the dollar, at a time when that currency was depreciating against other currencies, would be a source of inflationary pressures. As a result, in August 1986 a decision was taken to index the shekel to a basket of currencies, in accordance with the weighting of those currencies in Israel's foreign trade. In retrospect, it seems that the timing of this measure was unfortunate, because the depreciation of the dollar against the currency basket moderated the impact of the real appreciation (of the shekel

against the currency basket), and thereby moderated the erosion in the profitability of the tradable sector. It is reasonable to assume that were it not for the move to the currency basket, the subsequent erosion of the real exchange rate would have been less severe. The discreet devaluation in January 1987, which derived from fears of a loss of export competitiveness, could therefore have been postponed and reduced.

The move to the currency basket was made without a devaluation of the shekel, and from August 1986 to December 1986, the exchange rate against the basket remained stable. The period of exchange rate stability thereby lasted for 18 months, from August 1985 to December 1986. During that period, prices rose by 36 percent, far more than the 19 percent devaluation at the time the stabilization program was implemented. As a result of the stabilization of exchange rate, this development led to a substantial real appreciation of the shekel. The continued real appreciation, which was accompanied by a large increase in wages during 1986, led to fears of a contraction in non-financial activity and a deterioration in the balance of payments. Against this background, the exchange rate of the shekel (against the currency basket) was devalued for the first time, by 10 percent, in January 1987. (Daily data on the exchange rate and monthly data on the extent of foreign currency conversions during the relevant period are presented in Diagram 2.)

The devaluation of January 1987 took place even though it was not preceded by speculative purchases of foreign currency. This devaluation was therefore unexpected, and did not derive from any considerations inherent in the foreign currency market. This surprise development appears to have had a major impact on the future behavior of the public. From time to time, following a cumulative appreciation, devaluation expectations arose that largely dictated the subsequent devaluations.

During the last quarter of 1987, the exchange rate was gradually raised by 2.5 percent, implying a quiet and unannounced depreciation, and from the beginning of 1988 until the end of that year, the exchange rate against the basket remained stable. (From December 1986 to December 1988, prices rose by 13 percent relative to the exchange rate; see Table 1.) During the last quarter of 1988, devaluation expectations developed and the central bank had to sell large amounts of foreign currency to the public in order to protect the exchange rate. During the last days of 1988, a 5 percent devaluation was made in order to calm the foreign currency market. Policy-makers had apparently planned the devaluation for the beginning of 1989. The 5 percent devaluation was not planned and was actually dictated by the market. Several days later, a further devaluation of 8 percent was made and a change in the exchange rate regime was announced.



This policy of unexpected and discreet devaluations had several shortcomings. The need to adjust the exchange rate from time to time implied a serious decline in the exchange rate's effectiveness in serving as a price anchor. If prices increase for reasons unrelated to the exchange rate, due to a rise in wages for example, a real appreciation occurs. The adjustment of the exchange rate for the purpose of moderating a real appreciation implies monetary accommodation to the price increase or in other words, acquiescence with the price increase. The Bank of Israel was aware of this possibility, but appears to have hoped that with time it would be possible to reduce the extent of the devaluations, implying a partial accommodation, and thereby gradually reduce the inflation rate.

Another problem was that unexpected, discreet devaluations have the effect of generating speculative capital movements. These movements force the central bank to buy or sell large amounts of foreign currency. The ability to sell foreign currency is limited by the size of the central bank's foreign exchange reserves, with the public's demand increasing as the level of reserves decreases. Such a development necessitates a rise in the real interest rate, sometimes to an extent that seriously impairs non-financial activity. This means that the central bank has to devalue the exchange rate in order to stop purchases of foreign currency, and that means an erosion in the

effectiveness of the exchange rate's function as a price anchor. As it transpires therefore, a policy of discrete devaluations leads to capital movements that necessitate a rise in the interest rate, harm non-financial activity, and set off further devaluations and to a rise in prices. Another source of the increase in capital movements was the gradual liberalization of the money and foreign currency markets that began at the end of the 1980's and continued for most of the 1990's.

## **2.2 Limited mobility within horizontal band regime – 1989 to 1991**

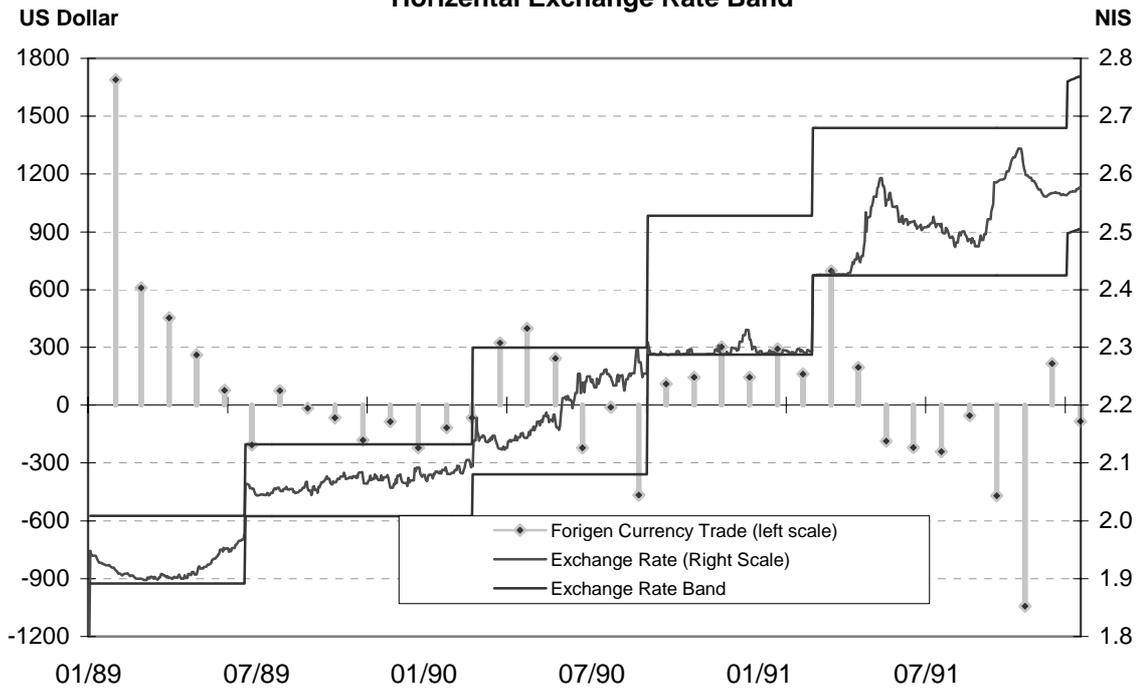
After the additional 8 percent devaluation at the beginning of January 1989, the regime was changed. A midpoint exchange rate was announced, and the exchange rate was permitted to move within a range of 3 percent above and below the midpoint rate - that is, a potential variation range of 6 percent was determined. The objective was to enable the exchange rate to respond to capital movements and thereby moderate these movements, to reduce the extent of the central bank's involvement in the foreign currency market, and to lighten the burden imposed on the interest rate as a tool for moderating capital movements. A horizontal midpoint rate was set, in the belief that if prices were to continue rising, the midpoint rate would be adjusted from time to time without necessarily leading to a concurrent devaluation.

During the first five months of 1989, the public converted foreign currency and the exchange rate fell close to the lower limit of the band of mobility (see Diagram 3). In June 1989, the foreign currency conversions ceased, the public began to purchase foreign currency and the Bank of Israel allowed the exchange rate to move up towards the midpoint rate. In June 1989, when the exchange rate reached the approximate level of the midpoint rate, the Bank of Israel raised the midpoint rate by 6 percent. Since the actual exchange rate was close to the midpoint rate, the actual exchange rate was also raised by 6 percent. This devaluation, which was unexpected and was not dictated by market forces, represented a clear deviation from the underlying concept of the new exchange rate regime that was announced at the beginning of 1989. The devaluation also conflicted with the concept of using the exchange rate as a price anchor.

This devaluation was made against the background of the recession prevailing in the economy at the time, and the desire for a real depreciation that would enhance export profitability. But such a depreciation could have been achieved gradually, by enabling the exchange rate to slowly rise above the midpoint rate, and by then raising the midpoint rate without changing the actual rate. Why was this not done? We believe that it was due to fears that the actual exchange rate would not rise; that is, that market forces were not supportive of a nominal depreciation, and in order to achieve a real depreciation the authorities decided to impose a nominal devaluation. It was

hoped that the recession in the economy would moderate the inflationary impact of the devaluation. In retrospect, it transpired that the cumulative devaluation of over 20 percent during 1989 did not lead to a real depreciation in that year<sup>11</sup>.

**Diagram 3:  
The NIS/Basket Exchange Rate<sup>1</sup> and Forigen Currency Trades<sup>2</sup>  
January 1989 - December 1991  
Horizontal Exchange Rate Band**



1. The Exchange Rate - Daily Data.
2. The Bank of Israel Forigen Currency Repurchase from the Public. Monthly Data.

From July 1989 to February 1990, the exchange rate gradually rose to slightly above the midpoint rate. At the end of February 1990, the midpoint rate was raised by 6 percent, with only moderate change in the actual exchange rate, and the range of mobility was increased from 3 to 5 percent. From March 1990 to September 1990, the exchange rate rose gradually from the lower limit to the upper limit of the band. In September 1990, the midpoint rate was raised by 10 percent without any major depreciation, and the exchange rate remained close to the lower limit of the band until March 1991. Overall, in the period from March 1990 to March 1991, capital movements were relatively stable, and the move to a regime of mobility within a specific range appeared to have succeeded.

<sup>11</sup> See page 7 of the Bank of Israel's Annual Report for 1989 (Hebrew).

However, another erroneous measure was taken in March 1991. The midpoint rate was increased by 6 percent, even though the exchange rate was close to the lower limit, and the period preceding this measure was characterized by conversions of foreign currency. That is, while market forces were exerting a stabilizing effect on the exchange rate and were actually leading to a decrease in the rate, the authorities chose to impose a 6 percent devaluation. This led to renewed speculative cycles in the last third of the year<sup>12</sup>. In September 1991, the public began to purchase large amounts of foreign currency. Unlike previous occasions, the Bank of Israel refrained from raising the range of mobility and instead, allowed the interest rate to rise considerably during September and October. The upturn in the interest rate eventually halted the purchases of foreign currency, and in November foreign currency conversions were actually recorded. Nevertheless, the exchange rate regime was changed again at the beginning of 1992.

The data in Tables 1 and 2 show that during the second period (of mobility within a limited range), the exchange rate depreciated more rapidly in comparison with the first period, and the standard deviation of the monthly depreciations also increased. (Disregarding the devaluation of January 1987, the standard deviation in the first period falls from 27.9 percent to 8 percent.) Despite the relative higher flexibility of the exchange rate during the second period, the Bank of Israel's intervention in the foreign currency market increased. The absolute value of foreign currency conversions rose from \$200 million to \$288 million a month, and the standard deviation of the conversions increased from \$272 million to \$468 million. (This was mainly due to the large conversions at the beginning of the period, and the large purchases at the end of the period.) The second period was also notable for a major relaxation of the monetary restraint that was apparent in the first period, and which was required in order to halt the inflationary process. The real interest rate on Bank of Israel sources fell from 10 percent in the first period to a negative interest rate of 2.4 percent in the second period. It should be noted that despite the faster pace of depreciation and the monetary expansion, the pace of inflation and its standard deviation remained similar to those in the first period. This was almost certainly due to the wave of immigration that began towards the end of 1989 and had the effect of moderating wage increases during the second period.

### **2.3 The upward sloping target zone regime – 1992 to 1997**

At the end of 1991, a decision was taken to move from a horizontal band to a diagonal band. Under this method, the midpoint rate is adjusted daily by a pre-defined rate. An annual rate of 9 percent

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<sup>12</sup> For a criticism of this measure, see page 9 of the Bank of Israel's Annual Report for 1991 (Hebrew).

was determined for 1992. The range of mobility of  $\pm 5$  percent around the midpoint rate was retained. Concurrently, the first annual inflation target was announced. A target of 14-15 percent was set for 1992. (The midpoint rate was raised by 3 percent when the new regime was introduced.)

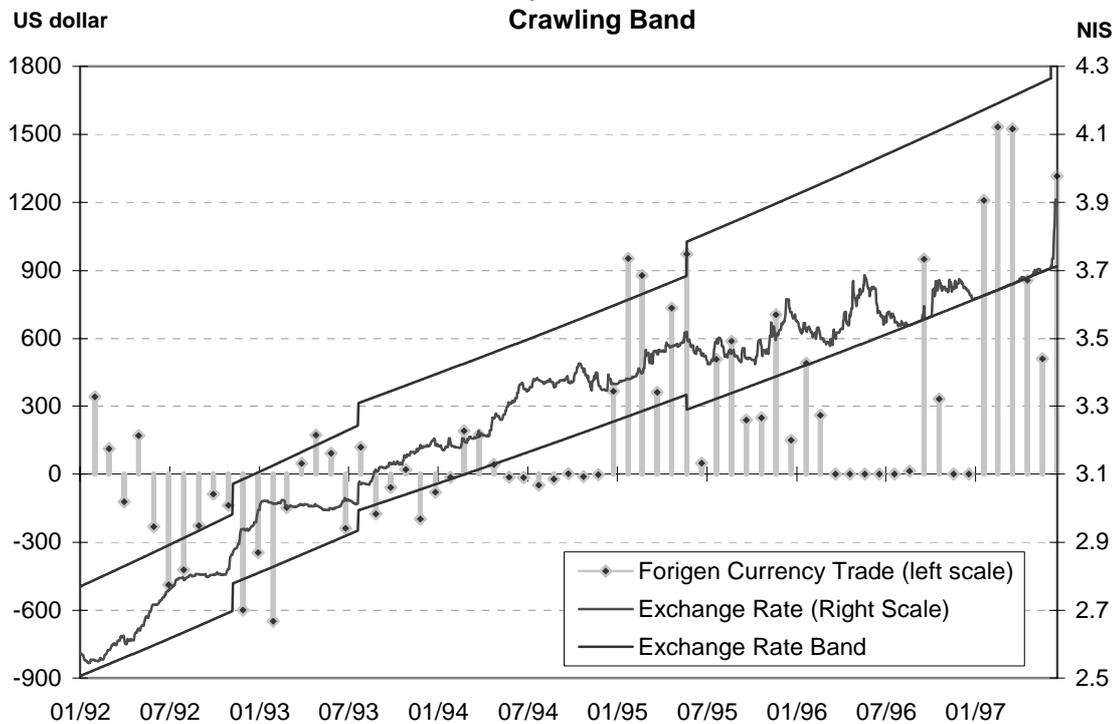
The new regime was intended to create greater certainty regarding the future course of the exchange rate, and thereby moderate speculative capital imports. It was hoped that the determination of a pre-defined course for the exchange rate and adherence to this course would induce prices to rise in a corresponding manner. In other words, in the absence of pressures for a real depreciation or real appreciation, prices were expected to rise to an extent corresponding to the rise in the exchange rate, plus the increase in prices in Israel's trading partners. Policy-makers estimated that wage pressures and other factors would lead to a price increase of 14 to 15 percent. At the same time, they estimated that prices in the countries with which Israel trades would rise by 5 to 6 percent. A depreciation of 9 percent was thereby derived, on the assumption of purchasing power parity. This was how the slope of the diagonal band was determined for 1992. Subsequently, policy-makers hoped that it would be possible to gradually lower the slope of the diagonal band and the inflation target with it. It should be realized that at the time, the operative target was not the inflation target, but still the exchange rate depreciation target. The interest rate thereby continued to serve as a tool for supporting the exchange rate, in the hope that anchoring the course of the exchange rate would also anchor the development of prices.

A possible advantage of the new method was the creation of greater certainty regarding the planned course of the exchange rate (as was the intention). But as regards the aspiration of achieving price stability, this method constituted a regression compared with the previous method, for the following reasons: If conditions favoring a decline in inflation and a decrease in the pace of depreciation emerge, the new method could hinder a decline in inflation by dictating a pre-defined course of depreciation. Another, non-economic disadvantage is that the government's agreement is needed in order to change the parameters of the exchange rate regime. It is easier to obtain agreement for an increase in the midpoint rate than for a decrease in the rate or a reduction in its slope. (Over the years, the government has exerted constant pressure on the central bank to take action in order to prevent a real appreciation.)

Developments during the years after 1992 indicate that the timing of the transition to a new regime was not exactly appropriate. In 1992, inflation fell to a lower level, from an annual rate of 16 to 21 percent during the years 1986 to 1991 to an annual rate of 10 percent during the years 1992 to 1997. Had it not been for the move to a new regime, a considerably larger decrease in the level of inflation might have been possible.

The move to the diagonal band regime failed to moderate speculative capital movements (see Table 2 and Diagram 4). However, the scale of these movements was also affected by the liberalization of the foreign currency market. Foreign currency conversions were recorded at the beginning of 1992. This process subsequently reversed, and was followed by large-scale purchases of foreign currency during the second half of the year. The Bank of Israel supplied this demand concurrent with a rise in the exchange rate along the midpoint rate of the diagonal band. During the period from the beginning of 1992 and until the beginning of 1996, the Bank of Israel intervened persistently in the foreign currency market in order to keep the exchange rate as close as possible to the midpoint rate of the diagonal band (see Diagram 4).

**Diagram 4:**  
**The NIS/Basket Exchange Rate<sup>1</sup> and Forigen Currency Trades<sup>2</sup>**  
**January 1992 - June 1997**  
**Crawling Band**



1. The Exchange Rate - Daily Data.

2. The Bank of Israel Foreign Currency Repurchase from the Public. Monthly Data.

In November 1992, the midpoint rate was raised by 3 percent, the slope of the diagonal band was reduced to 8 percent, and an inflation target of 10 percent was announced for 1993. In July 1993, the slope was reduced to 6 percent, and the inflation target for 1994 was set at 8 percent.

However, prices rose by 14.5 percent in 1994, far above the inflation target. In the last quarter of 1994, when the extent of the forecast deviation from the target for the year became apparent and inflation expectations for 1995 rose appreciably, policy-makers were faced with a

dilemma. During 1993 and 1994, prices rose by 11.2 percent and 14.5 percent respectively, even though the exchange rate rose by only 5.4 percent and 5.8 percent respectively. It thereby transpired that over time, prices could deviate by a rate far exceeding that derived from the course of the exchange rate. Policy-makers had to choose between raising the slope of the exchange rate and accommodating a rise in inflation expectations, or attempting to act by means of the interest rate. This was actually the first time that the Bank of Israel opted to use the interest rate in order to bring inflation back to the targeted range. Initially, the central bank maintained its intervention in the foreign currency market in order to keep the exchange rate as close as possible to the middle of the diagonal band.

In September 1994, an inflation target of 8 to 11 percent was set for 1995, without changing the parameters of the exchange rate regime, and it was decided to raise the interest rate to a considerable extent. The results of this measure soon became apparent. Inflation expectations fell gradually and a trend of foreign-currency conversions began at the beginning of 1995. Since the Bank of Israel wanted to prevent the exchange rate from falling towards the lower limit of the diagonal band, it had to purchase large amounts of foreign currency. In June 1995, the band was expanded to 7 percent, a technical increase of 0.8 percent was made in the midpoint rate, and the Bank of Israel allowed the exchange rate to rise to a slightly lesser extent than the slope and approach to the lower limit, while it continued to purchase large amounts of foreign currency from the public. In October 1995, an inflation target of 8 to 10 percent was set for 1996.

At the beginning of 1996, the attempt to prevent the exchange rate from falling towards the lower limit was perceived as having increased the extent of conversions. In February 1996 the Bank of Israel decided to cease its involvement in the foreign currency market unless the exchange rate were to approach the limits of the diagonal band. From February 1996 to August 1996, the Bank of Israel refrained from purchasing foreign currency and the exchange rate rose along the lower limit of the band. A pattern of capital imports developed in September 1996 and continued until mid-1997. In order to prevent the exchange rate from falling below the lower limit of the band, the Bank of Israel was once again forced to purchase large amounts of foreign currency.

Before we describe the transition to full mobility, we will briefly examine the differences between the period of the diagonal band and the previous periods as reflected by the data in Tables 1 and 2. As can be seen, in the period of the diagonal band, the pace of depreciation slowed appreciably and the standard deviation of the monthly depreciations decreased considerably. The decrease in the standard deviation reflected the concurrent retreat in the process of increased exchange rate flexibility. This retreat was also apparent from the growing extent of foreign currency conversions and the standard deviation of these conversions (although as stated, the

increased involvement also resulted from the continued liberalization of the foreign currency market). The period of the diagonal band is also notable for a gradual tightening of monetary restraint. The negative real interest rate in the previous period became positive during the period of the diagonal band, and gradually rose. From 1992 to 1994, the real interest rate averaged 2 percent. During 1995 to 1997, the real interest rate rose to an average of 4.6 percent. The decrease in the rate of inflation since 1992 derived, as stated, from the wave of immigration, which had a moderating effect on wage developments. However, the slower pace of depreciation and the monetary restraint typical of the years 1995 to 1997, were definitely the main reason for inflation remaining at a rate of 10 percent in the period of the diagonal band, and the decrease in the level of inflation from the second half of 1997.

## **2.4 The full mobility regime – from mid-1997**

The central bank's need to purchase large quantities of foreign currency in order to protect the lower limit of the diagonal band increased the dilemma facing policy-makers. While reducing the interest rate could halt the conversions of foreign currency, it was likely to lead to a rise in inflation to above its targeted level<sup>13</sup>. Expanding the range of mobility could make it possible to retain inflation target, but was likely to increase the real appreciation. The central bank favored expanding the range of mobility; the Finance Ministry supported a reduction in the interest rate.

Eventually, in June 1997, it was decided<sup>14</sup> to expand the band of mobility to a considerable extent. The upper limit was raised by 15 percent (without changing the upper slope), and the slope of the lower limit was reduced to 4 percent. The distance between the upper and lower limit was increased to 29 percent (see Diagram 1). Concurrently, the Bank of Israel totally ceased its intervention in the foreign currency market (except for a few days at the beginning of 1998).

The level of inflation fell in mid 1997. From July 1997 to July 1998, prices rose by 3.2 percent, while the exchange rate went up by 2.1 percent. In view of these developments, an inflation target of 4 percent for 1999 was set in August 1998. Concurrently, the slope of the lower limit of the exchange rate was reduced from 4 percent to 2 percent, and the difference between the lower and upper limit increased to 36 percent.

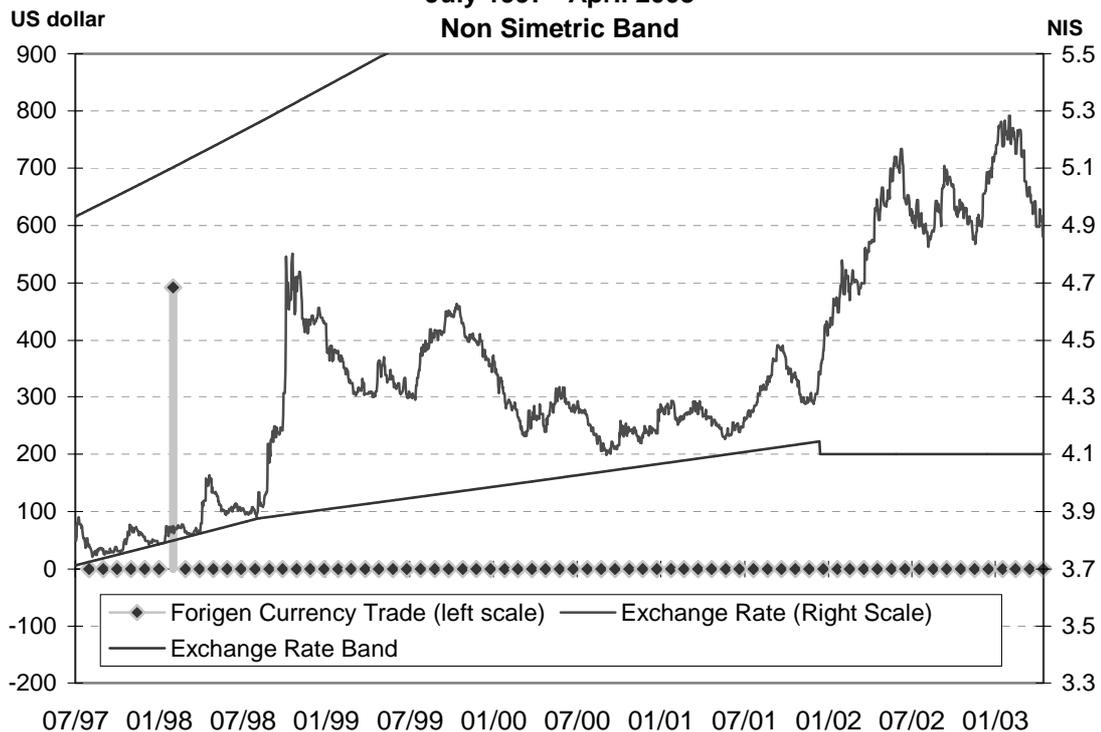
The increasingly serious economic crisis in Russia in August 1998 led to a massive outflow of foreign currency from developing countries. A worldwide financial crisis developed, and

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<sup>13</sup> An inflation target of 7 to 10 percent was set for the years 1997 and 1998. Only during 1998 was it realized that the level of inflation appeared to have fallen back in mid-1997.

intensified with the collapse of the LTCM hedge fund in September 1998. Demand for foreign currency in Israel grew appreciably as a result, and the exchange rate began to rise. From the end of August 1998 until the end of September, the exchange rate rose by 20 percent against the currency basket. The Bank of Israel chose not to intervene in the foreign currency market due *inter alia* to the fear that such intervention would increase demand, and opted to use the interest rate tool. At the beginning of November, the interest rate was raised by a cumulative amount of four percentage points. This completely stamped out the demand for foreign currency, and had the effect of gradually reducing inflation expectations. The central bank's decision not to intervene in the foreign currency market despite the large rise in exchange rate, and the fact that the interest rate succeeded in halting demand for foreign currency, were a decisive vindication of the policy of exchange rate mobility.

**Diagram 5:**  
**The NIS/Basket Exchange Rate<sup>1</sup> and Forigen Currency Trades<sup>2</sup>**  
**July 1997 - April 2003**  
**Non Simetric Band**



1. The Exchange Rate - Daily Data.
2. The Bank of Israel Foreign Currency Repurchase from the Public. Monthly Data.

During the years 1999 to 2001, the foreign currency market was calm, the rate of price increase fell to 0.9 percent a year, and the pace of depreciation amounted to 1.7 percent a year. At

<sup>14</sup> The decision was taken by the Prime Minister against the recommendation of the Finance Minister, leading to the resignation of the latter.

the end of December 2001, the government and the Bank of Israel decided to increase fiscal restraint and ease the monetary pressure. A decision was taken to lower the lower limit of the exchange rate by one percent, and to reduce its slope to zero percent. (The difference between the upper and lower limit thereby reached 66 percent.) Concurrently, the Bank of Israel made an unexpected 2 percentage point cut in the interest rate. This resulted in heavy demand for foreign currency and the exchange rate rose by 10 percent in January 2002. Subsequently, demand for foreign currency fell off temporarily. But in April, when it became clear that the government had failed to adhere to its declared policy of fiscal restraint, demand for foreign currency resumed and the exchange rate rose another 6 percent by the end of May. The Bank of Israel again chose not to intervene in the foreign currency market. In June and July, the interest rate was raised by a cumulative 4.5 percentage points. This stemmed the demand for foreign-currency, and subsequently led to a gradual decline in the exchange rate.

Table 3 - Standard Deviation of Exchange Rates

**Standard Deviation of Deviations of the Level of the Exchange Rate from the Trend<sup>15</sup>**

*Monthly average*

	<u>Shekel Basket</u>	<u>Shekel Dollar</u>	<u>Sterling Dollar</u>	<u>Mark-Euro Dollar</u>	<u>Yen Dollar</u>
86.01-88.12	3.7	3.4	4.8	5.6	5.7
89.01-91.12	1.6	3.7	6.6	6.7	5.1
92.01-9706	1.6	2.6	4.9	5.2	5.4
97.07-2003.04	4.3	3.4	3.1	4.8	6.6

**Standard Deviation of the Rate of Change in the Exchange Rate**

*Monthly, in annual terms*

	<u>Shekel Basket</u>	<u>Shekel Dollar</u>	<u>Sterling Dollar</u>	<u>Mark-Euro Dollar</u>	<u>Yen Dollar</u>
86.01-88.12	31.4	20.0	30.8	30.1	34.8
89.01-91.12	47.1	65.4	42.3	44.6	34.9
92.01-9706	12.4	18.6	50.8	30.7	37.4
97.07-2003.04	38.4	31.0	21.8	29.4	32.5

<sup>15</sup> The trend is estimated with the HP method.

The data in Tables 1 and 2 show that the pace of exchange rate depreciation increased to some extent during the period of mobility. Despite this development, the inflation rate fell considerably, under the impact of tighter monetary restraint that was intended to maintain the decline in the rate of inflation, which actually happened in the second half of 1997. The standard deviation of the changes in the exchange rate rose appreciably, reflecting the move to complete flexibility in the exchange rate. This certainly had the effect of increasing the volatility of inflation. As can be seen, the standard deviation of inflation rose in spite of the much lower rate of price increase in the second period. (The standard deviation of inflation rose from 6.3 percent to 8.3 percent, and the standard deviation relative to the mean increased from 0.58 to 2.2.) It should be noted that the move to mobility did not involve an increase in the volatility of the nominal interest rate.

As stated, the volatility of the exchange rate and the changes in it increased during the period of mobility. However, the extent of this volatility did not exceed that typical of other exchange rates, as can be seen from Table 3.

### **3. Impact on inflation of the changes in exchange rate regimes and interest rate policy**

#### **3.1 Impact of increased exchange rate flexibility on the extent of the pass-through from the exchange rate to prices**

During recent years, it has been claimed that the increased flexibility of the exchange rate has led to greater uncertainty regarding the permanency of the changes in the exchange rate, and has thereby weakened the pass-through from the exchange rate to prices<sup>16</sup>. We will now examine this hypothesis by means of an estimated inflation equation.

We will formulate the inflation equation as follows<sup>18</sup>:

$$(1) dp_t = a_1 + a_2 * (de_t + dpim_t) + a_3 * Edp_t + (1 - a_2 - a_3) * dp_{t-1} + a_4 * u_{t-1} + v_t$$

where:

$dp_t$  – rate of change in the consumer price index (excluding fruit and vegetables).

$de_t$  – rate of change in the exchange rate against the dollar.

$dpim_t$  – rate of change in the dollar prices of imports.

$Edp_t$  – inflation expectations for a year ahead (from capital market data).

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<sup>16</sup> See for example page 108 of the Bank of Israel report for 1999, and Bufman and Leiderman (2001).

<sup>18</sup> See for example Svensson (2000) for the theoretical background to this equation that is relevant to an open economy.

$u_t$  – deviation of the unemployment rate from the "natural" rate (estimated by the Hodrick Prescott filter) .

$v_t$  – random deviation.

It will be noted that according to the equation (and according to the theory) any change in the pace of depreciation is eventually fully reflected by a change in inflation. A full pass-through from the exchange rate to prices therefore exists in the long term. The claim that the pass-through has weakened refers to the short-term impact, that is, to the size of the coefficient  $a_2$ . We will now examine whether this coefficient decreases as the flexibility of the exchange rate increases. We estimated the equation with quarterly data for the period from the first quarter of 1989 to the first quarter of 2003. In order to examine the above hypothesis, we divided the period into two sub-periods: until the second quarter of 1997, when the central bank intervened in the foreign-currency market; and from the third quarter of 1997, when the exchange rate became mobile.

Since the pace of depreciation and inflation expectations are endogenous variables, which are also affected by current inflation, we estimated the equation by the TSLS method where the instrumental variables are: two lags of depreciation and change in import prices, one lag of inflation expectations, and four lags of inflation. The equation estimates for the entire period and the sub-periods are presented in Table 4 below.

**Table 4 - Equation (1) Estimates for the Entire Period and the Sub-Periods**  
(numbers in parentheses are *t* values)

<b>Explanatory variables</b>	<b>Entire period 1989.1-2003.1</b>	<b>Rate managed 1989.1 – 1997.2</b>	<b><u>Flexible rate</u> 1997.3-2003.1</b>
const	0.399 (0.8)	1.193 (1.5)	-0.659 (-1.4)
<b>de<sub>t</sub>+dpim<sub>t</sub></b>	<b>0.216 (3.8)</b>	<b>0.183 (2.1)</b>	<b>0.281 (7.2)</b>
Edp <sub>t</sub>	0.599 (4.7)	0.658 (3.8)	0.535 (4.4)
<u>dp<sub>t-1</sub></u>	0.185	0.159	0.184
u <sub>t-1</sub>	-0.805 (-1.6)	-0.637 (-0.9)	-1.864 (-2.6)
Rs <sub>q</sub>	0.781	0.577	0.855
DW	2.04	2.11	2.35
Sd	3.78	4.40	2.31

As can be seen, in the second period (mobile exchange rate), a large pass-through coefficient of 0.28 is obtained, compared with a coefficient of 0.18 in the first period. This means that the transition to mobility actually increased the short run impact of depreciation onto inflation. It should be noted that the effect of the unemployment gap was found to be larger and more significant in the second period. Moreover, a better equation was obtained in the second period, meaning a higher level of explanation and considerably lower standard deviations for the estimated parameters, than that in the first period. In other words, in the second period the explanatory variables explain a greater part of the variation of inflation despite the fact that the fluctuations in inflation increased in the second period.

A statistical test of the significance of the difference in the parameters  $a_2$  and  $a_3$  between the two periods shows that the difference is not significant. However, the large difference in the standard deviation of the equation between the two periods detracts from the validity of the test. In order to examine the robustness of the finding concerning the coefficient of depreciation, we checked the effect of an additional or substitute indicator for excess demand. This was the difference between the anticipated short-term real interest rate (the Bank of Israel's interest rate minus inflation expectations) and the "natural" real interest rate. We used the real yield-to-maturity on 10-year CPI-indexed bonds as an indicator of the natural interest rate. Table 4.1 in Appendix 1 presents the results that are obtained when this variable is added to the equation, and when the variable replaced the unemployment gap. As can be seen, a similar value to the coefficient of depreciation is obtained in all cases. For the entire period, this coefficient varied from 0.22 and 0.27, ranging between 0.18 and 0.25 in the first period, and 0.22 and 0.28 in the second period. Accordingly, there is no evidence that the pass-through from the pace of depreciation to inflation decreases with an increase in exchange rate flexibility.

### **3.2 Impact of changes in the exchange rate regime and interest rate policy, on the nature of the relationship between depreciation, inflation, inflation expectations and the interest rate**

As stated, from the third quarter of 1994 the Bank of Israel began to use the interest rate tool to attain the inflation target, while continuing to manage the exchange rate as previously. In order to examine also the impact of changes in the interest rate policy, the period must be divided into three sub-periods. We will use monthly data in the following three sub-periods<sup>19</sup>: the first period,

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<sup>19</sup> Due to the relatively large noise in the monthly data, we preferred to work with quarterly data, but the relatively short length of the periods made it necessary to use monthly data.

from 1989.01 to 1994.09, was notable for a policy of exchange rate management while the interest rate was mainly used for moderating capital movements; the second period, from 1994.10 until 1997.06, during which large-scale intervention in the foreign currency market continued concurrent with the adoption of a policy of monetary restraint that was intended to attain the inflation targets; and the third period, from 1997.07 to 2003.04, when intervention in the foreign currency market ceased (almost) completely, the exchange rate became mobile and monetary policy continued to be directed at attaining the inflation targets.

In order to examine the impact of changes in the exchange rate regimes and monetary policy on inflation and the nature of the relationship between the relevant variables, we ran for each of the periods a VAR model with monthly data for the following variables: the nominal interest rate on Bank of Israel tenders for the banks, the pace of depreciation in the exchange rate, inflation expectations<sup>20</sup> and the rate of increase in consumer prices.

Table 5 presents the coefficients of correlation between the remainders of each of the equations. Three numbers appear in each cell, representing the correlation coefficients for each of the periods (the first number is the correlation coefficient for the first period). When we examine the correlation between the remainders of the inflation, inflation expectations and depreciation equations, it can be seen that the correlation coefficients increase over time. In other words, during the second period and especially in the mobility period, surprises in inflation, inflation expectations and depreciation are better correlated in comparison with the first period.

**Table 5 - Coefficients of Correlation between the Remainders of the VAR Equations in the Different Periods**

	Depreciation	Inflation expectations	Interest rate
Inflation	<b>0.463</b>	<b>0.062</b>	<b>-0.013</b>
	<b>0.664</b>	<b>0.284</b>	<b>-0.127</b>
	<b>0.723</b>	<b>0.540</b>	<b>-0.174</b>
Interest rate	<b>0.049</b>	<b>0.164</b>	
	<b>-0.044</b>	<b>-0.258</b>	
	<b>-0.407</b>	<b>-0.414</b>	
Inflation expectations	<b>-0.164</b>		
	<b>0.321</b>		
	<b>0.599</b>		

\* **The table presents correlation coefficients for the following three period: the first period, 1989.01-1994.08; the second period, 1994.09-1997.06; and the third period, 1997.07-2003.04.**

<sup>20</sup> Inflation expectations derived from capital market data, according to the difference between the rate of yield-to-maturity on T-bills for a year and the rate of real yield-to-maturity on CPI-indexed bonds for a year.

It is interesting to examine the correlation between the interest rate and depreciation remainders. During the first and second periods, the correlation is close to zero. During the third period however, with the move to mobility, the correlation becomes negative. It is also interesting to examine the correlation between the interest rate and inflation expectation remainders. During the first period, the correlation is positive and small. During the second and third periods however, the correlation becomes negative and relatively large (in absolute value). This finding matches the assessment that the credibility of monetary policy increased following the transition to the use of the interest rate tool for the purpose of restraining inflation (a positive interest rate shock has the effect of reducing inflation expectations).

We will now analyze the impulse response reflecting the effect of an unexpected shock in one of the variables on the others. In order to calculate impulse response, assumptions must be made (or restrictions imposed) on the covariance matrix of the remainders from the equations. We chose the general impulse response method that was developed by Pesaran and Shin (1998). Under this method, in the event of a shock in one of the remainders, it is assumed that the shock occurs simultaneously in the other remainders in accordance with the estimated correlation among the remainders. We mention this in order to clarify that the meaning of impulse response is not clear-cut. The larger the correlation between the remainders, the more difficult it is to attribute the shock to a specific variable.

Diagram 6 presents graphs describing the manner in which inflation responds to an unexpected shock of one percent in the pace of depreciation. (All the data are in annual terms.) As can be seen, the response of inflation to an unexpected depreciation is positive in each of the periods. The most persistent impact was in the first period – five months. In the second period, when a policy of interest rate restraint was adopted, the immediate impact of an unexpected depreciation increased but the duration of the impact decreased to three months. In the third period, when the exchange rate became mobile, the immediate impact of a depreciation shock weakened in comparison with the first period as well, and the duration of the impact was also shorter than that in the first period. It can therefore be seen that the move to mobility had the effect of reducing the impact of an unexpected depreciation on inflation. This finding should not be interpreted as a decrease in the pass-through from the pace of depreciation to inflation. This is because the unexpected element of the impact of a depreciation is involved.

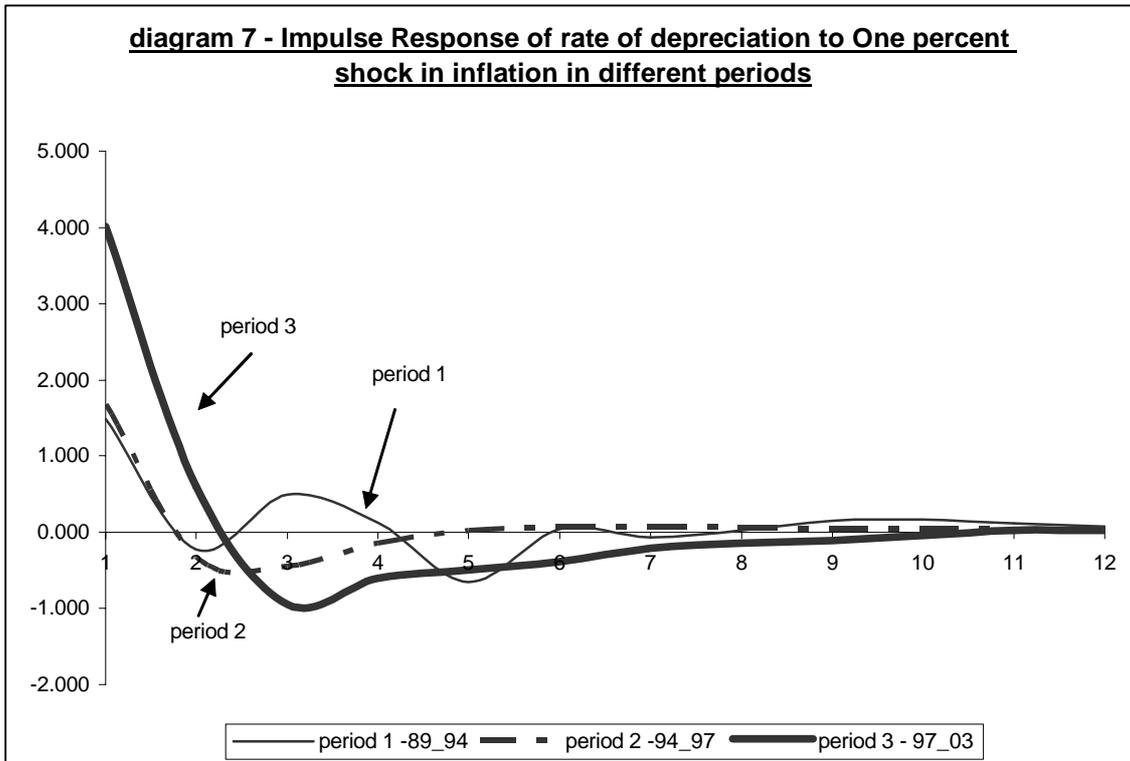
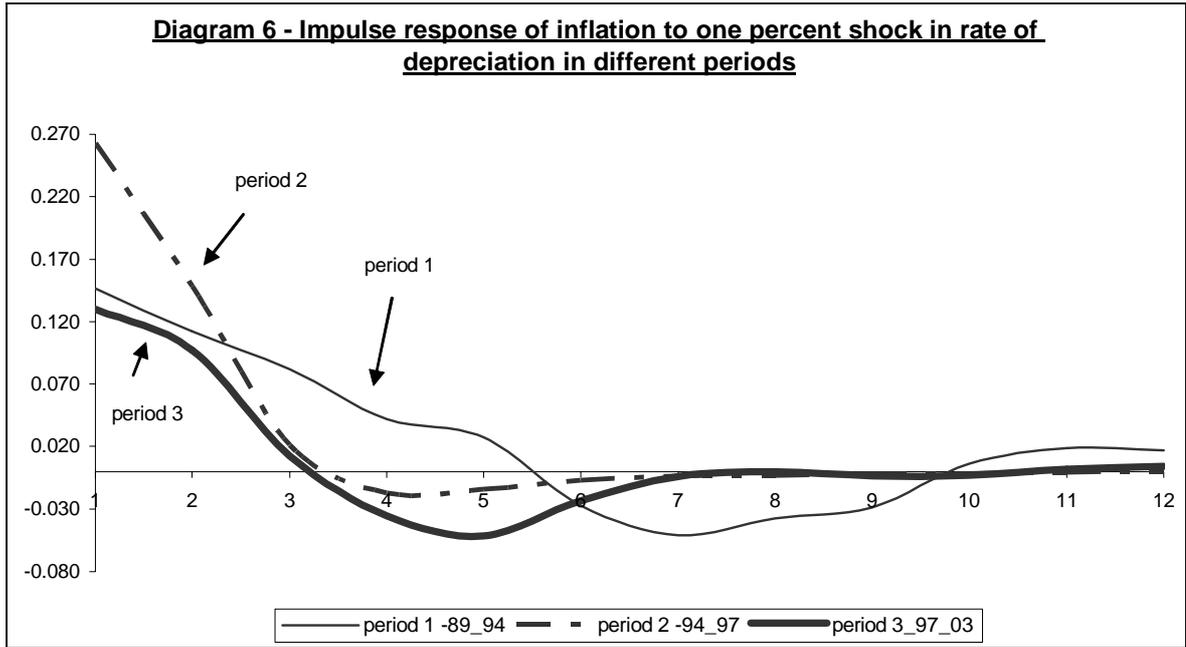
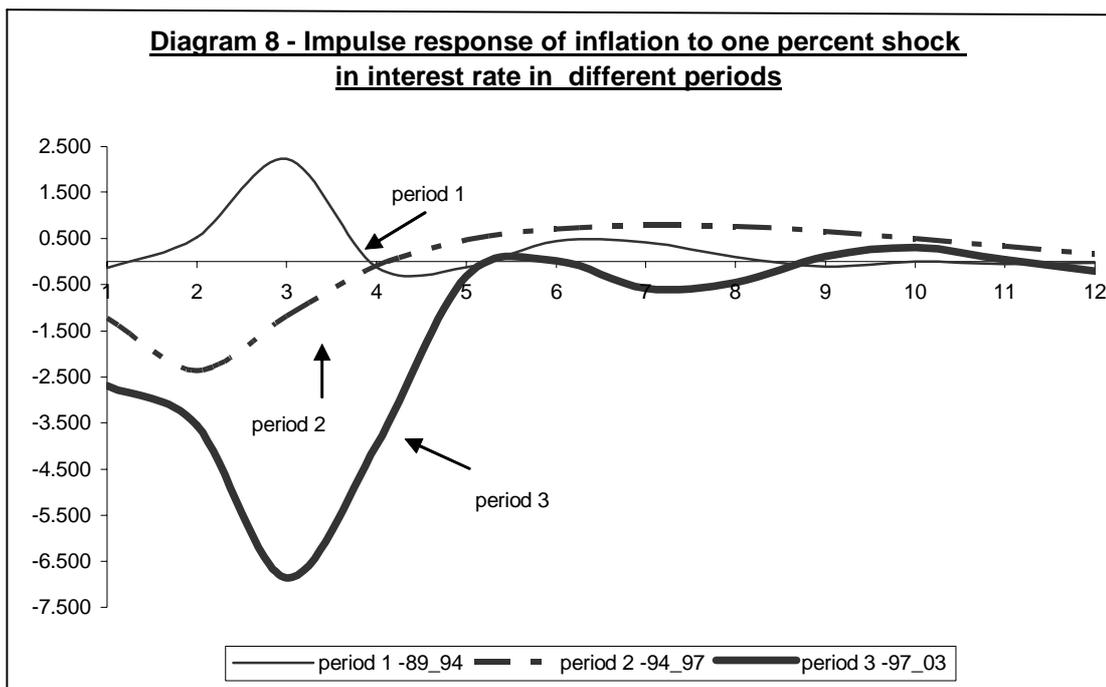


Diagram 7 presents graphs on the response of depreciation to an unexpected change of one percent in inflation. As the graphs show, the duration of the response was brief and confined to a single month during all three periods. During the first and second periods, when the exchange rate was managed, the response was relatively moderate and increased greatly with the transition to mobility (from 1.5 percent to 4 percent).

Diagram 8 presents graphs on the response of inflation to a positive unexpected shock of one percent in the nominal interest rate in each of the periods. As can be seen, there is a substantial difference between the first period and the other periods. During the first period, the inflation response was positive and moderate. During the second period, the Bank of Israel began to adopt a policy of monetary restraint and the response became negative and lasted for three months. During the third period, with the transition to exchange rate mobility, the negative impact of an interest rate shock on inflation became stronger, and the lag increased to four months. A similar situation is apparent in Diagram 9, which presents the response of the expected inflation to an unexpected interest rate shock.

Diagrams 8 and 9 reveal the interest rate’s potential effectiveness as a tool for suppressing inflation. The move to a policy of monetary restraint from the end of 1994 had the effect of increasing the credibility of the inflation target, and this credibility was enhanced by the increased flexibility in the exchange rate as reflected by the growing impact of interest rate shocks on inflation expectations.



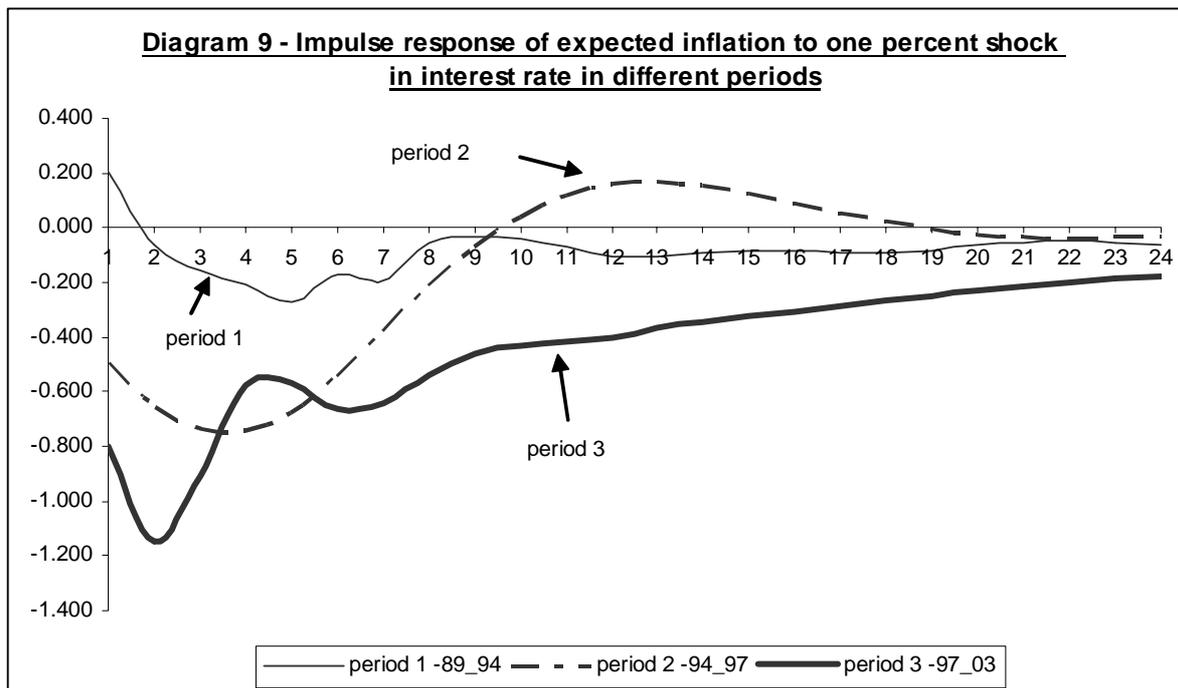
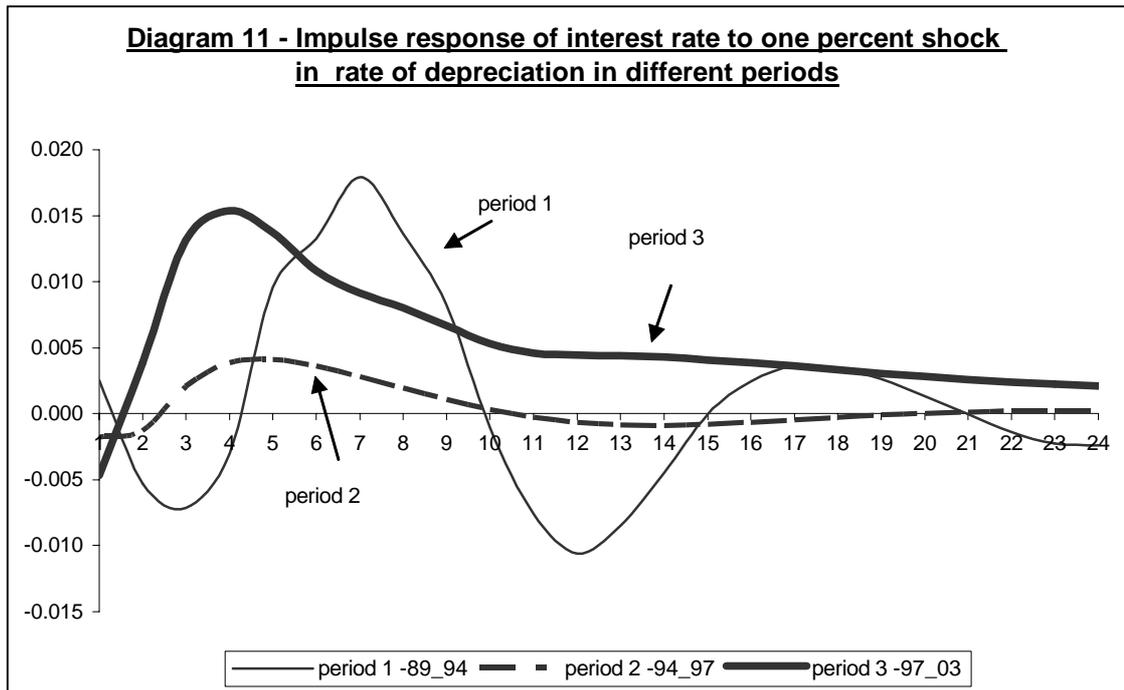
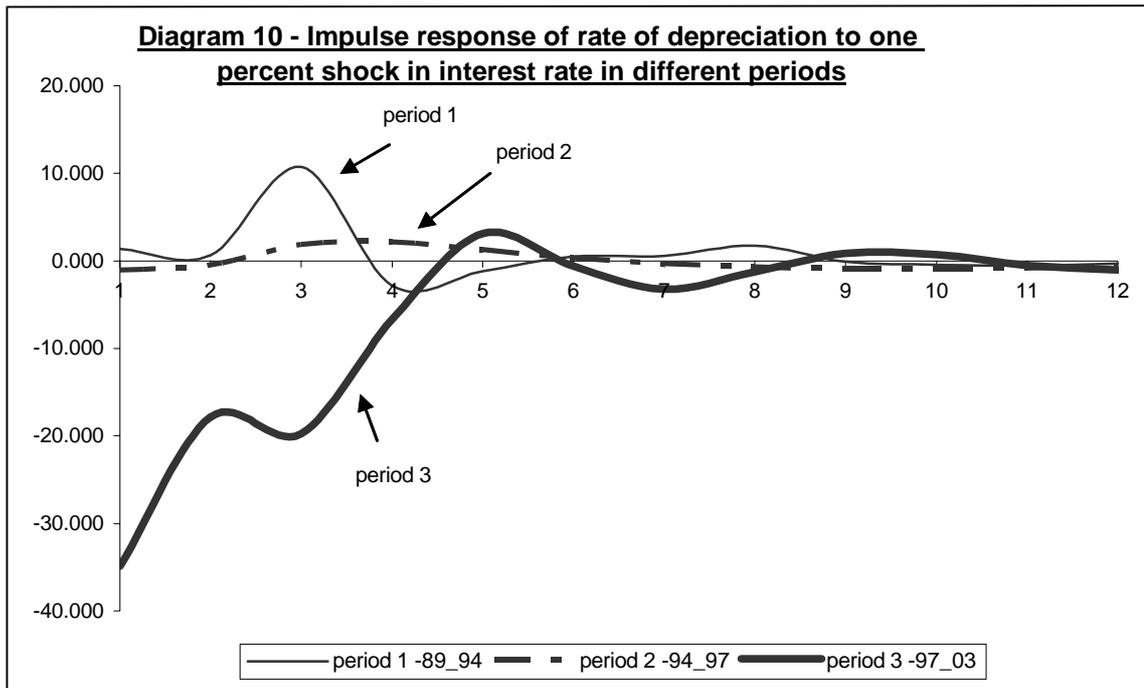


Diagram 10 presents the impact of an interest rate shock on depreciation. During the first period, this impact is positive and moderate. During the second period, the impact becomes negligible and only in the third period, with the transition to mobility, does a positive interest rate shock have the effect of reducing the exchange rate to an appreciable extent (negative depreciation). Accordingly, increased exchange rate flexibility heightened its sensitivity to interest rate adjustments, and thereby enhanced the effectiveness of the interest rate as a tool for controlling inflation. This interpretation is fully in keeping up with the findings relating to the impact of the interest rate on inflation expectations.

Diagram 11 presents the response of the Bank of Israel's interest rate to an unexpected depreciation shock. As can be seen, in the first period the initial response was a decline in the interest rate. The interest rate then rose and fell again, without any clear trend. During the second period, a positive response - a moderate rise in the interest rate - observed. Only during the third period does the interest rate rise to an appreciable extent that peaks after three months, followed by a gradual relaxation of monetary restraint that lasts for many months.



#### **4. Main elements of the liberalization of the foreign currency market**

A policy of gradual liberalization of the foreign currency market was adopted during the 1990's. In the first stage, the restrictions applying to Israeli banks, mutual funds and the business sector and foreign residents were lifted. For the banks, the restrictions relating to the extension of credit in foreign currency were lifted. For the business sector, the restrictions on investments abroad were lifted, as were the restrictions applying to foreign residents' investments in Israel. Subsequently, the restrictions on the mutual funds' investments in foreign currency were lifted.

In the second stage, the restriction applying to households were lifted. Initially, the restrictions on deposits in foreign currency in Israel and at a later stage, the restrictions on financial investments abroad were lifted. Finally, the restrictions on investments in real estate abroad were abolished.

The liberalization of the foreign currency market and the increased flexibility of the exchange rate led to a rapid expansion in foreign currency trading. This was reflected *inter alia* by a persistent growth in daily turnover, an increase in the number and type of participants, including foreign financial institutions, and a persistent expansion in the market for foreign currency options.

The liberalization of the foreign currency market had the effect of increasing the sensitivity of capital imports to interest rate gaps, and to an actual increase in capital imports. This development naturally affected the gradual transition from a stable exchange rate regime to a mobile regime. The mobility of the exchange rate increased the extent of exchange rate risk, and thereby moderated the extent of the speculative capital imports.

#### **5. Summary and discussion**

From the 1985 stabilization program and until mid-1997, various alternatives were employed in managing the exchange rate. Exchange rate management was aimed at reducing inflation while preventing a major appreciation of the exchange rate. The changes in the exchange rate regime were intended to moderate capital movements, without any notable success. The level of inflation dropped substantially in 1992, although it is difficult to attribute this development to exchange rate policy. Moreover, the change in the exchange rate regime at the beginning of 1992 actually appears to have prevented a larger decrease in inflation.

The liberalization process during 1990's eventually made it possible to move to a mobile exchange rate regime, which has been maintained since then. The mobility of the exchange rate

greatly increases the effectiveness of the interest rate tool as the sole means for obtaining price stability. Price stability has effectively existed since 1999.

The mobility of the exchange rate led to increased volatility, although the extent of this volatility did not exceed that in other currencies. Concurrently, market tools were developed that enable the business sector to cope with uncertainty regarding the exchange rate. It can be said that exchange rate insurance was actually privatized. Instead of the government supplying this insurance at the price of a distorted allocation of resources in the economy, the private sector now supplies the insurance, with the price of the exchange rate and the insurance against exchange rate risks being determined by means of demand and supply forces.

Exchange rate mobility implies that the exchange rate is affected by transitory capital movements. It is sometimes claimed that the exchange rate is a highly important variable, and that temporary fluctuations resulting from speculative factors should not be allowed to affect it. Our reply to this claim is that we are involved in choosing between alternatives. Insurance against exchange rate fluctuations can be purchased. The price of this insurance is the price of the liberalization process, but its cost to the economy is far less than the cost of regressing from the liberalization. In the future, if Israel is able to join a currency bloc, this problem is likely to be solved (at the price of other problems).

An important issue for which a solution is still required, is the existence of mobility limitations. Today, in July 2003, the lower limit is a horizontal at a rate of NIS 4.10 per currency basket unit. The upper limit has a slope of 6 percent, and its level in July 2003 was NIS 7.03 per basket unit. This means that the upper limit is 70 percent above the lower limit, and the actual exchange rate (an average of NIS 4.75 in July 2003) is 16 percent above the lower limit and 48 percent below the upper limit. These limits are very wide and the probability of reaching them in the near future is low, although not zero. Since the chances of reaching the limits are now small, this would seem to be an appropriate time to abolish them. Otherwise, changing or abolishing the limits when the exchange rate is actually approaching one of the limits could have seriously affect credibility.

## **Bibliography**

1. Avi Ben Basset (1995) – The exchange rate regime, monetary policy and the inflation target. Discussion Papers 95.10, Bank of Israel Research Department.
2. Bank of Israel Annual Report, 1989, 1991 and 1999.
3. Gil Bufman and Leonardo Leiderman (2001) – Surprises on Israel's road to exchange rate flexibility. Discussion paper.
4. Pesaran Hashem and Y. Shin – Generalized impulse response analysis in linear multivariate models. Economics letters, 1998, vol. 58, pp. 17-29.
5. Meir Sokoler (1999) – Credibility half-won in an ongoing battle – Analysis of inflation targets and monetary policy in Israel. Inflation and disinflation in Israel - Leonardo Leiderman, editor, Bank of Israel.
6. Lars Svensson (2000) – Open economy inflation targeting- Journal of international economics 50 (2000) 155-183.

## Appendix 1

Table 4.1 - Equation (1) Estimates for the Entire Period and the Sub-Periods  
(numbers in parentheses are *t* values)

Explanatory variables	Entire period 1989.1-2003.1		Rate managed 1989.1 – 1997.2		Flexible rate 1997.3 -2003.1	
	const	0.322 (0.7)	0.200 (0.4)	0.819 (0.9)	0.897 (1.0)	0.009 (0.0)
<b>de<sub>t</sub>+dpim<sub>t</sub></b>	<b>0.245 (4.6)</b>	<b>0.274 (4.7)</b>	<b>0.205 (3.0)</b>	<b>0.246 (3.2)</b>	<b>0.244 (4.6)</b>	<b>0.219 (4.1)</b>
Edp <sub>t</sub>	0.638 (5.7)	0.574 (4.7)	0.649 (4.2)	0.608 (3.8)	0.736 (3.5)	0.818 (3.8)
<u>dp<sub>t-1</sub></u>	0.117	0.152	0.146	0.146	0.020	-0.037
u <sub>t-1</sub>	-1.212 (-2.4)		-0.957 (-1.3)		-1.441 (-1.9)	
(I- Edp <sub>t-r</sub> ) <sub>t-1</sub>	-0.541 (-2.4)	-0.455 (-2.3)	-0.335 (-1.0)	-0.274 (-0.9)	-0.655 (-1.4)	-0.843 (-1.7)
Rsq	0.815	0.789	0.602	0.581	0.875	0.848
DW	2.22	2.22	2.18	2.27	2.03	1.82
Sd	3.52	3.71	4.34	4.38	2.22	2.37

א' אזולאי, ד' אלקיים – מודל לבחינת ההשפעה של המדיניות המוניטרית על האינפלציה בישראל, 1988 עד 1996	1999.01
ד' אלקיים, מ' סוקולר – השערת הניטרליות של שיעור האבטלה ביחס לאינפלציה בישראל – בחינה אמפירית, 1990 עד 1998	1999.02
M. Beenstock, O. Sulla – The Shekel's Fundamental Real Value	2000.01
O. Sulla, M. Ben-Horin – Analysis of Casual Relations and Long and Short-term Correspondence between Share Indices in Israel and the United States	2000.02
Y. Elashvili, M. Sokoler, Z. Wiener, D. Yariv – A Guaranteed-return Contract for Pension Funds' Investments in the Capital Market	2000.03
י' אלאשווילי, צ' וינר, ד' יריב, מ' סוקולר – חוזה להבטחת תשואת רצפה לקופות פנסיה תוך כדי הפנייתן להשקעות בשוק ההון	2000.4
ד' אלקיים – יעד האינפלציה והמדיניות המוניטרית – מודל לניתוח ולחיזוי	2001.01
ע' אופנבר, ס' ברק – דיסאינפלציה ויחס ההקרבה: מדינות מפותחות מול מדינות מתעוררות	2001.02
D. Elkayam – A Model for Monetary Policy Under Inflation Targeting – The Case of Israel	2001.03
ד' אלקיים, מ' רגב, י' אלאשווילי – אמידת פער התוצר ובחינת השפעתו על האינפלציה בישראל בשנים האחרונות	2002.01
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ר' אלדור, ש' האוזר, מ' קהן, א' קמרה – מחיר אי-סחירות של חוזים עתידיים (בשיתוף הרשות לניירות ערך)	2003.01
R. Stein – Estimation of Expected Exchange-Rate Change Using Forward Call Option	2003.02
ר' שטיין, י' הכט – אמידת ההתפלגות הצפויה של שער החליפין שקל-דולר הגלומה במחירי האופציות	2003.03
D. Elkayam – The Long Road from Adjustable Peg to Flexible Exchange Rate Regimes: The Case of Israel	2003.04