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The Money-Injection Function of the Bank of Israel and the Inflation Process

by

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ABSTRACT

This paper characterizes the monetary history of Israel since 1973 by a single quantitative index in the form of the "monetary injection of the Bank of Israel". The analysis suggests that the main concern of the Bank of Israel in the inflationary period (prior to 1985) was to stabilize the variance of the monetary base rather than to reduce the rate of inflation, about which it could do very little in view of the large fiscal deficits. After the stabilization in 1985 the Bank continued to stabilize the variance of the monetary base but in this period it also followed a policy of disinflation in the framework of an inflation target regime.

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Introduction.

It is usually thought that the central bank (CB) has a somewhat different scale of preferences than the government or the treasury. Thus the CB is considered as being tougher on inflation and financial stability than the government and less sensitive to unemployment. The more independent the CB, or the higher the inflation rate, the more likely are these differences to emerge as an actual struggle between the monetary and fiscal authorities (unless the latter internalize the need to safeguard financial stability). The policy stance of the CB is usually reflected in setting the interest rates on CB funds at higher levels than the preferred rates of the treasury. This is especially evident in the framework of the inflation target regimes, which became popular in recent years.

The interest rate on CB funds can take various forms. For example, there is the interest rate on the monetary loan to commercial banks and the interest on directed (subsidized) credit, which was formally allocated in Israel (through the eighties) by the CB. By changing these rates the CB can affect the injection of liquidity into the economic system. The CB can also influence the money supply by various other means, such as the reserve ratios against different types of deposits, open market operations, and through quantitative controls over CB credit.

A summary quantitative index of the above measures is the "liquidity injection" by the CB. The Bank of Israel (BOI) calculates this statistic on a historical basis[1]. Broadly speaking, the above injection is the change in net credit of the BOI to the private sector (which consist of various loans to the public and banks minus the non-reserve deposits of

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[1] See for example the Report of the Accountant of the BOI (2001).

the banks at the BOI). A more precise definition is given in the appendix. By its liquidity injection, the CB can affect the monetary base (MB). In fact, the change in the latter is composed of three types of injections. The identity, derived from the balance sheet of the CB (see appendix), is as follows: change in MB (denoted ΔMB)=Injection by the CB (denoted ΔCB)+ Injection by the treasury or government (denoted ΔG)+ Injection of liquidity resulting from sale of foreign exchange by the private sector to the CB (denoted ΔF). (In the rest of the paper we shall use the above notation to indicate injections normalized by the beginning of period monetary base.). The change in the monetary base (ΔMB) can also be defined independently as the change in currency outside the BOI plus the change in banks' deposits held in the BOI as reserves against their sheqel deposits. We note that ΔG is essentially the flow of net loans by the BOI to the treasury, that is loans minus the change in the government's deposits at the CB (net of the contribution of the government to the foreign exchange reserves of the BOI). ΔG also equals domestic public sector deficit plus the change in net long and medium-term government loans to the private sector.

There is of course an element of arbitrariness in the distinction between ΔG and ΔCB. For example, the sale of indexed bonds by the BOI (on behalf of the government) to the commercial banks as a backup for their saving deposits is counted as part of ΔG (that is, it reduces the liquidity injection by the public sector). By contrast, the sale of dollar-indexed short-term bonds to back the dollar-indexed deposits (Patam) are counted as part of ΔCB (that is, it reduces the injection of liquidity by the CB), presumably because they are considered as money substitutes. But on the whole ΔCB represents the items that are more subject to the control of the BOI.

Traditionally, the inflation tax models have focused solely on ΔMB (related to seigniorage) without paying much attention to its composition. However, more recent literature assigns a greater role to separate policy of the CB. Thus Sargent-Wallace (1981) envisage the public sector as composed of two entities: the treasury, which determines the

size of the fiscal deficit, and the CB which determines the composition of its finance. Similarly, the more recent policy-game approach of the Barro-Gordon type, enables one to consider the CB as having a different objective function than the government, which leads to the implementation of a different policy, usually one of a tougher stance on inflation [see Rogoff (1985) and Alesina and Tabellini (1987)]. In our framework we reflect the latter consideration by assuming that the CB, by using its ΔCB, can offset the effects of the other two injections on the MB.

In formulating its policies the CB is guided by several considerations, which are reflected in its policy towards ΔCB. Mainly, the CB can use ΔCB to offset the effect of the monetary injections by the treasury or by the external inflows on the MB. However, (realistically) the CB cannot ignore completely the interest of the treasury to use ΔMB to finance its deficit (the inflation tax motive). We have also to assume that, although the CB is interested in reducing inflation, it is aware of the fact that a contraction of the money supply can be counterproductive as a disinflationary device if the treasury persists in maintaining large deficits (as in Sargent-Wallace "unpleasant monetarist arithmetic"). In addition to its concern with the trend of inflation (or monetary growth), the CB is also concerned with financial stability, which can account for its incentive to reduce the variance of the monetary base. The latter approach assumes that the main source of monetary instability originates in the supply side of the money market.

In this paper we analyze the behavior of ΔCB as a policy variable of the BOI in the course of the inflationary period (1973-85) and in the post-stabilization era. We shall focus mainly on the offsetting policies of the BOI in view of the other monetary injections. As we shall see, this involves a trade off between controlling the trend of monetary growth and reducing the variability around this trend.

The nature of the tradeoff is as follows. By sterilizing the injections originating in the public sector, the CB can reduce the rate of growth of the monetary base. Does this necessarily reduce inflation? This is not clear. For example Sargent and Wallace (1981)

suggest that if the government does not cut its budget deficit then restricting monetary growth will lead to an increase in debt-finance of the deficit and thus increase the fiscal burden in the future. By rational expectations this may increase not only future inflation but even the current one. Note also, that a higher sterilization by the BOI tends to an increase the real interest rate on government paper, which is certainly viewed unfavorably by the treasury. So, in the inflationary era, the CB had two reasons why not to implement full sterilization: first, it was not clear whether it would reduce or increase inflation , and secondly, it might antagonize the treasury because it would imply an increase in public debt and interest rates. On the other hand, the CB had an interest in sterilizing the injections from the public sector because it helped to reduce the variance of the monetary base, which is potentially the cause of financial instability. Thus a higher degree of sterilization could be counterproductive for disinflation as long as the government persisted with large deficits, but it was beneficial in reducing the variance of the monetary base. Indeed, in the absence of CB independence, the CB may give up the aim of controlling the basic level of inflation and confine itself to stabilizing its variance.

There is also the question of why should the CB be interested in sterilizing the effect of capital flows on the monetary base. For example, by sterilizing outflows through an increase in ΔCB, the CB enables to shift the ownership of foreign assets from itself to the private sector, which is apparently against the interest of the CB. However, by the sterilization of capital flows the CB can stabilize the variance of the monetary base. This consideration is particularly important when the MB is small relative to the capital flows, as is often the case with small economies under a fixed ER regime. In fact this was the situation in Israel for most of the time.

The interest of the CB to stabilize the MB continues to hold even in non-inflationary conditions, since the variability of MB can induce variations in short term interest rates and inflation rates, which the CB tries to avoid.

When the CB enjoys a significant degree of independence it can aim at reducing the level of inflation (and inflationary expectations) and not only its variance. One of the main instruments that the BOI has employed in recent years for this purpose has been to raise the interest rate on its funds in the framework of an inflation target regime. However, this requires a policy with regard to its monetary injection, which is consistent with the above strategy. We shall investigate this issue at the end of the paper.

In the context of the foregoing considerations we intend to analyze statistically the following issues. Did in fact the BOI use ΔCB to offset the other liquidity injections? Was the reaction of the BOI to ΔG and ΔF different? If so, why? Did the BOI distinguish between injections originating in the current fiscal deficit and injections resulting from capital transactions of the public sector (like lending to firms)? Did the BOI react to inflation in addition to the liquidity injection from the other two sources (this distinction will be clarified later). Did the degree of offsetting differ at various stages of the inflation process? If so, why? To what extent was the BOI's injection motivated by the desire to smooth interest rates? Finally, what was the policy with regard to ΔCB in recent years when the BOI has been engaged in a disinflation process? The econometric analysis enables us to address all these questions.

Some stylized facts.

Table 1 describes the main features of the various monetary injections in the course of the inflationary developments in Israel over the past 30 years. This history is divided into four distinct parts. The first two relate to the inflationary era and the last two relate to the post 1985 stabilization. The inflationary period was characterized by very large government injections relative to the monetary base (Table 1A), and by large purchases of foreign exchange by the public from the BOI to finance the substantial current account deficits (Table 2) and capital flight. This is a feature of the twin deficit phenomenon, characteristic of fixed exchange rate regimes with capital controls.

Table 1B shows that seigniorage, as percent of GNP (column 4), was fairly constant in the inflationary period, in spite of the tremendous increase in the rate of growth of base money, which suggests that inflation cannot be explained fully by the fiscal motive alone. Throughout this period inflation outpaced the increase in the MB so that the real MB contracted. Apart from this, the relation between the rate of growth of MB and inflation was pretty close. The size of the injection of the BOI appears to be very small, but it hides intensive activity in two opposing directions, as can be inferred from the standard deviations in Table 3. The sizeable variation of conversions of foreign exchange into domestic currency (and vice versa) in all four periods shows that there never was a regime of a pure float for any extensive time span.

The post stabilization sub-periods show small injections from the public sector, and sizeable injection from the sale of foreign exchange by the private sector in the last period, resulting from the high interest rate policy of the BOI in that period. The latter policy required the sterilization of short term capital on a massive scale which is reflected by a close (negative) association between ΔCB and ΔF after 1994. This is in fact what we should expect from a tight monetary stance of the CB in an open economy with a managed exchange rate. In the fourth period inflation was practically eliminated, and this can in part be related to the tight monetary policy of the BOI as reflected by the large negative ΔCB in that period, in a regime with relatively low fiscal deficits (Table 1).

Table 4 shows the simple correlation coefficients between the various monetary injections in the inflationary and post stabilization periods. This table suggests that the BOI tried to offset the two other sources of monetary injection in most cases. The correlation between ΔMB and ΔCB is usually low, as one would expect if the latter were successful in stabilizing the former.

The monetary story in pictures

Figures 1-3 present the main features of the monetary history of Israel since 1973 (recall that all variables are expressed as percentages since they are normalized by the beginning of period MB). Figure 1 shows that the liquidity injection by the public sector (through the government budget and development loans) was a dominant feature of the inflationary era, especially in the 1979-84 period. To offset (partially) the inflationary consequences of this injection the BOI implemented a contraction of ΔCB. After the 1985 stabilization the monetary injection from the public sector behaved rather regularly, as a result of the "no printing law", enacted in 1985, which forbade the BOI to finance the deficits of the government.

Figure 2 shows that there were two major shocks associated with foreign exchange conversion by the private sector. Just prior to the stabilization of 1985 there started a capital outflow as a result of fears of repudiation of the large pubic debt, accumulated in the inflationary era (Table 2). The BOI tried to offset the effect of this outflow on domestic liquidity (after a short lag) by raising the rate of ΔCB, in spite of the acceleration of inflation in that period. After the stabilization, there was a period of lax monetary policy by the BOI in 1993 which was reflected in a capital outflow (a negative ΔF). The tight monetary policy implemented in the end of 1994 induced a large wave of capital inflows as a response to the large spread between the domestic and foreign interest rates, with the exchange rate (ER) movement restricted by the appreciated limit of the ER band. In order to restrain the expansionary effect of the foreign exchange conversion on the monetary base, the BOI implemented a sterilization policy on a massive scale, which was reflected by a sharp drop in ΔCB in 1995-97.

In figure 3 we combine the two former injections (ΔG+ΔF) and plot it against ΔCB. This shows that there were two main monetary shocks- one related to the fiscal expansion in the 1982-84 period and another related to the capital inflows resulting from the tight monetary policy in 1995-97. In both cases the BOI contracted ΔCB to offset the impact on the MB. The monetary contraction in these two episodes resulted, as one would expect, in

an increase in real short term interest rates. The difference between these cases is that in 1982-84 tight money was implemented in the context of large fiscal deficits, while in the second case tight monetary policy took place under relative fiscal discipline, as part of an explicit effort to bring down inflation to single digits. It is only in the latter case that tight monetary policy can be effective in reducing inflation. Note also that there was a considerable expansion of ΔCB in the year of stabilization (1985), which was due to the shift from dollar-linked deposits (Patam) to the non-linked base, with the reduction in inflation. By definition, this shift implies an increase in both ΔMB and ΔCB, but it has no inflationary implications.

The econometric model.

To construct our estimating equations we use the identity

(1) $\Delta MB= \Delta CB+\Delta G+\Delta F$

assuming that

(2) $\Delta MB= C+a_1\Delta G+a_2\Delta F -(1-a_3)x+u$

where a_j (j=1,2) are non-negative parameters indicating the desire of the CB to prevent the passthrough from the monetary injections to the MB. We treat these parameters in the present stage as arbitrary, but we will show later how they can be derived from an optimization process. In the above equation, x stands for other variables, such as inflation or the fiscal deficit, which we shall introduce later. For example if x represents inflation, then the CB may accommodate it (in which case $a_3 >1$) or sterilize it (in which case $a_3<1$). C is a constant and u is a random disturbance. We can treat the case of $a_j=1$ (j=1,2,3) and $C-(1-a_3)x+u=0$, i.e. $\Delta MB=\Delta G+\Delta F$, as a benchmark case of full monetary accommodation by the CB. Substituting (2) in (1) we obtain

(3) $\Delta CB=C- (1-a_1)\Delta G- (1-a_2)\Delta F -(1-a_3)x+u$

which is our basic estimating equation. [For the time being we ignore the term $-(1-a_3)x$] .Under complete sterilization we have $a_j=0$ (j=1,2) so that the coefficients of ΔG and ΔF will be minus one.

The need for econometric estimation is due to the fact that the aggregative data in Table 1 can be given different interpretations. Take for example the first line in Table 1A. We have approximately the realization [$\Delta CB=0$, $\Delta F= -12$, $\Delta G=18$ and $\Delta MB=6$]. Setting $C+u=0$ in (3) we see that this realization is consistent with full monetary accommodation $a_j=1$ (j=1,2), without any need for CB intervention. However it can be seen that $a_2 =0$ and $a_1=1-\lambda$, where $\lambda= -\Delta F/\Delta G$, is also consistent with the above realization. In the above example $1-\lambda=1/3$, which means that a high degree of sterilization is also consistent with the data. In fact, there is a whole intermediate range of parameters which is consistent with the realization in question. It is the role of the econometric analysis to uncover which was the

choice of the CB in practice, and the role of economic theory to explain the rationale of the choice. We shall present our results in terms of OLS estimation and then discuss some ways of overcoming possible biases.

The sterilization coefficients under different exchange rate regimes.

The Mundell-Fleming model (full capital mobility) with a fixed exchange rate.

In this case the CB has no control over the MB, consequently any exogenous shock will be fully reflected by a change in foreign reserves and in ΔF. (In this model ΔCB is identically zero, but we have seen that in fact its variance is sizeable). Hence this must be a case of full accommodation (a_i=1).

The Mundell-Fleming model with a pure float.

In this case the CB does not intervene in the foreign exchange market so that ΔF=ΔMB=0, and consequently (ΔCB+ΔG)=0. This implies that the offset coefficient of ΔG is minus one. The implication is that the variances of ΔF and ΔMB should be zero, but know from table 3 that in fact they are of the same order of magnitude as those of the other injections.

Current account convertibility (no capital mobility) and a fixed exchange rate.

In this case monetary injection from the public sector (ΔG) will reduce the interest rate and create a current account deficit, which requires purchase of foreign exchange from the CB (a negative ΔF). This leads to a negative relation between ΔG and ΔF (as was in fact the case). ΔMB will increase with ΔG unless it is sterilized by ΔCB. The degree of sterilization is a decision variable of the BOI. This model is more consistent with the data than the other alternatives.

The inflationary period

1. Sterilization.

We first estimate the equation

(4) $\Delta CB = C + b_1 \Delta G + b_2 \Delta F$

If C=0 then the b_i's are estimates of -(1- a_i). The results for the different sub-periods are presented in table 5. We consider first the inflationary era, which is divided into two sub-periods. It can be seen that C is not significant (except for the third period), so that the (minus) b_is are usually estimates of the sterilization coefficients (1- a_i) of the BOI with respect to monetary injection from the public sector and from capital inflows. The results indicate that these were close to one and highly significant. In the first period the BOI sterilized over one third of ΔG and over one half of ΔF, and in the second period (when inflation jumped to a higher plateau, see Table 1) ΔF was sterilized completely (b_2=-1) and ΔG by three quarters. So the answer to the question of whether the BOI sterilized shocks to the MB is a clear "yes". It seems also that the degree of sterilization increased with the inflation plateau. Was the tendency to fully sterilize ΔF after the seventies completely accidental? We will show later that there was an economic basis for this policy.

Although the sterilization coefficient of ΔG and ΔF are similar, it should be recalled that in the former case we speak about an increase in the MB while in the latter we deal with a decrease in MB (see Table 1). The sterilization of ΔG can be viewed as a tight monetary policy by the CB, which was intended to mitigate the inflationary effect of the fiscal policy. On the other hand, the sterilization of ΔF was in fact a policy of mitigating the mechanism of the "rules of the game" which requires that an outflow of foreign exchange, associated with a trade deficit, should be allowed to raise domestic interest rates. However, it seems that the policy of the BOI was to give priority to the stability of the money supply and the interest rates over the concern for external balance. .

We next use the estimating equation

(5) $\Delta CB= C+c_1(\Delta G+\Delta F)+c_2\Delta G$

to test the significance of the difference between the coefficients of ΔG and ΔF. In both sub-periods the BOI appears to have sterilized more heavily the capital outflows than the monetary injection of the public sector (this statement is statistically significant only in the second period in quarterly data, but is significant in both periods in monthly data (Table

5)). One explanation of this finding is that the BOI was more averse to a contraction of the monetary base (and a rise in interest rates) than to its expansion (and a consequent fall in real interest rates). This is consistent with the tendency of the government at that time to avoid the emergence of unemployment. Another explanation will be given below.

In view of the data in Table 1, the above findings raise the question of why did the BOI have to intervene so intensely, through ΔCB, in the process of foreign outflow originating in the monetary injection from the public sector. If we take the outflow of capital, related to ΔG, as an independent process, then a passive policy of the BOI , with a_i=1, would still result in approximately the same spillover of ΔG to ΔF and lead to the same ΔCB and ΔMB (we refer to lines 1 and 2 in Table 1A). Thus if the CB were interested only in the level of the rate of monetary expansion, then it could possibly attain the realized rate without any sterilization at all. So why did it adopt such an aggressive sterilization policy?

2. Smoothing interest and inflation rates.

A possible explanation for the actual policy is that by the active sterilization policy, the BOI could reduce the variance of the short-term interest and inflation rates. In the absence of active intervention, the leakage from ΔG to ΔF would require a prior reduction of domestic real interest rates or an increase in domestic inflation, which the BOI tried to avoid. This is a reasonable conclusion in view of the fact that the money injections were very large compared to the monetary base (Table 1A).

An indirect supporting evidence for the view that the BOI was interested in stabilizing the MB is provided by the Table 3, which shows that the standard deviation of the monetary base was consistently smaller than those of the various monetary injections. Table 13 provides similar evidence regarding the variation of the nominal interest rates on loans (Hahad) and on time deposits (Tafas). It is seen that in the first period of the inflationary era, the standard deviations of these interest rates were much smaller than those of other nominal variables, which incorporate inflation expectations, such actual

inflation, wage inflation and devaluation. The table suggests that when inflation went out of control after 1978, the stabilization effort was unsuccessful.

3. A model of sterilization

We now derive the a_i coefficients from an optimizing model. Suppose that the ΔMB function is given by:

(6) $\Delta MB=a_1\Delta G+a_2\Delta F+u$

where a_i are non-negative and u is a random variable. There is a spillover[2] from ΔG to ΔF given by λ, so that

(7) $\Delta F=AF-\lambda\Delta G$

where AF is random and unrelated to ΔG. Inserting (7) in (6) yields[3]

(8) $\Delta MB=\beta\Delta G+(a_2AF+u)$, $\beta=a_1-\lambda a_2$

The expected value of (8) is $\beta E\Delta G$ and its variance (V) is

$V(\Delta MB)=\beta^2V(\Delta G)+a_2^2V(AF)+V(u)$. We define the loss function of the CB as

(9) $L=(E\Delta MB-\Delta MB^*)^2+\gamma V(\Delta MB)$, $\gamma>0$

which is a function of a_i. This loss function assumes that the CB cannot deviate (with its $E\Delta MB$) too much from the needs of the treasury to finance the deficit, as indicated by the target value ΔMB^*. Given this constraint, the CB wishes to reduce the variance of ΔMB as much as possible. Optimizing w.r.t. the a_i parameters, which are determined prior to the realization of the random shocks, we obtain

(10) $a_2=0$ and $a_1= (\Delta MB^*/E\Delta G)/[1+\gamma V(\Delta G)/E\Delta G^2] >0$

The first result is intuitive[4]. In view of the expression for $V(\Delta MB)$ the CB can minimize the variability originating from AF (say foreign shocks) by setting $a_2=0$, which implies that the offset coefficient $(1- a_2)= 1$, as appears to be the case empirically after 1979. (10) shows also that $(1- a_1)$ is smaller than 1, as is the case empirically. Note also that a larger

[2]As in the model with capital controls and a fixed exchange rate. As a first approximation I assume that λ is independent of the sterilization policy.

[3] This implies that the shocks originate in the supply side of the money market, which justifies minimizing $V(\Delta MB)$, other things equal.

[4] The assumption $\lambda>0$ is critical for this result.

variance of ΔG is associated with a higher offset coefficient $(1- a_1)$, which is again consistent with the data of the inflationary period[5].

The foregoing model can be extended to include a component of capital flows which is related to the interest differential r-r*, where r denotes the domestic interest of the CB and r* is the foreign interest rate. We assume that the money injection induced by the interest differential (which depends on the exchange rate regime) is a positive function of the latter, say f(r-r*), with f(0)=0. We may then express ΔF as $\Delta F=-\lambda\Delta G+AF+f(r-r^*)$. With this extension we have

(11) $\Delta MB=a_1\Delta G+a_2\Delta F+u= \beta\Delta G+a_2AF+f+u, \qquad \beta =a_1-\lambda a_2$

and accordingly,

(12) $E\Delta MB=\beta E\Delta G+a_2 f$ and $V(\Delta MB)= \beta^2 V(\Delta G)+a_2^2V(AF)+V(u)$

We minimize the loss function (9) w.r.t. a_i treating the interest differential as a predetermined variable. This yields the following optimal values:

(13) $a_1=(\Delta MB^*-E\Delta MB)\gamma^{-1}\{[(E\Delta G/V(\Delta G)] +\lambda[f/V(AF)]\}, \quad a_2=(\Delta MB^*-E\Delta MB)f/\gamma V(AF)$

where $(\Delta MB^*-E\Delta MB)$ is positive by the first order conditions if $\beta>0$. By contrast with the previous results, $a_2>0$ when the interest differential is positive.

The equation $\Delta F=-\lambda\Delta G+AF+f(r-r^*)$ can be estimated by $\Delta F=C+a\Delta G$. The results are reported in Table 6, which shows that only in the last sub-period (1995:1-2001:3) do we find a significant positive constant C, which indicates a positive value for f(.). This makes sense, since we know that in this period the BOI created a positive interest differential.

The value of the parameter γ can be interpreted as an index of CB independence, since a higher value of this parameter means that the CB is less pressured to adhere to the government's target ΔMB^*. In view of (13) this implies that in the seventies, when the CB was presumably less independent, the offset coefficients $(1-a_i)$ should be smaller, insofar as the a_is are positive. This is a possible explanation why the offset coefficient of ΔG was relatively low in the beginning of the inflationary era (Table 5). An alternative explanation of this phenomenon is that in the early stage of the inflation process the BOI was restricted

[5] The results of this section are also consistent with a ΔF function of the form $\Delta F=AF- \lambda a_1\Delta G$.

by its limited control over the use of monetary policy instruments (see Cukierman and Sokoler 1989).

The model can be used to estimate to what extent did the actual (average) rate of monetary expansion ($E\Delta MB$) deviate from the government's target (ΔMB^*). If we assume that $\gamma=1$ then we obtain that the former was lower than the latter by 32% in the first period and by 17% in the second period. According to the model, this was the result of the BOI's incentive to stabilize the monetary base (otherwise the deviation should be zero).

4. Fiscal deficits and money injection.

The next question is whether the sterilization policy of the BOI distinguished between money injections originating from the flow of fiscal deficits (expenditures minus taxes) as opposed to injections associated with capital transactions, such as public sector lending to firms. Here we use the definition $\Delta G= Def+(L-B)$ where Def denotes the operational domestic deficit (excluding the BOI), L is public medium term and long term lending and B stands for the medium-term and long term borrowing from the private sector. One would expect that the inflationary consequences of an increase in Def, which may represent a long term stream, should be larger than of net lending (L-B), which is a balance sheet item. The latter can be viewed as a one-time open market operation. Therefore, one would expect that the marginal effect of Def on ΔCB, for given values of ΔG and ΔF, should be negative. However, Table 7 shows that the coefficient of Def was approximately significant (t-value close to 2) only in the inflationary period, where it had the "wrong" sign. This leads to the conclusion that the BOI did not assign any importance to the composition of ΔG. The lack of distinction between Def and L-B implies, for example, that an increase in government expenditures, which was financed by long term borrowing (and hence increased Def), did not induce any significant reaction from the BOI. However, according to long term models of economic behavior, bond-financed increase in the deficit may have immediate inflationary consequences. This suggests that

the BOI took the public sector's deficit and the debt/GDP ratio as given, as far as its monetary policy was concerned.

Targeting the monetary base and "unpleasant monetarist arithmetic"

We noted that the BOI sterilized most of the monetary injection from the public sector without paying much attention to whether it was related specifically to the fiscal deficit. This would indeed reduce inflation if the path of inflation were identical with the path of the supply of base money. However, as Sargent and Wallace (1981) have shown, tight money can raise inflation if the fiscal deficit remains intact. The reason is that a reduction in money finance of the deficit increases the bond-finance component, which raises the future interest burden, and therefore the possibility of future monetization of the deficit. This may raise not only future inflationary pressures, but also current ones. Figure 4 shows, in the framework of the above model [see also Liviatan (1984)], a possible scenario of the effect of a reduction in the rate of monetary growth (μ) over a certain time interval, when the primary deficit remains constant. The eventual stabilization of the public debt is assumed to be implemented partly by seigniorage. It is seen that up to the stabilization at time T, inflation (π) is increasing in spite of the decrease in the in the rate of monetary expansion. It is only at T that the latter is raised to catch up with inflation (this implies also that seigniorage is decreasing while the inflation tax is increasing).

The developments in Israel in the pre-stabilization phase, fit some features of the above scenario, although the general features of the growth of MB and of inflation are similar. The BOI tried to sterilize the monetary injection from the public sector while the latter did not cut the fiscal deficit. This contributed to the persistent increase in the public debt, as in the Sargent-Wallace model, with an associated acceleration of inflation in spite of sterilization of the money injections. Table 8 shows that while the BOI sterilized ΔG and ΔF, it did not react to the acceleration of inflation by reducing its monetary injections. (This is also confirmed in terms of the wage inflation in Table 9). These findings are

consistent with the view that the BOI gave up the objective of targeting inflation, and concentrated its efforts on stabilizing the variance of the monetary base, and (indirectly) of the interest rates and economic activity.

What were the alternative options of the BOI in this situation? There was not much that the BOI could do under persistent fiscal deficits. According to the Sargent-Wallace model the BOI could do better by remaining passive and not trying to sterilize the monetary injections of the public sector. However, this would entail greater instability of interest rates and output. So even if the BOI had an intuitive understanding of the Sargent-Wallace argument, it had a case for sterilizing monetary injections. Note also that when we view this issue from the real-time perspective, we have to take into account that it was not clear whether the government would persist in maintaining large deficits. In fact one cannot rule out the possibility that a tough stance of the BOI would cause the government to reduce its deficit. Consequently, in the context of a short term framework, the BOI's sterilization policy can be understandable even in the disinflationary context. Thus, if the fiscal deficits were expected to decrease in the near future, there was no point in raising the rate of monetary expansion (by reducing sterilization) as required by the Sargent-Wallace model. As the years went by and the fiscal deficits did not diminish, it can be assumed that the BOI accepted the fact that it cannot control inflation and it should better direct its efforts to minimize the damages of inflation variability.

The post-stabilization era

The basic feature of the post-stabilization era has been the drastic reduction in the fiscal deficit (Table 2), which enabled the reduction in the debt/GDP ratio and the gradual retreat of the government from the domestic capital market. The second feature of this stage was the greater integration of Israel in the world economy as a result of financial liberalization. From the point of view the monetary regime we can divide this period into two sub-periods. In the first sub-period (1985-94) the government adopted the exchange rate (ER) as the monetary anchor of the economy, first in the form of a fixed ER regime,

and then in the form of a sliding ER band, which was widened gradually over time. In this period real interest rates were very high, as is usual in the beginning of disinflationary processes. In this regime the interest rate was used mainly to support the ER anchor. In the second sub-period (1995-2001) the BOI adopted an inflation target regime, using the interest rate on its funds as the main policy instrument. The ER was endogenous to the inflation target and to the interest rate policy, but it was constrained by the floor (i.e. the appreciated limit) of the ER band, which prevented further appreciation. This introduced some inconsistencies in monetary strategy.

1. Invariance of the injection function of the BOI.

Table 5 shows that the BOI's policy of sterilizing monetary injections from different sources continued in the post-stabilization period. The striking feature of the post 1985 period is that the BOI's injection function remained much the same as in the high inflation period. For example, the sterilization parameters of the estimating equation for the high inflation period and for the period after 1995 are almost identical (Table 5A). Given that capital flows were virtually completely sterilized, the dominant factor in the reduction of ΔMB was the drastic reduction in ΔG.

Given that inflation was reduced drastically after 1985, what was the reason for maintaining such high sterilization coefficients? The expressions for the optimal coefficients in (10) may answer this question. Note that the coefficient of variation of ΔG [the square root of $V(\Delta G)/E\Delta G^2$ in (10)] can be calculated directly from tables 1 and 3. This calculation shows that the coefficient of variation increased dramatically after the 1985 stabilization (from less than one in the inflationary period to around three after 1985). These results suggest that the determination of the offset coefficients in the post stabilization era were dominated by considerations of variance-aversion rather than by the reduction of the growth of base money .

The main changes that distinguish the inflationary period from the following one are not to be found in the offset coefficients of the BOI's injection function but rather in the

background information. First and foremost was the reduction in the fiscal deficit and the gradual reduction of the public debt, which according to the Sargent-Wallace model was the source of the rise in inflation. According to this theory, tight monetary policy by the BOI, which was inflationary in an environment of large fiscal deficits, could be an effective disinflationary strategy when the deficit is reduced and the debt/GDP ratio is declining. A related feature was the decline in the current account deficit (Table 2), which was the source of external crises, which gave rise to inflation-devaluation cycles in the inflationary era.

2. Spillover from the public sector injection.

Another feature of the post-stabilization period is that the spillover from the fiscal deficit to capital outflows was much weaker in this period (see the correlations between ΔG and ΔF in Table 4 and the regressions in Table 6A), reflecting the greater willingness of the public to hold short term government paper. This implies that the expansionary effect of an increase in the fiscal deficit on the money supply could be offset by open market sale of short term bonds rather than by a sale of foreign exchange. Thus the foreign exchange reserves of the BOI were more immune to fiscal shocks, which tended to destabilize the system in the inflationary period.

The fact that the sterilization policy of the BOI continued on much the same intensity in the post stabilization period as in the high inflation years, suggests that the policy of stabilizing the interest rates continued to be an important objective of the BOI, along with the aim of reducing inflation.

3. The changing pattern of capital flows.

The differences between the two sub-periods of the post 1985 period, are also mainly explicable in terms of the background developments. In particular, the tight monetary policy changed the pattern of capital inflows and outflows. As can be seen in Table 1, the inflationary period was characterized by large capital outflows (as reflected by the sale of foreign exchange by the BOI), which continued on a smaller scale in the first years

following 1985. This pattern was reversed with the implementation of the tight monetary policy after 1994, where the economy experienced large capital imports attracted by the interest differential and by exogenous inflows in the form of financial and direct foreign investment. The BOI sterilized these inflows, as was required by the policy of maintaining high domestic interest rates. This was reflected by the large negative monetary injections by the BOI, of over 2% of GDP (on average after 1994), as indicated by Table 1.

4. Implementing tight money.

The tendency to use tight monetary policy in the post-1994 period, is shown clearly by the strong negative correlations in Tables 10 and 11 between ΔCB and the interest rates. Before the tight money strategy (1986-94) the correlations between these variables were small and usually positive, while after 1994 they became large and negative. Another feature of that regime, is the closer association between inflation and monetary contraction by the BOI, as indicated by the negative correlations between ΔCB and inflation in Table 12. The effort to reduce inflation was in fact the motivation behind the tight monetary policy of that period. Note that this is the only period in the monetary history of Israel that the BOI's injection reacted systematically to offset increases in inflation.

5. BOI injections and interest rates.

In 1994 the monetary strategy of the BOI shifted to the use of high interest rate policy in the framework of an inflation target regime. This required a reduction of the money injections by the BOI , which was characterized by a sharp curtailment of the monetary loan to the commercial banks. This shift can be seen clearly in figure 5 which shows that the increase in the real interest rate on BOI funds was supported by a cut in its monetary injections for a number of years starting in 1994. The other side of this picture are the large capital imports induced by the interest differential which had to be sterilized in order to contain the monetary base. This process was helped only to a small degree by the contraction of the injection by the public sector (figure 5).

The portfolio models tell us that the determinant of the real short term interest rate is the stock (rather than the flow) of domestic credit of the BOI to the public. The relatively long period of negative injections by the BOI described in figure 5 captures part of this effect. A more direct measure of the stock of domestic credit to the public is the cumulative real BOI injection. The development of this stock over time is therefore an indication of the stance of monetary policy in the period in question, and can accordingly be related to the path of real interest rates. Figure 6 shows that the two sub-periods (before and after 1994) were very different from this perspective. The first sub-period was one of (relatively) easy money as reflected by the rising trend of "domestic credit" and falling real interest rates on loans. By contrast, the second sub-period was one of contracting domestic credit and rising interest rates. Figure 6 points to some reversal of this policy in recent years.

The time dimension.

The comparison of regression coefficients obtained from quarterly and monthly data provides us with an additional aspect of the BOI's injection function, namely the speed of the policy response. Comparing Tables 5A and 5C we observe that, in the inflationary period, the monthly coefficients are systematically lower than the quarterly ones. This reflects the fact that in that period, it took more time for the BOI to react to changes in monetary injections originating in the public sector or in capital flows. This has probably to do with the limited range of instruments available to the BOI in that period.

Tables 6 and 6A show another aspect of the time dimension. A comparison of these two tables shows that the government injection affects the monetary base less in quarterly data compared with monthly data, while the opposite is true for capital flows. This implies that in the short run the main thrust of money injection from the public sector is to increase the monetary base, while after a while ΔG finds its way to the balance of payments.

The problem of simultaneity.

We have finally to deal with a difficult econometric problem in the form of simultaneity, which stems from the fact that all three injections are to some extent endogenous variables of the economic system. It may be the case, however, that ΔG and ΔF are exogenous from the point of view of the BOI. However, we never know for sure whether this is a legitimate assumption in the concrete empirical setting of our analysis. Even if the above variables are endogenous, it is likely that the random element in the equation of ΔMB is positively correlated with ΔG or ΔF so that the estimated offset coefficients are smaller than the true ones. In this case our conclusion that the offset coefficients are large is only strengthened.

It is usually believed that ΔG is indeed exogenous with respect to ΔCB, which is not necessarily true for ΔF. In that case we may estimate a reduced form regression of ΔMB on ΔG. According to the optimization model described earlier this yields an unbiased estimate of $\beta=a_1-\lambda a_2$. If in addition $a_2=0$, as in that model, then we obtain an unbiased estimate of a_1. The reduced form estimates of b are presented in Table 6A and are in most cases (except for the first period) consistent with the aforementioned hypotheses.

Suppose, however, that we cannot rely on any of the above assumptions, so that we have to eliminate the possible bias. One way of dealing with this simultaneity problem is by instrumental variables. As is well known, it is difficult to find variables which are correlated with our independent variables and uncorrelated with the error term in the estimating equation (as required by this approach). All that we can do is to search for variables which approximate the required characteristics. Table 14 reports the results of using Libid as an instrument in the equation $\Delta CB=C+b(\Delta G+\Delta F)$. It can be seen that the t-statistics are below 2. But the point estimates in this table are broadly in line with our previous results, or at least do not contradict them (compare with Table 7A, taking account of the standard errors).

Another approach to the simultaneity bias is based on the idea that if we can find a cointegration relationship between our variables then the estimates are consistent (that is,

they are free from the simultaneity bias in large samples). We base this analysis again on the equation $\Delta CB=C+b(\Delta G+\Delta F)+u$. As a preliminary check we conducted ADF tests for the degree of integration of the variables. It turned out that ΔCB passes the I(0) test at the 1% level while $(\Delta G+\Delta F)$ is not rejected as I(0) at the 5% level and u just touches I(0) at the 1% level[6], which is not entirely satisfactory. The estimating equation yields as an estimate b= -0.79 with standard error 0.07, which confirms a high degree of offsetting over the sample as a whole.

Conclusions

In this paper we characterized the monetary history of Israel by a single quantitative index in the form of the "monetary injection of the BOI". Our analysis shows that the main concern of the BOI in the inflationary period (before 1985) was to stabilize the variations of the monetary base, rather than to reduce the inflation level. In fact, the BOI could do very little with regard to the level of inflation as long as the government persisted with large fiscal deficits. But it could, and did, offset the effect of monetary shocks originating from the public sector or from the balance of payments on the monetary base.

In the post-stabilization era the BOI continued with the tight sterilization policies in order to stabilize the monetary base. This can be attributed to the fact that the coefficient of variation of the monetary injections from the public sector increased after the stabilization, thus requiring continuation of the sterilization effort. The special feature of the monetary policy in recent years was the effort to reduce inflation by means of high interest rates, as was the case with disinflation programs in other countries in the nineties. The large capital imports induced by this policy were absorbed by the BOI in order to maintain the competitive position. However, this required a sharp cut in the monetary injection from the BOI in order to stabilize the monetary base. The period after 1995 is in fact the only period

[6] The ADF values of ΔCB, $\Delta G+\Delta F$ and u for I(0) are –3.64, -2.88 and –3.10. The critical values are 1% -3.49, 5% -2.89 and 10% -2.58.

in the economic history of Israel where monetary policy was used actively to reduce inflation.

Appendix- Definitions of Monetary Injections

1. Private conversion (ΔF)= Sale of foreign exchange by the private sector to the BOI minus the increase in commercial banks' forex deposits at the BOI.

2. BOI injection (ΔCB)= Change in (BOI's monetary loan to the banks +directed credit) minus change in [stock of short term treasury bills (Makam) in the hands of the public (a liability of the BOI) + stock of commercial bank's (non-reserves) deposits acquired at BOI's auctions + banks' deposits originating in swap operations+ basis of short term dollar-linked deposits (Patam) held by the banks] minus net income originating in the balance of these instruments, plus other net expenditures of the BOI (such as wage payments, etc.).

3. Government injection (ΔG)= Change in BOI's loans to government minus change in government's deposits at the BOI plus government's contribution to the foreign exchange reserves of the BOI plus the balance of the profit and loss account of the BOI.

ΔG also equals domestic public sector deficit plus long and medium-term government loans to the private sector minus long and medium term public sector borrowing.

4. Change in the monetary base (ΔMB)= Change in currency outside the BOI plus change in banks' deposits held in the BOI as reserves against their sheqel deposits. Also equals sum of the first three items.

REFERENCES

Alesina, A. and G. Tabellini, (1987), "Rules and discretion with non-coordinated monetary and fiscal policies", Economic Enquiry, 25:619-630.

Cukierman, A. and M. Sokoler, (1989), "Monetary policy in Israel and its institutional arrangements: past, present and future", Economic Quarterly, (Hebrew), No. 139, pp.371-426.

Liviatan, N. (1984), "Tight money and inflation", Journal of Monetary Economics, 13:5-15.

Rogoff, K. (1985), "The optimal degree of commitment to an intermediate monetary target", Quarterly Journal of Economics, 100:1069-1190.

Sargent, T.J. and N. Wallace, (1981), "Some unpleasant monetarist arithmetic", Federal Reserve Bank of Minneapolis Quarterly Review, 1-17.

Table 1: Monetary Injections, Inflation and Deficit

A. Normalized by monetary base at the beginning of quarter (percent)

	BOI Injection (ΔCB) (1)	Private conversion (ΔF) (2)	Government injection (ΔG) (3)	Quarterly change in money base (ΔMB) (4)=(1)+(2)+(3)	Quarterly inflation (5)	Domestic deficit* (6)
	Quarterly data					
1973:2 - 1978:4	0.84	-12.68	18.55	6.70	8.62	28.72
1979:1 - 1985:2	-2.46	-55.39	84.67	26.82	29.09	109.87
1986:1 - 1994:4	3.93	-7.11	8.36	5.10	3.77	19.83
1995:1 - 2001:4	-14.97	17.00	1.94	3.97	1.33	18.22

B. Normalized by GNP (percent)

	BOI Injection (1)	Private conversion (2)	Government injection (3)	Quarterly change in money base (4)=(1)+(2)+(3)	Quarterly inflation (5)	Domestic deficit* (6)
	Quarterly data					
1973:2 - 1978:4	0.53	-4.70	6.47	2.29	8.62	8.76
1979:1 - 1985:2	0.05	-4.42	6.27	1.91	29.09	9.36
1986:1 - 1994:4	0.77	-1.12	1.18	0.82	3.77	3.09
1995:1 - 2001:4	-2.20	2.52	0.19	0.51	1.33	2.56

* Available from 1977:Q1

Table 2: Internal and External deficits and public debt.

Percent of GDP, annual data

	Total deficit[1] (+)	Public debt[2]	Public debt[3]	CA account
1973 - 1978	15.78	112.58		-7.10
1979 - 1984	12.06	153.17	136.00	-6.46
1986 - 1994	3.63	126.68	117.86	-1.35
1995 - 2001	4.24	96.45	85.86	-3.47

[1] Internal and external fiscal deficits

[2] The data is for 1978 - 1996, Dahan and Stravchinsky (1999)

[3] The first observation is for 1983 (BOI annual reports)

Table 3: Standard Deviations, quarterly data, normalized by beginning of the period monetary base

	BOI Injection	Private conversion	Government injection	Quarterly Inflation	Private conversion+Gov. injection	Change in monetary base
1973:2 - 1978:4	9.06	15.15	10.08	4.11	12.48	8.19
1979:1 - 1985:2	45.24	60.6	75.38	14.07	45.17	31.66
1986:1 - 1994:4	38.5	34.17	26.56	1.58	40.29	13.37
1995:1 - 2001:3	30.74	29.76	19.37	1.38	31.21	10.33

Table 4: Correlations between Monetary Injections[1] - quarterly data

1973:1-1978:4

	BOI Injection	Private conversion	Government injection	Change in monetary base
BOI Injection	1.0000	-0.6884	0.1000	-0.0437
Private conversion	-0.6884	1.0000	-0.5742	0.3808
Government injection	0.1000	-0.5742	1.0000	0.2797
Change in monetary base	-0.0437	0.3808	0.2797	1.0000

1979:1-1985:2

	BOI Injection	Private conversion	Government injection	Change in monetary base
BOI Injection	1.0000	-0.3592	-0.1634	0.3523
Private conversion	-0.3592	1.0000	-0.8006	-0.5054
Government injection	-0.1634	-0.8006	1.0000	0.6149
Change in monetary base	0.3523	-0.5054	0.6149	1.0000

1986:1-1994:4

	BOI Injection	Private conversion	Government injection	Change in monetary base
BOI Injection	1.0000	-0.6772	-0.5576	0.0593
Private conversion	-0.6772	1.0000	-0.1377	0.3065
Government injection	-0.5576	-0.1377	1.0000	0.0291
Change in monetary base	0.0593	0.3065	0.0291	1.0000

1995:1-2001:4

	BOI Injection	Private conversion	Government injection	Change in monetary base
BOI Injection	1.0000	-0.8386	-0.1363	0.3036
Private conversion	-0.8386	1.0000	-0.3490	-0.2686
Government injection	-0.1363	-0.3490	1.0000	0.4641
Change in monetary base	0.3036	-0.2686	0.4641	1.0000

[1] Normalized by beginning of quarter monetary base.

Table 5: Regressing BOI Injection on the Other Injections (Quarterly Data), percent*

(Normalized by beginning of the period monetary base)

	C	Private conversion	Government injection	Private conversion+Gov. injection	R2	DW
Table 5A						
1973:2 - 1978:4	1.0387 2.6781	-0.5631 0.1028	-0.3959 0.1544		0.6040	1.6283
1979:1 - 1985:2	4.9392 7.7609	-1.0191 0.1433	-0.7540 0.1152		0.6956	2.0035
1986:1 - 1994:4	5.8179 2.3252	-0.8656 0.0655	-0.9614 0.0843		0.8904	3.0354
1995:1 - 2001:3	4.2461 2.1410	-1.0421 0.0650	-0.7752 0.0999		0.9129	2.9447
1973:2 - 1985:2	2.8958 3.5965	-0.9763 0.1007	-0.7143 0.0782		0.6796	1.9772
1986:1 - 2001:4	3.9013 1.5677	-0.9474 0.0457	-0.8974 0.0659		0.8931	2.9724
Table 5B						
1973:2 - 1978:4	1.0387 2.6781		0.1672 0.1272	-0.5631 0.1028	0.6039	1.6283
1979:1 - 1985:2	4.9392 7.7609		0.2651 0.0859	-1.0191 0.1433	0.6956	2.0035
1986:1 - 1994:4	5.8179 2.3252		-0.0958 0.0994	-0.8656 0.0655	0.8904	3.0354
1995:1 - 2001:3	4.2461 2.1409		0.2669 0.0984	-1.0421 0.0650	0.9129	2.9447
1973:2 - 1985:2	2.8958 3.5958		0.2620 0.0560	-0.9763 0.1007	0.6796	1.9772
1986:1 - 2001:4	3.9013 1.5677		0.0500 0.0707	-0.9474 0.0457	0.8931	2.9723

* Numbers in small script are stansard errors

Table 5: Regressing BOI Injection on the Other Injections (Monthly Data), percent*

(Normalized by beginning of the period monetary base)

	C	Private conversion	Government injection	Private conversion+Gov. injection	R2	DW
Table 5C						
1973:02 - 1978:12	-0.1776 0.8426	-0.4934 0.0828	-0.2532 0.0859		0.3694	2.1308
1979:01 - 1985:06	0.7280 3.2086	-0.7161 0.1132	-0.4723 0.0930		0.3704	2.8563
1986:01 - 1994:12	1.9538 1.1123	-0.8915 0.0755	-0.8772 0.0788		0.6839	2.8515
1995:01 - 2001:09	1.4563 1.0222	-1.0114 0.0797	-0.8421 0.0693		0.7621	2.7294
1973:01 - 1985:06	0.4083 1.5799	-0.6958 0.0794	-0.4534 0.0635		0.3662	2.8263
1986:01 - 2001:12	1.4638 0.7339	-0.9393 0.0529	-0.8602 0.0538		0.7185	2.7913
Table 5D						
1973:02 - 1978:12	-0.1776 0.8426		0.2402 0.1085	-0.4934 0.0828	0.3694	2.1308
1979:01 - 1985:06	0.7280 3.2086		0.2438 0.1014	-0.7161 0.1132	0.3756	2.8386
1986:01 - 1994:12	1.9538 1.1123		0.0143 0.1001	-0.8915 0.0755	0.6839	2.8515
1995:01 - 2001:09	1.4563 1.0222		0.1693 0.0953	-1.0114 0.0797	0.7621	2.7294
1973:01 - 1985:06	0.4083 1.5799		0.2434 0.0680	-0.6958 0.0794	0.3662	2.8263
1986:01 - 2001:12	1.4638 0.7339		0.0791 0.0681	-0.9393 0.0529	0.7185	2.7913

* Numbers in small script are standard errors

Table 6: Private conversion as dependent variable and Government Injection*

(Normalized by beginning of the period monetary base)

	C	Government injection	R2	DW
Table 6-1 - Quarterly Data				
1973:2 - 1978:4	3.3176 5.6376	-0.8626 0.2639	0.3297	1.4911
1979:1 - 1985:2	-0.8919 11.0507	-0.6436 0.0983	0.6410	1.7911
1986:1 - 1994:4	-5.6301 6.0077	-0.1771 0.2185	0.0189	2.0696
1995:1 - 2001:3	18.0396 5.3992	-0.5363 0.5824	0.1218	0.7887
1973:2 - 1985:2	-0.6565 5.2068	-0.6467 0.0626	0.6940	1.8152
1986:1 - 2001:4	5.3538 4.3064	-0.3452 0.1780	0.0572	1.4887
Table 6-2 - Monthly Data				
1973:2 - 1978:4	-3.4125 1.1621	-0.1810 0.1239	0.0304	0.7795
1979:1 - 1985:2	-4.7678 3.2050	-0.4367 0.0798	0.2825	2.0809
1986:1 - 1994:4	-1.9628 1.4175	-0.1664 0.1000	0.0254	1.2241
1995:1 - 2001:3	5.9619 1.2531	-0.1639 0.0943	0.0355	0.8037
1973:2 - 1985:2	-3.0405 1.6276	-0.4528 0.0545	0.3207	2.0027
1986:1 - 2001:4	1.5453 1.0002	-0.1883 0.0725	0.0343	1.0106

* Numbers in small script are stansard errors

Table 6A: Change in Monetary base as dependent variable and Government Injection*

(Normalized by beginning of the period monetary base)

	C	Government injection	R^2	DW
Table 6A-1 - Quarterly Data				
1973:2 - 1978:4	2.4880 3.5757	0.2273 0.1702	0.0782	1.7013
1979:1 - 1985:2	4.9562 7.5994	0.2583 0.0676	0.3781	2.0116
1986:1 - 1994:4	4.9809 2.3726	0.0147 0.0863	0.0008	3.0537
1995:1 - 2001:3	3.4859 1.7707	0.2474 0.0926	0.2153	2.9105
1973:2 - 1985:2	2.8802 3.5596	0.2703 0.0428	0.4589	1.9682
1986:1 - 2001:4	4.1388 1.5393	0.0841 0.0636	0.0274	3.0149
Table 6A-2 - Monthly Data				
1973:2 - 1978:4	-1.9063 0.9836	0.6551 0.1049	0.3646	1.7362
1979:1 - 1985:2	-0.6254 3.2711	0.4037 0.0815	0.2441	2.6939
1986:1 - 1994:4	1.7176 1.1056	0.1042 0.0780	0.0166	2.8320
1995:1 - 2001:3	1.1044 0.9069	0.1704 0.0673	0.0724	2.7233
1973:2 - 1985:2	-0.5167 1.6329	0.4088 0.0547	0.2767	2.6436
1986:1 - 2001:4	1.4429 0.7343	0.1321 0.0529	0.0317	2.7930

* Numbers in small script are stansard errors

Table 7: Regressing BOI Injection on the Other Injections and Deficit (Quarterly Data)*

(Normalized by beginning of the period monetary base)

	C	Private conversion	Government injection	Deficit	R^2	DW
1977:1 - 1985:2	-3.2871 6.8060	-1.0426 0.1192	-0.8835 0.1231	0.1735 0.0982	0.7248	1.9825
1986:1 - 1994:4	5.8338 3.0228	-0.8657 0.0676	-0.9609 0.1056	-0.0011 0.1240	0.8904	3.0364
1995:1 - 2001:3	3.0002 3.0360	-1.0634 0.0752	-0.8681 0.7880	0.0982 0.1673	0.9141	2.9722

* Numbers in small script are stansard errors

Table 8: BOI Injection as dependent variable and Inflation (Quarterly Data)*

(Normalized by beginning of the period monetary base)

	C	Private conversion+Gov. injection	Inflation	Government injection	R^2	DW
Table 8A						
1973:2 - 1978:4	4.0521 1.4075	-0.5481 0.1039			0.5698	1.7059
1979:1 - 1985:2	19.6785 7.1221	-0.7560 0.1341			0.5696	2.0106
1986:1 - 1994:4	5.0593 2.1858	-0.8999 0.0550			0.8873	3.0237
1995:1 - 2001:3	3.7400 2.3794	-0.9881 0.0691			0.8872	2.9046
Table 8B						
1973:2 - 1978:4	6.5528 3.0701	-0.5473 0.1043	-0.2907 0.3168		0.5872	1.6356
1979:1 - 1985:2	-6.9805 12.6083	-0.8729 0.1308	1.0342 0.4198		0.6594	2.6322
1986:1 - 1994:4	9.7767 5.7415	-0.8970 0.0553	-1.2521 1.4084		0.8899	2.9060
1995:1 - 2001:3	4.8102 2.8841	-0.9692 0.0752	-1.0699 1.5915		0.8892	2.8060
Table 8C						
1973:02 - 1978:12	2.5192 5.2026	-0.5606 0.1054	-0.1215 0.3630	0.1431 0.1488	0.6063	1.6186
1979:01 - 1985:06	-1.4056 12.4794	-1.0065 0.1464	0.3627 0.5542	0.2110 0.1199	0.7014	2.1691
1986:01 - 1994:12	13.8395 6.3557	-0.8423 0.0669	-2.0192 1.4917	-0.1482 0.1055	0.8963	2.8643
1995:01 - 2001:03	5.2366 2.5896	-1.0244 0.0705	-0.9928 1.4265	0.2655 0.0995	0.9146	2.8095

* Numbers in small script are standard errors

Table 9: BOI Injection as dependent variable and Wage Inflation (Quarterly Data)*

(Normalized by beginning of the period monetary base)

	C	Private conversion	Government injection	Wage Inflation[1]	R^2	DW
1973:2 - 1978:4	2.9485 3.3788	-0.5422 0.1056	-0.3752 0.1565	-0.2200 0.2360	0.6213	1.5794
1979:1 - 1985:2	-3.8129 12.2248	-0.9958 0.1459	-0.7812 0.1192	0.4121 0.9285	0.7071	2.1869
1986:1 - 1994:4	9.8504 3.4436	-0.8813 0.0646	-0.9907 0.0849	-0.9476 0.5539	0.9011	2.7172
1995:1 - 2001:3	2.9098 2.6985	-1.0549 0.0673	-0.7608 0.1021	0.7856 0.9548	0.9153	2.9411

1) Rate of increase in nominal wage per employee post.

* Numbers in small script are stansard errors

Table 10: Interest on Loans (Hahad) and Monetary Injections[1], quarterly data

(Quarterly correlations coefficients)

1973:1 - 1978:4					
	HAHAD t-2	**HAHAD t-1**	**HAHAD t**	**HAHAD t+1**	**HAHAD t+2**
BOI Injection	-0.3043	-0.2925	-0.3021	-0.3957	-0.4210
Private conversion	0.0701	0.0373	0.0058	0.1310	0.1563
Res. Priv. Conver.[3]	0.3472	0.3402	0.3184	0.4315	0.4559
Government injection	0.2953	0.3461	0.3836	0.3072	0.2929
Government injection and Private conversion	0.3237	0.3249	0.3169	0.4073	0.4264
Change in monetary base [2]	0.1564	0.1713	0.1486	0.1827	0.1839
Domestic deficit (since 1977)	0.3884	0.5885	0.2205	0.1309	0.4473
1979:1 - 1985:2					
	HAHAD t-2	**HAHAD t-1**	**HAHAD t**	**HAHAD t+1**	**HAHAD t+2**
BOI Injection	0.1994	0.0923	0.2140	0.1894	-0.2599
Private conversion	-0.3064	-0.3999	-0.6288	-0.7564	-0.5419
Res. Priv. Conver.[3]	-0.1548	-0.0224	-0.2034	-0.3140	0.0367
Government injection	0.2656	0.4804	0.6302	0.7064	0.7009
Government injection and Private conversion	0.0322	0.2653	0.2080	0.1641	0.4427
Change in monetary base [2]	0.3308	0.5102	0.6026	0.5047	0.2601
Domestic deficit	0.1194	0.3858	0.5295	0.5249	0.4616
1986:1 - 1994:4					
	HAHAD t-2	**HAHAD t-1**	**HAHAD t**	**HAHAD t+1**	**HAHAD t+2**
BOI Injection	0.1080	0.0948	-0.0195	0.0389	0.0732
Private conversion	0.0279	0.1111	0.2250	0.1704	0.1619
Res. Priv. Conver.[4]	-0.0105	0.0478	0.1716	0.1071	0.0901
Government injection	-0.1429	-0.2361	-0.1998	-0.2363	-0.2679
Government injection and Private conversion	-0.0706	-0.0614	0.0591	-0.0112	-0.0393
Change in monetary base [2]	0.0992	0.0877	0.1200	0.0783	0.0937
Domestic deficit	-0.3433	-0.4799	-0.5620	-0.6292	-0.6697
1995:1 - 2001:4					
	HAHAD t-2	**HAHAD t-1**	**HAHAD t**	**HAHAD t+1**	**HAHAD t+2**
BOI Injection	-0.6564	-0.6500	-0.6297	-0.5533	-0.5136
Private conversion	0.6292	0.6314	0.5695	0.4662	0.4751
Res. Priv. Conver.[4]	0.6805	0.6768	0.6242	0.5276	0.5260
Government injection	0.0605	0.0354	0.0892	0.1421	0.0964
Government injection and Private conversion	0.6781	0.6635	0.6367	0.5673	0.5458
Change in monetary base [2]	-0.0311	-0.0537	-0.0700	-0.0385	0.0203
Domestic deficit	0.4049	0.3591	0.3821	0.4592	0.4393

[1] Normalized by beginning of quarter monetary base. Monetary injections relate to quarter t. Hahad t+j is nominal interest on Hahad loans in quarter t+j.

[2] Quarterly change in monetary base.

[3] Residuals from regression of Private Conversion on Government Injection for 1973:01 - 1985:02.

[4] Residuals from regression of Private Conversion on Government Injection for 1986:01 - 2001:04.

Table 11: Tafas Interest and Monetary Injections[1], quarterly data

(Quarterly correlations coefficients)

1973:1 - 1978:4					
	TAFAS t-2	**TAFAS t-1**	**TAFAS t**	**TAFAS t+1**	**TAFAS t+2**
BOI Injection	-0.2817	-0.3257	-0.3257	-0.2700	-0.3080
Private conversion	0.0788	0.0912	0.1641	0.1297	0.1404
Res. Priv. Conver.[3]	0.2422	0.3055	0.3793	0.3398	0.3978
Government injection	0.2264	0.3110	0.2746	0.2730	0.3467
Government injection and Private conversion	0.2749	0.3573	0.4153	0.3728	0.4445
Change in monetary base [2]	0.1064	0.1837	0.2729	0.2703	0.3379
Domestic deficit (since 1977)	0.3891	0.5134	0.2438	0.4570	0.5651
1979:1 - 1985:2					
	TAFAS t-2	**TAFAS t-1**	**TAFAS t**	**TAFAS t+1**	**TAFAS t+2**
BOI Injection	0.2218	0.0565	0.0957	0.2062	-0.2872
Private conversion	-0.3158	-0.3786	-0.5415	-0.7817	-0.5128
Res. Priv. Conver.[3]	-0.1912	0.0046	-0.0726	-0.2907	0.0275
Government injection	0.2502	0.4741	0.6191	0.7552	0.6579
Government injection and Private conversion	-0.0062	0.2832	0.3066	0.2116	0.4100
Change in monetary base [2]	0.3081	0.4846	0.5742	0.5964	0.1744
Domestic deficit	0.1008	0.3633	0.5425	0.6250	0.4537
1986:1 - 1994:4					
	TAFAS t-2	**TAFAS t-1**	**TAFAS t**	**TAFAS t+1**	**TAFAS t+2**
BOI Injection	0.0718	-0.2590	-0.1855	0.1336	0.1175
Private conversion	0.0192	0.4938	0.1977	-0.0364	0.0461
Res. Priv. Conver.[4]	0.0070	0.4565	0.2276	-0.0743	-0.0049
Government injection	-0.0466	-0.1459	0.1135	-0.1453	-0.1957
Government injection and Private conversion	-0.0137	0.3286	0.2426	-0.1250	-0.0869
Change in monetary base [2]	0.1718	0.2355	0.1957	0.0145	0.0852
Domestic deficit	-0.2683	-0.3614	-0.3326	-0.4406	-0.4621
1995:1 - 2001:4					
	TAFAS t-2	**TAFAS t-1**	**TAFAS t**	**TAFAS t+1**	**TAFAS t+2**
BOI Injection	-0.6703	-0.6390	-0.6042	-0.5242	-0.4875
Private conversion	0.6462	0.6184	0.5359	0.4366	0.4562
Res. Priv. Conver.[4]	0.6934	0.6623	0.5928	0.4973	0.5046
Government injection	0.0397	0.0321	0.1063	0.1462	0.0902
Government injection and Private conversion	0.6813	0.6482	0.6141	0.5401	0.5226
Change in monetary base [2]	-0.0640	-0.0648	-0.0576	-0.0288	0.0324
Domestic deficit	0.3831	0.3381	0.3797	0.4471	0.4206

[1] Normalized by beginning of quarter monetary base. Monetary injections relate to quarter t.

[2] Quarterly change in monetary base.

[3] Residuals from regression of Private Conversion on Government Injection for 1973:01 - 1985:02.

[4] Residuals from regression of Private Conversion on Government Injection for 1986:01 - 2001:04.

Table 12: Inflation and Monetary Injections[1], quarterly data

(Quarterly correlations coefficients)

1973:1 - 1978:4					
	Q_INFLATION t-2	**Q_INFLATION t-1**	**Q_INFLATION t**	**Q_INFLATION t+1**	**Q_INFLATION t+2**
BOI Injection	0.0117	-0.0408	-0.1612	0.1825	-0.2547
Private conversion	0.0462	-0.0081	0.4508	0.0109	0.1750
Res. Priv. Conver.[3]	0.1594	-0.0122	0.2067	0.0056	0.3103
Government injection	0.2122	-0.0055	-0.6432	-0.0144	0.2130
Government injection and Private conversion	0.2160	-0.0136	0.0318	0.0017	0.3663
Change in monetary base [2]	0.3453	-0.0670	-0.1319	0.2075	0.2772
Domestic deficit (since 1977)	0.3947	0.0101	-0.1093	0.3101	0.1543
1979:1 - 1985:2					
	Q_INFLATION t-2	**Q_INFLATION t-1**	**Q_INFLATION t**	**Q_INFLATION t+1**	**Q_INFLATION t+2**
BOI Injection	0.2053	0.0403	0.0054	0.2015	-0.3659
Private conversion	-0.4670	-0.4207	-0.6397	-0.7788	-0.3854
Res. Priv. Conver.[3]	-0.2292	-0.0027	-0.0852	-0.3622	0.1270
Government injection	0.4098	0.5210	0.7317	0.6983	0.5736
Government injection and Private conversion	0.0573	0.3050	0.3629	0.1205	0.4403
Change in monetary base [2]	0.3751	0.4927	0.5255	0.4598	0.1053
Domestic deficit	0.2175	0.4634	0.4582	0.4838	0.2657
1986:1 - 1994:4					
	Q_INFLATION t-2	**Q_INFLATION t-1**	**Q_INFLATION t**	**Q_INFLATION t+1**	**Q_INFLATION t+2**
BOI Injection	0.0524	-0.2270	-0.1151	0.2131	-0.2060
Private conversion	-0.0401	0.2777	0.3041	0.0632	0.1085
Res. Priv. Conver.[4]	-0.0866	0.3090	0.2384	-0.0211	0.1002
Government injection	-0.1778	0.1186	-0.2533	-0.3235	-0.0326
Government injection and Private conversion	-0.1492	0.3143	0.0967	-0.1548	0.0719
Change in monetary base [2]	-0.2953	0.2915	-0.0555	0.1481	-0.3826
Domestic deficit	0.0803	0.0152	-0.3178	-0.3024	-0.0779
1995:1 - 2001:4					
	Q_INFLATION t-2	**Q_INFLATION t-1**	**Q_INFLATION t**	**Q_INFLATION t+1**	**Q_INFLATION t+2**
BOI Injection	-0.4107	-0.3382	-0.3744	-0.2280	-0.4807
Private conversion	0.2981	0.3323	0.2851	0.4182	0.3827
Res. Priv. Conver.[4]	0.3480	0.3818	0.3271	0.3745	0.4479
Government injection	0.1351	0.1251	0.1055	-0.2828	0.1780
Government injection and Private conversion	0.3923	0.4203	0.3593	0.2349	0.5067
Change in monetary base [2]	-0.1125	0.1905	-0.0975	-0.0126	0.0068
Domestic deficit	0.3496	0.2293	0.4631	0.0323	0.3712

[1] Normalized by beginning of quarter monetary base. Monetary injections relate to quarter t.
[2] Quarterly change in monetary base.
[3] Residuals from regression of Private Conversion on Government Injection for 1973:01 - 1985:02.
[4] Residuals from regression of Private Conversion on Government Injection for 1986:01 - 2001:04.

Table 13A: Nominal rates of change - means and standard deviations, (quarterly data)

	Nominal Hahad rate		Nominal Tafas rate		Change in nominal wage		Inflation		Change in exchange rate	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
1973:1 - 1978:4	7.56	2.00	4.26	1.44	9.22	5.55	8.62	4.11	7.03	9.22
1979:1 - 1985:2	35.79	20.41	22.21	15.24	29.95	14.21	29.09	14.07	28.36	16.61
1986:1 - 1994:4	7.65	3.07	3.11	0.82	4.74	4.48	3.77	1.58	2.06	3.68
1995:1 - 2001:4	4.43	0.76	2.53	0.68	2.11	1.85	1.33	1.39	1.30	2.83

Table 13B: Coefficients of variation (SD/Mean), (quarterly data)

	Nominal Hahad rate	Nominal Tafas rate	Change in nominal wage	Inflation	Change in exchange rate
1973:1 - 1978:4	0.27	0.34	0.60	0.48	1.31
1979:1 - 1985:2	0.57	0.69	0.47	0.48	0.59
1986:1 - 1994:4	0.40	0.26	0.94	0.42	1.79
1995:1 - 2001:4	0.17	0.27	0.87	1.04	2.18

Table 14: Regressing BOI Injection on the Other Injections (Quarterly Data), percent, TSLS[1]

(Normalized by beginning of the period monetary base)

Instrument: Libid[2]	C	Private conversion+ Gov. injection	R^2	DW
1973:1 - 1985:2	9.1229 9.9195	-0.5535 0.5102	0.5098	2.0072
1986:1 - 2001:4	8.2849 12.7003	-1.4042 1.3818	0.6658	2.4743

1) Numbers in small script are standard errors.

2) London Interbank Bid Rate, the rate bid by banks on dollar deposits for 3 months.

Figure 1: Government and BOI Injections

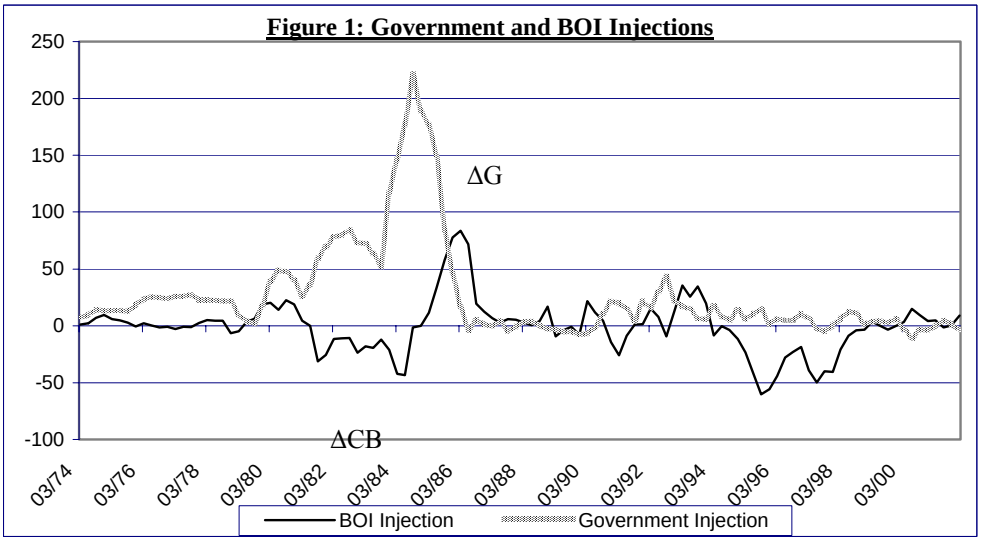


Figure 2: BOI Injections and Private Conversion

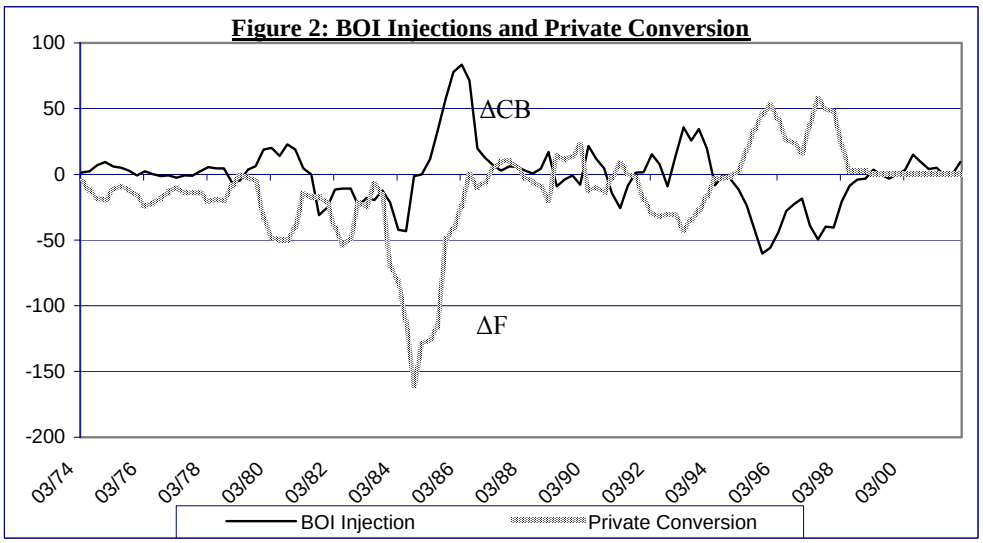
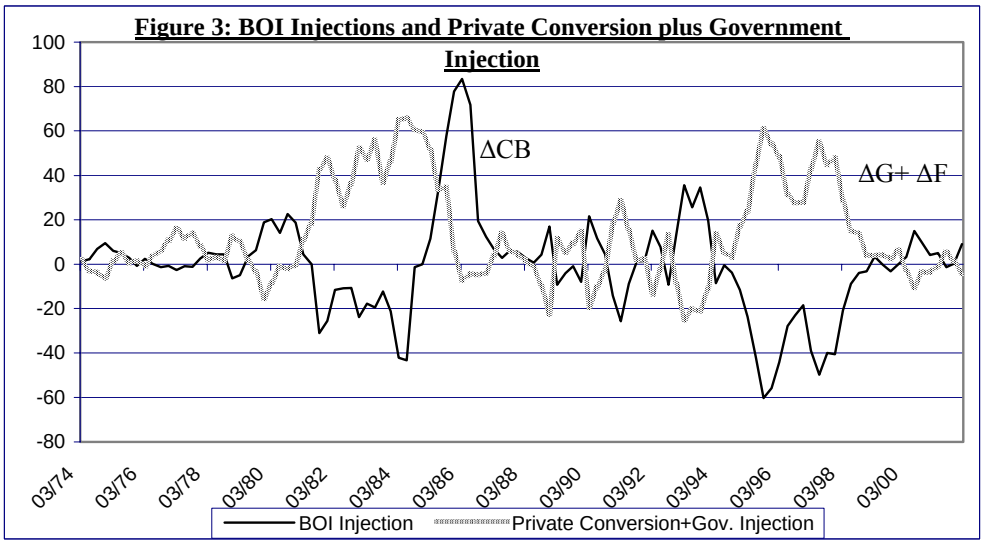


Figure 3: BOI Injections and Private Conversion plus Government Injection



* Four quarter moving average. Normalized by beginning of period monetary base. Percentages.

Figure 4: A possible scenario of the Sargent-Wallace model

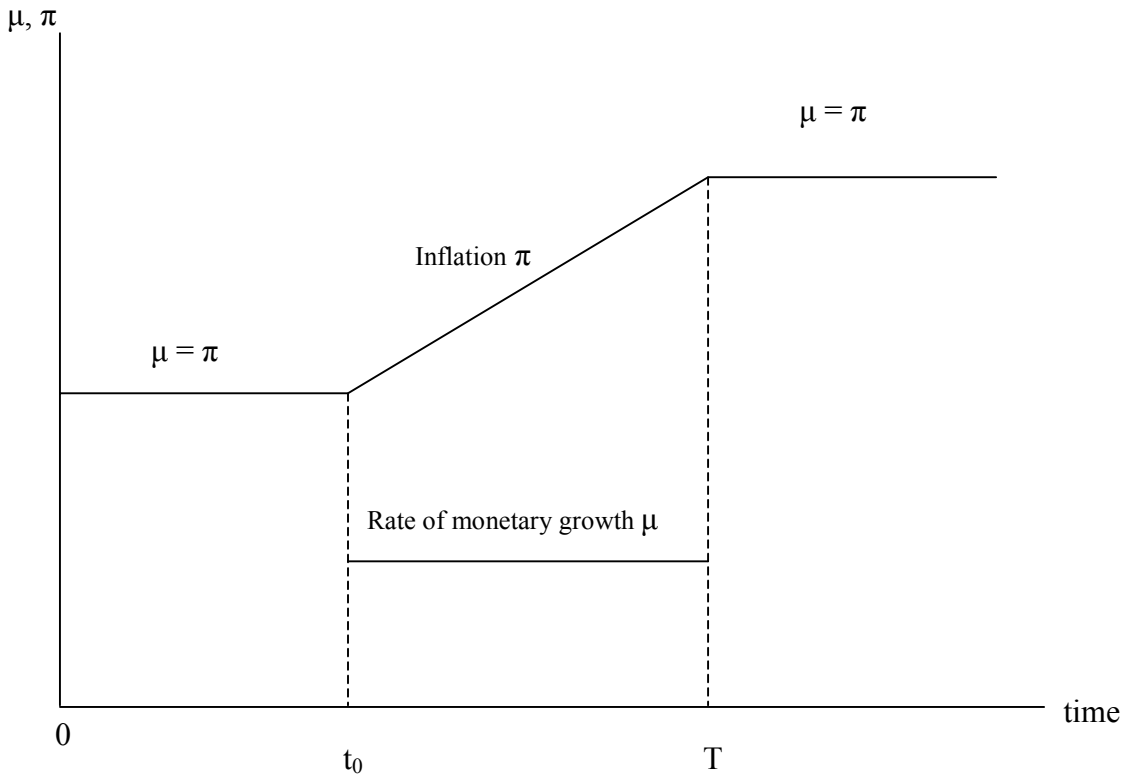
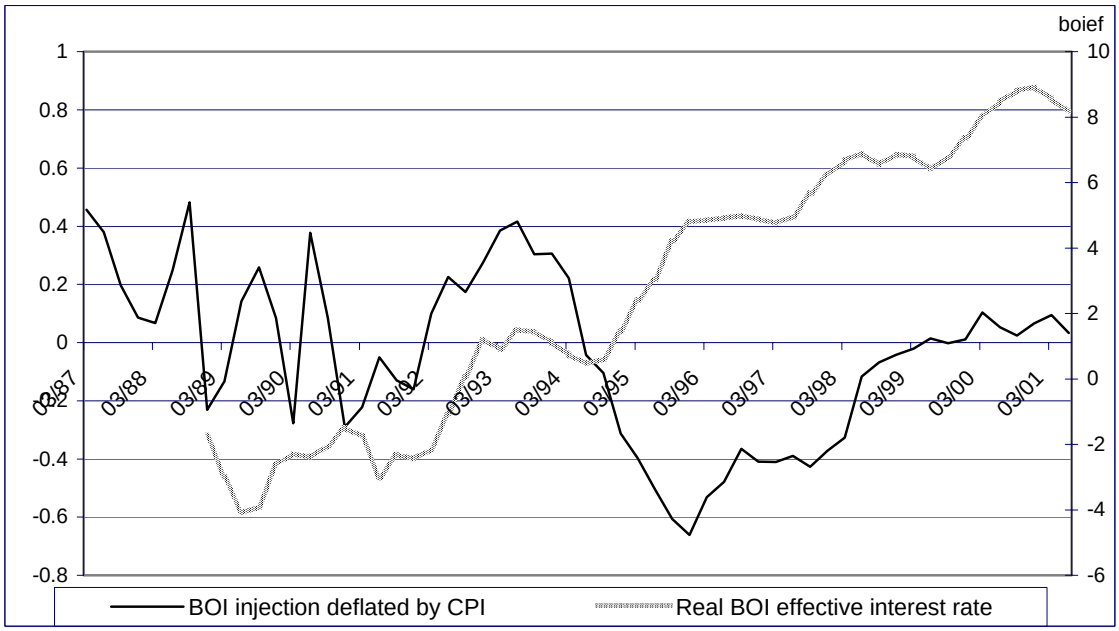


Figure 5: BOI Injection and real interest rate, moving average of 6 quarters



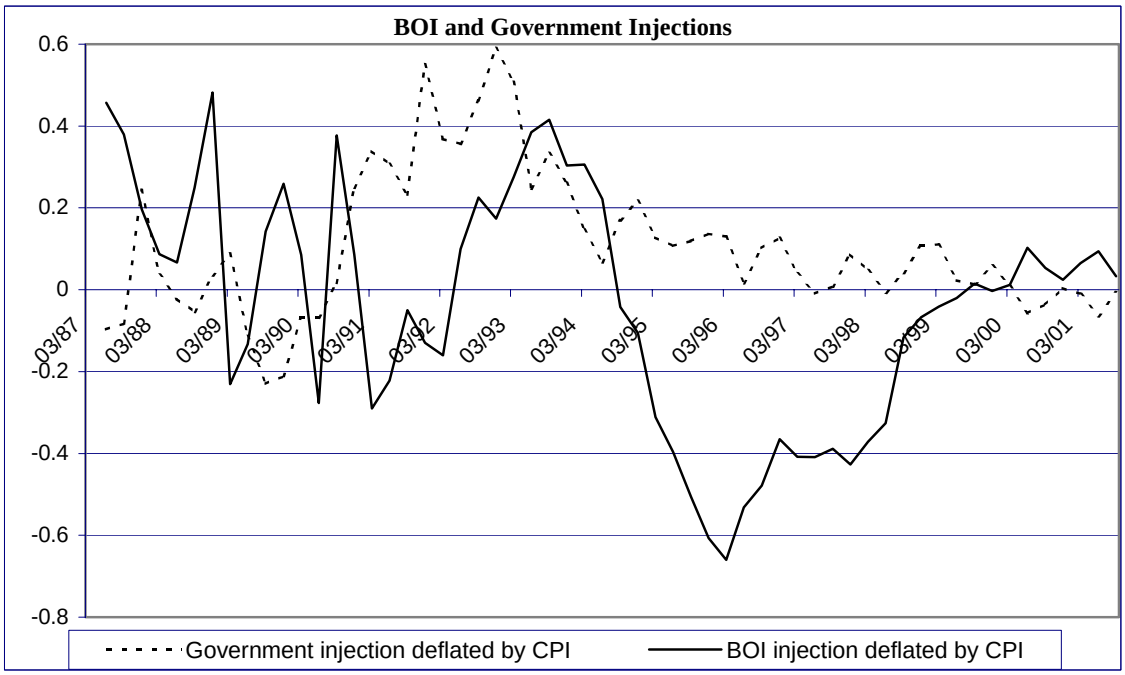
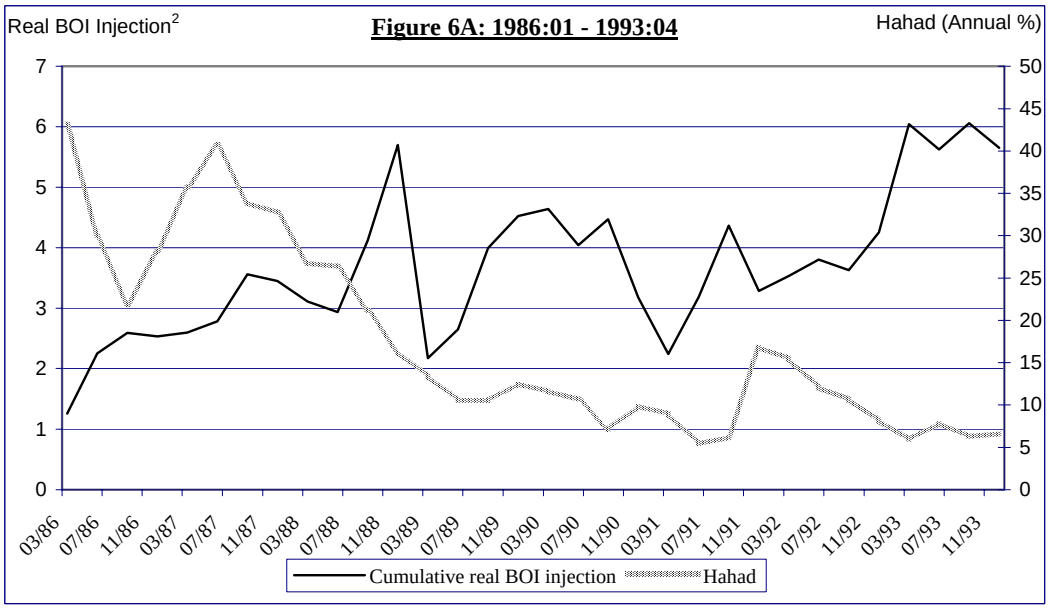
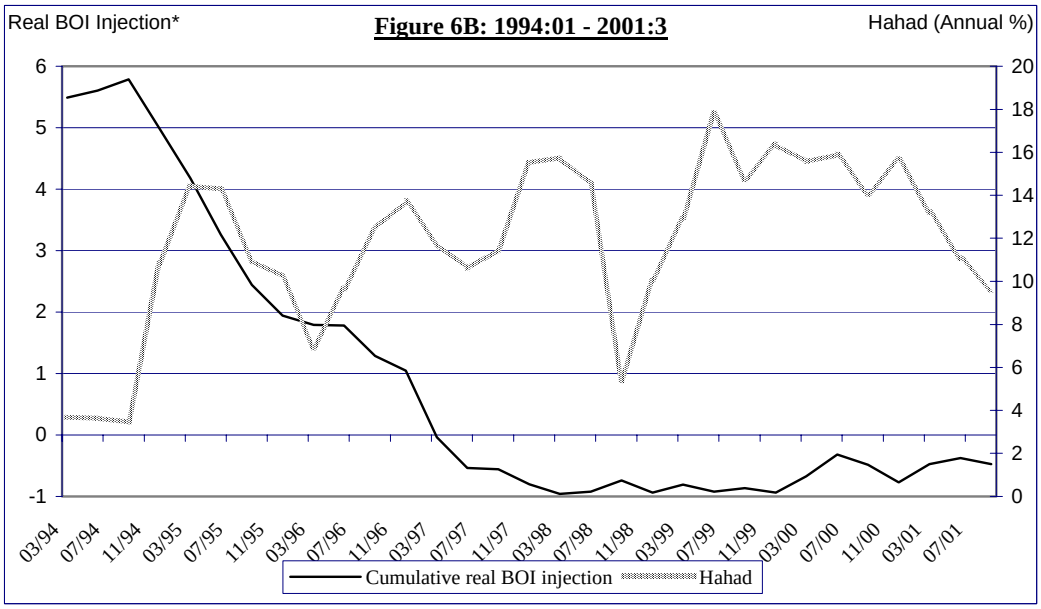


Figure 6: Cummulative Real BOI Injection and Real Interest Rate on Loans (Hahad)[1] continued





[1)] Quartely nominal Hahad rate deflated by 3 quarter moving average inflation.

[2)] Quarterly BOI injection deflated by CPI