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Fiscal Dominance and Monetary Dominance in the Israeli Monetary Experience[1]

by

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Abstract

This paper analyzes the monetary history of Israel in the framework of the concepts of fiscal dominance (FD) and monetary dominance (MD), which appeared in the recent macroeconomic models. It is shown that the inflationary period in Israel (1973-85) had distinct features of FD while the periods before and after the foregoing period can be characterized as belonging to a regime of MD. In this analysis we draw a distinction between solvencey of the public sector (which is based on the discounted public debt) and sustainability (which is based on the undiscounted debt). We also extend the concept of the Pigou effect to cover the price shocks that followed balance of payments crises. We claim that in the absence of a nominal anchor (which characterizes FD), these shocks entail increases in the inflation plateau. After the stabilization of 1985 (and especially in the nineties) the economic regime changed to MD, being based on a sustainable path of the public debt and on an inflation target regime.

Fiscal Dominance and Monetary Dominance in the Israeli Monetary Experience

By Nissan Liviatan

Recent macroeconomic literature (see for example Woodford 2001) distinguishes between models that are characterized by fiscal and monetary dominance (henceforth FD and MD). There is some intuitive appeal to regard the inflationary era in Israel (1973-85) as belonging to the category of FD (large deficits and little regard for inflation) and the post-1985 stabilization as belonging to the class of MD (relatively small deficits and inflation targeting). I believe that there is much economic sense in this classification, which may enhance better understanding of these two periods, but we have to make some adjustments to the conventional definitions of these concepts in view of the Israeli experience.

The benchmark definition of MD is that the fiscal policy has to accommodate any monetary policy. By this we mean that the fiscal policy has to ensure that the solvency of the public sector is maintained for any monetary policy. FD is the opposite. It states that any arbitrary fiscal policy has to be supported by monetary policy. By this we mean that monetary policy has to ensure the solvency of the public sector for any fiscal policy. The "unpleasant monetarist arithmetic" of Sargent-Wallace (1981) represents an attempt to use monetary policy for disinflation in a model of FD as if it were a model of MD. The attempt to reduce inflation in this way was bound to fail because monetary policy was forced eventually to ensure solvency of the public sector (by an increase in inflation) as required by FD. The policy game approach of the Barro-Gordon (1983) type can be associated with FD, but not with MD which does not allow any "tricks" of this kind (for example, inflation targeting is just the opposite to surprise inflation tactics). Monetary policy that operates in the framework of the MD regime is much more effective because it has the backing of fiscal policy for its monetary targets. For example, an exchange rate based stabilization is an effective way of reducing inflation only if it is supported by fiscal policy.

An important aspect of the distinction between these regimes, which is not sufficiently stressed in the literature, is that the concept of a *nominal anchor* (like an inflation target) is part of MD and not of FD. Since the latter

concentrates mainly on solvency of the public sector, the issue of monetary targets is implicitly of secondary importance, while for MD it is of prime importance. This should be remembered when we compare the inflationary period with the one of disinflation in Israel.

The Sargent-Wallace model makes it clear that a monetary objective needs the backing of a fiscal rule. This can be realized in a regime of MD, which imposes the acceptance of the monetary objectives by the fiscal authorities. In practice, this arrangement can be achieved by inflation targeting which requires a consensus between the central bank and the treasury about the importance of price stability. This regime gives the central bank the authority to use interest rate policy to deal with deviations from target, even if this has short term recessionary implications. It was the adoption of this kind of regime which is mainly responsible for the successful disinflation in Israel.

These alternative regimes have also been termed by Woodford (2001) as Ricardian (for MD) and Non-Ricardian (for FD). This terminology is quite intuitive in view of the fact that in the Ricardian model government bonds do not represent net worth. For example, a bond financed tax cut should not affect the price level under MD, but it may affect it under FD. It should be stressed that both regimes assume that the solvency of the public sector is a condition of equilibrium. Thus the crucial question [as noted by Canzoneri et.al. (2001) and (2002) and by Christiano and Fitzgerald (2000)] is which policy (fiscal or monetary) is responsible for ensuring the solvency of the public sector . The fiscal theory of the price level (FTPL) maintains that it is the monetary part of the economy which reacts to disturbances to public sector solvency by changes in the price level (the Pigou effect) while the fiscal parameters remain unchanged. The opposite view is held by the proponents of MD. I shall argue later that the Israeli reality is best described by a mixed FD-MD model.

One of the problems with the above approach is that any type of dominance is consistent with a wide range of possible solutions. Thus Canconeri et.al. argue that the fiscal constraints of the Maastricht Treaty (which presumably belong to the MD class) are excessive, and that price stability could have been achieved with more permissive fiscal constraints. Indeed the above analytical framework leaves a lot of degrees of freedom for the choice of policies, which can be viewed as a disadvantage or as an advantage. The set of solutions is narrowed down if we introduce considerations of sustainability, as we shall point out later.

Another problem with the benchmark definition is that in practice, the solvency of the public sector is secondary to considerations of sustainability, as we shall explain later. This calls for some modifications of the benchmark definitions, as explained in the next section.

It is clear that MD can be valid only if monetary policy can count on the credibility of the public in the policies of the central bank. Thus in the seventies and early eighties, when the credibility of the central banks was low there was no case for MD. By contrast, in the nineties the global trend was characterized by a reduction in inflation and an increase in the prestige of the central banks, which created the basis for the MD regime. No wonder that the distinction between FD and MD emerged in the macro literature only in the nineties.

The purpose of this paper is to apply the above concepts to the Israeli monetary experience. But in order to do this we must modify the benchmark definitions in order to conform with actual developments. The considerations involved in these modifications are quite general and may be discussed before turning to the data.

Modifications of the benchmark definitions

One of the problems which we encounter in the empirical analysis of the inflationary era in Israel is that the fiscal shock associated with the transition to the inflationary regime was much in excess of any possible adjustment by the Pigou effect or by seigniorage. In particular, the increase in the fiscal deficit as a result of the 1967 and 1973 wars and the burden of the first oil shock was in the range (or even in excess) of the entire monetary stock. So redressing the fiscal problem by the Pigou effect was out of the question. Inflationary finance by means of seigniorage has also its limitations[1]. As a result, the adjustment that was required over time to ensure fiscal solvency had to be based mainly on the fiscal sector (which is a feature of MD), although the regime possessed important FD features. This implies that we have to consider a *mixed FD-MD regime,* as we shall explain later.

A major difficulty concerns the role of solvency in the definitions of the two regimes. For example, the solvency criterion with regard to government bonds is satisfied if the stock of bonds increases slower than the real interest rate (adjusted for growth), *regardless of the size of this stock.* But financial markets may disapprove of this scenario if the public debt is large and grow-

[1]The fact is that seigniorage in the lost decade was around 2% of GDP, which is similar to its size in the sixties.

ing, even if it is solvent in the eyes of the government or the econometrician. We define a *sustainable path* as one which does not violate the capital market's limit on public borrowing. This may be regarded as the clash between liquidity (involving credit rationing) and solvency, as is commonly perceived in the theory of the firm, or in the relation of the typical bank with its customers. In practice, solvency is regarded as a necessary condition for sustainability, but not as a sufficient one. For example, the Maastricht criteria set an *absolute* value of 60% for the debt/GDP ratio, which is much more than the requirements of solvency. This is in contrast with the theoretical literature that focused on the solvency criterion only, as in Sargent-Wallace (1981) and in Drazen-Helpman (1990)[2]. We shall see, however, that in the Israeli experience the solvency criterion was less important than sustainability which refers to the constraints on *un*discounted debt. This implies that we have to add a constraint, reflecting considerations of sustainability, to the benchmark definitions. We will show that the fiscal policy in the inflationary period passes the test of solvency, but the eventual collapse of the inflationary regime implies that it violated the sustainability constraints.

Apart from considerations of solvency and sustainability we have to consider the nature of the reaction to shocks. It seems that the most important implication of the FD regime for the Israeli experience in the inflationary era was the reaction to temporary (negative) shocks by large hikes of the price level (that is, by some variant of the Pigou effect), instead of by fiscal measures. *In the absence of a nominal target, the reliance on price shocks can easily be translated to shocks to the level of inflation.*

In the Israeli monetary history, the foregoing mechanism was reflected mainly by the reaction to balance of payments (BOP) stresses. Although these stresses are not directly related to fiscal solvency, yet indirectly they can be regarded as potential threats to the fiscal position because of the implicit bailout operations in case of BOP crises (as in Burnside et. al. 1998), as in the recent currency crises. It is characteristic of Israel's external position prior to 1985 that it had large current account deficits and the fear of reaching "the last dollar" was always on the mind of the policymakers. It

[2]Thus Drazen-Helpman (1990) state (p.147) "For unchanged macroeconomic policies, government debt will therefore grow faster than the interest rate, implying an unsustainable path". In this statement we would rather use the terminology "*insolvent path*", because it relates to the discounted debt which does not converge. We use the term "*unsutainable path*" to the absolute value of the *un*discounted debt, which exceeds the level which the capital deems appropriate.

was felt that a BOP crisis will involve a costly crisis- management operation by the government. This explains why the policy reaction to potential BOP crises were always dramatic. We may regard the policy reactions to the BOP stresses as indicators of the FD or MD nature of the economic regime. As the policy reaction to these stresses relied heavily on price shocks, which affected wide sectors of the economy, we have to modify the Pigou effect so as to cover the impact of price shocks on wider aggregates than real money balances.

Finally, given the identity of the fiscal accounts, one has to decide which parts should be classified as "fiscal" and which as "monetary". The recent papers on the subject of dominance include only the Pigou effect in the monetary category (as in the early literature of the fifties), while there is a case for viewing the path of money expansion and that of inflation as belonging to the monetary sector, especially with the growth of central bank independence in recent years (more on this later) .

Formal benchmark properties of FD and MD

Let us begin the analysis of the properties of the FD and MD regimes abstracting for the moment from the sustainability constraint. The evolution of government bonds at any moment of time is given by:

$$Db = (r - n)b + (pd - \mu m) \tag{1}$$

where b is the ratio of the real stock of (indexed) government bonds to GDP, m is the ratio of the stock of real money balances to GDP, r is the real interest rate, n is the rate of growth of GDP, μ is the rate of growth of nominal money (M), pd is the primary deficit and D denotes the time derivative operator (D$\equiv \frac{dx}{dt}$ for any variable x). Note that seigniorage μm=Dm+(n+π)m, where π denotes inflation, so that adding Dm to both sides of (1) yields

$$Da = (r - n)a + (pd - im) \tag{2}$$

where a=b+m denotes financial assets[3] and im is the inflation tax (i=$r + \pi$).

To simplify let us introduce the notation $\rho \equiv$r-n (assumed positive on average), (pd -μm)$\equiv$pd$_b$ and (pd-im)$\equiv$pd$_a$. Viewing pd$_b$ as a function of time we may solve (1) to obtain the evolution of b as:

[3]m denotes the real monetary base, assumed to equal the means of payment m$_1$.

$$b(t) = [\int_0^t pd_b(v)e^{-\int_0^v \rho(j)dj}dv + C]e^{\int_0^t \rho(v)dv} \tag{3}$$

where the adjusted real interest rate ρ is allowed to vary over time, and C is a constant to be determined by initial conditions. If ρ is constant over time (3) reduces to

$$b(t) = [\int_0^t pb_b(v)e^{-\rho v}dv + C]e^{\rho t} \tag{3'}$$

Solvency of the public sector in terms of its bonds requires that the limiting value of the discounted b(t) should tend to zero as t tends to infinity[4], which implies for (3)

$$e^{-\int_0^\infty \rho(v)dv}b(\infty) = [\int_0^\infty pd_b(v)e^{-\int_0^v \rho(j)dj}dv + b_0] = 0 \tag{4}$$

where the constant C is equated to the initial value of b.

This means that the present value of all adjusted primary surpluses must equal the value of the initial stock of government bonds. If this condition is not satisfied then we run into various contradictions. For example, if the discounted debt tends to a positive limit then it means that the debt is growing faster than the interest rate, which implies that the debt is never repaid. Thus government expenditures exceed its tax receipts on a permanent basis

[3] m denotes the real monetary base, assumed to equal the means of payment m_1.

[4] This condition can be stated in additional two equivalent ways. We use the definition b=B/(PQ) where B, P and Q are respectively the nominal value of government bonds, the price level and real output. We may then write $(B/P)_t = b(t)e^{nt}$, which implies that the transversality condition can be expressed in terms of $(B/P)_t$ discounted by the cumulative real interest rate r(t) instead of $\rho(t)$. Similarly, since $B_t = b(t)e^{\int_0^t [n+\pi(v)]dv}$ we may express the transversality condition in terms of B_t discounted by the cumulative *nominal* interest rate $i(t) = r(t) + \pi(t)$.

$$\int_0^\infty pb_b(v)e^{-\rho v}dv + b_0 = 0 \qquad (4')$$

Similarly, the solvency of the public sector in terms of the financial assets requires that

$$e^{-\int_0^\infty \rho(v)dv}a(\infty) = \int_0^\infty pd_a(v)e^{-\int_0^v \rho(j)dj}dv + a_0 = 0 \qquad (5)$$

and for a constant ρ

$$\int_0^\infty pb_a(v)e^{-\rho v}dv + a_0 = 0 \qquad (5')$$

Assuming that bonds are indexed to the price level, we may write $a_0 = b_0 + M_0/P_0Q_0$, where b_0 is free from the Pigou effect, Q is real GDP and P_0 is the initial price level. We may then write (for the case of constant ρ)

$$M_0/P_0Q_0 = \int_0^\infty -pb_a(v)e^{-\rho v}dv - b_0 \qquad (6)$$

It is agreed that this equation holds, as an equilibrium condition, both for MD and FD. According to Canzoneri (op.cit.) and other recent papers, the whole difference between these regimes is whether the adjustment to a shock will be done by P_0 (the Pigou effect) as required by FD, or by some parameters on the right hand side of (6) as required by MD.

Note the different treatment of P_0 and the inflation tax (im) or seigniorage μm in (6). The change in P on the LHS of (6) is the Pigou effect, which plays a major equilibrating role in the short run, known as the "real balance effect" [see Patinkin (1966)]. This is the short term reaction of the price level to an unanticipated shock, and is considered in the benchmark definitions as part

[5] A symmetrical argumnet can rule out a negattive limit.

cannot exist in a steady-state equilibrium, while the inflation tax can. In practice we may observe a positive correlation between P_0 and the path of i or π, especially if the nominal anchor is weak.

The above remarks indicate that we have to distinguish between short term and long term shocks. It is possible that the reaction to short-term (unanticipated) shocks is done by the Pigou effect (through P) while the reaction to long term shocks is done through the RHS of (6), i.e. through the fiscal adjustment. Thus suppose that the RHS of (6) contains a random variable η, with zero mean, which is offset by P on the LHS of (6). Then formally the regime is FD. However, the same regime may react to long term disturbances to (6) by the RHS. Thus in the case of the latter shocks it is the fiscal side that takes care of the solvency of the public sector, which is a feature of MD. It follows that we have a *mixed* regime which is FD for some shocks and MD for others. In the former case the equilibration is done by the LHS of (6) and in the latter case by the RHS.

We note that the classification of the rate of monetary expansion (μ) as being part of the fiscal accounts is rather arbitrary. Most economists would regard monetary expansion as belonging to the realm of monetary policy of the central bank. Similarly, the rate of inflation can be regarded as part of monetary policy which sets the inflation target. Clearly, the appropriate classification has to depend on the degree of independence of the central bank. For example, in the inflationary era in Israel (1973-85), when monetary policy was dominated by fiscal considerations, it makes sense to classify the path of seigniorage as part of fiscal policy, but this does not seem to be the appropriate procedure for the nineties when the Bank of Israel was more independent in conducting monetary policy. We leave the issue of what is to be included under the heading of "monetary policy" as an open question on which one may decide according to the specific circumstances.

It is clear from the above remarks that the distinction between MD and FD cannot be based solely on the Pigou effect, but rather on the combination of the latter and the existence of a nominal target. For example, a permanent increase in defence expenditures can be financed by an increase in the inflation tax, without an appreciable increase in the current price level. This may look like a feature of MD since the adjustment is carried out by the RHS of (6). However this is misleading since it represents the use of the monetary sector for fiscal purposes. On the other hand, a jump in the price level as a reaction to a speculative attack (as Israel experienced in October 1998), can be regarded as a feature of FD, since the adjustment to (6) was carried out

by the LHS of this equation. However, if the inflation target is not changed as result of this attack, then the regime is basically MD.

In view of the foregoing considerations, we regard a MD regime as one which has a *nominal target* (price stability) and enjoys the backing of fiscal policy which takes care of the balancing of the public sector accounts. The FD regime is one which has *fiscal targets* (public sector expenditures, deficits), *without an explicit nominal objective*, which leaves the balancing of the public sector accounts to monetary policy.

A condition to ensure solvency

Returning to equation (6), it can be shown that, quite generally, a sufficient condition for the solvency of (say) b is that $pd_b(v)$ be negatively related to b, say $pd_b = k_b(v) - \beta_b b(v)$, where $\beta_b > 0$. (A similar condition applies to 'a' as we shall point out later). In this case b(t) evolves according to

$$b(t) = [\int_0^t k_b(v) e^{-\int_0^v |\rho(j) - \beta_b| dj} dv + C] e^{\int_0^t |\rho(v) - \beta_b| dv} \tag{7}$$

Discounting this expression by $e^{-\int_0^t \rho(v) dv}$ will, under broad conditions, ensure solvency of the public sector in terms of b. Since we do not state (for the sake of simplicity) the precise conditions under which this statement is true, we can confine ourselves in treating it as an assumption. (We shall later provide a simple example which indicates a class of models where this is true). A similar consideration applies to a, in which case we have $pd_a = k_a(v) - \beta_a a(v)$ and we require that β_a be positive (as pointed out by Tanner and Ramos 2002). This leads to the following important conclusion:

if the primary deficit, adjusted for seigniorage, is negatively related to the stock of government bonds, then the public debt is solvent. Similarly, if the primary deficit, adjusted for the inflation tax, is negatively related to the stock

the argument for the simple case of a constant k and ρ[6]. In this case we may express the evolution of (say) b as $Db = (\rho - \beta_b)b + k_b$, (where $pd_b = k_b - \beta_b b$ and β_b is assumed to be constant), which can be solved to yield

$$b(t) = b^* + (b_0 - b^*)e^{(\rho - \beta_b)t} \tag{8}$$

where b*=-$k_b/(\rho - \beta_b)$. If $(\rho - \beta_b) < 0$ then b(t) converges to a steady state value of b (which equals b*). For example, if $(b_0 - b^*) > 0$, as is often the case in stabilization programs, then the undiscounted debt b(t) will decrease over time towards b* , which implies that the discounted debt will tend to zero. However, the discounted debt may tend to zero even when b(t) is *increasing*. Thus if $(\rho - \beta_b) > 0$ and $(b_0 - b^*) > 0$, then b(t) grows indefinitely[7] but still the *discounted* debt $e^{-\rho t}b(t)$ tends to zero with t. This is so since $e^{-\rho t}b(t) = b^*e^{-\rho t} + (b_0 - b^*)e^{-\beta_b t}$ tends to zero with t for positive ρ and β_b. So regardless of the sign of $(\rho - \beta_b)$, the discounted debt converges to zero for $\beta_b > 0$[8]. Note that β_b has to be strictly positive, a zero value is not sufficient for the convergence of discounted debt. Note also that ρ has to be positive[9] in order for discounted debt to converge. A similar argument can be made for a=m+b, in which case we have Da= $(\rho - \beta_a)a + k_a$, (where $pd_a = k_a - \beta_a a$,with $\beta_a > 0$).

It can be seen that the solvency condition is rather weak in the sense that it does not force a specific solution. For example, b(t) is solvent if (pd -μm)=pd_b is negatively related to b. However, for the FD regime, this is consistent with many paths for seigniorage, which may range from price sta-

[6]This model can be generalized to some extent for variable ρ and k, provided they are bounded.

[7]The condition for an increasing b(t) can also be stated as operational deficit (rb+pd)>μm+nb. Note, however, that the assumption that b(t) grows indefinitely is implausible from the macroeconomic standpoint.

[8]If $\rho = \beta$, then $Db = k$ =constant, which still implies that the discounted debt tends to zero.

[9]In the empirical analysis it is not clear whether this condition is satisfied. It seems to depend on which real interest rate is used. For example the interest rate on short term loans was in excess of the rate of growth in the first half of the eighties [according to Brock (1984) this is the right measure since the central bank can be viewed as backing the monetary base by lending at the loan rate]. Also, the ratio of the interest bill to the stock of public debt was in excess of the growth rate in the inflationary era (table 2). So in these cases the condition is in fact satisfied. This conclusion can be strengthened by the consideration that with a variable r it is possible that in future periods the real interest will decline.

bility to high inflation. Similarly, for the MD regime, the restrictions on fiscal policy can be consistent with many paths of the primary deficit, seigniorage and the public debt. This range of inflation paths can be narrowed down if we introduce considerations of sustainability, as we shall explain later.

Extensions of the benchmark conditions
a. Solvency and sustainability

The condition for solvency assumes that the real interest r is the market equilibrium rate, in which markets clear. It is possible, however, that the increase in b raises credibility problems involving fears of repudiation, which lead to credit rationing on government borrowing. In this case the economy cannot proceed without a major macro adjustment. Thus the path given by (3), which assumes no credit rationing, may not be initially sustainable even if it is solvent in the eyes of the government (this can be viewed as a case of asymmetric information). This is akin to the problem that a firm faces when it asks for additional credit from the bank. The firm may be convinced that it is solvent, and therefore creditworthy, but the bank, who has limited information about the firm, has to take precautions, which include credit rationing. A path b(t) of this kind needs to be modified in order to be able to proceed without running into the constraint of sustainability. This implies that in addition to the solvency constraint there is also the one related to sustainability, which has to be taken into account. A path which satisfies the solvency constraint without encountering[10] credit rationing is consistent with our concept of a "sustainable path" (of course this distinction is usually not known in real time).

How are these considerations related to the FD and MD regimes? We regard staying within the limits of the sustainability constraint, when effective, as a necessary condition for an economic equilibrium in any kind of regime. Hence, if the sustainability constraint is effective then FD requires that monetary policy should prevent the violation of the above constraint, and MD requires that fiscal policy should do the same. Thus the condition for an equilibrium in any regime is more stringent if the sustainability constraint is effective.

To introduce the sustainability constraint in a simple way, we assume that the path of a should not exceed an upper limit a_u, as in (9), or, similarly we may place an upper limit on the path of b, b_u, as in (10).

[10]This includes the case where steps are taken to avoid credit rationing.

$$a(v) \leq a_u \tag{9}$$

or[11]

$$b(v) \leq b_u \tag{10}$$

These constraints should supplement the conditions for solvency; ignoring them, if they are effective, may be critical for the viability of the macro equilibrium. To be more realistic, we have to allow for a rule of adjustment in case these limits are exceeded. The general principle, in the spirit of the Maastricht criteria, is that these deviations should be redressed over time, and that this should done in a way which takes account of the size of the deviations. For the sake of simplicity I will confine myself to the weak statement that if the above limits are exceeded, then these variables (a and b) should decrease over time towards the specified limits. This will suffice for our analysis. A viable macroeconomic equilibrium must satisfy both the solvency *and* the sustainability constraints . (I shall present later an alternative interpretation of these constraints).

We can use (8) to illustrate these concepts. We have shown that this equation is solvent whenever β_b>0. However if $\rho > \beta_b$ then the path of b is potentially unsustainable, since b(t) grows indefinitely, while $\infty > b_u > 0$.By contrast, if $\rho < \beta_b$ then b(t) converges to the state value b*. Hence b(t) is sustainable if $b* \leq b_u$. Note that, in this case, if b(t)>b_u, which violates (10), the former will converge over time to b$*$, as required by the rule of redressing deviations from (10). The condition for convergence can always be secured by an appropriate reduction in the constant term k_b of the adjusted primary deficit.

In order for b(t) to be both solvent and sustainable we have to require that $\rho < \beta_b$ (for convergence to a steady state) and $b^* \leq b_u$ (to ensure a convergence to a *sustainable* steady state), which implies

$$k_b/(\beta_b - \rho) \leq b_u \tag{11}$$

b. Extension of the Pigou effect

The narrow view of the Pigou effect is through the impact of the hike

[11]These conditions are not equivalent. However, if the model converges to a steady state then only one of the constraints is relevant for the solution.

in the price level on the erosion of real balances and of the nominal part of public debt. However, in a wider sense the hike in the price level can erode real wages and subsidies and in this way cause a reduction in domestic demands in the short run. It is in this wider framework that we conduct the analysis of the Pigou effect in the Israeli economy by means of the reaction to shocks originating in the BOP

We may formalize the foregoing consideration by separating the flow of the adjusted short term primary deficits from the long term ones in (6) as follows:

$$M_0/P_0Q_0 + \int_0^{\delta} pb_a(v)dv = \int_{\delta}^{\infty} -pb_a(v)e^{-\rho v}dv - b_0 \tag{12}$$

where $[0,\delta]$ indicates a short time interval where the Pigou effect is operative. A rise in the price level will erode the stock of real balances, which is likely to be quantitatively small, since people will reduce their money holdings in inflation. However, the bigger effect can be due to the erosion of real wages (since indexation is lagged) and of public sector prices, which reduce the deficits over the $[0,\delta]$ interval.

The statistical approach and the underlying economic model

Equations (1) and (2) were derived from the budget identity of the public sector, and therefore are not related to any macro theory. Conditions (4) and (5) involve the assumption that the public sector is solvent, which is a theoretical constraint on the latter. Empirically, we observe the variables which appear in (3), or in the equivalent expression for financial assets (a), over a limited number of years and we try to evaluate whether the recorded information is consistent with the theoretical concept of solvency. Specifically, we examine whether the observed behavior, if continued indefinitely, is consistent with solvency. If this is not the case, we conclude that there must be a change in policy to ensure solvency, if we believe that the latter is a condition of equilibrium. For example, if we find that the primary deficit (adjusted for seigniorage) is declining with the growth of debt, we are inclined to conclude that the public sector is solvent. However, this involves the assumption that the observed behavior will be sustained over the infinite future.

The capital market may be skeptical about the foregoing assumption, especially if the debt is large and growing. Since the concept of solvency involves an evaluation of future developments it is necessarily subjective.

The conclusion of the public debt being solvent on the basis of inference based on a *limited* number of years, which we may call "statistical solvency", may be quite unrelated to true solvency in the economic sense, which is based on the *entire future horizon*. It has been pointed out[12] that the distinction between solvency and sustainability may be entirely due to the difference between "statistical solvency" and true solvency.

To illustrate this argument, suppose that there is "floor" to the level of the adjusted primary deficit pd_b, say pd^0.This implies that if b(t) is increasing, then after some b, pd_b will hit the floor and stop decreasing. This means that β_b is not a constant, as we have assumed, and we may suppose that for large enough b (say b_L) it will switch from $\beta_b > 0$ to $\beta_b = 0$. This may result in b(t) being insolvent because the operational deficit is large, although in the *observed period* β_b (for $b<b_L$) was positive. Thus we have constructed a a case where b(t) is "statistically solvent" but economically it is not. It is possible to calculate b_L on the assumption that pd^0 is a steady state, which yields b_L=-pd^0/ρ. Note that even in this case there is a limit on b(t), although there is no real difference between the concepts of solvency and sustainability, so we can talk about these concepts interchangeably.

In terms of the underlying macroeconomic model of the economy, equation (4) is an equilibrium condition for the *public* sector, which has to be supplemented by the sustainability constraint of the type of (9) or (10), if the latter is effective. To formulate a model of a general equilibrium of the economy we need to specify the condition for the equilibrium of the *private* sector as well. For example, the real balances (m) which appear in the definition of pd_b have to be willingly held by the private sector according to its demand function for money. It is for this reason that we cannot confine ourselves with the analysis of the public sector alone. Different models for the private sector may have entirely different implications for the path of the economy. In addition, we have to allow for the case that the sustainability constraint is effective. We shall tackle these issues in the final sections of the paper, after examining the facts of the Israeli experience.

Israel under the Bretton-Woods regime

In the fifties and sixties the Israeli economy operated under the rules of the Bretton-Woods regime which required that official devaluations should be subject to prior consent of (or at least consultations with) the IMF. As a

[12]The following interpretation came up in a seminar which I gave in the Bank of Israel, by Yossi Jivre and Ami Barnea.

result, official devaluations in Israel took place infrequently, every few years. This was a period of only a *semi*-fixed exchange rate regime, because it allowed a crawling "*effective* exchange rate" (involving taxes on imports and subsidies to exports) and because it was confined to the current account (it permitted controls on capital flows). Nevertheless, this system was effective in providing a nominal anchor to member countries and in keeping world inflation low. In Israel this was a period of price stability from the mid fifties to the late sixties. From the point of view of our distinction between MD and FD we can classify this period as belonging to MD, since there was a nominal anchor and the government did not use price shocks to solve pressures originating in the balance of payments[13]. In addition, the operational deficit was low (in fact for most of this period the public sector experienced fiscal surpluses, as indicated in table 1).

A test case came up when the current account deficits forced the government to implement recessionary policies in 1966-67 (prior to the outbreak of the six-day war), which caused a drastic drop in GDP growth and an increase in unemployment. However, this was done mainly by the reduction in (or the discontinuation of) government-controlled investment projects, and not by the use of massive devaluations. Although Israel devalued officially along with Great Britain in the end of 1967, the *effective* exchange rate hardly changed in the course of 1965-67 (the effective exchange rate for imports increased by a mere 3.7% during this period). So on the whole the external crisis was handled by fiscal measures rather than by the Pigou effect. Indeed inflation was rather low and fairly constant during 1965-67. Note also that this was a period of low, and fairly stable, public debt (table 1).

The inflationary period in Israel

The inflationary period in the Israeli economy is associated mainly with the ("lost") decade of 1974-84. The relevant statistics for our analysis of this period are presented in table 2. It can be seen that the transition to the inflationary period from the tranquil times of the early sixties, involved an increase in the operational deficit of about 20% of GDP (row 1 in tables 1 and 2), with a somewhat lower increase in the primary deficit. This increase can be attributed to the 1967 and 1973 wars and to the oil shock of 1973, as well as to internal political factors, and it resulted in an appreciable increase

[13]The Pigou effect was used effectively to eliminate the monetary overhang of the repressed inflation in the early fifties. After that the use of the Pigou effect was very limited by the Bretton-Woods regime of the exchange rates.

in public debt (from around 50% of GDP in the mid sixties to over 100% in 1974-77).

The increase in public debt in the initial stage of the lost decade can be formally described as an increase in b_0 in equation (6). It is clear that a shock of this magnitude could not be offset by the Pigou effect since the fiscal shock was larger than the monetary base and of similar size as the entire stock of real M_1. Similarly, the shock could not be redressed by seigniorage or the inflation tax under stable conditions. As a result, the government had to take in the seventies and early eighties corrective fiscal measures. In this sense the policies of the inflationary period were not exactly FD of the benchmark definition, in which the role of securing solvency is assigned to monetary policy. It represents a case of a long term shock that had to be handled by fiscal measures.

In fact, table 2 indicates that our measures of pd, pd_b and pd_a were all decreasing over time in the inflationary period, while b and 'a' were increasing (although m was decreasing). According to our previous analysis it implies that the public sector was (statistically) solvent[14] in the inflationary period, as a result of the fiscal efforts by the government. This is contrary to the view expressed in the literature related to the Sargent-Wallace model which was based on the assumption that the *primary* deficit was constant, and consequently the public sector was insolvent prior to stabilization. However, the facts are that the *operational* deficit (rb+pd) and seigniorage were fairly constant in the inflationary period, which implies that the government budget was intertemporally balanced (on the assumption that this state were to continue indefinitely), in view of the fact that government debt was increasing. However, it was the latter feature of the inflationary regime which contributed to its demise. This became clear in 1984 when the public refused to acquire additional government bonds, which forced the central bank to finance the fiscal deficit by drawing on the international reserves. So it was not the solvency constraint that toppled the inflationary regime, but rather the "undiscounted public debt", which was increasing and reached 163% of GDP in 1984 (more than one hundred percentage points in excess of the Maastricht criterion). It seems therefore that the constraints that were violated were not those of solvency but rather those of sustainability.

We may formalize the foregoing account by the simple model we used earlier. We may express (1) as $Db = \rho b + [(od - \mu m) - rb]$, where od denotes

[14]Here we use again the assumption that the observed behavior will continue indefinitely.

the operational deficit (od=rb +pd), so that when od, μm and r are approximately constant we have, in terms of our earlier notation, $k_b = (od - \mu m)$ and $\beta_b = r$. In this case $\rho - \beta_b = -n$, so that b(t) converges to $(od - \mu m)/n$.This formula can be computed directly. This calculation implies a steady state value of the debt /GDP ratio in the inflationary period of about 3-4, which was much in excess of the actual b(t). Although this is consistent with fiscal solvency, it was apparently not sustainable.

One still has to explain why the public was willing to acquire the massive stock of government bonds if it exceeded by far the sustainable level. One possible explanation of this phenomenon is in the spirit of a "rational bubble", as in Blanchard and Fischer (1989), ch. 5. The underlying reason seems to be that these bonds were made gradually more liquid by the increased intervention of the Bank of Israel to stabilize their rate of return. Sokoler and Cukierman (1989) show that the Bank of Israel increase its intervention in the secondary market quite drastically since the late seventies till 1982 in order to stabilize the rate of return on government bonds. Under these conditions the public believed that it can withdraw any time from the bond market without a substantial loss, and still be assured of a positive real return in the meantime. This explains why the measured real return on government bonds did not increase along with the stock of public debt. Thus the public was lured to acquire new bonds. This process stopped after 1982 when the Bank reduced gradually its intervention.

The other side of this puzzle is the incentive of the government to carry on with the high debt policy even though we may assume that it was well aware of the risks involved in this option. The answer is to be found in the political stalemate that characterized the lost decade. This was the time of drastic political changes centered around the loss of the 1977 elections by the ruling labor party and the beginning of the Likud administration, which contributed to political uncertainty in which it was not possible to perform a change in the economic regime. The result was a scenario of a death foretold, as in a Greek tragedy, where the Israeli society proceeded to financial crisis through a series of failed stabilization attempts, till the formation of a national unity government in 1984. The possibility of the emergence of such a stalemate is described very aptly by the "war of attrition" model of Alesina and Drazen (1991).

We have seen that two features of the benchmark FD regime were not exactly in place in the inflationary era: the active role of the fiscal authorities (instead of the monetary authorities) in securing solvency of the public sector

(which is a feature of the benchmark MD regime) and the limited importance attributed to fiscal solvency (which is based on the discounted debt) as compared to the crucial role of the *un*discounted debt in the actual developments. We turn now to the remaining feature of the FD, concerning the reaction to shocks by the Pigou effect. Here we note that the secular reduction of m during this period was due to the increase in anticipated inflation and was not related directly to the Pigou effect. However the latter played a major role in the inflation process, as we noted earlier and will expand presently.

It can be seen in figure 1 that there were three major (negative) shocks to BOP in the inflationary era, as measured by the ratio of the civilian import surplus to GDP. Two of them were associated with the oil shocks of 1973 and 1979 (the first shock was also related to the Yom-Kippur war), and the third was associated with the crisis which emerged following the collapse of the Tablita-type policy in 1983. It was only in the latter case that the government had to intervene in order to bail out the banking system (in the wake of the "bank share crisis"). However, the risk that something of this kind[15] might happen was potentially present in other cases as well. In each of the three cases the government reacted to the external stress by raising the prices under its control. These included public sector controlled prices (like subsidized food stuffs) and the exchange rate on external transactions (figure 2). In the 1973 crisis the main policy instrument to generate the price shock was the depreciation of the currency while in 1979 it was the increase in public sector controlled prices. It can be seen in figure 1 that following each crisis inflation went up a step[16]. There was no attempt to bring inflation back to the pre-crisis level, since there was no inflation target and no commitment to a nominal anchor. In the absence of the latter there was no point in incurring the recessionary short term costs of raising interest rates. Indeed table 2 shows that real interest rates in the 70's were lower than in the 60's.

The erosion of real wages as a result of the price shock reduced domestic demand and supported a real depreciation which alleviated the external pressures. In addition, the fiscal deficit was reduced by means of the above cut in the real value of wages and in subsidies. Indeed, the data show that

[15]For example, the private sector could use the liquid part of the public debt to launch an attack on the foreign reserves of the banking system, in which case the government will have to bail out the banks, as it happened in recent currency crises in Mexico (1994) and in Asia.

[16]This process is described in detail in Liviatan and Piterman (1986).

the price shock reduced temporarily the operational and the primary deficits of the public sector[17] (see figures 3 and 4), which was thought to contribute to the reduction in the external deficit through the "twin deficit" mechanism[18]. Figures 3a and 3b show that the inflation tax went up with each crisis, while the seigniorage went down. This indicates that the policy was to raise prices (the Pigou effect) while restraining the growth of the monetary base. The price shocks contributed to the secular acceleration of inflation by raising inflationary expectations and by the conversion of price shocks into inflation shocks through the indexation mechanism in the absence of a nominal anchor.

We conclude that in the inflationary period the fiscal authorities pursued policies which were consistent with solvency of the public sector by reducing the primary deficit (a feature of the benchmark MD regime), but they did not prevent the growth of the undiscounted public debt to unsustainable levels because the operational deficit was too large. Thus fiscal policy did only a partial job; it ensured solvency but ignored the sustainability constraints. This left the monetary policy with an impossible task- to ensure sustainability without fiscal backing. This was bound to lead eventually to a financial crisis. The FD nature of the regime was more clear cut in the use of price shocks in reaction to BOP crises (the Pigou effect), which threatened indirectly the fiscal solvency of the public sector. In the absence of an inflation target the government did not try to reduce inflation in the wake of the initial shock by raising the interest rate[19] or by other means, and this enabled the secular rise in inflation.

The period of disinflation

The 1985 stabilization laid the foundations for price stability which materialized many years later. The main feature of the post stabilization policies was the sharp reduction in the deficit of the public sector (table 3), which was made possible largely by the reduction in the defence expenditures. This prevented the growth of the undiscounted debt, which was another target of the program. In fact, as a result of the fiscal adjustment, the public debt reversed its historical trend and started to contract as a proportion of GDP

[17] In 1973 the reduction in the operational deficit occurred with a lag.

[18] One should also note that the indexation of the public debt was never perfect, so that the price shock had usually some effect of reducing the wealth of the private sector.

[19] Thus the government avoided the short run (Phillip's Curve) tradeoff between inflation and unemployment, at the cost of a long term acceleration of inflation.

(table 3). However, from the disinflation aspect, no less important was the law of "no printing" (which forbade the Bank of Israel to finance the fiscal deficits) and the implementation of an inflation targeting regime since 1991 (which was used actively as a policy guide since 1995). The inflation target represented a consensus of the BOI and the treasury about the desired course of inflation and effectively turned the economic regime gradually into one of monetary dominance, because of the implicit fiscal commitment to support the inflation target. In the new policy framework inflation fell down along with the world trend, and reached some sort of price stability around the year 2000.

The adjusted primary deficits of the inflationary period turned into surpluses after 1985. There was an initial overshooting of the reduction in the operational deficit, but after that the different measures of the fiscal deficit remain fairly constant in 1990-2002. In particular, the operational deficit of the public sector was maintained in the range of 3.5%-4.5% of GDP throughout the latter period.

It is clear that the fiscal policy in the post-stabilization paid full attention to the sustainability constraints, and prevented the pattern observed in the inflationary period of secular growth of the debt/GDP ratio. In fact this ratio decreased considerably in the post stabilization period.

One can use our simple model to describe the nature of the economic setting in the post stabilization era. Since the operational deficit and seigniorage were fairly constant in the post-stabilization era we can make use of equation (11) with $k_b = od - \mu m$ and $\beta_b - \rho = n$ to obtain $(od - \mu m)/n \leq b_u$.If we assume the Maastricht requirement of $b_u = 0.6$, and use the average values of the other variables in the post-stabilization era (imposing a strict equality in the above relationship), we obtain an operational deficit of 3.4% of GDP, which is not far from the actual deficit for most of the period[20]. This rough calculation indicates that by and large, the macroeconomic policy in Israel has been consistent with the Maastricht norms.

Our main test for the nature of the macroeconomic regime continues to be based of the reaction to BOP stresses. These developed in the period 1994-95 as a result of the growth of domestic fiscal deficits because of generous increases in public sector wages during the Rabin administration. In the inflationary period deviations of this type were redressed by a price shock, we have seen earlier. However, as figures 4a and 4b show, in the nineties the

[20]Note that this calculation abstracts completely from cyclical factors.

worsening of the external position was redressed by a reduction in the fiscal deficit by the new Likud administration, without an increase in the inflation tax . The reduction in the primary deficit and the tightening of monetary policy in the second half of the nineties (see real interest rates in table 3) resulted in an economic recession for a number of years which contributed to the improvement of the external position through the reduction in imports (we have seen similar developments in the mid sixties). This behavior suggests that in the nineties the economic regime converged to MD in terms of the reaction to shocks, and in addition it took care that the undiscounted debt did not rise.

One cannot totally prevent the occurrence of speculative attacks in the foreign exchange market even if the macro policy is conservative. Indeed these occurred in 1998 (following the crash of the Russian stock exchange) and in the first half of 2002 (following the drastic reduction of the BOI's interest rate in December 2001). These attacks raised inevitably the current inflation through the exchange rate passthrough. However, they did not affect the path of the inflation *targets* to which the Bank of Israel (BOI) was committed. This was made possible by increased central bank independence which allowed the BOI to raise its interest rate in order rein in inflation to the announced target. Figure 5 shows that the big devaluations of 1998 and 2002 (and the corresponding jumps in measured inflation) did not derail the path of the inflation *targets* (it was only in 1994 that the inflation shock led the policymakers to raise the ceiling of the inflation target range). The interest rate policy of the BOI thus helped to maintain the inflation target *regime* which provided a nominal anchor for the economy, and laid the foundation of price stability. It was therefore not the long-term level of the real interest rate of the BOI but its role in protecting the inflation target regime, which ruled out surprise-inflation tactics, that was crucial for the reduction of inflation. There are reasons to believe that the option of using surprise inflation tactics rather than adherence to monetary rules was one of the main factors for the rise of inflation (Liviatan and Frish 2003).

This kind of interest rate policy was not necessary under the Bretton-Woods regime when there was great credibility in the nominal anchor. However, after the inflationary experience of the lost decade it was necessary to restore confidence in the commitment to price stability by means of the interest rate policy. The adoption of the inflation targeting regime is another indication that Israel moved to a MD regime, because the monetary objectives of the BOI were backed by the fiscal commitment.

The MD nature of the macroeconomic regime in this period was strengthened by the continued liberalization of the capital account of the BOP, which turned the sheqel eventually into a virtually convertible currency. In the era of globalization this means that the influence of the world capital markets assumed a dominant role in the shaping of macro policies in Israel. By its relentless support of the liberalization of the capital account, the Bank of Israel imposed, indirectly (through the world capital markets), fiscal discipline on the treasury. In this setting the Bank of Israel could pursue its disinflation policies taking account of the influence of external markets on fiscal policies.

The view that Israel has been in recent years in a regime of MD is also supported by the observation that as a result of the current recession there was a decline in *nominal* wages in 2003. Another piece of evidence about the nature of the macroeconomic regime can be derived from the econometric studies of the reaction function of the Bank of Israel. These studies show that the influence of the business cycle on the interest rate policy of the Bank weakened in the nineties. Thus the Bank was ready to tolerate an increase in unemployment without reacting by countercyclical policies, in order to pursue its disinflation objective, which is consistent with the spirit of a MD regime. In fact, there is evidence that the Bank of Israel followed a tougher policy concerning the economic recession than its American counterpart (the Fed).

Finally, we may use the information on the fiscal impulse to throw some light on the transition process to MD. While in the first half of the nineties policymakers were inclined to tolerate deviations from the law of deficit reductions and redress them later, this tendency was was modified from the second half of the nineties. A case in point is the positive fiscal impulse (using the IMF definition) in 1995, resulting from the increases in public sector wages by the Rabin administration (which we mentioned earlier), which required a fiscal retrenchment by the Likud administration in 1997, reflected in a negative fiscal impulse for that year. This behavior was discontinued in later years, where the fiscal policy became more conservative, which we may interpret as a drift towards MD[21].

Solvency and sustainability in a "monetarist arithmetic" model

We turn now to present a model which includes the solvency and the sustainability constraints of the public sector policies as part of the macroeconomic setup, but it combines it with the equilibrium of the *private* sector

[21]I owe this observation to Michel Stawczynski.

to form a full equilibrium. For this purpose we use the analytic framework of the Sargent-Wallace (1981) model. Before going into the applications of this model to the Israeli experience described above, we note that the original Sargent-Wallace paper illustrates what is meant by the case of FD. The latter model views the rate of monetary expansion as part of monetary policy. In this framework monetary policy tries to reduce μ while the *primary* deficit is kept constant. This leads to an increasing debt (because bonds are substituted for money in the finance of the deficit), which is inconsistent with public sector solvency. Eventually, solvency is restored by a jump in inflation and seigniorage (that is, by monetary policy) with an increased level of the the public debt and a larger operational deficit. The fact that the primary deficit does not respond to stabilize the system, which is performed by monetary policy, is consistent with the benchmark FD regime. In terms of our previous analysis this implies that $\beta_b = 0$[22],and hence the public sector is not solvent prior to the monetary adjustment. However, this scenario does not fit the Israeli experience.

We have seen that in the Israeli experience the government adjusted the primary deficit in the inflationary period so as to ensure solvency of the public sector. In fact, the government maintained the *operational* deficit constant over time in the inflationary period. In this sense the regime in the inflationary period shared some features of MD. However, the Israeli experience shows that the relevant criterion for stability of the system was not solvency in the traditional sense (which is stated in terms of the discounted debt) but rather the ability to keep the absolute level of the undiscounted debt under control (that is, observing the sustainability constraints). This was where the government failed, and the undiscounted debt grew to unacceptable levels. We may refer to the latter case as representing an "unsustainable policy", which may be potentially solvent.

In order to present the developments in the inflationary period in Israel by means of a "monetarist arithmetic" model we have to make use of the fact that the operational deficit was held approximately constant, and that the undiscounted debt imposed some restrictions on the macroeconomic evolution, which were ignored and thus led to an unsustainable policy. This setting is fundamentally different from the Sargent-Wallace model, since the

[22]In fact, seigniorage μm can be decreasing in the Sargent-Wallace model prior to stabilization, as in the example given in Liviatan (1984), which means that β_b is negative, and hence it strengthens the conclusion that the public sector is not solvent.

constancy of the *operational* deficit implies fiscal solvency in the monetarist arithmetic model, while the constancy of the *primary* deficit does not. However, the constancy of the operational deficit does not ensure *sustainability,* which was the source of the crisis that developed in this period. To analyze this case I use the analytical framework of Liviatan (1984). In this analysis I abstract completely from the reaction to BOP shocks.

The model consists of dynamic equations for m and b. Using our earlier notation we write

$$Db = -nb - \mu m + od \tag{13}$$

$$Dm = (\rho + \mu)m - c \tag{14}$$

where od stands for the operational deficit rb+pd (treated like a parameter), and where pd consists only of net transfer payments and c is the constant level of the consumption endowment. Equation (13) is just the budget identity (1), which will be shown to satisfy the transversality condition of fiscal solvency[23]. Equation (14) is derived from the optimization of the representative agent, as described in Liviatan (1984). In this model the real interest r is constant (= rate of time preference plus n) and the demand for m is given by c/(r+π). For a given μ these equations form a dynamic system in m and b where the steady state equilibrium is a saddle point (see point E in figure 6), with a horizontal saddle path. As we vary μ we trace out a locus of steady state points (Dm=Db=0) given by

$$m = (n/\rho)b - (od - c)/\rho \tag{15}$$

which is depicted by the SS curve in figure 7. It is assumed that government bonds (b) are indexed, and accordingly we treat the stock of these bonds as a state variable in the dynamic analysis (we rule out open market operations).

A model of the inflationary period

To describe the inflationary period we assume that the initial steady

[23]Since the end point is a steady state.

state equilibrium is at the point A in figure 7. Then the operational deficit increases unexpectedly, pushing down the SS curve to S'S'. The way this is drawn in figure 7, it is not possible to stabilize the system by a reduction in m through the Pigou effect at t=0 (since m is assumed to be non-negative). As a result b has to increase over time, as μm cannot be raised sufficiently to offset the increase in od, in order to reach a steady-state solution. However, there are various paths to reach S'S', such as the path AA' ,where the original μ is maintained and the convergence to A' is asymptotic, or the path NM where the system lands at M with a convergence time $T<\infty$. It can be seen that the path NM implies an acceleration of inflation over time, and requires the monetary authorities to raise μ at M in order to support the new steady state[24]. If we require only fiscal solvency, then, in the absence of an inflation target, many inflation paths are possible. It is important to note that along any of these paths b is increasing till stabilization.

How does the growth of b (which consists of indexed bonds) succeed in stabilizing the system at S'S' ? This is because the growth of the stock of b provides a non-inflationary source of finance of the public deficit to the tune of nb per period. *If we confine ourselves to fiscal solvency, we find that when the operational deficit is kept constant it is always possible to stabilize the economy at any inflation target as long as the rate of growth (and hence the slope of SS) is positive, without the need to perform any change of policy.*

Thus fiscal policy ensures solvency, by keeping the operational deficit constant. However, this feature of the model is problematic from the point of view of a skeptical capital market that may consider a large b as a source of instability[25]. This is precisely the problem of sustainability, which was ignored in the early literature. Thus the calculations of the "warranted deficit", which were fashionable in the past, were based on the assumption that the public is willing to maintain the current ratio of debt to GDP permanently, regardless of the size of this ratio[26]. This is in contrast to the idea of sustainability as reflected, for example, by the Maastricht rules.

If we impose an upper bound on b, given by b_u in figure 7, to represent considerations of *sustainability*, then this will limit the possible solutions along S'S'. To fix ideas, consider the case where inflation is kept constant, so

[24]Note also that along this path, only the shift from A to N represents the Pigou effect, and the path NM reflects the increase in future inflation. This shows that we cannot separate the Pigou effect from the future path of inflation.

[25]The reason might be the growing risk of default, as in Blanchard (2003).

[26]See for example the calculation of the warranted deficit in Bruno (1993), table 3.2.

that the adjustment is along a horizontal path (where μ is held constant). Given b_u it is not possible to proceed along AA' without violating the sustainability constraint[27], and the convergence must take place along VW, where inflation is higher than along AA' (the point Q is not a steady state). This shows that a sustainable inflation target has to be matched by an appropriate operational deficit.

It is even possible that there does not exist any steady state solution without a reduction in the operational deficit, as is the case where the intersection of b_u, now represented by b'_u in figure 7, and S'S' is below the horizontal axis. We propose that this was indeed the case in the inflationary period. According to this interpretation of the inflationary era in Israel, the government tried to ensure the solvency of the public sector by pursuing a constant-operational-deficit policy, but this was not sufficient to prevent the eventual crisis because the undiscounted debt continued to grow in excess of the limit (b_u) set by financial markets. In this case a sustainable policy would reduce the operational deficit till the debt would decrease over time towards b_u. But this did not happen. *Thus the government's fiscal policy ensured solvency but not sustainability.* This means that the government ignored the sustainability constraints, which led to the crisis.

Price stability

The case of MD, which was presumably followed in the post stabilization period (especially since 1995), is described in figure 8. Suppose we start at the steady state point A and then the central bank reduces μ to $\mu_1$in the framework of a disinflation program, keeping the operational deficit constant. Unlike the "unpleasant monetarist arithmetic" model, where the *primary* deficit is held constant, the constancy of the *operational* deficit requires the reduction of the primary deficit to offset the increase in rb along the convergence path. So according to the solvency criterion the system can converge to the point A' on SS. However, this requires again the increase in b, which may be unsustainable if it violates the constraints (9) or (10). The way to avoid this development, if b_u is equal to b_0, is to cut the operational deficit sufficiently (raising SS) so as to render the point E a steady state[28]. This is in line with the spirit of the MD regime which requires the support of fiscal policy to any monetary policy.

[27]If we cross the point Q, the system will continue moving towards A', contrary to the requirement that if b exceeds b_u, then the former must decrease.

[28]Suppose that $b_u > b_0$ and we have an inflation target, then the operational deficit can be set so that $b = b_u$ is a steady state. In this case b will converge to b_u over time.

If the public debt is to *decrease* in the course of the stabilization program, because b_u (which corresponds to B in figure 8) is less than b_0, then the operational deficit has to be cut further, so that the new SS curve (denoted S"S") will be located above the point E. In this case we start with a level of debt which is not sustainable in the long run, but then it decreases over time, towards the saddle point B, in line with the rule for deviation from the sustainability constraint. Thus sustainability may require not only a constant, but also a *low* operational deficit. This is in fact what separates the post 1985 period in Israel from the inflationary one.

In general, if only solvency is required, then the constancy of the operational deficit at an arbitrary level, is sufficient to ensure convergence at any rate of inflation, as long as the growth rate of the economy is positive. This is so, because the growth of b provides the non-inflationary finance to support any inflation target regardless of the size of the operational deficit. However, if we require sustainability (based on a given b_u), then the constant operational deficit has to match the inflation target. Suppose for simplicity that b_u=b* (steady state). Then when we require sustainability, the target inflation level is a function of both b_u and the operational deficit. Alternatively, the operational deficit depends on both the inflation target and b_u. This justifies the Maastricht criterion which is stated in terms of the three quantities- the target inflation, the operational deficit, and the sustainable level of the public debt. Thus, *a monetary rule in the form of an inflation target requires a fiscal rule to match it, if the sustainability constraint is binding.*

Formally, suppose we set a constant inflation target π. Then the demand for money, m=c/(r+π), is constant, which implies that μ=π+n is also constant over time, and so is seigniorage μm to be denoted S(π). The steady state solution for b is b*=(od-μm)/n. If the sustainability constraint is binding, which requires the adjustment of od so that b*$\leq b_u$, we obtain from (13), for a stationary b,

$$S(\pi) + nb_u \geq od \tag{16}$$

where S'(π)>0 if r>n[29] (which is our assumption). This equation shows that the operational deficit has to be consistent with the inflation target and the sustainability constraint (as reflected by b_u). Normally, a lower inflation target and a tighter sustainability constraint will require a lower od. This implies that we cannot set an inflation target without ensuring that the

[29]This is because $\mu m = c - \rho m = c - c(r-n)/(r+\pi) \equiv S(\pi)$.

operational deficit is consistent with it, in view of the constraints imposed on b by the capital market .

If the operational deficit is large, so that b*>b_u then b(t) tends to converge to an unsustainable steady state. If the operational deficit is sufficiently small so that b*$\leq$ b_u then the path of b(t) is sustainable (Db<0 if b(t) is larger than b* and conversely if b(t) is smaller). If n=0, then S(π)=od in a stationary solution, and there is a one-to-one correspondence between the inflation target and the operational deficit[30], without dynamics. If od is always larger than S(π), then there is no steady state solution and b must increase over time. If there is an inflation target, b(t) will evolve as a linear function of time, according to a path which is solvent but unsustainable. In this case the operational deficit has to be cut so as to ensure sustainability.

The short term effect of the interest rate

One can raise the question of why was the short term interest rate an important anti-inflationary tool after the 1985 stabilization and not earlier. This question should be analyzed in connection with the exchange rate, which was the main channel through which the rise in the BOI interest rate affected inflation in the short run. We find it useful to analyze this issue using Blanchard's (2003) paper, which considers fiscal and monetary policies in an open economy in the context of a default risk associated with a large public debt. Blanchard presents a simple (one period) model which shows that the interest rate policy has opposite effects when the public debt is high as compared with the case when public debt is low, because in the former case the risk of default is high while in the latter case it is low. The possibility that a rise in the interest rate of the central bank, may have an ambiguous effect on the exchange rate is not new[31], but Blanchard's point is that this effect is related to the level of the debt. When the debt is high an increase in the central bank's interest rate increases the default risk (because it tends to increase the debt) to the extent that it outweighs the usual effect of the above policy.

[30]If n=0 we may determine μ and m individually from μm=od and ρm+μm=c, independently of b, in the framework of a steady state, provided one exists . Then b* can be set so as to satisfy b*$\leq$$b_u$. This will determine pd through the constant value of od.

[31]Thus Furman and Stiglitz (1988) show that a hike in interest rates tends to raise both the probability of default and the risk premium, which may reduce the expected return of the domestic interest rate. By the uncovered interest parity this requires a reduction in the expected rate of devaluation. If the level of the expected exchange rate is rigid, then todays exchange rate will rise. Thus one can establish a positive relation between the interest rate and the exchange rate. However they do not relate it directly to the level of debt, which is the main point of Blanchard.

Specifically, the increase in default risk reduces the capital inflows (in spite of the rise in the domestic interest rate) and hence must cause a real exchange rate depreciation, in order to balance the current account with the capital account under a pure float. So the increase in the interest rate has a perverse effect, relative to what we may expect when the debt is low. By contrast, when the debt is low a rise in the domestic interest rate does not raise the default risk and hence the rise in the interest rate has the usual effect on the exchange rate (an appreciation)

Empirically, the large debt/GDP ratio in Israel was associated with the inflationary FD regime in the lost decade, and the relatively low ratio was associated with the MD regime of the nineties. Indeed, when we apply the above model to the Israeli experience in the nineties we find that an increase in the real interest rates in the second half of the nineties (as part of the disinflation policy), was associated with an *appreciation* of the real exchange rate (table 5). Hence, interest rate policy could be used to support the disinflation process. In order to apply Blanchard's theory to the Israeli experience with FD we focus on the developments in 1984, the year prior to the 1985 stabilization, where the debt was at its peak and the risk of default was clearly present. As table 4 shows, in this year all interest rates were increased and all measures of the real exchange rate increased, which is consistent with the theory that when the risk of default is high we should expect that an increase interest rates should lead to a real depreciation[32]. The fact that a rise in the interest rates could result in a depreciation may provide one of the reasons for the BOI passive interest rate policies in the lost decade. However, in my evaluation, the main reasons for avoiding the increase in interest rates in the inflationary period were associated with the full-employment policy, and with the incentive to provide cheap finance for the government.

These facts suggest that the preconditions for the use of the short term interest rate as a tool in disinflation strategy are a low public debt and a MD regime.

Conclusion

In conclusion, what were the factors that brought about the transition from the inflationary era to price stability of recent years? The first factor,

[32]A more conventional explanation is that the increase in real interest rates depressed domestic demands and thus led to a real depreciation. This explanation ignores the role of capital flows, and cannot explain why after stabilization the rise in interest rates led to an appreciation.

and the most important one, which represents the fiscal side, was the reduction in the operational deficit, which stopped the growth of the undiscounted public debt, and even generated a decline in the debt/GDP ratio till the mid-nineties. This was a precondition for sustainability of the public sector (regardless of the type of regime) although there is still a long way to go towards the norms of OECD. The "no printing law" which forbade the BOI to finance fiscal deficits, was instrumental in keeping low operational deficits and preventing the growth of the debt.

The second factor, which represents the monetary side, was the institution of the inflation target regime, which provided a nominal anchor of price stability and prevented the use of surprise inflation tactics. This was the basis for ensuring the cooperation of the treasury in attaining the inflation target (although this consensus has been strained at times because of mutual suspicion). The third factor (which is essentially part of the previous one) was the severance of the inflation target from the actual inflation shocks, and reducing the latter towards the target by means of temporary increases in the interest rate of the BOI which might have a temporary recessionary effect. This contrasts with the practice of accepting a higher rate of devaluations as *permanent* feature, as used to be the case in the inflationary era. Of course, this strategy could not have worked, if it were not part of the acceptance of the OECD model.

If we accept that FD means that fiscal policy sets targets that monetary policy has to accommodate, and that MD means the opposite, then we may claim that in the inflationary period we had FD and after stabilization we had MD. This is based on the following considerations.

In the inflationary period we had the following FD features:

a. Fiscal policy behaved as if it set a target of a fixed operational deficit (which was too large and did not ensure sustainability), leaving the task of equilibration to monetary policy.

b. Monetary policy did not set inflation targets, and did not redress the inflation path after shocks.

c. Monetary policy was subordinated to fiscal policy, by keeping low interest rates and financing fiscal deficits by the inflation tax.

d. Monetary policy reacted to balance of payments stresses by price shocks (the Pigou effect), in order to erode the real value of wages and disposable income.

After stabilization (especially in the nineties) we had the following MD features:

a. There was a nominal target (a fixed exchange rate of some sort, an inflation target).

b. There was a policy of adhering to these targets by interest rate policy.

c. The reaction to BOP stresses was *not* by massive devaluations.

d. Fiscal policy internalized (usually) the monetary objective of price stability in the framework of the consensus concerning the inflation target.

e. Fiscal policy accepted, in principle, the Maastricht Rules, and was responsive to the constraints of Globalization.

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Table 1: Total and Primary Public Sector Deficits, % of GDP 1960-73

		1960-64	1965-67	1968-73
(1)	Operational Deficit of the Public Sector	-5.32	-0.09	9.77
(2)	Annual change of monetary base	2.20	1.70	2.45
(3)	Inflation Tax[1]	1.47	1.30	2.31
(4)=(1)-(2)	Total Deficit of the Public Sector minus segniorage	-7.52	-1.79	7.33
(5)=(1)-(3)	Total Deficit minus Inflation Tax	-6.79	-1.38	7.46
(6)	Net real interest payments	1.31	1.40	3.00
(7)=(1)-(6)	Primary deficit of the public sector	-6.63	-1.49	6.77
(8)=(7)-(2)	Primary deficit of the public sector minus segnoirage	-8.84	-3.18	4.32
(9)=(7)-(3)	Primary Deficit minus Inflation Tax	-8.10	-2.78	4.46
(10)	Net Public Debt[2]			80.76[2a]
(11)	MB/GDP	12.20	12.34	12.90
(12)	Inflation(% annual)	6.43	6.03	11.68
(13)	MB - growth(% annual)	20.71	14.78	22.35
(14)	Real interest rate (r)			
a	On Government Bonds [3]	5.41	4.41	5.60
b	On Bank Loans [4]	8.84	6.03[6]	11.55[7]
c	Actual Interest Payment [5]			4.08
(15)	GDP - growth (n)	9.86	4.24	10.69
(16)	Unemployment	3.76	7.13	3.87

[1] $im = ((1+r)(1+\pi)-1))*m$, r from (14)a

[2] Dahan and Strawczynski (1999)

[2a] Average:1969-73.

[3] Real Yield to Redemption of CPI-Indexed Bonds.

[4] 1960-72 real interest rate on free credit bank (source:1968-72 Manzli Series).

[5] Actual interest payments, average of annual ratios (6)/(10).

[6] Average:1965-66.

[7] Average:1968-72

Source: BOI

Table 2: Total and Primary Public Sector Deficits, % of GDP 1974-84

		1974-77	1978-80	1981-83	1984
(1)	Operational Deficit of the Public Sector	15.98	13.55	12.25	14.53
(2)	Annual change of monetary base	1.97	1.44	2.04	3.00
(3)	Inflation Tax[1]	3.76	4.06	3.76	10.22
(4)=(1)-(2)	Total Deficit of the Public Sector minus segniorage	14.00	12.11	10.21	11.53
(5)=(1)-(3)	Total Deficit minus Inflation Tax	12.21	9.49	8.49	4.31
(6)	Net real interest payments	5.25	8.47	9.35	11.53
(7)=(1)-(6)	Primary deficit of the public sector	10.73	5.07	2.90	3.00
(8)=(7)-(2)	Primary deficit of the public sector minus segnoirage	8.75	3.63	0.87	0.00
(9)=(7)-(3)	Primary Deficit minus Inflation Tax	6.96	1.01	-0.86	-7.22
(10)	Net Public Debt[2]	120.43	142.70	157.67	162.50
(11)	MB/GDP	8.36	4.74	2.62	2.18
(12)	Inflation(% annual)	40.07	97.49	141.23	444.88
(13)	MB - growth(% annual)	30.54	47.83	127.74	438.17
(14)	Real interest rate (r)				
a	On Government Bonds [3]	2.45	0.13	1.63	4.30
b	On Bank Loans [4]	-4.39	2.05	12.46	62.05
c	Actual Interest Payment [5]	4.32	5.93	5.93	7.09
(15)	GDP - growth (n)	3.24	4.13	2.91	2.21
(16)	Unemployment	3.40	3.77	4.87	5.90

[1] $im = ((1+r)(1+\pi)-1))*m$, r from (14)a

[2] Dahan and Strawczynski (1999)

[3] Real Yield to Redemption of CPI-Indexed Bonds.

[4] Real interest rate on overtdraft (Hahad).

[5] Actual interest payments, average of annual ratios (6)/(10).

Source: BOI

Table 3: Total and Primary Public Sector Deficits, % of GDP 1986-02

		1986-89	1990-94	1995-99	2000-02
(1)	Operational Deficit of the Public Sector	0.96	4.51	4.55	3.47
(2)	Annual change of monetary base	0.83	0.67	0.59	0.43
(3)	Inflation Tax[1]	1.13	0.56	0.41	0.31
(4)=(1)-(2)	Total Deficit of the Public Sector minus segniorage	0.13	3.84	3.96	3.04
(5)=(1)-(3)	Total Deficit minus Inflation Tax	-0.17	3.95	4.14	3.16
(6)	Net real interest payments	9.66	6.93	5.66	5.20
(7)=(1)-(6)	Primary deficit of the public sector	-8.70	-2.42	-1.11	-1.73
(8)=(7)-(2)	Primary deficit of the public sector minus segnoirage	-9.53	-3.09	-1.70	-2.16
(9)=(7)-(3)	Primary Deficit minus Inflation Tax	-9.83	-2.98	-1.51	-2.04
(10)	Net Public Debt[2]	128.75	111.76	97.85[2a]	
(11)	MB/GDP	5.33	3.62	3.93	4.92
(12)	Inflation(% annual)	18.22	14.14	7.13	2.64
(13)	MB - growth(% annual)	18.57	20.60	17.70	9.34
(14)	Real interest rate (r)				
a	On Government Bonds [4]	2.46	1.14	3.20	3.36
b	On Bank Loans [5]	29.10	8.66	12.83	13.45
c	Actual Interest Payment [6]	7.48	6.19	6.13	
(15)	GDP - growth (n)	3.67	6.13	4.05	1.85
(16)	Unemployment	7.13	9.84	7.16	9.00

[1] $im = ((1+r)(1+\pi)-1))*m$, r from (14)a

[2] Dahan and Strawczynski (1999)

[2a] Average:1995-96.

[3] Average:2000-01.

[4] Real Yield to Redemption of CPI-Indexed Bonds.

[5] Real interest rate on overtdraft (Hahad).

[6] Actual interest payments, average of annual ratios (6)/(10).

Source: BOI

Table 4: Real exchange rates, Real interest rate and Net public debt/GDP ratios

Real exchange rates (Indices 1990=100)

	IMP prices/GDP Deflator	EXP prices/GDP Deflator	RE[1]R = (E*US GDP Deflator)/Israel GDP Deflator	Real interest rate[2] (r)			Net Public Debt (% gdp)
				Hahad[3]	Tafas[4]	Bonds[5]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1970							63.3
1971	121.13	121.57	135.92	-11.80	-0.25	4.90	74.1
1972	127.56	122.49	136.73	5.47	-1.02	5.29	70.3
1973	125.43	119.24	118.60	-3.32	-11.78	5.80	74.6
1974	130.28	120.18	102.62	-19.73	-22.36	3.60	83.4
1975	130.54	124.97	113.79	4.65	-12.18	2.90	98.5
1976	135.66	129.36	118.10	-2.37	-13.76	1.50	109.6
1977	133.26	134.99	119.22	-0.13	-10.55	1.80	110.6
1978	148.73	147.63	132.68	0.84	-15.27	0.70	120.9
1979	140.65	140.41	117.62	-11.94	-33.28	-0.50	118.9
1980	145.64	139.55	115.19	17.23	-23.88	0.20	119.4
1981	140.57	135.50	123.92	35.38	-9.07	1.10	119.0
1982	130.12	126.52	124.81	4.67	-23.71	1.90	120.2
1983	116.54	118.36	121.93	-2.67	-27.22	1.90	125.8
1984	124.50	122.11	139.99	62.05	1.14	4.30	148.8
1985	138.40	127.57	154.76	115.09	-19.50	4.66	158.2
1986	117.90	110.55	129.89	38.80	-3.13	4.19	148.6
1987	114.14	105.79	118.71	39.42	0.30	2.98	124.3
1988	102.50	99.44	103.86	26.24	-3.69	2.46	131.9
1989	103.84	101.55	106.46	11.92	-6.30	0.19	134.8
1990	100.00	100.00	100.00	10.26	-4.08	-0.16	122.7
1991	90.76	93.90	97.23	9.98	-4.96	1.09	109.7
1992	86.81	89.99	95.71	12.39	0.84	1.18	102.9
1993	86.17	89.77	100.77	6.19	-0.87	1.81	100.4
1994	81.39	84.45	96.17	4.47	-1.82	1.77	91.1
1995	79.39	80.20	89.22	13.47	4.03	2.98	88.4
1996	74.78	77.90	86.97	11.13	2.43	3.01	88.4
1997	70.69	75.73	88.26	13.06	4.28	2.49	86.1
1998	68.87	75.80	91.89	9.04	3.82	3.59	85.6
1999	68.99	79.20	95.47	17.47	7.38	3.93	88.2
2000	68.27	76.49	94.26	15.96	7.47	4.23	80.2
2001	67.32	75.19	98.04	11.48	3.48	3.23	84.4
2002	72.63	80.06	106.24	12.90		2.62	

[1]E=Sheqels for USD.

[2]Real interest rate (Hahad,Tafas) : Nominal interest rates deflated by within-year CPI inflation.

[3]Hahad=Overdrafts.

[4]Tafas=Short-term deposits.

[5]Bonds=Yield to maturity on government indexed bonds.

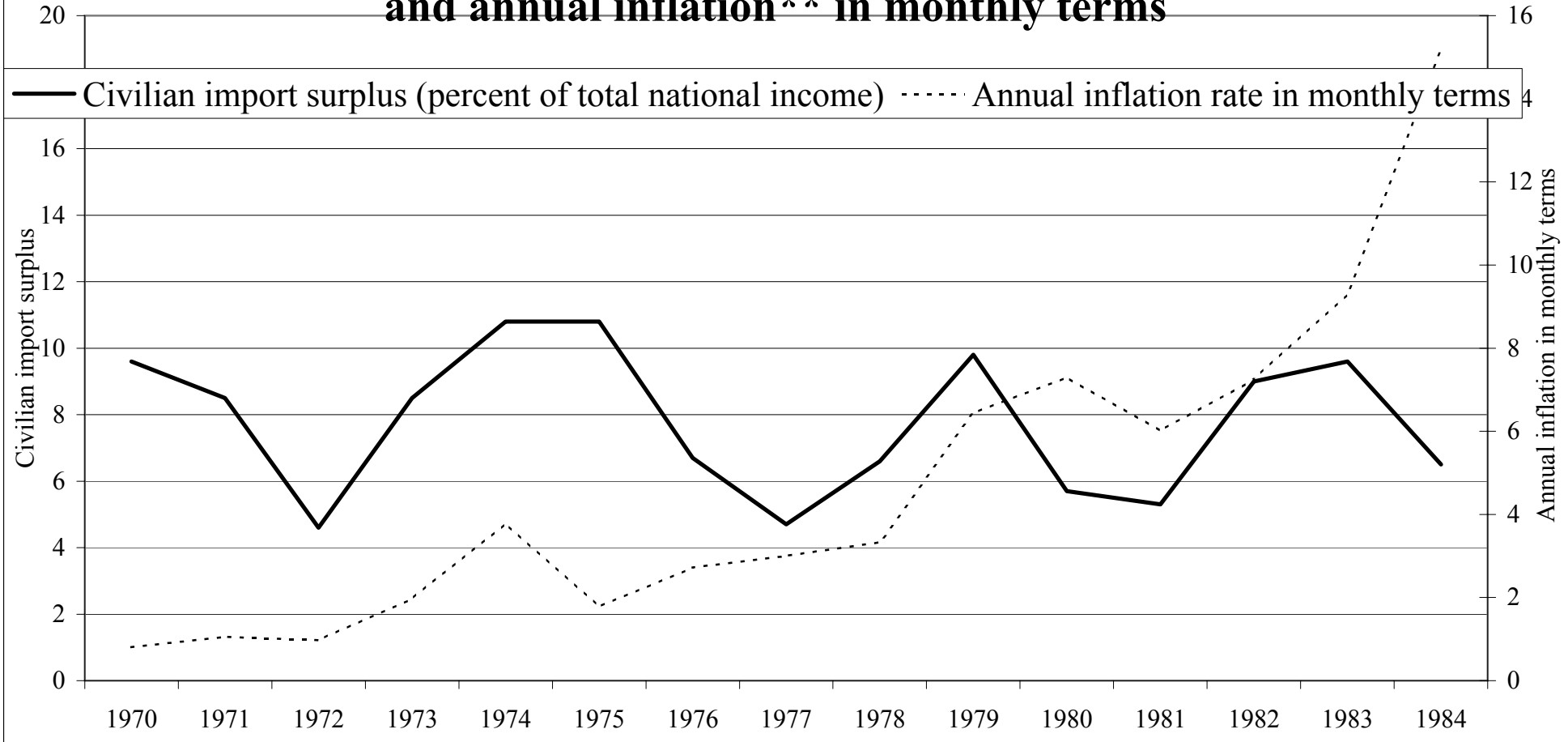
Source: BOI

Table 5: Real exchange rates, Real interest rate and Net public debt/GDP ratios by groups of years

Indices 1990=100

	IMP prices/GDP Deflator	EXP prices/GDP Deflator	RER = (E*US GDP	Real interest rate (r)			Net Public Debt
	average	average	average	Hahad	Tafas	Bonds	average
1971-73	124.71	121.10	130.42	-3.22	-4.35	5.33	73.01
1974-77	132.43	127.37	113.43	-4.39	-14.71	2.45	100.53
1978-80	145.00	142.53	121.83	2.05	-24.14	0.13	119.72
1981-83	129.07	126.79	123.55	12.46	-20.00	1.63	121.66
1984	124.50	122.11	139.99	62.05	1.14	4.30	148.80
1985	138.40	127.57	154.76	115.09	-19.50	4.66	158.20
1986-89	109.59	104.33	114.73	29.10	-3.20	2.46	134.90
1990-94	89.02	91.62	97.97	8.66	-2.18	1.14	105.36
1995-99	72.54	77.77	90.36	12.83	4.39	3.20	87.34
2000-02	69.40	77.25	99.51	13.45	5.47	3.36	82.30

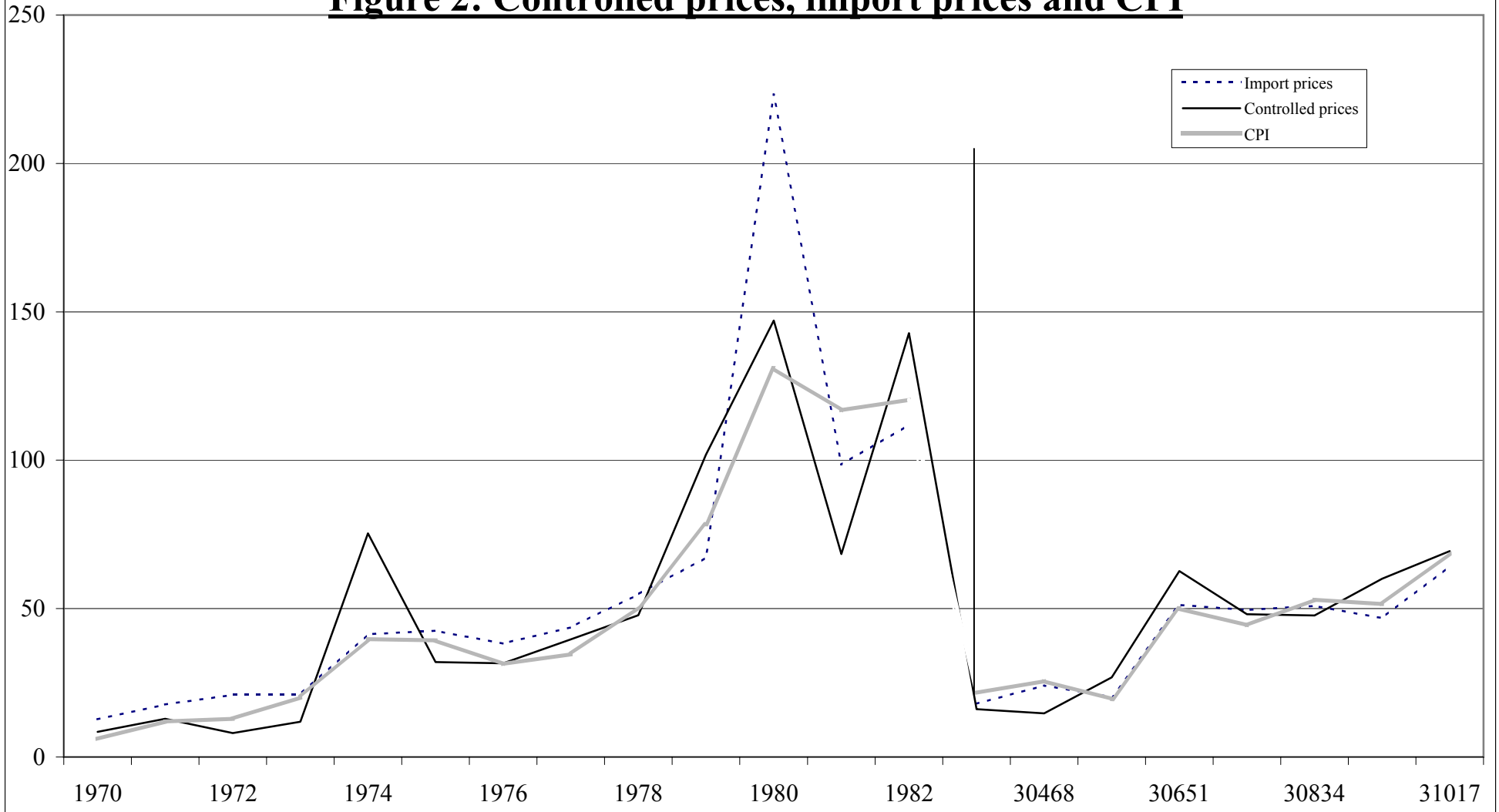
Figure 1: Civilian import surplus (percent of national income*) and annual inflation** in monthly terms



* From all sources ** Within years

Source: BOI

Figure 2: Controlled prices, import prices and CPI



* For 1983-1984: quarterly data

Source : BOI

Figure 3a: Import surplus, total public deficit, seiniorage and inflation tax (% GDP)

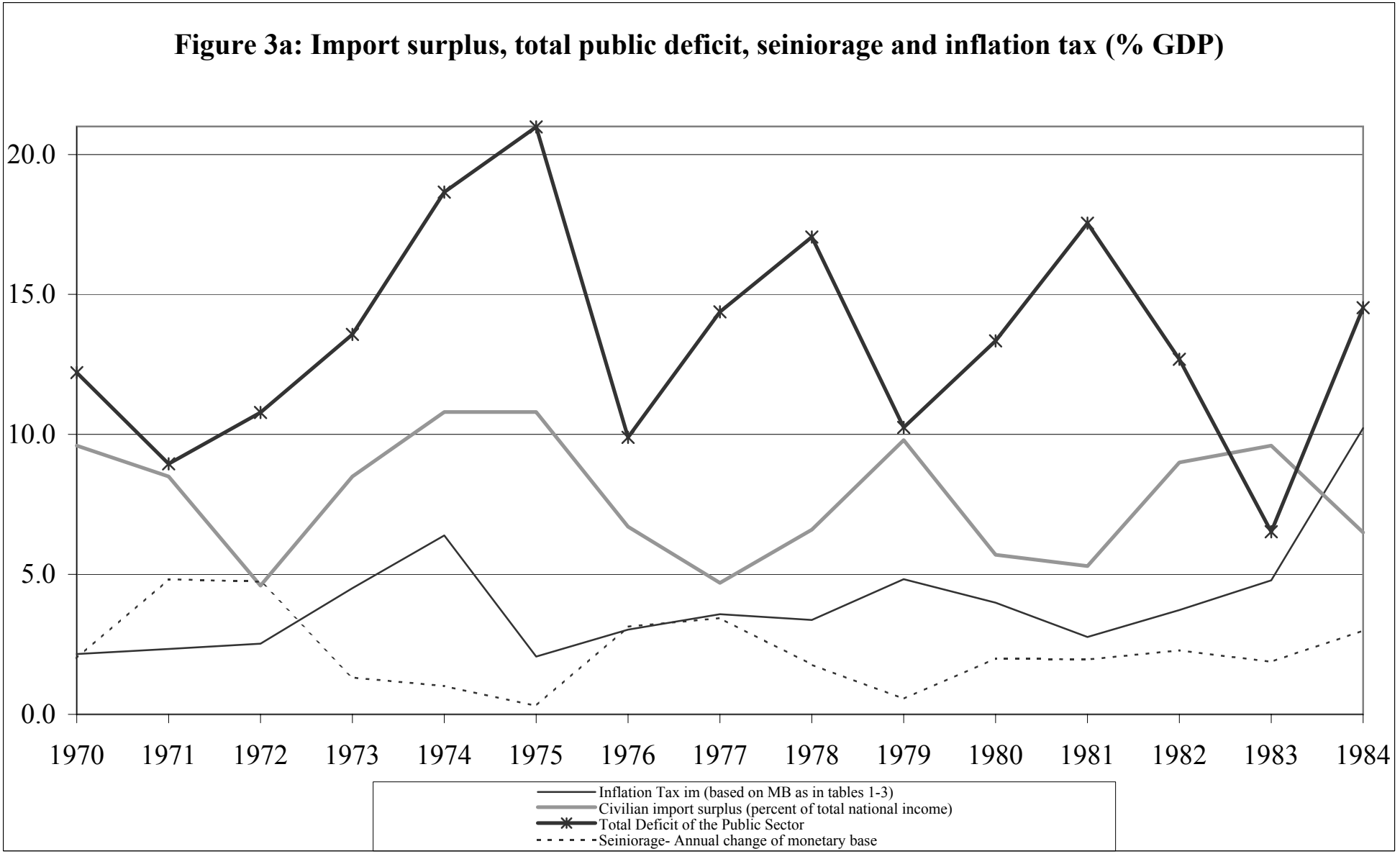


Figure 3b: Import surplus, primary public deficit, seiniorage and inflation tax (%GDP)

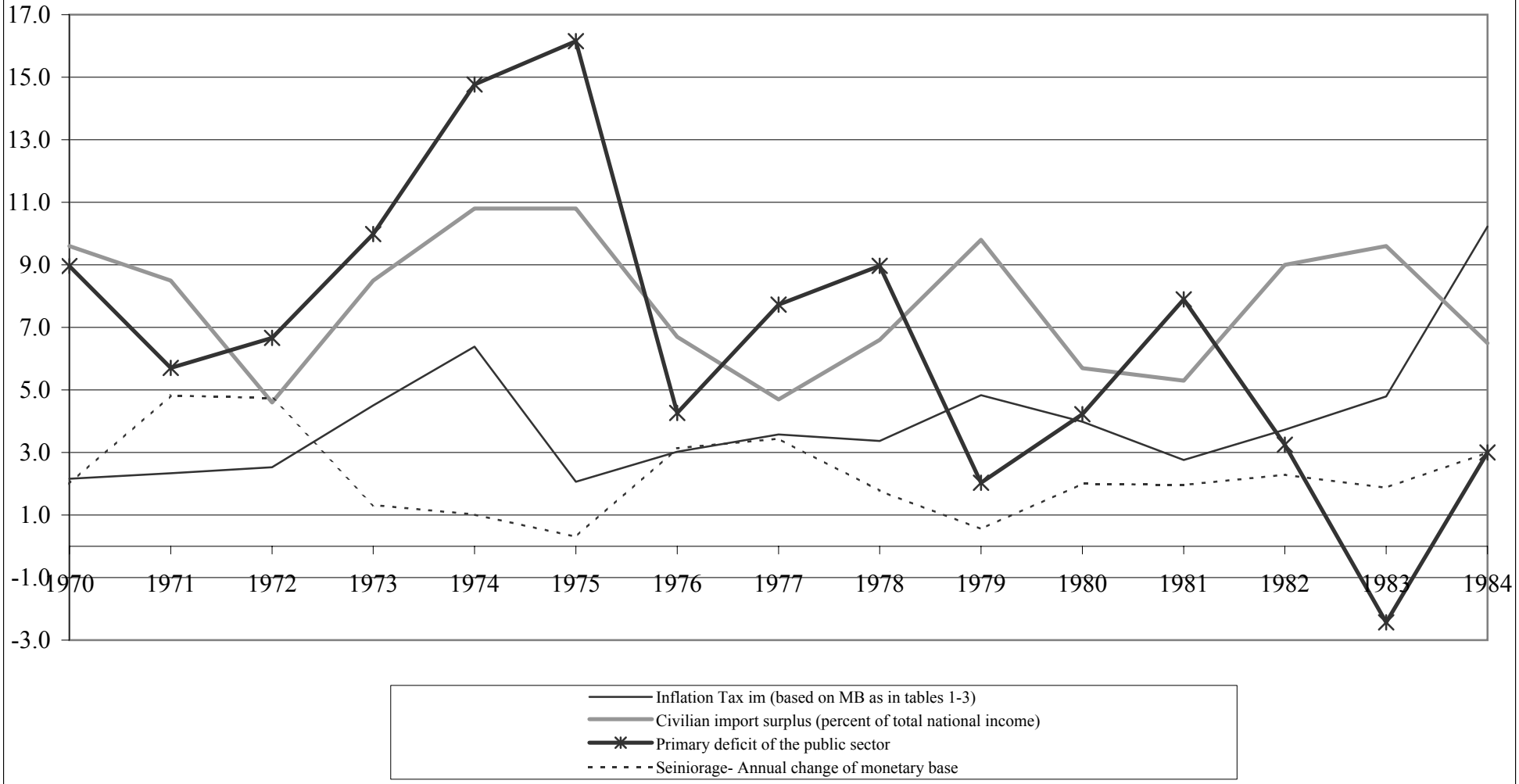


Figure 4a: Import surplus, total public deficit, seiniorage and inflation tax (% GDP)

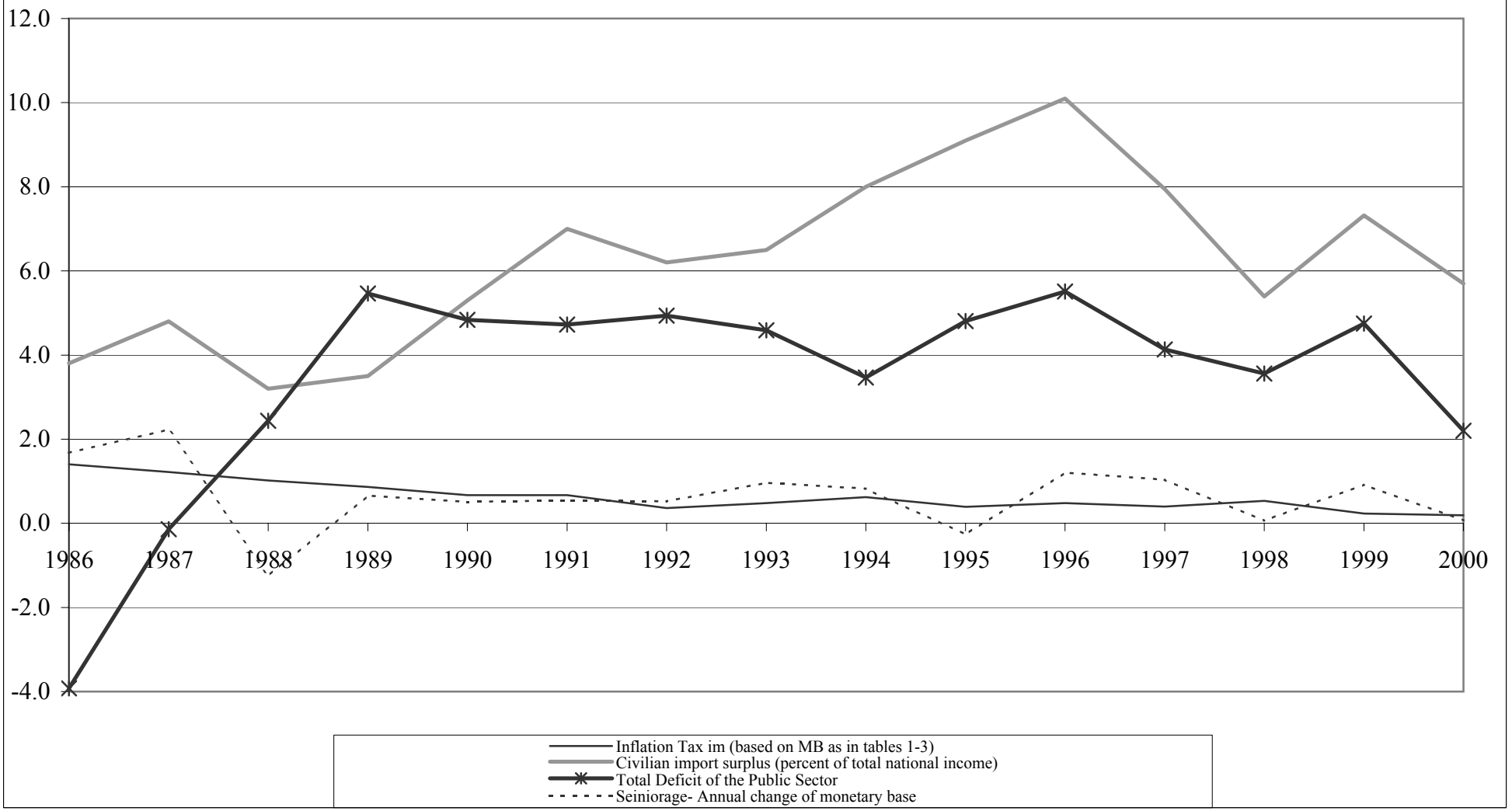


Figure 4b: Import surplus, primary public deficit, seiniorage and inflation tax (% GDP)

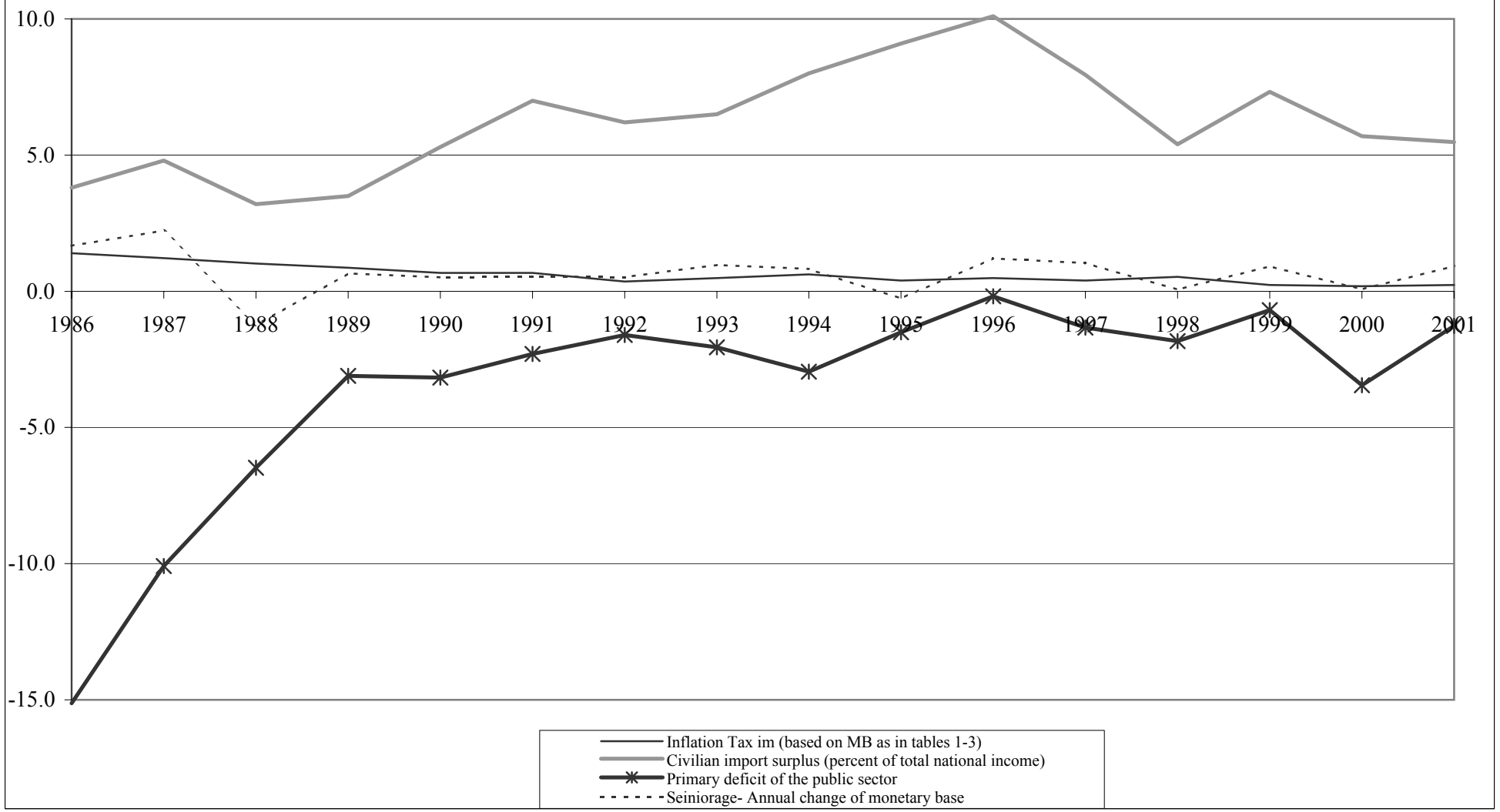


Figure 5: Expected inflation*, CPI and inflation target

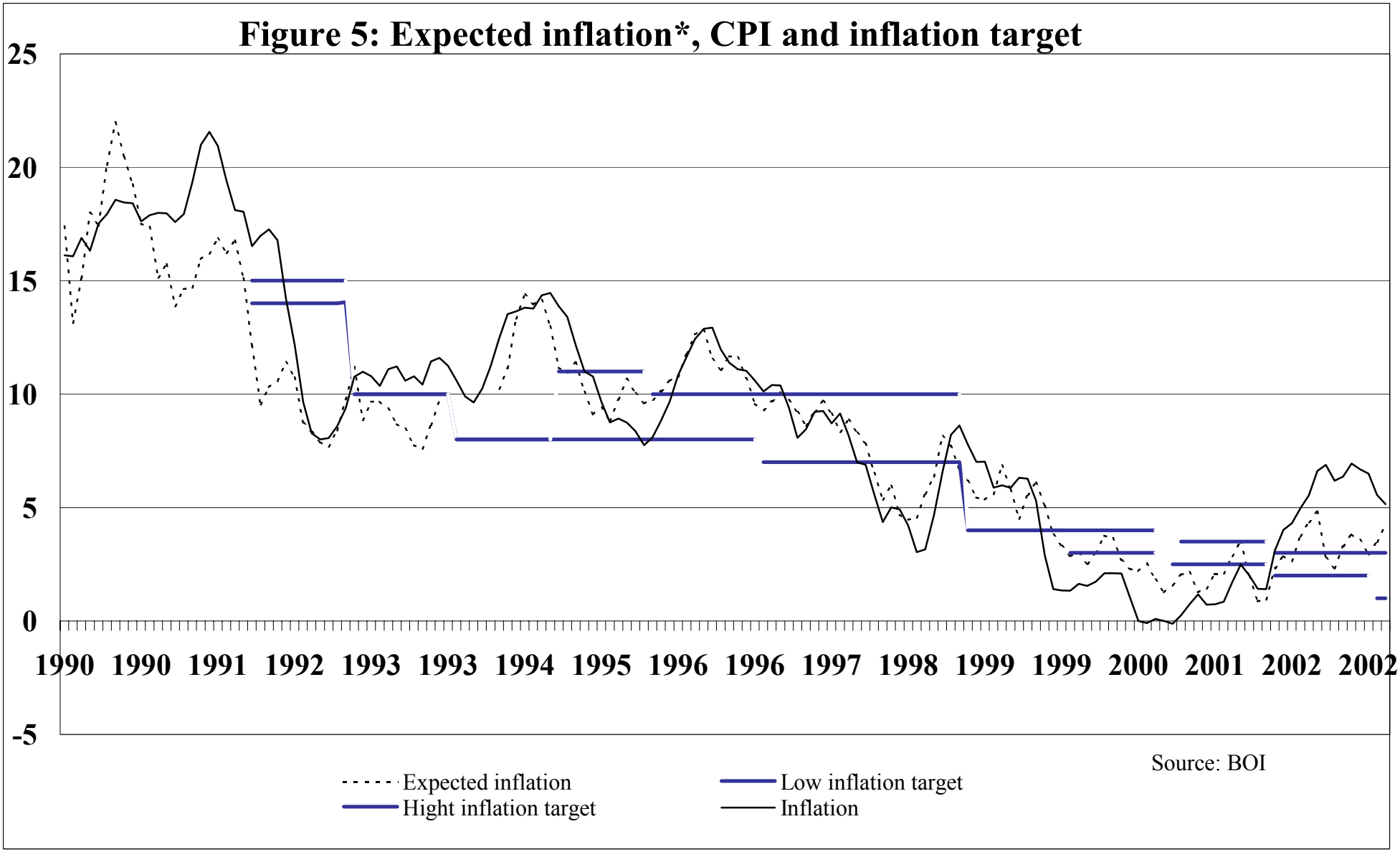


Figure 6 : Saddle point at E

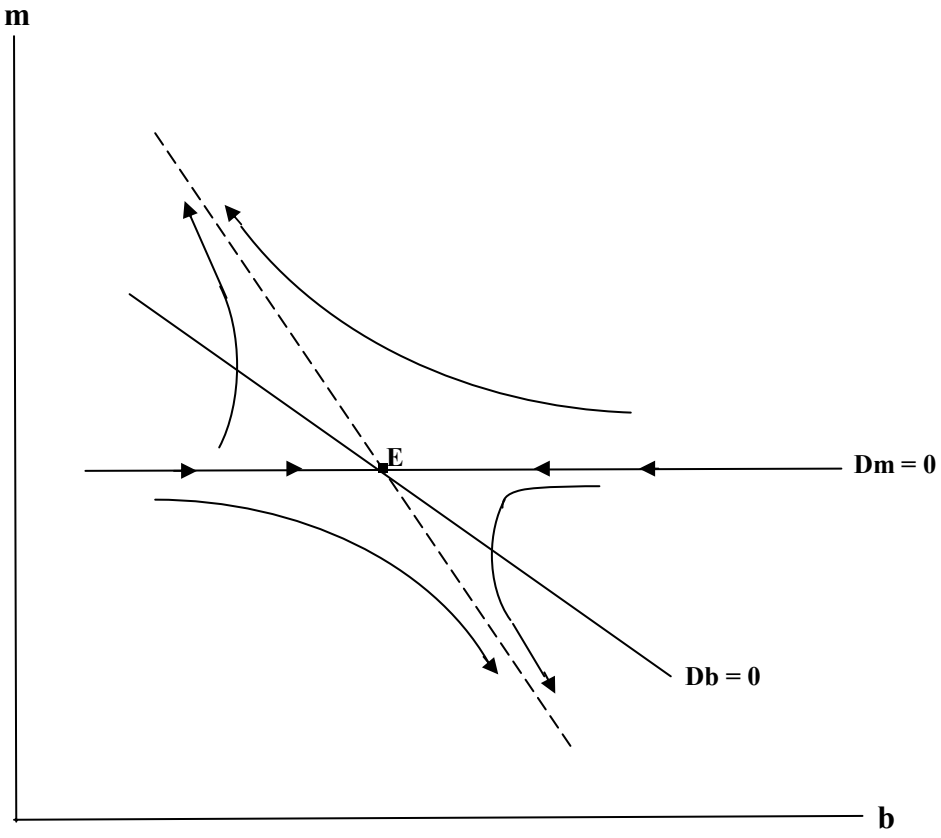


Figure 7 : FD Regime

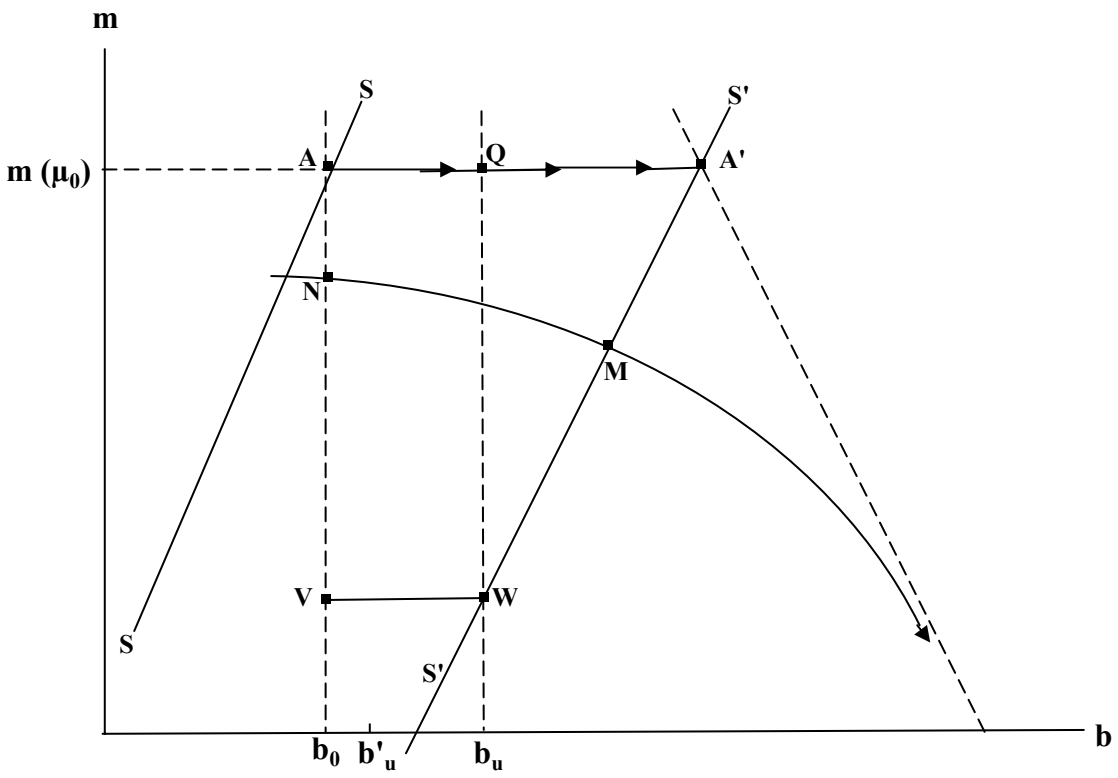


Figure 8 : MD Regime