Exchange Rate-Based Stabilization: 
Pleasant Monetary Dynamics?

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Abstract

High inflation economies have ultimately been successful in stabilising their prices using the exchange rate as a nominal anchor. Besides stabilization, these recent examples have shown boom-recession cycles, contrary to what can be expected from (pure) money-based stabilizations. Various theoretical explanations of such boom-cycles are discussed and a model of aggregate supply and demand generating such an outcome is developed. There the boom dynamics depend mainly on a slump in real interest rates and wage flexibility.

Keywords: macroeconomic modelling, exchange rate-based stabilization, high inflation, Latin America.

JEL Classification: E10, E31, E52, E63.
1 Introduction

High inflation economies, especially the typical Latin American cases like Argentina and Brazil, have ultimately been successful in stabilising their prices using the exchange rate as a nominal anchor. Similar experiences were already made by their hyperinflationary predecessors of the 1920s (as analyzed, e.g., by Sargent, 1982). But besides stabilization, these recent cases have shown boom-recession cycles, contrary to what one would predict from monetary theory and contrary to the typical outcome of the often applied money-based stabilizations, namely a recession-boom cycle.

With a money-based stabilization program, output losses are almost unavoidable due to either adaptive expectations or, as a structural element of the economy, slow price adjustments or both. In any case, a money squeeze has to force the price rises to a halt. And while prices are realigning, quantities have to take the burden of adjustment. To speed up the price adjustment, various so-called "heterodox" stabilization programs had been implemented in the inflation prone countries. In such cases price rises were put to a halt through price freezes and strict wage regulations (see, e.g., Kiguel/Liviatan, 1992b). Often showing a boom shortly after implementation, many economies resumed the old path of high inflation after prices had been released. This fact is mainly due to the difficulty of freezing prices in economies with high inflation (and thus a high price variability) at market clearing levels. Furthermore, the political economy setting often made it necessary for politicians to trade the price and wage freezes for once and for all wage rises right before the implementation of the program or a certain fiscal accommodation of the drop in private demand caused by it.

So how should it be possible to have a successful and almost costless stabilization (in terms of output losses) by means of fixing the exchange rate, or at least to shift output costs to later periods, when the political acceptance of the program is larger due to successful inflation stabilization? Some stylized facts of exchange rate-based stabilizations and theoretical explanations for the observed boom cycles are given in the next section 2. An AS/AD model is developed and analyzed in section 3, and it will be shown that it can exhibit this "abnormal" boom behaviour. Some open questions are shortly addressed in the last section 4, suggesting further research on the topic.

2 Stylized Facts and Theoretical Underpinnings

Some stylized facts and theoretical explanations of such programs and their outcomes have been compiled by Kiguel/Liviatan (1992a) and are, with some
extensions, shown in tables 1 and 2. In almost all cases output rose shortly after
the implementation of the program, and in cases where the exchange rate was
fixed only after monetary and fiscal stabilization this caused at least no recession.
Some countries experienced a recession before the stabilization program was
introduced. This could indicate free capacities and therefore favourable supply
side conditions for the stabilization period.

The deterioration of the current account in all cases, mostly due to a real
appreciation, was initially financed by capital inflows, and in cases where such
inflows could not be sustained or external deficits could not be stabilized the
programs had to be abandoned. The observed higher real wages at the end (as
compared to the beginning) of the stabilization packages hide the fact that in
many cases wages fell with the implementation of the program, such wage flex-
ibility allowing favourable supply side effects to develop (e.g., Israel). Some
packages, though, contained an initial "once and for all" wage increase (es-
pecially where wages were frozen afterwards). Such measures, however, generally
brought about a slowdown of the following wage increases. The fiscal deficit
decreased in many cases, displaying on the one hand the effects of supporting
and necessary fiscal measures of the stabilization packages, and on the other
(partly) effects of automatic stabilizers improving the deficit during the boom
accompanying the stabilization period.

As mentioned before, higher consumption and higher investments seem to
be the typical effects of exchange rate-based stabilizations. In many cases con-
sumption was the first variable to react and thus leading the boom process.
Investments were higher (almost only) in cases where they were supported by
foreign capital.

Theoretically, various explanations of such favourable output effects have
been given in the literature. A more traditional approach relies on the positive
effect of a lower real interest rate on investment and consumption. If real interest
r is defined as the difference between nominal interest i and the expected rate
of inflation, \( \hat{\pi} \), and furthermore, with (uncovered) interest parity in a small
open economy, nominal interest is given by foreign nominal interest, \( \hat{i}^* \), and
the expected rate of devaluation, \( \hat{e} (e \text{ being the exchange rate}) \), and eventually a
risk premium \( \varphi \), one can write

\[
r = i - \hat{\pi} = i^* + \hat{e} + \varphi - \hat{\pi}.
\]

If in a high inflation economy with a floating exchange rate the rate of devalu-
tion were positive (\( \hat{e} > 0 \)), a credible exchange rate stabilization (in the extreme
\( \hat{e} = \hat{e} = 0 \)) would abruptly lower real interest in the home economy, assuming
that due to structural rigidities \( \hat{\pi} \) comes down only slowly, restoring the initial
real rate after a while.

\footnote{The experiences of some economies in transition are not reported here; see, e.g., Bofinger (1990) for a short discussion of such programs introduced in (former) Czechoslovakia (1991),
Estonia (1992), and Poland (1990).}
Table 1: Selected Cases of Exchange Rate-Based Stabilizations: Policy Measures

<table>
<thead>
<tr>
<th>Country</th>
<th>Period(^1)</th>
<th>Exchange rate</th>
<th>Income policy</th>
<th>Budget reform</th>
<th>Trade policy</th>
<th>Restr.(^2)</th>
<th>Dev.(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1959.3-1962.2</td>
<td>fixed</td>
<td>no</td>
<td>at beg.</td>
<td>inv.(^4)</td>
<td>yes(^6)</td>
<td>yes</td>
</tr>
<tr>
<td>1967.2-1970.3</td>
<td>fixed</td>
<td>gradual</td>
<td>yes</td>
<td>KA(^6)</td>
<td>no</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>1973.3-1975.2</td>
<td>fixed</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>1978.4-1981.1</td>
<td>tab.(^7)</td>
<td>no</td>
<td>moderate</td>
<td>CA,KA(^8)</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>1985.1-1986.3</td>
<td>fixed</td>
<td>shock</td>
<td>at beg.</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>from 1991.2</td>
<td>fixed</td>
<td>yes</td>
<td>yes</td>
<td>CA,KA(^8)</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1964.2-1968.3</td>
<td>st.fixed(^9)</td>
<td>gradual</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>1986.1-1986.4</td>
<td>fixed</td>
<td>shock</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>from 1994.2</td>
<td>fixed</td>
<td>gradual</td>
<td>moderate</td>
<td>CA,KA(^8)</td>
<td>no</td>
<td>gradual</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>1976.3-1982.3</td>
<td>var.(^10)</td>
<td>no</td>
<td>yes</td>
<td>CA,KA(^8)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Israel</td>
<td>from 1985.1</td>
<td>fixed w.d.(^11)</td>
<td>shock</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Mexico</td>
<td>from 1988.1</td>
<td>fixed, c.p.(^12)</td>
<td>smльн shock</td>
<td>yes</td>
<td>CA,KA(^8)</td>
<td>fiscal p.</td>
<td>yes</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1968.2-1972.1</td>
<td>fixed</td>
<td>shock</td>
<td>at beg.</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>1978.4-1982.4</td>
<td>tab.(^7)</td>
<td>no</td>
<td>yes</td>
<td>CA(^8)</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

A "shock" in income policy indicates a price or wage freeze; "trade policy" refers to changes in or reforms in the respective policy at the beginning of or shortly before the stabilization.

\(^1\) Period: year quarter.

\(^2\) Restrictive monetary or fiscal measures.

\(^3\) This refers to a large discretionary devaluation with the introduction of the stabilization program.

\(^4\) Incentives for foreign direct investment.

\(^5\) Incentives for foreign capital inflows.

\(^6\) IMF adjustment program implemented six months before actual stabilization.

\(^7\) Pre-announced devaluation by "tablita".

\(^8\) Liberalization of the current account (CA) or current and capital account (CA,KA).

\(^9\) Stepwise devaluation with fixed rates between steps.

\(^10\) Various regimes: firstly floating rates, then pre-announced devaluations ("tablita"), then fixed.

\(^11\) Fixed exchange rate with occasional devaluations.

\(^12\) Fixed exchange rate during first year, then crawling peg.

Sources: See table 2.
Table 2. Selected Cases of Exchange Rate-Based Stabilizations: Results

<table>
<thead>
<tr>
<th>Country</th>
<th>Inflation rate</th>
<th>GDP high</th>
<th>Cons. boom</th>
<th>Invest. boom</th>
<th>CA</th>
<th>$\epsilon$</th>
<th>$\frac{\pi}{\pi}$</th>
<th>$\frac{E}{GDP}$</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1969.3-1970.2</td>
<td>9.5-1.9</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
<td>1969.3-1970.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>1964.2-1968.3</td>
<td>6.4-4.2</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-/+</td>
<td>1964.2-1968.3</td>
</tr>
<tr>
<td>Chile</td>
<td>1976.3-1982.3</td>
<td>11.2-6.5</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
<td>1976.3-1982.3</td>
</tr>
<tr>
<td>Israel</td>
<td>from 1985.1</td>
<td>2.5-2.7</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
<td>1985.1</td>
</tr>
<tr>
<td>Mexico</td>
<td>from 1988.1</td>
<td>2.1-2.6</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
<td>1988.1</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1968.2-1970.2</td>
<td>9.5-3.9</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
<td>1968.2-1970.2</td>
</tr>
<tr>
<td>1978.4-1982.4</td>
<td>5.4-4.6</td>
<td>yes</td>
<td>no</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-/+</td>
<td>1978.4-1982.4</td>
<td></td>
</tr>
</tbody>
</table>

"n.a." indicates an unclear outcome or data not available; "=" indicate no or insignificant changes of respective variables; information within parenthesis indicate preliminary results.

1. Period: year.quarter.
2. Monthly percentage change in inflation rates from the starting to the end point of the respective stabilization program.
3. First year in which GDP grew above trend.
5. Real exchange rate $\epsilon$: "+"... depreciation, "-"... appreciation.
6. Real wages $\frac{W}{P}$: "+"... rise, "-"... fall.
7. Budget deficit ratio $\frac{B}{GDP}$: "+"... rise, "-"... fall.

In principle such propagating mechanisms are present in the models of Rodríguez (1982) and Rama (1992), the latter working with a Malinvaud-type disequilibrium model where exchange rate stabilization brings the economy from a situation of “repressed inflation” with an output boom to a recessionary one of “Keynesian unemployment”.

Another type of models takes into account that especially in the exchange rate-based stabilization experiences of the eighties boom cycles could be observed in spite of rising real interest rates: *Lacking credibility* of a stabilization program is the driving force of the models elaborated by Calvo and Végh (1991). Taking advantage of the stopped devaluation when exchange rates are stabilized, conceived as lasting only for a short period until the program is abandoned, intertemporally maximising individuals shift their (import) consumption and investment to the first period of the stabilization, generating a boom in absorption, and, through second round and other effects, on output in general. The real interest rate drops initially and then, starting from this lower level, will rise in the course of the program (and it may even fall again by some smaller amount), never reaching its old level until stabilization is abandoned. If stabilization were totally credible, nothing would happen in the real variables due to the “Ricardian equivalence structure” of these micro-founded models. Only a backward-looking wage mechanism or the introduction of capital controls (as opposed to the full capital mobility assumed in the general setting) lead to a recessionary stabilization cycle.

It is a moot question whether such a setting accurately maps real world circumstances in general, but it is especially questionable whether the latest experiences of Argentina and Brazil really suffered from low credibility.

The model outlined in the following section follows the more conventional lines of Rodríguez (1982) and will show how boom-cycles of exchange rate-based stabilizations can exist together with – or even due to – high credibility. As mentioned for the models above this outcome relies mainly on interest rate effects, but, as will be discussed, such effects will, inter alia, have to be supported by wage flexibility. The general structure is such that the effects are very sensi-

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3 Cf. also a summary presentation of these models given in Végh (1992, pp. 652ff). For other analyses of credibility in this context see the references given in Rama (1992, p. 510).
4 For Brazil see e.g. the opinion polls cited in various local newspapers shortly after the implementation of the “Plano Real”. Low credibility may certainly have been present in some of the “follow-up” heterodox programs in the mid-eighties in Argentina and Brazil, when individuals had learned about the failure of preceding stabilization packages. The presence of substitution effects in these periods seemed to have been responsible for more than sixty percent of the respective output booms, as shown in Carmen M. Reinhart and Carlos A. Végh (1992), Nominal Interest Rates, Consumption Booms, and Lack of Credibility: A Quantitative Examination, Washington, D.C.: International Monetary Fund (mimeo); cited in Végh (1992, pp. 652ff).
tive to changes in parameters, and "the wrong" setting can turn the adjustment unstable.\footnote{A more detailed presentation of the following can be found in Wehinger (1996, pp. 270ff and 415ff).}

3 Exchange Rate-Based Stabilization in an AS/AD Model

The conventional recessionary dynamics of stabilization can be generated in simple IS/LM-models including a Phillips curve and adaptive expectations\footnote{For a closed economy version see, e.g., the textbook of Simonsen/Cyan: 1989, pp. 421ff; an open economy extension is presented and discussed in Wehinger, 1996, pp. 270ff.}. The latter and the inflation-output trade-off are then responsible for the temporary slump in output if the exchange rate and/or the money base are stabilized. Typical adjustment paths in the inflation-output plane ($\pi-z$) are shown in figures 1 (a) and (b).

Figure 1: Exchange Rate-Based Stabilization in a Phillips Curve Model: Phase Diagram

![Phase Diagram](image)

In the course of the stabilization program, starting at a full employment level ($z = 0$), output and inflation begin to fall. At a certain point in time inflation even turns negative, meaning the price level then starts to decrease from its maximum value. Depending on the parameters of the dynamic system (the stable solutions can then have (a) two real roots or (b) two complex conjugated roots), inflation stays negative, converging to zero "from below", as does the
output gap (fig. a), or output and inflation show cyclical behaviour, converging with ever smaller amplitudes to their zero values (fig. b). The price level then has to fall steadily or cyclically to its new steady-state value. If we define the costs of stabilization in terms of the accumulated output gap, one can see that they are certainly positive. A model’s analysis can show that the costs are higher the higher is the inertia in inflationary expectations, the higher is the Phillips curve trade-off and the more open is the economy.

The main driving force behind the recessionary dynamics in that model is the Phillips curve trade-off. If the Phillips-curve, the assumption of a relation between wage growth and output, is dropped from the model and substituted by an equation of aggregate supply, one can generate the typical positive output effects of exchange rate-based stabilizations described above. The model is presented as a whole in table 3, in the following its equations will be commented on shortly. All variables are in logs, the interest and other rates (“x”) can be understood as transformed by log(1 + x).

Aggregate supply \( y^s \) in equation (2) is determined by the real exchange rate \( \varepsilon \) (defined in (11)) and the real wage \( (w - q) \), where both the nominal exchange rate \( \varepsilon \) and nominal wages \( w \) are deflated by the producer price index \( q \). \( y^s \) in (11) is the foreign price level, \( g \) in (10) the full-employment (or potential) output, and \( \delta \) and \( \psi \) are respective elasticity parameters. A real appreciation (decrease in \( \varepsilon \)) tends to increase supply, and higher real wages will lower it (for a similar, discrete time version of such an AS-equation cf. Fischer, 1986, pp. 248, equ. (2), and 1988, p. 31, equ. (2)).

As a counterpart, aggregate demand \( y^d \) in equation (3) is lower the more appreciated is the real exchange rate and, as common in an IS/LM context, the higher is the real interest rate \( r \). Real money demand in (4), based on the consumer price index \( p \) and \( m \) being nominal money,\(^7\) is positively driven by real income \( y \) and negatively by the nominal interest rate \( i \), as typical for an LM equation. \( \phi \) is a scaling or shock parameter.

Adaptive expectations for CPI inflation defined in (9) (a hat on the variables indicate their expected values) are modelled in (5) in the usual form, the adjustment factor \( \beta \) determining the speed of adjustment.\(^8\) It is important to note that if one wants to give up the assumption of individuals adapting their expectations gradually and backward-looking, such an equation can also describe some nominal rigidities in wage adjustment, caused for example by overlapping contracts (see, e.g., Barro, 1991, and Evans/Yarrow, 1981). In this sense "adaptive" expectations are not inconsistent with the immediately credible stabilization (and "rational expectations") described later.

\(^7\) Others use a producer price adjustment for real money, cf., e.g., Simonsen/Cyvis (1980, pp. 463), Dornbusch (1976); see also Fischer (1986, pp. 249 and 261, n. 4). There are no commonly accepted rules for the use of a particular index. Here CPI is used for the purpose of determining the model.

\(^8\) So \( 1/\beta \) is the mean time lag, giving the time length for the expected value to adjust by approx. 63% to a 100% shock in the actual variable. Cf. Gandolfo (1981, pp. 12f).
Table 3: Equations of the Model

\begin{align*}
y^s &= \bar{y} - \delta \varepsilon - \psi (w - q), \ \delta, \ \psi > 0 \quad \text{(aggregate supply, AS),} \quad (2) \\
y^d &= \bar{y} + \gamma \varepsilon - \rho r, \quad \gamma, \ \rho > 0 \quad \text{(aggregate demand, AD),} \quad (3) \\
m - p &= \eta y - \alpha i + \phi, \quad \eta, \ \alpha > 0 \quad \text{(money demand, LM),} \quad (4) \\
\dot{\pi} &= \beta (\pi - \bar{\pi}), \quad \beta > 0 \quad \text{(adaptive expectations),} \quad (5) \\
y &= y^s = y^d \quad \text{(market equilibrium),} \quad (6) \\
w &= \bar{p} + \alpha \quad \text{(wage formation),} \quad (7) \\
p &= (1 - \kappa) q + \kappa (c + p^s), \quad 0 < \kappa < 1 \quad \text{(consumer price index),} \quad (8) \\
\pi &\equiv \dot{p}, \quad \bar{\pi} \equiv \bar{p}, \quad \pi^* \equiv \bar{p}^* \quad \text{(inflation rates),} \quad (9) \\
z &\equiv y - \bar{y} \quad \text{(output gap),} \quad (10) \\
\varepsilon &\equiv \epsilon + p^* - q \quad \text{(real exchange rate),} \quad (11) \\
r &\equiv i - \bar{\pi} \quad \text{(real interest rate),} \quad (12) \\
i &= i^* + \varphi \bar{\varepsilon}, \quad \varphi > 0 \quad \text{(interest parity).} \quad (13)
\end{align*}

The market equilibrium condition is given in (6), bringing together aggregate demand and supply.

The wage formation in (7) proposes that nominal wages will be paid according to the expected CPI level, \( \alpha \) being the (required) real wage or, technically, a constant scaling factor. In a dynamic interpretation wage increases will follow expected CPI inflation (possibly corrected for, e.g., productivity shocks \( \dot{\alpha} \)). This implies the maybe heroic assumption of a vertical Phillips curve (wages being independent of the employment situation), but this can be accepted even for the short term in a high inflation economy model, where nominal wages are usually indexed to inflation and the inflation part of the wage rises makes up for
most of the wage increases (for a formal exposition cf., e.g., Lees et al., 1990, pp. 56ff). Indexation then is commonly installed in a backward looking way, so that the wage equation (7) together with adaptive (backward-looking) expectations (5) leads to a consistent and rather realistic description of the wage formation process. For the stabilization dynamics depicted below one has to note that the supply side effects of real wages depend on the producer prices, not the (expected or actual) CPI.

This consumer price index \( p \) (CPI) is given in (8) and is calculated as a weighted average of producer prices and the foreign price level \( p^* \), adjusted by the nominal exchange rate \( e \) to domestic levels. The (fixed) weighting factor \( \kappa \) is determined by the import share in domestic demand, expressing also the openness of the economy. An output gap \( z \) is defined in (10) as the difference between actual output \( y \) and its full employment level \( \bar{y} \).

The open-economy-with-full-capital-mobility assumption is expressed in the interest parity (13). As one can see it is not an expected or forward depreciation but the actual value \( \hat{e} \) that enters the respective equation, accounting for the difference between the domestic (\( i \)) and the foreign interest rate (\( i^* \)). This should enhance the tractability of the model and can simplify the analysis of a fully credible stabilization. The parameter \( \varphi \) should then be able to express somewhat any deviation from this interest parity, expectations of a falling (with \( \varphi < 1 \)) or rising (with \( \varphi > 1 \)) inflation or speculative elements in general.

The nominal interest \( i \) determined through international relations is itself the sum of the real rate \( r \) and expected inflation \( \pi \), as shown in (12). To understand part of the stabilization dynamics in the following, it should be made clear that by (12) and (13) (due to capital mobility) the real interest rate which enters the AD (or IS) relation (3) is given as

\[
r = i^* + \varphi \hat{e} - \pi \quad \text{(real interest rate).} \tag{14}
\]

If \( \hat{e} > 0 \) is positive during the high inflation regime, a strict and fully credible exchange rate-based stabilization, abruptly ending devaluation, leads to \( \hat{e} = 0 \). With adaptive expectations (or structural inflation inertia) \( r \) decreases immediately, gradually converging to its new equilibrium value (c. p. the former level).

Now we assume the implementation of an exchange rate-based stabilization program, which (in this model's context) has to be double anchored, namely from the exchange rate and the monetary side. So from \( t = 0 \) on, when the program starts, we have (for a detailed exposition of the following see Wehinger,

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9To motivate an inflation stabilization in a full employment situation one has to associate certain costs with high inflation, making any full employment situation with relatively lower inflation superior to the initial equilibrium. This fact is not captured by the models presented here and has to remain an assumption, nevertheless one quite well founded analytically and empirically. See, e.g., Fischer/Modyihan (1978) for an analytical survey and, e.g., Gregorio (1992) for empirical evidence for negative growth effects of high inflation.

10See Bruno (1990, pp. 24ff) for a discussion of using multiple anchors for the purpose of inflation stabilization.
\[ \dot{e} = \ddot{e} = \dddot{e} = 0 \quad \forall t \geq 0 \quad (\text{exchange rate-based stabilization}) \quad (15) \]

and

\[ \dot{\bar{m}} \equiv \ddot{\bar{m}} = 0 \quad \forall t \geq 0 \quad (\text{monetary stabilization}). \quad (16) \]

Here \( \dot{\bar{m}} \) and \( \ddot{\bar{m}} \) indicate money demand adjusted for influences of potential output,

\[ \bar{m} = m - \eta \bar{y}. \quad (17) \]

and its growth (\( \dot{\bar{m}} = \ddot{\bar{m}} \)), respectively. It has to be noted that condition (16) also implies full sterilization of foreign capital movements (mainly inflows). To make the dynamics tractable we further assume

\[ \pi^* = \frac{dV^*}{dt} = 0 \quad \text{(no foreign shocks)} \quad (18) \]

and\(^{11}\)

\[ \epsilon(t) = \bar{m}(t), \quad \pi^*(t) = \pi^*(t) = 0 \quad \forall t \geq 0 \quad (\text{homogeneity}). \quad (19) \]

The dynamic system in \( z \) and \( \pi \) can then be reduced to\(^{12}\)

\[ \begin{bmatrix} \dot{z} \\ \dot{\pi} \end{bmatrix} = \begin{bmatrix} -\frac{\psi[(1 - \kappa) - \gamma\eta]}{\rho(1 - \kappa)} & \frac{\delta + \psi}{1 - \kappa} \\ \frac{\psi[(1 - \kappa) - \gamma\eta]/(\beta\rho - \psi)}{\rho[\beta + \gamma - \beta\rho(1 - \kappa)]} - \frac{(\delta + \psi + \gamma)(\beta\rho - \psi)}{\rho[\beta + \gamma - \beta\rho(1 - \kappa)]} \end{bmatrix} \begin{bmatrix} z \\ \pi \end{bmatrix}, \quad (20) \]

with stability given by the conditions

\[ \delta + \psi + \gamma > \beta\rho(1 - \kappa), \]

\[ 1 - \kappa > \gamma\eta \quad \text{and} \quad \beta\rho > \psi \quad (\text{stability conditions}). \quad (21) \]

The phase diagram of the adjustment dynamics during stabilization is shown in figure 2.

Economic interpretations of the conditions (21) can be given as follows:

- \( 1 - \kappa > \gamma\eta \) requires the economy not to be "too open". Then the real exchange rate elasticity of demand (\( \gamma \)) and the income elasticity of real money demand (\( \eta \)) should be relatively small. This means that the import demand (the "import boom" which also exerts pressure on domestic producer prices) should not react too heavily on real appreciation, and that rising income (during the stabilization) should not cause too high a rise in money demand, counteracting the restrictive monetary measures taken for the purpose of stabilization. The smaller \( \gamma \) and \( \eta \) the bigger can be the degree of openness \( 1 - \kappa \) without leaving the stability region.

\[ \text{The homogeneity assumption does not change the qualitative results of the adjustment dynamics, only the levels and the jumps in variables, as analyzed in the following, would be different. In particular, if } \epsilon \text{ were not adjusted to } \bar{m} \text{ when starting the stabilization a certain level of inflation would remain in the steady state.} \]

\[ \text{Calculations referred to in the following are given in the appendix.} \]
• The condition $\beta \rho > \psi$ indicates that expectations should adjust "rather rapidly" (or other nominal rigidities should not be "too large", large $\beta$), and that real interest elasticity of demand ($\rho$) should be "high enough", with, at the same time, a "rather low" real wage elasticity of production ($\psi$). So with a low $\beta$ a big inertia in inflationary expectations can keep the real interest low for a while (as can be seen in (14)), but too much of this inertia will counteract a stable adjustment as it hampers positive supply side effects of wage flexibility.

• All arguments brought forward so far are restricted by the condition $\delta + \psi + \gamma > \beta \rho(1 - \kappa)$. This means that the adjustment in inflationary expectations ($\beta$), real interest elasticity of demand ($\rho$), and autarky ($1 - \kappa$) should not be so high as to exceed the sum of real exchange rate elasticity of supply ($\delta$) and demand ($\gamma$), and the real wage elasticity of production ($\psi$). In general this means that the boom dynamics should be mainly supply-driven, as too high a demand would put upward pressure on prices and impede inflation stabilization. Of all the parameters in the restrictions (21) only two have one-sided restrictions (besides the one that they are all positive): the real exchange rate elasticity of supply ($\delta$) is not restricted upwards and the income elasticity of real money demand ($\eta$) not downwards (but above zero). So to ensure stability of an exchange rate-based anti-inflation program
— production should show a strong reaction on real appreciation and
— real money demand should rise very little with an increase in income.

It seems as the success of an exchange rate-based stabilization program lies
within the very narrow bands of the parameter values guaranteeing stability,
but such stability values seem to be compatible with respective parameter values
from real world estimates.\textsuperscript{13}

The stable dynamics (derived in the appendix) can be analyzed further with
the help of figure 2. The equations for the loci where $\dot{z} = 0$ and $\pi = 0$
respectively, are given by (20) as

$$
\dot{z} = 0 : \quad \pi = \frac{\psi[(1 - \kappa) - \gamma \eta]}{\rho(\delta + \psi)} z \quad (\dot{z} = 0 \text{ line}), \tag{22}
$$

$$
\dot{\pi} = 0 : \quad \pi = \frac{\psi[(1 - \kappa) - \gamma \eta]}{\rho(\delta + \psi + \gamma)} z \quad (\dot{\pi} = 0 \text{ line}). \tag{23}
$$

As shown in the figure, the first line is steeper than the second. With
the stability restriction (21) this will always be the case, with $(1 - \kappa) < \gamma \eta$ it will
be true for the absolute values of the respective slopes.

In points above (or left of) the $\dot{z} = 0$ line output grows, and it falls in points
below (or right of) the line, as indicated by the arrows in figure 2. This implies
that the maximum output will be reached when the adjustment trajectory in
the $z$-$\pi$ plane cuts this line. For all points above the $\dot{\pi} = 0$ line inflation falls,
below this line it increases, as indicated by the arrows.

The development of the variables’ levels during the stabilization is derived in
the appendix and shown in figure 3 for a set of the most important aggregates.
Starting with a positive inflation ($\pi(0) > 0$) and full employment ($z(0) = 0$) in
a flexible exchange rate regime, at a certain point in time ($t = 0$) stabilization
begins with fixing the exchange rate and money supply (adjusted $m$), after
the exchange rate has been brought in line with money supply through a once and
for all appreciation (at $t = 0^-$).

The immediate nominal appreciation is accompanied by a singular real de-
valuation at $t = 0^-$, caused by a downward jump in domestic producer prices $q$.
This leaves room for the following real appreciation taking place in the course of
stabilization.

An immediate downward jump can also be observed in nominal and real
wages, $w$ and $w-q$ respectively, which will rise during the adjustment converging
to their old level. The same behaviour is observed for the path of the real interest

\textsuperscript{13}\textit{In fact some estimations with Brazilian data (1985-90) have shown that it is possible
to have such a stable adjustment process. Due to data specifications the results cannot be
regarded as very significant and will not be documented in detail here. Values estimated were
$\delta = 0.04$, $\psi = 0.05$, $\gamma = 0.02$, $\rho = 0.43$, $\eta = 1.08$ and $\kappa = 0.13$, with values imposed for $\beta$,
\ e. g. $\beta = 0.2$ (values as estimated by Cagan, 1956).}
Figure 3: Exchange Rate-Based Stabilization: Indicative Time Plots of Variables

The plots are shown for a case of exchange rate-based stabilization with $c(t) = \dot{\hat{p}}(t) = 0 \forall t \geq 0$, $\bar{m}_0 \equiv \bar{m}_s = \bar{m}_1 = \bar{m}_{ss}$. For further assumptions, variable and subindex definitions see the text and appendix (especially equations (48), (51), (53) to (60) and (67) to (75).

rate. Thus demand is initially stimulated. This interest rate effect tapers off in the course of the adjustment.

In the process of stabilization all variables adjust to their respective long-run (or steady-state) values (subindex “ss”). Monetary variables adjust with reference to the fixed level of money supply $\bar{m}_0$, real variables with reference to the goods market equilibrium $z_{ss} = 0$.

As opposed to the Phillips curve model, here bringing down inflation by fixing the exchange rate leads to stabilization gains instead of costs. As derived in the appendix, these gains are higher:

- the higher is the degree of openness of the economy (the higher is $\kappa$),
- the higher is the income elasticity of real money demand (the higher is $\eta$),
• the higher is the real exchange rate elasticity of supply (the higher is $\delta$) and

• the higher is the inertia in inflationary expectations (the lower is $\beta$).

For the other parameters ($\psi$, $\rho$, $\gamma$) the (direction of) effects are undefined (unless further restrictions are imposed). With the above statements one still has to take into account the stability restrictions (21). This is not the case for $\delta$, the real exchange rate elasticity of supply. This underlines the importance of supply side effects invoked by the real appreciation ($\dot{e} < 0$) during stabilization.

4 Conclusions

The analysis of exchange rate-based stabilization has shown that even within a rather conventional AS/AD model it is possible to generate an adjustment to lower inflation with a concomitant output boom, uncommon to the usually recessionary stabilization cycles. The structure of the model is quite simple, and further versions could include, for example, an uncovered interest parity (with expected instead of the actual rate of devaluation as presently specified) and a partial adjustment equation for devaluation expectations.

A recessionary response to stabilization is usually caused by expectations' inertia or structural rigidities. Then quantities have to take the burden of adjustment before prices have reached their new equilibrium levels. If we allow for supply-side effects, supported by wage flexibility, a downward pressure from import prices, and lower real interest rates pushing demand, it seems to be possible to overcome the fate of stabilization costs in terms of output (and thus employment) losses.

But there are some caveats to this argument. The model presented here is of a short-run nature, and we do not model the balance of payments. As it affects the long-run equilibrium we have to be aware of the fact that with balance of payments disequilibria the stabilization costs might have to be born at later periods. As during exchange rate-based stabilization programs the current account typically deteriorates – financed by capital inflows at least in the first periods – this might lead to unsustainable situations, especially if foreign investors lose their confidence in the long-term success of the program.

Some experiences, especially in Latin America, show that due to the oligopolistic structure in some of the high inflation economies it was possible to bring back real appreciation by enhanced import competition, without heavily restricting demand, and thus the necessary stabilization of the current account could be attained without too high a cost. Nevertheless, this needs not to be the case in general. And it will to a great extent depend on the possible speed of structural adjustments whether import competition will destroy domestic industries with long-term effects.
Not taking general time preferences into consideration, an exchange rate-based stabilization might be preferred to pure money-based stabilizations (with higher initial costs) for political reasons if it is only able to shift the costs of adjustment towards later periods. This is the case if support for an immediately recessionary program cannot be expected from the constituency. And then, still, as was argued, with structural adjustments these later costs need not be too high, (partially) compensated by long-term growth effects.

With the further appraisal of the recent experiences of exchange rate-based stabilizations not only in Latin America but also in Eastern Europe, we should be able gain further insights into the short and long-run dynamics of such programs.

Appendix: The Dynamics of the Model

In the following the dynamics of the AS/AD model given in table 3 in the text (p. 8) shall be analyzed in its details. First we can compact the equations in the following way: From (2), (6), (7), (8) and (10) we have the aggregate supply

$$z = \frac{\delta + \psi}{1 - \kappa} p - \psi \bar{p} - \frac{\delta + \psi \kappa}{1 - \kappa} \bar{\epsilon} - \frac{\delta + \psi \kappa}{1 - \kappa} \bar{p}^* - \psi \alpha \quad \text{(AS).} \quad (24)$$

The aggregate demand is given by (3) and substituting from (6), (8), (10) and (11) as well as the real interest rate (14) from (12) and (13), after rearranging,

$$z = \rho \bar{\pi} - \frac{\gamma}{1 - \kappa} p - \rho \phi \dot{\epsilon} + \frac{\gamma}{1 - \kappa} \bar{\epsilon} + \frac{\gamma}{1 - \kappa} \bar{p}^* - \rho \bar{\pi} \quad \text{(AD).} \quad (25)$$

With (10) and (13) as well as with the income-adjusted money demand (17) we have the liquidity preference

$$\bar{m} - \bar{p} = \eta z - \alpha \bar{\pi}^* - \alpha \phi \dot{\epsilon} \quad \text{(LM).} \quad (26)$$

The reduced model then consists of the equations (24), (25), and (26) as well as adaptive expectations (5).

In analyzing the dynamics we assume an exchange rate-based stabilization (15) with a concomitant monetary restriction (16), and, for ease of calculation, no shocks (18); furthermore we impose the restriction of homogeneity (19) (cf. p. 10f). The dynamics of the expected inflation can then be calculated from the time derivatives of (24) and (25), using definition (9) and substituting \(\pi\) from (5), as

$$\dot{\bar{\pi}} = - \left[ \frac{\beta (\delta + \gamma + \psi \kappa)}{\delta + \psi + \gamma - \beta \rho (1 - \kappa)} \right] \bar{\pi}. \quad (27)$$

The solution of this differential equation is stable if

$$\delta + \psi + \gamma > \beta \rho (1 - \kappa) \quad \text{(1st stability condition)} \quad (28)$$
holds.\textsuperscript{14}

To analyze the dynamics in $z$ and $\pi$ we first substitute $\dot{z}$ from (25) in the time derivative of (24). Using definition (9) and substituting $p$ from (26) we have

$$\dot{z} = \frac{\psi(1 - \kappa) - \psi \gamma \eta}{\rho(1 - \kappa)} z + \frac{\delta + \psi}{1 - \kappa} \pi.$$  \hspace{1cm} (29)

With the first time derivative of (25) and second time derivatives of (24) and (25), using definition (9) and substituting from the time derivative of (5) and (26) we get

$$\ddot{\pi} = \frac{\psi(1 - \kappa) - \psi \gamma \eta}{\rho^2(1 - \kappa)[\delta + \psi + \gamma - \beta \rho][1 - \kappa]} z - \frac{(\delta + \psi + \gamma)(\beta \rho - \psi)}{\rho[\delta + \psi + \gamma - \beta \rho]} \pi.$$ \hspace{1cm} (30)

Equations (29) and (30) now represent the dynamic system in $z$ and $\pi$ as stated in (20) (p. 10).

Defining the parameter matrix of (20) as $E$ local stability is given if (Routh-Hurwitz criterion)

$$\det E = \frac{\psi \gamma [(1 - \kappa) - \gamma \eta](\beta \rho - \psi)}{\rho^2(1 - \kappa)[\delta + \psi + \gamma - \beta \rho]} > 0,$$ \hspace{1cm} (31)

$$\text{tr } E = \frac{\psi [(1 - \kappa) - \gamma \eta]}{\rho(1 - \kappa)} - \frac{(\delta + \psi + \gamma)(\beta \rho - \psi)}{\rho[\delta + \psi + \gamma - \beta \rho]} < 0.$$ \hspace{1cm} (32)

If the first stability condition (28) is met we can analyze the further parameter restrictions for (31) and (32) to hold. The determinant is positive if

$$(1 - \kappa) - \gamma \eta > 0 \text{ and } \beta \rho - \psi > 0$$ \hspace{1cm} (33)

or

$$(1 - \kappa) - \gamma \eta < 0 \text{ and } \beta \rho - \psi < 0.$$ \hspace{1cm} (34)

The trace of $E$ is negative if

$$- \frac{\psi [(1 - \kappa) - \gamma \eta]}{\rho(1 - \kappa)} < \frac{(\delta + \psi + \gamma)(\beta \rho - \psi)}{\rho[\delta + \psi + \gamma - \beta \rho]}.$$ \hspace{1cm} (35)

Imposing (28) the latter relation is only valid with (33), not with (34). Therefore we have (33) as a second stability condition, rearranged as

$$1 - \kappa > \gamma \eta \text{ and } \beta \rho > \psi \text{ (2nd stability condition).}$$ \hspace{1cm} (36)

Both conditions, (28) and (36), are necessary and sufficient for local stability of the system (20).\textsuperscript{15}

\textsuperscript{14}Note that this condition is sufficient as all parameters of the model are positively defined.

\textsuperscript{15}For further details on the dynamics, a proof that no cyclical adjustment can exist and the analysis of the unstable trajectories see Welinger [1996, pp. 424ff].
In the following we will analyze the time paths of the model’s variables. For this purpose we first define values for the steady state, which is characterized by

\[ z = \dot{z} = \ddot{z} = \hat{e} = \dot{\hat{e}} = \ddot{\hat{e}} = \hat{g} = \dot{\hat{g}} = \ddot{\hat{g}} = \hat{h} = \dot{\hat{h}} = \ddot{\hat{h}} = 0, \]  
(37)

and to simplify the calculations we assume

\[ p^* = \dot{p}^* = a = g = h = 0. \]  
(38)

Then we get from adaptive expectations (5) and the time derivatives of CPI, AS and AD, (8), (25) and (26), respectively, the steady state relations

\[ \ddot{\mu} = \pi = \hat{\pi} = \hat{q} = \dot{\hat{e}} \quad (\text{steady state}). \]  
(39)

Before the implementation of the stabilization program, up to time \( t = 0^- \), we assume a steadily expansive monetary policy of the form

\[ \ddot{\mu}_0 \equiv \ddot{\mu}(t) = \pi(t) = \hat{\pi}(t) = \hat{q}(t) = \dot{\hat{e}}(t) > 0 \]
\[ \forall \ t \leq 0^- \quad (\text{pre-stabilization steady state}). \]  
(40)

After stabilization and its (infinitely lasting) adjustment period the long-run equilibrium shall be given by

\[ \ddot{\mu}_{ss} = \pi_{ss} = \hat{\pi}_{ss} = \hat{q}_{ss} = \dot{\hat{e}}_{ss} = 0 \]
\[ \text{for} \quad t \to \infty \quad (\text{post-stabilization steady state}). \]  
(41)

Using (37), (38) and (40) we can derive variables’ time paths before stabilization from (24) (AS), (25) (AD), (26) (LM), (7) (wages), (14) (real interest rate) and the definitions (8) (CPI) and (11) (real exchange rate):

\[ p(t) = m(t) + \alpha \varphi \mu_0, \]  
(42)

\[ e(t) = \ddot{m}(t) + \frac{\gamma \alpha \varphi - \rho(1 - \varphi)(1 - \kappa)}{\gamma} \ddot{\mu}_0, \]  
(43)

\[ q(t) = \ddot{m}(t) + \frac{\gamma \alpha \varphi + \rho \kappa (1 - \varphi)}{\gamma} \ddot{\mu}_0, \]  
(44)

\[ \epsilon(t) = \frac{\rho(1 - \varphi)}{\gamma} \ddot{\mu}_0, \]  
(45)

\[ \ddot{p}(t) = \ddot{w}(t) = \ddot{m}(t) + \frac{\psi \gamma \alpha \varphi + \rho(1 - \varphi)(\psi \kappa + \delta)}{\gamma \psi} \ddot{\mu}_0, \]  
(46)

\[ r(t) = -(1 - \varphi) \ddot{\mu}_0, \]  
(47)

\[ \forall t \leq 0^- . \]
With the homogeneity assumption (19)\textsuperscript{16} and from (24) (AS), (25) (AD), (26) (LM), (7) (wages), (14) (interest), (8) (CPI) and (11) (real exchange rate) we get the post-stabilization, long-run equilibrium condition

\[ z = z = r = i = 0, \quad m = p = \tilde{p} = w = q \quad \text{for} \quad t \to \infty. \] (48)

Now we have to analyze whether the time paths of certain variables show a discontinuity when stabilization is implemented, i.e. whether variables will have to jump "between" the points in time \( t = 0^- \) and \( t = 0^+ \). For this purpose we define jumps (and respective subindices) as

\[ d j \equiv j(0^+) - j(0^-), \quad j(0^+) \equiv j_{(+)}, \quad j(0^-) \equiv j_{(-)}. \]

\[ j = z, p, \pi \ldots \text{ (all variables)} \] (49)

and assume for simplicity no jumps in shock and external variables,

\[ da = da = dg = dg = dh = dh = dp = dp = dr = dr = d \left( \frac{dr^*}{dt} \right) = 0. \] (50)

Furthermore we assume that inflationary expectations (or nominal rigidities) and money supply and are continuous, the latter meaning that there will be no "monetary reform", i.e. no measure to immediately lower the money supply,\textsuperscript{17} and thus, with (40), we have

\[ dm = d \pi = 0, \quad \pi_{(-)} = \bar{\mu}_0 \quad \text{(continuity assumptions).} \] (51)

These assumptions will imply jumps in other variables, especially in output. To calculate the jumps we first compute variables values "exactly before" stabilization from (42) to (47). Taking into consideration (19) (homogeneity) and (51) (continuity), i.e.

\[ e_{(+)} = \bar{m}_{(+)} = \bar{m}_{(-)} \equiv \bar{m}_0, \] (52)

we then get

\[ p_{(-)} = \bar{m}_0 + \alpha \varphi \bar{\mu}_0, \] (53)

\[ e_{(-)} = \bar{m}_0 + \gamma \alpha \varphi - \rho (1 - \varphi) (1 - \kappa) \bar{\mu}_0. \] (54)

\textsuperscript{16}Note that before stabilization the monetary variables are non-homogenous with respect to money and inflation.

\textsuperscript{17}If there were a jump in money supply instead of output, this would imply an immediate adjustment of the price level to its steady state value, without inflation. One could, of course, also analyze the more complicated dynamics with an initial jump in money supply. For the case of a "monetary reform" and thus an initial jump in money supply (and where such a policy is the outcome of an optimization problem) cf. Barbiela (1990, pp. 533ff) and also Simonsen/Cynes (1989, pp. 42ff).
\[ q(-) = \tilde{m}_0 + \frac{\gamma \alpha \varphi + \rho \kappa (1 - \varphi)}{\gamma} \tilde{\mu}_0, \quad (55) \]
\[ \varepsilon(-) = -\frac{\rho (1 - \varphi)}{\gamma} \tilde{\mu}_0, \quad (56) \]
\[ \bar{p}(-) = w(-) = \tilde{m}_0 + \frac{\psi \gamma \alpha \varphi + \rho (1 - \varphi) (\psi \kappa + \delta)}{\psi \gamma} \tilde{\mu}_0, \quad (57) \]
\[ (w - q)(-) = \frac{\rho \delta (1 - \varphi)}{\psi \gamma} \tilde{\mu}_0, \quad (58) \]
\[ (w - p)(-) = \frac{\rho (1 - \varphi) (\delta + \psi \kappa)}{\psi \gamma} \tilde{\mu}_0, \quad (59) \]
\[ r(-) = -(1 - \varphi) \tilde{\mu}_0. \quad (60) \]

From (24) (AS), (25) (AD), (23) (LM), (7) (wages), (14) (real interest), (8) (CPI) and (11) (real exchange rate) and with assumptions \( \varepsilon(+ = \tilde{m}_0 \) and exchange rate-based stabilization (15) we have at \( t = 0^+ \)

\[ z(+^) = \frac{\delta + \psi}{1 - \kappa} p(+^) = \psi \bar{p}(+) - \frac{\delta + \psi \kappa}{1 - \kappa} \tilde{m}_0, \quad (61) \]
\[ z (+^) = \rho \tilde{\mu}_0 - \frac{\gamma}{1 - \kappa} p(+) + \frac{\gamma}{1 - \kappa} \tilde{m}_0, \quad (62) \]
\[ m_0 - p(+) = \eta z(+) , \quad (63) \]
\[ p(+) = \frac{(1 - \kappa) q(+) + \kappa \tilde{m}_0}{1 - \kappa} , \quad (64) \]
\[ \varepsilon (+^) = \tilde{m}_0 - q(+^), \quad (65) \]
\[ r(+) = -\tilde{\mu}_0. \quad (66) \]

From the respective differences between (61) to (66) and (53) to (60) the jumps are given as\(^{18}\)

\[ dz = z (+^) = \frac{(1 - \kappa)}{(1 - \kappa) - \gamma \eta} \tilde{\mu}_0 > 0 , \quad (67) \]
\[ dc = \varepsilon (+^) - \tilde{m}_0 = -\frac{\gamma \alpha \varphi + \rho (1 - \varphi)(1 - \kappa)}{\gamma} \tilde{\mu}_0 \quad (<0) , \quad (68) \]
\[ dp = -\left[ \frac{\rho \eta (1 - \kappa)}{(1 - \kappa) - \gamma \eta} + \alpha \varphi \right] \tilde{\mu}_0 \quad (<0) , \quad (69) \]
\[ dp = dw = -\alpha \varphi \mu_0 - \frac{\rho (\delta + \psi \kappa) [(1 - \kappa)(1 - \varphi) + \gamma \eta \varphi]}{\gamma \psi [(1 - \kappa) - \gamma \eta]} \tilde{\mu}_0 + \]

\(^{18}\) Inequalities indicating positive or negative jumps are calculated under the stability condition (30). Expressions in parentheses indicate the direction of jumps assuming the most common cases \( \varphi \leq 1 \) or \( \varphi = 1 \), respectively.
\begin{equation}
\frac{\rho \gamma(1 - \kappa)(1 - \psi \eta)}{\gamma \psi[(1 - \kappa) - \gamma \eta]} \dot{\mu}_0 \quad (< 0), \tag{70}
\end{equation}

\begin{equation}
\frac{1}{\rho \eta} + \frac{\alpha \varphi \gamma + \rho \kappa(1 - \varphi)}{\gamma} \dot{\mu}_0 \quad (< 0), \tag{71}
\end{equation}

\begin{equation}
\frac{\rho [(1 - \kappa)(1 - \varphi) + \gamma \eta \varphi]}{\gamma [(1 - \kappa) - \gamma \eta]} \dot{\mu}_0 \quad (> 0), \tag{72}
\end{equation}

\begin{equation}
-\mu \dot{\varphi} < 0, \tag{73}
\end{equation}

\begin{equation}
-\frac{\rho [\delta(1 - \kappa)(1 - \varphi) + \gamma(1 - \kappa) + \delta \gamma \varphi \psi]}{\psi \gamma[(1 - \kappa) - \gamma \eta]} \dot{\mu}_0 \quad (< 0), \tag{74}
\end{equation}

\begin{equation}
-\frac{\rho [\delta(1 - \kappa)(1 - \varphi)(\delta + \psi \kappa) + \gamma(1 - \kappa)]}{\psi \gamma[(1 - \kappa) - \gamma \eta]} \dot{\mu}_0 \quad (< 0). \tag{75}
\end{equation}

The overall trajectories of the most important variables are presented in figure 3 (p. 13). 19

To calculate stabilization costs, defined as accrued output losses during stabilization, we use the model’s equations and its time derivatives under the usual assumptions (as in the calculations for the system (20)) to get

\begin{equation}
z = \frac{\rho(1 - \kappa)(\delta + \psi + \gamma)}{\gamma \psi[(1 - \kappa) - \gamma \eta]} \dot{z} - \frac{\rho^2[(\delta + \psi)(\delta + \psi + \gamma - \beta \rho(1 - \kappa))]}{\gamma(\beta \rho - \psi)[\psi(1 - \kappa) - \psi \gamma \eta]} \dot{\pi} \tag{76}
\end{equation}

Integrating (76) output costs (gains) up to time \(t\) are given as

\begin{equation}
L(t) \equiv -\int_0^t z(\tau) \, d\tau = -\frac{\rho^2[(\delta + \psi)(\delta + \psi + \gamma - \beta \rho(1 - \kappa))]}{\gamma(\beta \rho - \psi)[\psi(1 - \kappa) - \psi \gamma \eta]} \nabla \pi + \frac{\rho(1 - \kappa)((\delta + \psi + \gamma))}{\gamma \psi[(1 - \kappa) - \gamma \eta]} \Delta \nabla z, \tag{77}
\end{equation}

with

\begin{equation}
\Delta \nabla z \equiv z(t) - z(0) \quad \text{and} \tag{78}
\end{equation}

\begin{equation}
\nabla \pi \equiv -\Delta \pi \equiv \pi(0) - \pi(t). \tag{79}
\end{equation}

To get the total stabilization costs, up to \(t \to \infty\), we consider the long-run equilibria \(\pi(t)|_{t \to \infty} \equiv \pi_{ss} = 0\) and \(z(t)|_{t \to \infty} \equiv z_{ss} = 0\), starting with full employment \(z(0) = 0\) (at \(t = 0\)), and have

\begin{equation}
L \big|_{z(0) \cdots 0} = \int_0^\infty z(\tau) \big|_{z(0) \cdots 0} \, d\tau = -\frac{\rho^2[(\delta + \psi)(\delta + \psi + \gamma - \beta \rho(1 - \kappa))]}{\gamma(\beta \rho - \psi)[\psi(1 - \kappa) - \psi \gamma \eta]} \pi(0). \tag{80}
\end{equation}

\footnote{The exact trajectories would have to be calculated integrating (solving) the respective differential equations.}
For an analysis of the parameters’ effects on stabilization costs partial derivatives have to be computed. The directions of effects are unambiguous only for \( \kappa \) (positive), \( \eta \) (positive), \( \delta \) (positive) and \( \beta \) (negative) and are interpreted in the text p. 13.

References


Results are not shown here and are available from the author on request or given in Weilinger (1996, pp. 43ff).


Stanley Fischer (1988). "Real Balances, the Exchange Rate, and Indexation: Real Variables in Disinflation". Quarterly Journal of Economics 103 (1); pp. 27–49.


