Rochester Center for Economic Research

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Working Paper No. 405
June 1995

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REAL EFFECTS OF EXCHANGE-RATE-BASED STABILIZATION: AN ANALYSIS OF COMPETING THEORIES*

Sergio Rebelo† and Carlos A. Végh‡

May 1995

Abstract

This paper uses a unified analytical framework to assess, both qualitatively and quantitatively, the relevance of the different hypotheses that have been proposed to explain the real effects of exchange-rate-based stabilizations. The four major hypotheses analyzed are: (i) the supply-side effects associated with an inflation decline; (ii) the perception that the exchange rate peg is temporary; (iii) the fiscal adjustments that tend to accompany the peg; and (iv) the existence of nominal rigidities in wages or prices.

J.E.L. Classification Numbers: F41.

Keywords: Inflation, Stabilization, Fixed Exchange Rates.

*Rebelo's work on exchange-rate-based stabilizations was initiated under the support of the NBER's Olin fellowship. This support is gratefully acknowledged. We thank Ben Bernanke and Julio Rotemberg for their suggestions. We also benefited from the comments of Richard Agenor, Marianne Baxter, Enrique Mendoza, Anne Mikkola, Jorge Roldos, Jeff Sachs, Ratna Sahay, Pierre Sarte, Martin Uribe, and Carlos Zarazaga. Finally, we are thankful to Nii Kote Nikoi for research assistance and to seminar participants at UCLA, Yale, UC Santa Cruz, Suny Albany, Board of Governors, Philadelphia Fed, Chicago Business School, Penn State, and Texas Third Monetary Conference for their feedback. The opinions expressed in this paper are those of the authors and do not necessarily represent those of the IMF.

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1 Introduction

According to conventional wisdom, inflation can only be reduced at the cost of a short-term contraction in economic activity. Available evidence for industrial countries has been taken to support the notion that disinflation is contractionary (Gordon, 1982). The costs of disinflation are generally attributed to the presence of nominal contracts (Fischer (1977), Taylor (1980)), and are thus expected to hold for open economies (Fischer, 1986). The last 15 years, however, have witnessed the emergence of a large body of evidence on the real effects of stabilization in high inflation countries which clearly defies this conventional view.

The first clear indication that there was something missing in the traditional understanding of disinflation came from the stabilization programs in the Southern Cone of Latin America (Argentina, Chile, and Uruguay) in the late 1970s. In spite of a very large real exchange rate appreciation, economic activity expanded rapidly in the first years after stabilization. The contraction typically associated with inflation stabilization came only later in the programs. An examination of similar episodes in chronic inflation countries clearly suggests a common pattern (Kiguel and Liviatan (1992), Végh (1992)): countries that use the exchange rate as the nominal anchor in inflation stabilization programs experience a boom in economic activity (consumption, investment, and GDP expand), a large real exchange rate appreciation, a rise in the real wage rate, and a deterioration in the external accounts. Later in the programs, these effects are often reversed with the economy contracting sharply and the real exchange rate depreciating.

A large literature has sought to explain these intriguing phenomena. Early work by Rodriguez (1982) and Dornbusch (1982) on the Southern-Cone programs of the late 1970s emphasized the presence of sticky inflation. According to this hypothesis, under high capital mobility a reduction in the rate of devaluation leads to a fall in nominal interest rates and, given sticky inflation, to a lower real interest rate. This fall in the real interest rate causes an economic boom. An alternative explanation is the "temporariness hypothesis" (Calvo (1986) and Calvo and Végh (1993)), which focuses on the effects of lack of credibility. This hypothesis considers the case in which agents expect the inflation stabilization program to be reversed in the future. If money is needed to carry out transactions, a temporary reduction in nominal interest rates lowers the effective price of consumption today

relative to the future and induces an initial consumption and output boom accompanied by an appreciated real exchange rate. Several authors have emphasized the role of fiscal policy. In Helpman and Razin (1987), the reduction in the inflation tax generates a wealth effect, and thus a boom, due to the lack of Ricardian equivalence. In Drazen and Helpman (1988), the wealth effect comes through the expectation of a future reduction in government spending. Rebelo (1994) considers a scenario in which, in the absence of reforms, government expenditure increases, thus raising the present value of the resources that the government eventually needs to extract from the private sector through taxation or other means (nationalizations, forced lending, etc.). By bringing the fiscal situation under control, a stabilization produces a wealth effect that can generate a boom, even though taxes increase in the short run. The role of durable goods consumption has been stressed by De Gregorio, Guidotti, and Vegh (1994). In their model, consumers follow (S,s) rules for the purchases of durable goods. Since transacting is costly, a fall in inflation frees resources for other uses. The resulting wealth effect induces consumers to bring forward purchases of durables, thus generating an initial boom and a later slowdown. Finally, the more recent literature has focused on the supply-side effects that may result from removing the inflationary distortion on labor supply (Roldos (1993)) or capital accumulation (Roldos (1995) and Uribe (1995)).

While this large theoretical literature has provided useful insights into different aspects of exchange rate-based stabilization, there has been no attempt at tackling the different hypotheses within a single analytical framework to assess their relative importance. Furthermore, a comparison of the quantitative relevance of the various theoretical mechanisms in light of the orders of magnitude observed in practice is also lacking. The purpose of this paper is thus to assess–both qualitatively and quantitatively–the different hypotheses using a unified framework. To this end, we develop a small open economy model characterized by two sectors of activity (tradables and non-tradables), physical capital accumulation, a transactions-based demand for money, and an endogenous supply of labor.

At a qualitative level, we find that several hypotheses perform fairly well in a number of dimensions, although no single hypothesis seems capable of accounting for all empirical regularities. The supply side effects of disinflation proved to be an essential component of any scenario that comes close to mimicking actual stabilization dynamics. At a quantitative level we find it

very difficult to explain the magnitudes of the observed real appreciations and consumption booms. Hence, improving the quantitative performance of this class of models remains an important challenge for future research in this area.

The paper proceeds as follows. Section 2 reviews the stylized facts of exchange rate-based stabilization in chronic inflation countries and illustrate these facts with data for four major stabilization episodes: the 1978 Uruguayan "tablita", the 1985 Israeli stabilization, the 1987 Mexican stabilization, and the 1991 Argentine Convertibility Plan. Section 3 uses a model with exogenous labor supply, which abstracts from money and investment in physical capital, to isolate four basic mechanisms: the wealth effect, the labor supply effect, the effective price effect, and the investment effect. Section 4 extends this model to incorporate endogenous labor supply, a transactions-based demand for money, and physical capital accumulation subject to adjustment costs. We calibrate the model using data for Argentina and solve it numerically. Section 5 proceeds to examine four hypotheses: credible disinflation, temporariness, fiscal effects, and nominal rigidities (sticky wages and sticky inflation). Section 6 evaluates the performance of the different hypotheses and discusses the implications of several extensions and modifications of our baseline model. Section 7 concludes.

2 Stylized Facts of Exchange-Rate-Based Stabilizations

Since the late 1940s, many developing countries have endured long periods of chronic inflation. Chronic inflation is characterized by high (relative to industrial countries) and persistent inflation.[1] Unlike hyperinflation–whose duration is measured in months and exhibits an explosive nature–chronic inflation is relatively stable and may last for decades. Countries adapt to living with high inflation by creating various indexation mechanisms in financial, labor, and goods markets which, by reducing the costs of inflation, tend to perpetuate the inflationary process. Thus, as stressed by Bruno (1993), while large fiscal deficits typically constitute the "original sin" behind chronic in-

[1]The important distinction between chronic inflation and hyperinflation goes back to Pazos (1972). For recent analyses, see Bruno (1993), Sachs (1987a) and Végh (1992).

flation, accommodative monetary and exchange rate policies and widespread indexation explain the adaptation to "living in sin."

Getting rid of chronic inflation has proved to be a long and arduous process. More often than not, stabilization attempts have failed and inflation has come back with a vengeance. During the 1980s, however, some countries–most notably, Chile, Israel, Mexico, and, more recently, Argentina–have succeeded in drastically reducing their rates of inflation.

With a few exceptions, most major stabilization programs in chronic high inflation countries have used the exchange rate as the main nominal anchor. The choice of the exchange rate over a monetary aggregate reflects the fact that in high inflation countries velocity is likely to be subject to unpredictable shifts–often exacerbated by a high degree of dollarization–which makes it difficult to assess the rate of monetary growth consistent with a targeted inflation rate. Moreover, a pegged exchange rate has the advantage of allowing for an endogenous increase in the nominal money stock.

During the past 30 years there have been 13 major exchange-rate-based stabilizations in Argentina, Brazil, Chile, Israel, Mexico, and Uruguay. Roughly half of these programs were "heterodox" in the sense that they supplemented the fixing of the exchange rate with price and wage controls. The remaining stabilization plans were "orthodox", that is, they used the exchange rate as the sole nominal anchor. Whether successful or not, exchange rate-based stabilizations in chronic inflation countries have been characterized by a series of empirical regularities documented in Kiguel and Liviatan (1992), Végh (1992), and Reinhart and Végh (1994). These regularities, listed below, can be easily detected in Figures 1-4, which describe four major stabilization episodes: the 1978 Uruguayan "tablita", the 1985 Israeli stabilization, the 1987 Mexican stabilization, and the 1991 Argentine Convertibility Plan.

(i) *Slow convergence of the inflation rate to the devaluation rate.* An exchange rate anchor is often advocated on the basis that, through its immediate effect on inflation of traded goods, overall inflation will quickly converge to the rate of devaluation. However, a comparison of four quarter changes in the exchange rate and prices suggests that inflation has normally converged slowly, particularly in orthodox programs (with the Southern-Cone "tablitas" being the most prominent example, as illustrated for the Uruguayan 1978 program in Figure 4).

(ii) *An initial expansion in economic activity followed by a later slowdown.* Contrary to what traditional Phillips-curve type relationships would predict,

economic activity (GDP, employment, private consumption, and private investment) has typically expanded in the first stages of the programs. The increase in the private consumption of durable goods has been particularly dramatic, as illustrated in Figures 2-4 for Israel, Mexico, and Uruguay (car sales). In all the plans that failed the initial boom was later followed by a severe recession, as illustrated in Figure 4 for the Uruguayan 1978 stabilization. This late recession has also been observed in some successful programs, such as the Israeli stabilization.[2] Although not well documented, it also appears that output in the non-tradables sector typically expanded by more than output in the tradables sector, which has even fallen relative to trend.[3]

(iii) *A rise in the relative price of non-traded goods (real exchange rate appreciation).* As Figures 1-4 illustrate, the increase in the relative price of non-traded goods has generally been substantial. In failed programs, the relative price of non-traded goods has typically followed an inverted-U shaped path, as illustrated in Figure 4 for the Uruguayan 1978 program.[4]

(iv) *An increase in real wages measured in units of tradable goods.* Real wages have typically increased in the initial stages. The Uruguayan experience seems to be an exception in this respect.[5]

(v) *An ambiguous response of real interest rates.* The behavior of (ex-post) real interest rates appears to depend on whether the plans have been orthodox or heterodox. In orthodox plans realized real interest rates have typically declined while in heterodox plans they have typically increased.

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[2]Using panel data for seven high inflation countries for the period 1964-1993, Reinhart and Végh (1994) show that GDP growth is significantly above the mean growth rate (by 2.3 percent) in the early stages of exchange-rate-based stabilizations and significantly lower (by 5.4 percent) in the late stages.

[3]In Israel, for example, the tradable sector grew at the same rate as before the program, while the non-tradable sector grew considerably more (at an annual rate of 7.5 percent in 1986-1987, compared to 2 percent per year growth in 1981-1986 (Bufman and Leiderman (1995)). In Uruguay, non-tradables sectors like construction and retail grew by 20 and 22 percent, respectively, in the first three years of the stabilization plan, while manufacturing (a tradable sector) grew by only 4.7 percent (Central Bank data). In the first two years of the Mexican program, some tradable sectors contracted while non-tradable sectors typically expanded.

[4]The relative price of non-tradable goods is a trade-weighted index using CPI's computed by the IMF. For Israel the relative price of non-tradables was computed using the US and the Israeli CPI indexes reported in IFS.

[5]Due to data limitations, the real wage series reported in Figures 1-4 were deflated using the CPI.

(vi) *A remonetization of the economy.* The ratio of M1 to GDP has typically increased rapidly in the aftermath of stabilization plans (Uruguay is an exception in this respect).

(vii) *A deterioration of the trade and current account.* The external accounts have generally deteriorated sharply, reflecting a large increase in imports of durable goods and capital goods.

(viii) *A large fiscal adjustment (in successful or temporarily successful programs).* The elimination of large public sector deficits is clearly a necessary condition for an enduring disinflation. Programs where the fiscal adjustment has been either partial or absent (as in the Argentine 1978 "tablita", in the 1985 Austral plans, and in the 1986 Brazilian Cruzado plans) have quickly gotten off track. In successful programs (or programs that have lasted for several years, like the Uruguayan tablita), the public sector accounts have been balanced upon or shortly after implementation of the program, with the 1985 Israeli plan (Figure 2) and 1991 Argentine Convertibility plan (Figure 1) being dramatic examples. Large fiscal adjustments have taken place either through major cuts in public expenditures (as in Israel) or increases in taxes.

(ix) *A boom in the real estate market.* The price of residential and commercial property tends to rise significantly in exchange-rate-based stabilization episodes. In the first two years following the implementation of the Uruguayan 1978 stabilization plan, the prices of housing and land (in dollar terms) rose by 181 percent and 212 percent, respectively (Roldos, 1991). Prices of housing and land fell sharply in 1982 when the program ended and returned to their pre-stabilization levels. During the Chilean 1978 "tablita", real housing prices increase by 135 percent in the first three years of the program and then fell precipitously in 1982 to pre-stabilization levels when the program was abandoned (Morande, 1992).

3 The Basic Mechanisms

Before proceeding with a model that contains all the elements we want to study, we use a simpler model to isolate the key economic mechanisms that will be present in most of the hypotheses that we will discuss. This section describes an optimizing small open economy with perfect international capital mobility. In this economy the supply of labor is exogenous, there is no

physical capital accumulation, and money plays no role.[6]

3.1 The Model

Preferences

The economy is populated by a large number of identical households. The representative household seeks to maximize its lifetime utility defined over sequences of consumption of tradable goods (C_t^T) and non-tradable goods (C_t^{NT}):

$$U = \sum_{t=0}^{\infty} \beta^t \frac{1}{1-1/\sigma} \left\{ \left[\left(C_t^T\right)^{\gamma} \left(C_t^{NT}\right)^{1-\gamma} \right]^{1-1/\sigma} - 1 \right\} \qquad 0 < \gamma < 1 \qquad (1)$$

where $0 < \beta < 1$ is the discount factor and $\sigma > 0$ is the intertemporal elasticity of substitution. Each agent supplies inelastically N units of time per period which he allocates to working in the tradables (N_t^T) and non-tradables (N_t^{NT}) sector:

$$N_t^T + N_t^{NT} = N \qquad (2)$$

Production Technology

This economy has the production structure of a specific factors model (Jones (1971) and Mussa (1974)). Labor is the mobile factor and the specific factors are capital (K) and land (T). Production of tradables (Y_t^T) and of non-tradables (Y_t^{NT}) are described by the following Cobb-Douglas production functions, where Z^T and Z^{NT} are time-invariant level parameters:

$$Y_t^T = Z^T (N_t^T)^{\alpha} K^{1-\alpha} \qquad 0 < \alpha < 1 \qquad (3)$$

$$Y_t^{NT} = Z^{NT} (N_t^{NT})^{\eta} T^{1-\eta} \qquad 0 < \eta < 1 \qquad (4)$$

[6]See Frenkel and Razin (1987) and the references therein for a discussion of optimization-based open economy models. For the recent simulation-based literature, see the surveys by Backus, Kehoe and Kydland (1995) and Baxter (1995). The small open economy framework that we employ is most similar to the models of Mendoza (1991), Lundvik (1992), Correia, Neves and Rebelo (1995), and Roldos (1995).

The stock of land is fixed and, for the purposes of this section, the stock of capital is also taken as constant. Since non-tradables are labor intensive, we assume that $\alpha < \eta$.

The Household's Problem

To economize on notation, we assume that households directly operate the economy's technology and sell their production in the goods market. Hence, they face the following budget constraint:

$$Y_t^T + p_t Y_t^{NT} + \Omega_t + b_{t-1}(1 + r^*) = (1 + \tau_t^c)C_t^T + (1 + \tau_t^c)p_t C_t^{NT} + b_t \quad (5)$$

where p_t is the relative price of non-tradables in terms of tradables. Households can borrow and lend in the international capital market at the exogenous real interest rate r^*. The variable b_t represents private net foreign asset holdings. The government levies taxes on the consumption of both goods at a rate τ_t^c. To isolate the distorting effects of taxation, we assume in this section that the tax revenue is rebated to the households in the form of lump sum transfers (Ω_t). The no-Ponzi game condition for the representative household is:

$$\lim_{t \to \infty} \frac{b_t}{(1 + r^*)^t} = 0 \quad (6)$$

To abstract from the presence of trends in the current account, we assume that $\beta = (1 + r^*)^{-1}$. The household's problem then consists in maximizing lifetime utility, defined in (1), subject to the constraints (2)-(6). This formulation is equivalent to one in which there are domestic factor markets for capital, labor, and land. Firms in both sectors hire factors of production in order to maximize profits. Households choose their consumption path in order to maximize lifetime utility.

The Government Budget Constraint

The government collects taxes on the consumption of both goods and rebates this revenue to the households through lump sum transfers. Government net foreign asset holdings (f_t) evolve according to:

$$f_t = f_{t-1}(1 + r^*) + \tau_t^c C_t^T + \tau_t^c p_t C_t^{NT} - \Omega_t \quad (7)$$

The no-Ponzi game condition for the government is:

$$\lim_{t\to\infty} \frac{f_t}{(1+r^*)^t} = 0 \tag{8}$$

Equilibrium in the Goods Markets

We assume that non-tradables are only used for consumption, so in equilibrium the sequence of relative prices $\{p_t\}_{t=0}^{\infty}$ has to be such that:

$$Y_t^{NT} = C_t^{NT} \tag{9}$$

Using this equation and aggregating the private and public budget constraints, we obtain the equilibrium conditions for the tradable goods market:

$$Y_t^T = C_t^T + TB_t \tag{10}$$

$$a_t = (1+r^*)a_{t-1} + TB_t \tag{11}$$

where $a_t = b_t + f_t$ represents the consolidated net asset holdings of the government and the private sector, while TB_t is the economy's trade balance. The current account is given by $CA_t = r^*a_{t-1} + TB_t$. In the absence of shocks, this economy is always at a steady state where $TB = -r^*a$. Any level of a is consistent with the steady state. Positive levels of net foreign asset holdings allow the economy to finance a trade deficit that makes it possible to enjoy higher levels of consumption of both goods.

3.2 Four Basic Effects

Consider now the economic mechanisms at work in this model. Understanding these mechanisms will make clear which are the key elements that need to be combined to reproduce the stylized facts described in Section 2. The qualitative implications of the first three effects on the main variables of interest are summarized in Table 1.

3.2.1 The Wealth Effect

The stabilization literature often refers to "wealth effects" as being important in understanding the outcomes of stabilizations. The wealth effect in the

Hicksian sense comprises the responses of the different choice variables to an increase in lifetime utility at unchanged prices.[7] In this economy, a wealth effect takes the form of a proportional increase in the consumption of both goods with no change in the labor allocation across the two sectors, as follows from the optimality conditions:

$$\frac{1-\gamma}{\gamma}\frac{C_t^T}{C_t^{NT}} = p_t \tag{12}$$

$$p_t \eta Z^{NT}(N_t^{NT})^{\eta-1}T^{1-\eta} = \alpha Z^T(N_t^T)^{\alpha-1}K^{1-\alpha} \tag{13}$$

Equation (12) dictates the optimal proportions in which tradables and non-tradables are consumed. Equation (13) determines the optimal allocation of labor across the two sectors. These equations show that a proportional increase in the two productivity parameters Z^T and Z^{NT} in an economy where $a = 0$ generates a pure wealth effect: the consumption of both goods rises in the same proportion, leaving their relative price unchanged.

To illustrate the effects of a shock that generates a wealth effect, suppose that there is an increase in the stock of net foreign assets in period zero. By increasing a we obtain a combination of the Hicksian wealth effect and the substitution effects that take place in equilibrium as a result of the increase in p. All these effects take place immediately since the model displays no transition dynamics. An increase in a leads households to expand their consumption of both goods. Notice that if p were unchanged households would maintain the same ratio C^T/C^{NT}. This is, however, unfeasible. Equation (13) shows that when p does not change, the values of N^{NT} and Y^{NT} remain the same. In order for C^{NT} to expand, p has to rise to induce a reallocation of labor toward the non-tradable sector. In equilibrium, therefore, p always rises and the consumption of tradable goods always expands by more than the consumption of non-tradables.[8] The reallocation of labor toward the non-tradable sector leads to a fall in the production of tradable goods. The trade balance deteriorates as a result of the fall in Y^T and the rise in C^T. This fall in the trade balance is compensated by the increase in returns to net foreign assets (r^*a).

[7] For a discussion of wealth and substitution effects in dynamic models, see King (1991).

[8] It is obvious that the same increase in demand that generates a real appreciation raises the rental price of land, which in equilibrium is $p_t(1-\eta)Z^{NT}(N_t^{NT})^{\eta}T^{-\eta}$. This is consistent, at least at a qualitative level, with the boom observed in real estate markets.

The consistency of these various effects with prominent features of exchange-rate-based stabilizations explains why wealth effects are considered important in understanding these episodes. A key issue is thus what may be the source of wealth effects in stabilization programs.

3.2.2 The Labor Supply Effect

In a model with an endogenous labor supply the total amount of time devoted to market activities will generally respond to the stabilization shocks. The effects of these labor supply movements can be illustrated in this simple model by considering an exogenous, permanent increase in the total supply of labor N. This triggers both a positive wealth effect and substitution effects associated with changes in the relative price of non-tradables. To understand the effects of an increase in N, suppose for a moment that the relative price of non-tradables remains unchanged. Given the assumption that $\alpha < \eta$, N^{NT} will increase by more than N^T. For this to be an equilibrium, the consumption of non-tradables would have to increase by more than the consumption of tradables. However, if p remains constant households will want to increase the consumption of both goods in the same proportion. Thus, in equilibrium the relative price of non-tradables will have to fall. This implies that C^{NT} will increase by more than C^T. The current account remains unchanged because the increase in N is permanent. We conclude that an increase in the labor supply will help explain the consumption booms but will make it more difficult to rationalize the observed increase in the relative price of non-tradables.

3.2.3 The Effective Price of Consumption Effect

Macroeconomic stabilizations are generally characterized by a decline in the rate of inflation. To the extent that money is used to purchase consumption goods, the fall in inflation lowers the effective price of consumption. This effect can be illustrated in this real model by considering a reduction in the consumption tax rate, since it produces similar effects to a fall in the rate of inflation. Given that labor supply is exogenous and that the tax revenue is rebated to the households in a lump sum manner, a permanent change in τ^c has no effects. However, *temporary* changes in τ^c are not neutral because they distort the relative price of consumption today vis-a-vis consumption in the

future. This effect is the crux of the "temporariness" hypothesis discussed in Section 5.

Denote the current period by t and suppose that τ^c takes on a lower value between now and period $t+T$, after which it returns to its initial level. Consumption of both goods will be higher during the low tax periods and lower afterwards. These higher levels of consumption are financed by depleting the stock of net-foreign assets, i.e. by running a current account deficit. A rise in consumption leads to an increase in p for the reasons discussed before: the relative price of home goods has to increase in order to elicit the increase in N^{NT} that makes the rise in C^{NT} feasible.[9] For T periods we will observe a consumption boom and a higher level of p. The magnitude of the consumption boom depends on the elasticity of intertemporal substitution, σ, and on the production parameters α and η.

What happens from period $t+T+1$ onward? The economy looks just like it did before period t but it has a lower level of net foreign assets. Thus both consumption and p will be lower than before time t.

It is worth noting that this experiment does not isolate the pure substitution effect associated with the temporary decline in τ^c. The results reflect a mixture of this substitution effect with a *negative* Hicksian wealth effect. To see this, recall that the tax revenue is rebated to the household, so a constant consumption tax rate has no effects on the level of welfare. By distorting the intertemporal price of consumption, the temporary decline in τ^c actually lowers the utility of the representative household.

3.2.4 The Investment Effect

Before we move on to a more complex formulation it is worthwhile to incorporate investment in physical capital in this model to discuss the determinants of the domestic capital stock. To accomplish this we only need to introduce three changes into the model: include investment expenditures (I_t) in the right hand side of equation (5) and in the market clearing condition (10), and append the standard capital accumulation equation, where δ denotes the rate of depreciation:

[9]The relative price p remains unchanged only when the two goods are perfect substitutes (in this case C^{NT} does not change) or when both production functions are linear in labor (in this case the technology dictates a constant relative price).

$$K_t = I_t + (1-\delta)K_{t-1} \tag{14}$$

This assumes that investment in physical capital requires only tradable goods. Since investment does not involve adjustment costs, the stock of capital adjusts immediately to equate the world real interest rate to the domestic marginal productivity of capital, net of depreciation:

$$r^* = (1-\alpha)Z^T(N^T_{t+1})^{\alpha}K_t^{-\alpha} - \delta \tag{15}$$

This equation shows that investment in physical capital is affected both by direct and indirect forces. An increase in the productivity parameter Z^T is the simplest example of a direct force that increases investment. A decline in taxes on output or investment, as well as a decline in inflation when investment transactions require the use of money, have effects similar to those of an increase in Z^T. However, investment is also affected by changes in the demand for non-tradables which, through their effects on N^T, alter the desired stock of capital.

We have seen that both a temporary decline in the effective price of consumption and an increase in net foreign assets generate consumption booms and real appreciations. In both cases the amount of labor employed in the tradables sector declines. This will lead to a fall in investment that restores the parity between the domestic net productivity of capital and the international real interest rate. In order for investment to rise, this indirect effect has to be compensated by a shock that raises domestic capital productivity.

4 A Monetary Model with Capital Accumulation

This section extends our simple model to include physical capital accumulation with costs of adjustment, a transactions-based demand for money, and an endogenous labor supply.

Preferences

To make the supply of labor endogenous we adopt a two-good version of the momentary utility used in Greenwood, Hercowitz and Huffman (1988):

$$U = \sum_{t=0}^{\infty} \beta^t \frac{1}{1-1/\sigma} \left\{ \left[\left(C_t^T\right)^{\gamma} \left(C_t^{NT}\right)^{1-\gamma} - \psi(N_t^T + N_t^{NT})^{\nu} \right]^{1-1/\sigma} - 1 \right\}$$
$$\sigma > 0,\ \nu > 1, \psi > 0 \tag{16}$$

In small open economy models, such as those of Mendoza (1991), Lundvik (1992), and Correia, Neves, and Rebelo (1995), this form of preferences produces a more realistic behavior for consumption and for the trade balance than instantaneous utility functions that are Cobb-Douglas in consumption and leisure.

Production Technology

We maintain the same specific factors structure of Section 3, described by (3) and (4) but we no longer treat K as fixed.

Capital Accumulation Technology

Tradable goods can be used for consumption or investment (I_t). The law of motion for the capital stock features adjustment costs to investment (without which investment flows are implausibly volatile):

$$K_t = \phi(I_t/K_{t-1})K_{t-1} + (1-\delta)K_{t-1} \tag{17}$$

The parameter $0 < \delta < 1$ denotes the rate of depreciation and the function $\phi(.)$ is an increasing, concave, twice continuously differentiable function with two properties that guarantee the absence of adjustment costs in the steady state: $\phi(\delta) = \delta$, $\phi'(\delta) = 1$. This formulation implies that Tobin's q, the ratio of the value of capital to its replacement cost, is $q_t = 1/\phi'(I_t/K_{t-1})$, and is thus equal to one in the steady state.

Transactions Technology

Money is used for transactions according to a specification in which holdings of real money balances expressed in terms of traded goods allow the agent to economize on the amount of resources devoted to transactions. We denote these resources by S_t and assume that they are denominated in terms of tradable goods[10]:

[10]This type of transactions technology has been widely used in monetary macro models,

$$S_t = Z^S(C_t + I_t)v\left(\frac{M_t/P_t^T}{C_t + I_t}\right) \tag{18}$$

where P_t^T is the nominal price of traded goods, M_t/P_t^T represents real money balances, and Z^S is a level parameter. Total consumption defined in units of the tradable good is given by $C_t = C_t^T + p_t C_t^{NT}$. We assume that the function $v(.)$ has the following quadratic form:

$$v(X) = X^2 - X + 1/4 \tag{19}$$

where $X_t = M_t/\left[P_t^T(C_t + I_t)\right]$ is the inverse of the velocity of circulation with respect to total expenditure. As will become clear below, this particular quadratic form ensures that transactions costs are zero when the nominal interest rate is zero.

The Household's Problem

Households maximize their utility described by (16) subject to the specification of the technology (3),(4),(18),(19) and to the following constraint:

$$\begin{aligned} & b_t + C_t^T + p_t C_t^{NT} + I_t + S_t + \frac{M_t}{P_t^T} \\ = \; & b_{t-1}(1+r^*) + \frac{P_{t-1}^T}{P_t^T}\frac{M_{t-1}}{P_{t-1}^T} + (1-\tau_t)Y_t^T + p_t(1-\tau_t)Y_t^{NT} + \Omega_t \end{aligned} \tag{20}$$

where τ_t is the tax rate levied on the output of both sectors, while Ω_t is a lump sum transfer from the government. The borrowing and lending opportunities in the international capital market remain the same as in Section 3. The no-Ponzi game condition described in (6) continues to apply here. We will also continue to assume that $\beta = (1+r^*)^{-1}$.

Money Demand

The optimal conditions for the household problem, together with the quadratic form assumed for $v(.)$, imply that the demand for real balances

see, e.g. Kimbrough (1986) and Marshall (1992). The properties of a monetary economy in which $v(.)$ has the quadratic form used in (19) below and S represents time devoted to transactions activities were analyzed in Végh (1989).

is homogeneous of degree one in total expenditures, which accords with the estimates of Reinhart and Végh (1995):

$$M_t/P_t^T = (C_t + I_t)\frac{1}{2}\left[1 - \frac{R_t}{Z^S(1+R_t)}\right] \tag{21}$$

where R_t denotes the nominal interest rate. For simplicity we assume that tradables inflation in the country to which the currency is pegged (typically the U.S.) is zero. The nominal rate is then given by:

$$R_t = (1+\varepsilon_t)(1+r^*) - 1 \tag{22}$$

where ε_t is the rate of devaluation. One useful property of the quadratic transactions technology is that it implies a finite demand for real balances when the nominal interest rate is zero. In this case the optimal value of X is $1/2$, and transactions costs are nil ($v(X) = 0$). Thus, when $R_t = 0$ the equilibrium of our economy coincides with that of a model in which all goods are "credit goods", so that money plays no role.

Labor Supply

The supply of labor at each point in time is given by:

$$N_t^T + N_t^{NT} = \left\{\frac{\gamma^\gamma(1-\gamma)^{1-\gamma}(1-\tau)p^{\gamma-1}w_t}{\nu\psi\left[1 + Z^S\left(1/4 - X_t^2\right)\right]}\right\}^{1/(\nu-1)} \tag{23}$$

where w denotes the before-tax real wage rate defined in units of tradables:

$$w_t = \alpha Z^T K_{t-1}^{1-\alpha}(N_t^T)^{\alpha-1} \tag{24}$$

As a result of our preference specification the supply of labor behaves in a simple, intuitive fashion. The labor supply at time t is solely a function of the after-tax wage rate deflated by the consumer price index ($(1-\tau)p^{\gamma-1}w_t$), the relative price of non-tradables and the expected rate of inflation at time t (which determines X_t). Thus there is no income effect or intertemporal substitution effect driving the supply of labor. The elasticity of labor supply with respect to the real wage is $1/(\nu-1)$.

The Government Budget Constraint

The government collects taxes on the production of both goods, buys tradables (G_t^T) and non-tradables (G_t^{NT}) and makes a lump sum transfer to the households. Government net foreign asset holdings (f_t) evolve according to:

$$f_t = f_{t-1}(1+r^*) + \frac{M_t}{P_t^T} - \frac{P_{t-1}^T}{P_t^T}\frac{M_{t-1}}{P_{t-1}^T} + \tau_t Y_t^T + \tau_t p_t Y_t^{NT} - \Omega_t - G_t^T - p_t G_t^{NT} \quad (25)$$

The path for f_t has to satisfy the government no-Ponzi game condition (8). In all the experiments that we will study we compensate changes in seignorage, tax revenue or government expenditures by adjusting lump sum taxes or transfers.

Monetary Policy

Since we are interested in fixed exchange rate regimes we will model the rate of devaluation ε_t as the exogenous policy parameter that the government controls. The level of M_t will be endogenously determined by the money demand equation (21) and by the requirement that the price of tradable goods be the same in the two countries: $P_t^T = eP^{T*}$, where P^{T*} is the foreign price of tradable goods and e is the exchange rate.

Equilibrium in the Goods Market

Equilibrium in the non-tradable goods market requires:

$$Y_t^{NT} = C_t^{NT} + G_t^{NT} \quad (26)$$

Using this equation and aggregating the private and public budget constraints, we obtain the equilibrium conditions for the tradable goods market:

$$Y_t^T = C_t^T + I_t + S_t + G_t^T + TB_t \quad (27)$$

$$a_t = (1+r^*)a_{t-1} + TB_t \quad (28)$$

Here $a_t = b_t + f_t$, represents, as before, the consolidated net asset holdings of the government and of the private sector. TB_t is the economy's trade balance.

The Steady State

Given that we abstracted from technological progress, all the variables defined above will be constant in the steady state. The steady state for this economy is defined by a set of conditions that include the resource constraints and equations (12), (13), (21), (23), and (24). Conditions (12) and (13) relate p to the labor allocations across the two sectors and to the consumption mix. Conditions (21), (23) and (24) are, respectively, the equations that describe money demand, labor supply, and the real wage rate.

Since there are no adjustment costs in the steady state, the net marginal product of capital (adjusted for the transactions costs associated with the investment process) is equated to the international real interest rate:

$$r^* = \frac{(1-\alpha)(1-\tau)Z^T(K^T)^{-\alpha}(N^T)^{\alpha}}{1+Z^S(1/4-X^2)} - \delta \tag{29}$$

Notice that we recover the usual expression that equates the domestic marginal product of capital net of depreciation to the world real interest rate when the nominal interest rate is zero, since in this case X is equal to $1/2$ (see equation (21)).

The steady state level of investment is given by $I = \delta K$. The steady state trade balance is determined by the condition:

$$TB = -r^* a \tag{30}$$

As in Section 3, the steady state is consistent with any level of net foreign assets.[11] Economies with higher levels of a have higher steady state levels of consumption of tradables, non-tradables, as well as lower levels of investment and of production of tradable goods.

Calibrating the Model

Our model has no known closed form solution, so we employ the numerical linearization methods of King, Plosser and Rebelo (1988) to explore its

[11] For high enough values of a the steady state can be characterized by a corner solution in which N^T is zero. Since in all the scenarios that we consider a is negative, this possibility is never relevant.

properties.[12] Our baseline parameters are described in Table 2. Each period is meant to represent a quarter. These parameters were chosen to try to replicate the average values of some key ratios for the Argentine economy in the decade prior to the 1991 Convertibility Plan. This is a difficult task given the instability of the Argentine economy during the 1980s. We nevertheless chose Argentina as the reference country because the Convertibility plan was orthodox, i.e. it did not rely on price and wage controls.

We employed the point estimates of the elasticity of intertemporal substitution obtained by Reinhart and Végh (1995) for Argentina ($\sigma = 0.2$) . We followed Uribe (1995) in setting the rate of inflation to its average value in the period 1970-1990: 10% per month. We also employed his estimates for the labor shares in the tradable and in the non-tradable sector ($\alpha = 0.48$ and $\eta = 0.63$). The share parameter in the utility function was set equal to 0.5; together with our choices for Z^T and Z^{NT} this implies that approximately half of total consumption expenditures are devoted to non-tradables. We chose $\nu = 3$, which implies an elasticity of labor supply of 0.5, so as to obtain realistic labor supply responses (increases in labor supply on the order of 3%) in the experiments that we considered. We chose $\psi = 22.75$ which implies that in the steady state agents devote 20% of their time to working in both sectors.

We chose the transactions technology parameter Z^S to match the 7% ratio of seignorage to GDP estimated by Kiguel (1989) for the period 1984-87.[13] The level of net foreign assets (a) was chosen so as to generate a steady state trade balance/GDP that coincides with the long run average for this variable in the period 1970-1990 (0.0267). Tax revenue during the period from 1985-87 was 10% of GDP, while government expenditures for the non-financial public sector (excluding real interest payments) represented roughly 30% of GDP.[14] We chose $\tau = .10$ and set the overall level of government expendi-

[12]This method involves linearizing the model around the steady state. The fact that this model displays a unit root (associated with the ability to borrow and lend at a fixed interest rate) may lower the accuracy of the numerical approximations, since we linearize around a steady state to which the economy never returns.

[13]Kiguel's (1989) seignorage estimates were computed as the change in M1 because in Argentina reserve requirements on time deposits and other interest bearing deposits were remunerated by the Central Bank. These estimates are broadly consistent with the money demand function estimated by Rodriguez (1994) which implies that a 10% monthly inflation is consistent with a ratio of seignorage to GDP of 6%.

[14]The source for these figures is the Argentine Ministry of Economy and Fund staff

tures consistent with these figures. We assumed that 70% of government expenditures were devoted to non-tradable goods, with the remaining spent on tradables.

The model was parameterized with standard values for the real interest rate (1% per quarter) and for the rate of depreciation (2.5% per quarter). We chose adjustment costs so that the elasticity of Tobin's q with respect to the investment-capital ratio $(-\phi''(\delta)\delta/\phi'(\delta))$ is equal to 1/15, which is Baxter and Crucini's (1993) baseline parameter.

In all the experiments described in the next section, we follow the literature in treating stabilizations as unanticipated events. We start the economy in period zero at the steady state and assume that the stabilization was until then unanticipated, but is perfectly foreseen from that point on. Throughout the paper the results we report are expressed in terms of percentage deviations from initial steady state values.

Money-Based versus Exchange-Rate-Based Stabilizations

Before we proceed, it is important to notice that in our model there is no difference between an exchange-rate-based stabilization and a money based stabilization (where the government controls the money supply and the exchange rate is endogenous). Fixing the exchange rate implies a certain path for M_t. Any money-based stabilization in which the government adopts the same path for M_t will produce the same outcome.

In practice, however, exchange-rate-based programs are preferred to money based programs for two reasons.[15] First, the velocity of circulation shifts so much at the onset of a stabilization episode, that it is difficult for policy makers to determine what the appropriate growth rate of M_t should be. Fixing the exchange rate makes M_t endogenous and avoids this problem. A second problem with money-based stabilizations is that, if the government wants, for some reason, to avoid a period of deflation, it has to announce a permanent decline in the growth rate of money, at the same time it engineers a one time increase in M_t. This rise in M_t, which is necessary to accommodate the rise in money demand produced by the decline in expected inflation without

estimates.

[15]In Reinhart and Végh's (1994) data set, which comprises 7 countries and 17 stabilization plans from 1964 to the present, there are 12 exchange-rate-based stabilizations but only 5 money-based programs.

a price fall, might undermine the credibility of the disinflation program.

5 The Alternative Theories

The stylized facts reviewed in Section 2 have given rise to a large theoretical literature. In this section we use the model of Section 4 to examine the implications of the different theories for all the relevant macroeconomic variables. This is an indispensable task. The stabilization literature generally focuses on a few variables at a time, either to ensure analytical tractability or to isolate particular mechanisms of interest. To facilitate the comparison between the different hypotheses, we summarize their qualitative implications in Table 3, which reports the direction of change for the different variables at the end of the first year after the implementation of the stabilization for our benchmark parameterization.

5.1 Credible Disinflation: Supply-Side Effects

A natural starting point to study exchange rate-based stabilizations is to isolate the effect of a credible, permanent reduction in the devaluation rate (ε). The resulting supply side effects have recently been emphasized by Roldos (1993,1995) and Uribe (1995). In all the experiments that we consider, we reduce the rate of devaluation by 100%. This is consistent with the Convertibility plan, where the exchange rate was fixed.

The effects of a decline in the rate of devaluation are depicted in Figure 5.[16] The decline in the rate of inflation generates the type of investment effect discussed in Section 3. The fall in the nominal interest rate reduces the transactions costs associated with investment, which increases the marginal productivity of capital net of these costs (equation (29) shows the steady state version of this effect). As a result, the steady-state capital/labor ratio in the tradables goods sector will be higher, implying higher values of w and p and a lower ratio C^{NT}/C^{T}. There is also a wealth effect produced by the reduction in resources spent transacting (S). On impact, the consumption of both goods increases. Given the magnitudes involved, the increase in labor supply is not enough to accommodate the increase in demand for non-traded

[16]Roldos (1995) derives similar results in a cash-in-advance model with exogenous labor supply.

goods. Hence, N^T falls and N^{NT} rises on impact. The rise in the stock of capital that takes place during the transition is associated with a fall in N^{NT} and a rise in N^T.

5.2 The Temporariness Hypothesis

A rich history of failed stabilization attempts in chronic inflation countries typically leads the private sector to view with skepticism any new attempt to bring down inflation to international levels. This has been the motivation underlying the temporariness hypothesis explored by Calvo (1986) and Calvo and Végh (1993). This hypothesis considers the case in which the stabilization plan is not credible, and hence the reduction in the rate of inflation is viewed as strictly temporary. Figure 6, which shows the effects of a 100% decline in the rate of devaluation that only lasts for 10 periods, illustrates the implications of the "temporariness" hypothesis

Since money must be used to purchase goods, a temporary fall in the interest rate lowers the effective price of consumption today relative to the future–along the lines discussed in Section 3–leading to a consumption/output boom followed by a later contraction. The temporarily lower effective price of consumption induces the household to increase consumption today (i.e., between period 1 and period 10) relative to the future (i.e., after period 10). Thus, on impact both C^T and C^{NT} rise. The higher levels of consumption observed between period 1 and period 10 are financed in part by a higher level of the labor supply and in part by a depletion of net foreign assets. Absent the increase in labor supply we would observe: (i) an increase in w due to the reallocation of labor from the tradable to the non-tradable sector; and (ii) a rise in p reflecting the higher demand for non-tradables. These effects continue to be present but the expansion in the labor supply is associated with an initial fall in the real wage rate. The increase in N is primarily a result of the fall in inflation which lowers the price of consumption in terms of leisure (recall from (23) that inflation affects labor supply through changes in X). The fall in inflation makes investment temporarily cheaper. This causes a large investment boom during the stabilization and a fall in investment below its initial level after period 10.

5.3 The Effects of Fiscal Policy

The idea that some of the effects of stabilization plans are a result of the fiscal reforms that tend to accompany the decision to fix the exchange rate has been stressed in the work of Drazen and Helpman (1988, 1990) and Agenor (1994). One puzzling feature of stabilization experiences is that they seem to be associated with an economic boom, despite the fact that there is often an immediate increase in taxes and a reduction in government expenditures. The possibility that fiscal contractions may be expansionary has been explored empirically by Giavazzi and Pagano (1991), in their analysis of the fiscal contractions observed in Ireland and Denmark in the 1980's. Recently, Rebelo (1994) has shown that an expansion can occur in the presence of an increase in taxes in situations where the present value of the resources that the government needs to extract from the private sector declines as a result of the stabilization plan.

5.3.1 Fiscal Adjustment During Stabilization

Most successful (or temporarily successful) stabilization programs typically include a drastic fiscal adjustment that features a combination of higher taxes and lower expenditures (see, for example Sachs (1987b)). As an illustration, Table 4 documents the nature of the fiscal adjustment that took place in the four stabilization episodes depicted in Figures 1 through 4. In Argentina, the fiscal improvement from 1990 to 1993 took the form of higher revenues (including taxes). In Israel, the drastic fiscal improvement of 18.4 percentage points in the general government deficit as percentage of GDP from 1984 to 1986, reflected a decline of roughly 10 percentage points in public expenditure (primarily in defense and subsidies) and an increase in revenues. Part of the increase in revenues, however, seems to have been an endogenous response to the initial boom, as evidenced by the fact that revenues as proportion of GDP fell sharply with the 1988-1989 recession.[17] Mexico already had a large primary surplus (close to 10 percent of GDP) by the time the stabilization plan was implemented at the end of 1987. The large overall deficits in the first years of the program shown in Table 4 are explained by the large interest payments that resulted from high real interest rates. In Uruguay, the

[17]The relationship between fiscal revenues and the initial consumption boom in exchange-rate-based stabilizations has been stressed by Talvi (1994a).

fiscal adjustment had also taken place before the program was implemented. In 1982, the fiscal situation deteriorated sharply due to a large increase in expenditures (related to social security and government salaries).

5.3.2 Simple Fiscal Experiments

We will focus on three simple experiments that highlight permanent changes in fiscal policy that are common components of stabilization packages: (i) a reduction in government expenditures on tradables; (ii) a reduction in government expenditures on non-tradables; and (iii) an increase in taxes. The outcomes of these experiments are reported in Figures 7 through 9. In these Figures the solid lines correspond to the effects of fiscal policy in isolation, while the dotted lines display the fiscal effects combined with the permanent disinflation featured in Figure 5.

Since the economy can borrow and lend at a fixed rate, a reduction in government expenditures on tradables is equivalent to the expansion in a discussed in Section 3. The timing of government expenditures on tradable goods is irrelevant from the standpoint of the private sector; only the present value of these expenditures matters. The solid line in Figure 7 shows the effect of a 6% reduction in G^T. This implies a fall in total government expenditures on the order of 2%. This corresponds roughly to the contraction in expenditures for the consolidated public sector observed in Argentina. The model predicts a consumption boom, an expansion in the non-tradable sector and a contraction in the tradable sector, a real appreciation, and an increase in the real wage. Investment falls and the current account improves. It is clear that, in isolation, this type of fiscal contraction cannot explain the stylized facts of Section 2. However, if we combine the effects of a contraction in G^T with those of a permanent reduction in the rate of devaluation, we obtain a scenario that comes close to what we observe. The two effects combined imply a 12% rise in consumption of tradables and a 8% increase in home goods consumption. The real exchange rate appreciates by roughly 4% on impact. The rise in p attributable solely to the fiscal contraction is on the order of 1%.

Figure 8 shows the effect of a permanent decline of 3% in G^{NT}, which represents a 2% fall in total government spending. The response of the economy to a reduction in G^{NT} is similar to that induced by the labor supply effect discussed in Section 3. After all, the fall in G^{NT} increases the supply

of labor available to the private sector. Thus we observe a fall in p and in w. When we combine this fiscal contraction with the effects of disinflation, we obtain a scenario that fits in qualitative terms the main stylized facts. A large contraction in G^{NT} would, however, overwhelm the effects of disinflation and produce counterfactual implications. It is unfortunate that the fiscal impacts depend so heavily on the type of expenditures that is reduced, since this complicates considerably the interpretation of the evidence.

Figure 9 shows the effects of an increase in the output tax rate from 10% to 11%. This is roughly consistent with the tax increases associated with the convertibility plan (e.g. the VAT tax rate increased from 14% to 16% in 1991, and then increased again to 18% in 1992). Not surprisingly, the increase in taxes generates a recession, as well as other effects which are the opposite of what we observe in the initial stages of exchange-rate-based stabilizations. However, mild tax increases combined with permanent disinflation can still generate realistic scenarios.

5.4 Sticky inflation and nominal wage rigidity

The earliest explanations for the empirical regularities described in Section 2–put forward by Rodriguez (1982) and Dornbusch (1982)–were based on reduced-form models which incorporate backward-looking elements into the inflationary process (i.e., adaptive expectations or backward-looking indexation of nominal wages). In these models, which were motivated by the Southern-Cone tablitas of the late 1970s, interest rate parity is assumed to hold and aggregate demand depends negatively on the real interest rate and positively on the real exchange rate (the relative price of traded goods). In this context, a permanent reduction in the rate of devaluation reduces the real interest rate on impact and generates a boom in economic activity. The stickiness in the inflation of home goods causes a sustained real exchange rate appreciation which eventually throws the economy into a recession. This hypothesis lost some practical relevance in the mid-1980s when, unlike what had been observed in the Southern-Cone tablitas, real interest rates rose sharply in the early stages of the plan.

From an analytical point of view, the explanatory power of sticky wages and sticky inflation has recently been called into question by Calvo and Végh (1994) who argue, in the context of an intertemporal optimizing model, that the initial fall in real interest rate will be associated with an initial boom only

in the (empirically implausible) case in which the intertemporal elasticity of substitution is higher than the intratemporal elasticity of substitution. Sticky inflation, however, continues to be a popular notion to think about stabilization, as recently illustrated by Dornbusch and Werner's (1994) study of the Mexican 1987 stabilization.

We now examine the merits of two hypotheses that embody nominal rigidities in the context of our benchmark model. Instead of specifying nominal contracts or lags in the adjustment of prices, we fed in realistic paths for real wages or for the real exchange rate that converge to their long run equilibrium values. This seems a natural first step since it allows us to determine whether, given some unspecified nominal rigidity that generates the required price behavior, the model is consistent with the empirical regularities observed for real variables. If nominal rigidities survive as a useful hypothesis, the problem of uncovering the source of sustained disequilibrium rises in wages and prices becomes pertinent. We first consider the effects of a permanent disinflation together with an increase in the real wage that depends on an exogenous component and on the level of employment relative to the steady state. Then we study the impact of sticky inflation by analyzing the effects of a disinflation that is accompanied by an exogenous rise in the price of non-tradables.

5.4.1 Nominal Wage Rigidities

A common explanation for the outcome of an exchange-rate-based stabilization program is that nominal wages are indexed to past inflation. The materialization of low rates of inflation after the reform makes the real wage too high. To study the implications of this hypothesis, we compute the perfect foresight equilibrium of our base model that corresponds to a sustained, but temporary, increase in the real wage rate. Since the real wage is above its equilibrium value we assume that the number of hours hired in the labor market is determined by the short side of the market, which in this case is the demand side.[18] Thus there will be involuntary unemployment: the number of hours employed by firms will fall short of the total number of hours available

[18] Cho and Cooley (1995) and King (1995) are examples of dynamic models that embody nominal rigidities and disequilibrium allocation rules. Erceg and Levin (1994) have recently discussed the role of nominal rigidities in stabilization episodes in a framework similar to the one we employ here.

in the economy. We assumed that real wages follow the process given by:

$$\widehat{w}_t = \zeta_t + \upsilon \widehat{N}_t$$

where $\widehat{w}_t$ is the percentage deviation in the wage rate relative to the steady state, ζ_t is a wage shock, and υ is the sensitivity of changes in the wage rate to variations in total employment ($\widehat{N}_t$), defined as the percentage deviation of $(N_t^T + N_t^{NT})$ from its steady state value. The term $\upsilon \widehat{N}_t$ captures the notion that the real wage rises as labor markets conditions tighten. In the results that we report we set $\upsilon = 1$. We studied the effects of a hump-shaped increase in the wage shock ζ_t with a peak value of 12%. This corresponds to half of the 24% increase in the real wage, measured in units of tradable goods, observed in Argentina. The resulting real wage is always above its equilibrium value but converges to its long run equilibrium. We did not parameterize the shock to reproduce the full wage increase observed in Argentina to maintain comparability with the other hypotheses, which predict moderate wage increases.

The effects of nominal wage rigidities considered in isolation generate strongly counterfactual features: a recession in both sectors, and a decline in both consumption and investment. Firms fire workers because of the high wages and unemployment leads to a drop in consumption. Investment falls in reaction to the low returns to capital implied by the high cost of labor.

However, much to our surprise, we found that nominal wage rigidities combined with the supply-side effects of a permanent reduction in the rate of devaluation produce a realistic scenario (see Figure 10).

5.4.2 Sticky Inflation

We now consider the effects of a permanent reduction in the rate of devaluation, which leads to the instantaneous convergence of tradables inflation but to a slow convergence in home goods inflation. This setting in which the price of one of the goods is sticky is similar to the one studied in Stockman and Ohanian (1993). Specifically, we assume that in response to a permanent reduction in the rate of devaluation, the path of p follows the inverted-U pattern depicted in the first panel of Figure 11. We chose the peak value of p to be 18%, which is half of the rise in the real exchange rate observed in Argentina during the Convertibility Plan. Since p is higher than its market-clearing value the consumer's demand for non-traded goods falls short of the

firms' desired supply (i.e., equilibrium condition (26) does not hold). We assume that the short-side of the market prevails, in the sense that firms will only supply what consumers demand. We did not require the model to be consistent with the full real appreciation observed in Argentina so that the results can be compared with those of the other hypotheses, which generate small increases in p.

In isolation, a rise in p increases the consumption of tradable goods and lowers non-tradable consumption, it raises investment (which responds to the reallocation of labor toward tradables) and lowers the real wage rate, at the same time as it deteriorates the current account.[19] Figure 11 shows the combination of these effects with a permanent reduction in the rate of devaluation. This scenario is broadly consistent with the facts discussed in Section 2.

6 Evaluating the Different Hypotheses

Qualitative Performance

Both a temporary and a permanent decline in the rate of devaluation are capable of reproducing most of the stylized facts described in Section 2. Our version of the temporariness hypothesis has, however, an implausible implication: investment increases by 75% on impact. This unrealistic investment response can be eliminated by increasing the degree of adjustment costs. This leads to a smaller deterioration of the current account and to a smaller real appreciation, but has a relatively minor impact on the behavior of the other variables depicted in Figure 6.

None of the three simple fiscal experiments that we consider–a permanent decline in G^T, G^{NT}, and a permanent increase in the tax rate–can, in isolation, produce the main effects of exchange-rate-based stabilizations. However, mild fiscal contractions combined with the effects of disinflation can produce realistic scenarios. The most promising of these scenarios com-

[19]The fact that p is temporarily high leads to a depletion of net foreign assets. Since the long run level of p depends on a (see Section 3) we had to construct Figure 11 using an iterative procedure. This method ensures that p returns to a long run equilibrium that is consistent with the level of a that is observed in the end of the period during which p is above its equilibrium level.

bines a contraction in government tradable expenditures with a permanent disinflation.

Nominal wage rigidity by itself produces a recession with strong counterfactual features. However, the effects of nominal rigidities combined with those of disinflation are consistent with most of our stylized facts. The same holds for sticky inflation.

Unfortunately, the ability of the different hypotheses to replicate the empirical regularities differs most with respect to the two least documented facts: (i) a recession (or at least no boom) in the tradable sector; and (ii) a boom-recession cycle observed even in successful programs.

Both a temporary and a permanent decline in the rate of devaluation are incapable of producing a visible recession in the tradable sector, unless they are combined with a fiscal contraction. The sticky wage hypothesis leads naturally to a decline in tradables production. In contrast, the sticky inflation hypothesis tends to predict an expansion in the tradable sector after the first quarter.

There are three hypotheses that generate a boom-recession cycle: temporariness, sticky wages and sticky inflation. In our versions of sticky wages and sticky prices, however, the recession comes too early: after a one quarter expansion there is a decline in investment, employment and the production of non-tradables.

Quantitative Issues

The evolution of some of the key macroeconomic variables is described in Table 5 for the four countries that we considered. This table makes clear that all our simulations underpredict the consumption booms observed in practice. This is partly due to the inclusion of durables purchases in the data reported in Table 5. However, the consumption booms predicted by our model are still smaller than the ones observed in non-durable consumption in the two countries for which we have disaggregated data for durables and non-durables, Mexico and Israel. It is important to stress that in our experiment the fall in seignorage was compensated by a rise in lump sum taxes. When the total amount of resources extracted from the private sector falls one-to-one with the decline in seignorage, the wealth effect of disinflation is much stronger and the model generates larger consumption booms. In this case, the model comes close to replicating the rise in non-durable consumption in

Mexico (15% from 1987 to 1991) but falls short of predicting the staggering 44% boom in non-durable consumption observed in Israel between 1985 and 1990.

The most important quantitative shortcoming of our model is that it produces real appreciations that are much smaller than the ones observed. The difficulties involved in accounting for the real appreciation can be demonstrated using equation (13), which requires that the value of a marginal unit of labor be identical in the two sectors. Suppose that labor is equally distributed between the two sectors ($N_t^T = N_t^{NT} = 0.5$) and that $\alpha = \eta = 0.5$. To simplify, assume also that the level of capital is fixed and that the supply of labor is exogenous. Under these assumptions, the change in the relative price of non-tradables, p_t, coincides with the percentage increase in the hours of work devoted to the non-tradable sector. To explain the 60% appreciation observed in Mexico over the period from 1987 to 1994, N^{NT} would have to have increased (at the expense of employment in the tradable sector) by an implausible 60%![20] We can reduce the magnitude of this labor reallocation if we adopt smaller values of α and η. These values, however, may be inconsistent with the share of labor in income in the overall economy. In order to generate large movements in p_t, while maintaining empirically reasonable labor shares and avoiding implausible labor reallocations, we need to modify the technology in order to make steeper the marginal cost schedule for non-tradables production.

Extensions of the Model

We explored several extensions of the model that improve on the results discussed in the previous section. We also studied modifications of the model that significantly deteriorated its performance. We now discuss briefly both successes and failures.

First, if we modify the model to make the marginal cost of producing non-tradables increase more steeply with Y^{NT} we will obtain larger real appreciations and lower consumption booms. The simplest modification along

[20] When both sectors use capital and labor, as in the models of Rebelo (1993) and Uribe (1995) it is even more difficult to generate large increases in p_t. In that setting, p_t is proportional to $(K_t^T/N_t^T)^{\eta-\alpha}$, where η and α are the labor shares in the tradables and non-tradables sector, respectively. Since empirically reasonable values for $\eta - \alpha$ are in the range of 0.1 to 0.4, large increases in p_t require very large changes in the capital-labor ratio of the tradables sector.

these lines involves a reduction in the elasticity of substitution between labor and land in the non-tradables sector. An interesting extreme case is obtained when we assume that there is a fixed endowment of non-tradables that cannot be increased. Such modifications produce large appreciations only if we assume that the intratemporal substitution between C^T and C^{NT} is low. Otherwise, these changes in technology have a small impact on p and a large impact on the response of C^{NT}.

Second, if we assume that investment requires the use of tradables and non-tradables, we obtain larger rises in p. Once again, to produce large increases on p we need to assume that substitution between these two goods is low *both* in consumption and in the investment process. It is obvious that the presence of substitutability in either of the activities will dampen the rise in the price and magnify the quantity adjustment.

Third, we incorporated a form of preferences widely used in the dynamic macroeconomics literature:

$$\begin{aligned} U &= \sum_{t=0}^{\infty} \beta^t \frac{1}{1-1/\sigma} \left\{ \left[\left(C_t^T\right)^{\gamma^T} \left(C_t^{NT}\right)^{\gamma^{NT}} (1 - N_t^T - N_t^{NT})^{1-\gamma^T-\gamma^{NT}} \right]^{1-1/\sigma} - 1 \right\} \\ 0 &< \gamma^T < 1, 0 < \gamma^{NT} < 1, 0 < \beta < 1, \sigma > 0 \end{aligned}$$

In this version of the model the supply of labor exhibited a counterfactual decline in many of our experiments. This is not surprising since the same wealth effect that leads agents to expand their consumption leads, with preferences of this type, to an increase in leisure. In many of our experiments the substitution effect associated with the wage increase was not powerful enough to offset the positive wealth effect on leisure. It is the absence of a wealth effect on leisure implied by the Greenwood, Hercowitz, and Huffman (1988) preferences that allowed our model to be consistent with the observed increase in the supply of labor.

Fourth, we considered a version of the model where S (the cost associated with transactions) represented time instead of resources. This meant that the disinflation process, by reducing S, produced a strong labor supply effect of the type discussed in Section 3.2.2, thereby dampening the increase in p that the model generated.

Finally, we studied a version of the model in which investment transactions did not require the use of money. In this case a reduction in the rate

of devaluation (both temporary and permanent) still leads to an increase in investment, as a result of an increase in the labor supply which leads to a rise in N^T. However, this effect is quantitatively very small. The only hypothesis that produces a sizable investment increase when investment is a "cash good" in sticky inflation. In this case the rise in p can lead to a reallocation of labor toward tradables that is large enough to produce a sizable investment rise.

7 Conclusions

The empirical evidence on the outcomes of exchange-rate-based stabilizations defy the conventional wisdom that inflation stabilization needs to be painful. Using a dynamic model with rational agents who have perfect foresight, we have found that the following hypotheses work well on a number of dimensions: (i) a credible, permanent reduction in the rate of devaluation; (ii) a reduction in the rate of devaluation believed to be strictly temporary; (iii) a fiscal contraction that reduces tradables expenditures combined with a reduction in inflation; and (iv) a permanent disinflation in the presence of nominal wage rigidities or sticky inflation. Unfortunately, the performance of these different scenarios is most distinct with regard to the two facts about which we know the least: the presence of a recession in the tradable sector and of a boom-recession cycle even in successful programs. A recession in the tradable sector arises naturally in an economy with sticky wages. In order to produce a fall in tradables production, both the temporary and the permanent reduction in the rate of devaluation need to be combined with a sizable fiscal contraction. The only hypotheses that generate a boom-recession cycle are temporariness and sticky wages or prices.

It is important to stress that the supply side effects of disinflation proved to be an essential component in accounting for the stylized facts of exchange-rate-based stabilizations. This is particularly true with respect to the nominal wage rigidity hypothesis. When considered in isolation this hypothesis produces strongly counterfactual results, but when combined with the supply side effects of disinflation, it generates a realistic scenario.

At a *quantitative* level the results for our baseline parameterization fall short of explaining the orders of magnitude involved in stabilization episodes, suggesting that the large consumption booms and the sizable real appreciations are puzzling. While there are configurations of the technology that

are consistent with the magnitudes present in the data, there is currently not enough information on the role played by non-tradable goods in actual economies to assess whether these configurations are empirically plausible. Improving our understanding of the role of non-tradables in actual economies is a natural goal for future research.

Another research direction that seems fruitful is to improve the treatment of the way in which agents form expectations and to model the evolution of credibility over time. In all our results we made use of extreme assumptions: policy reforms were either perfectly anticipated or totally unforeseen, reform was either perfectly credible or doomed to fail with certainty. Going beyond these stark assumptions is likely to enhance our understanding of stabilization episodes.[21]

From a policy perspective, a better understanding of the dynamics involved in bringing down inflation from high levels seems essential. As recent events in Mexico vividly illustrate, some of the dynamics unleashed by an exchange rate-based stabilization (in particular, the real appreciation and the current account deterioration) may pose a difficult policy dilemma as to whether corrective measures are needed or not. Similar issues have also come up in the context of transition economies (Bruno (1993) and Hansson and Sachs (1994)). While structural changes are likely to add additional uncertainty, the main lessons from the experience of high inflation developing countries should prove quite helpful in designing effective stabilization policies for these countries.

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8 Appendix

This appendix describes the main features of the four major stabilization plans described in Figures 1-4.

8.1 Argentina: April 1991 Convertibility Plan

Date of stabilization plan: April 1991 to the present.

Exchange rate/monetary policy: The Convertibility plan was a shock orthodox program. The exchange rate was fixed and the monetary base was, by law, fully backed by gold and foreign reserves.

Fiscal policy: During the Convertibility program, the overall deficit of the public sector was basically eliminated . The Convertibility plan also included a massive privatization program.

Structural policies: The main structural change has probably been the dramatic reform of the public sector, which included the privatization of some large public enterprises. Financial markets have been essentially free since the Convertibility plan begun.

Wage and price indexation: During the Convertibility plan, formal indexation to past inflation was prohibited.

8.2 Israel: 1985 Stabilization Plan

Date of stabilization plan: Implemented in July 1985.[22]

Exchange rate/monetary policy: The July 1985 plan was an heterodox plan which included a freeze of the exchange rate and wage and price controls. Initially (first six months), there were also ceilings on banking credit enforced through higher reserve requirements and short-term capital controls.

Fiscal policy: Drastic fiscal reforms were used to balance the budget almost overnight. The key component was about a 10 percent reduction in public domestic expenditure (half of this reduction reflected a decline in defense expenditure and the remaining was achieved by cuts in subsidies of

[22]See Bruno (1993) and Bufman and Leiderman (1995) for detailed discussions of this stabilization plan.

various kinds). The fiscal correction actually started in September 1984 and was further strengthened in July 1985.

Structural policies: In comparison to other programs, structural policies were rather limited and gradual. The greatest changes appear to be in financial markets, which were substantially deregulated over the period 1985-1991. Basically, no progress was done on privatization.

Wage and price indexation: Price and wage indexation was rampant in Israel up to the 1985 plan, which justified in the eyes of policy makers the use of wage and price controls in the 1985 program. Unions are very powerful in Israel and a social pact was viewed as a necessary condition to break the inflationary inertia resulting from indexation to past inflation.

8.3 Mexico: December 1987 Stabilization Plan

Dates of stabilization plan. A major (heterodox, a la Israeli) plan was introduced in December 1987.[23]

Exchange rate/monetary policy. The exchange was fixed for a year, and then devalued according to a constant daily amount. Then, an exchange rate band was implemented.

Fiscal policy. Major fiscal reforms were undertaken in the years preceding the disinflation plan. Reforms included major cuts in government spending, tax reforms to increase the tax base and collecting taxes more efficiently, and privatization of state-owned enterprises. During the program, the operational deficit was high due to the service of the public debt (real interest rates were quite high) but there was a large primary surplus from the very beginning.

Structural policies. A large number of important structural changes took place during the 1980s and early 1990s, with many taking place before the stabilization plan of December 1987. Both the number of public enterprises and public sector employment were dramatically reduced over the period 1982-1992. Trade liberalization also took place with the average tariff falling from 27 percent in 1982 to 13 percent in 1992, a process which culminated with the signing of NAFTA. Mexico was virtually cut off world financial markets up to 1989 when voluntary lending resumed.

Wage and price indexation: Indexation to past inflation was widespread. As in Israel, there was a "pacto social" to reduce inflation. The "pacto" has

[23]See Dornbusch and Werner (1994) and Santaella and Vela (1994) for a discussion.

been renewed regularly.

8.4 Uruguay: October 1978 Stabilization Plan

Plan Duration. Implemented in October 1978, by preannouncing the exchange rate 90 days in advance. Ended in November 1982, when the central bank was forced to let the exchange rate float, and the currency depreciated by 140 percent.[24]

Exchange rate/monetary policy. Preannounced and declining rate of devaluation. There was no attempt at targeting monetary aggregates because the high degree of capital mobility made this unfeasible.

Fiscal policy. The public sector was in balance by 1979. There were no major fiscal measures during the tablita, except for a tax reform in late 1979 whose aim was to make the system more efficient. The large increase in the fiscal deficit in 1982 was related to an increase in social security payments and government salaries, and a reduction in labor taxes.

Structural policies. A time-table for trade liberalization was introduced in 1978. The trade liberalization proceeded gradually and was interrupted in 1983.

Wage and price indexation. During the tablita, semi-annual public sector wage increases and social security benefits were de facto indexed to past inflation.

[24]See Hanson and de Melo (1985) and Talvi (1994b).

TABLE 1

BASIC EFFECTS

Shock	Effect in Period:	Y^T	Y^{NT}	C^T	C^{NT}	N^T	N^{NT}	p	w	a
INCREASE IN a	1	↓	↑	↑	↑	↓	↑	↑	↑	↑
	∞	↓	↑	↑	↑	↓	↑	↑	↑	↑
INCREASE IN N	1	↑	↑	↑	↑	↑	↑	↓	↓	-
	∞	↑	↑	↑	↑	↑	↑	↓	↓	-
TEMPORARY DECLINE IN τ^C	1	↓	↑	↑	↑	↓	↑	↑	↑	-
	t>10	↑	↓	↓	↓	↑	↓	↓	↓	↓

The symbol "-" indicates that the variable remains unchanged. Period 1 is the period in which the shock takes place.

TABLE 2

PARAMETER VALUES

PARAMETERS	Baseline Values
International Real Interest Rate (r^*)	0.01
Discount Factor (β)	0.99
Rate of Devaluation (ε)	0.46
Depreciation Rate (δ)	0.025
Labor Share, Tradable Sector (α)	0.48
Labor Share, Non-Tradables Sector (η)	0.63
Elasticity of Intertemporal Substitution (σ)	0.20
Elasticity Parameter, Momentary Utility (ν)	3.00
Level Parameter, Momentary Utility (ψ)	22.75
Share Parameter, Momentary Utility (γ)	0.50
Level Parameter, Tradables Production (Z^T)	1.00
Level Parameter, Non-Tradables Production (Z^{NT})	4.76
Level Parameter, Shopping Technology (Z^S)	1.00
Level of Net Foreign Assets (a)	-6.81
Adjustment Costs Elasticity (ξ)	0.067
Government Expenditures in Tradables (G^T)	0.25
Government Expenditures in Non-Tradables (G^{NT})	0.51
Tax Rate on Output (τ)	0.10

Note: Each period is meant to represent one quarter.

TABLE 3

QUALITATIVE EFFECTS

	Y^T	Y^{NT}	C	I	TB	N	W	p	M/P^T
Stylized Facts	↓	↑	↑	↑	↓	↑	↑	↑	↑

Five Hypotheses	Y^T	Y^{NT}	C	I	TB	N	W	p	M/P^T
Permanent Disinflation	↑	↑	↑	↑	↓	↑	↑	↑	↑
Temporariness	↑	↑	↑	↑	↓	↑	↑	↑	↑
Fiscal Contraction									
1- Fall in Tradables Expenditures	↓	↑	↑	↓	↑	↑	↑	↑	↑
2 - Fall in Nontradables Expenditures	↑	↑	↑	↑	↓	↓	↓	↓	↑
3 - Rise in Taxes	↓	↓	↓	↓	↑	↓	↓	↓	↓
Sticky Wages With Supply Side Effects of Disinflation	↓	↑	↑	↑	↓	↓	↑	↑	↑
Sticky Inflation With Supply Side Effects of Disinflation	↑	↑	↑	↑	↓	↑	↑	↑	↑

Note: This table summarizes the results observed in the fourth quarter after the beginning of the stabilization. These would be the effects that one would observe with annual data.

TABLE 4

FISCAL ADJUSTMENTS DURING STABILIZATION

ARGENTINA (Public Sector Excluding Provinces)

% GDP	1989	1990	1991*	1992	1993
1. Total Revenues	13.7	13.8	15.8	17.1	17.4
1.1 Tax Revenue	8.6	8.4	10.0	11.7	11.3
2. Expenditures (1)	30.7	16.6	18.3	17.3	16.7
2.1 Interest (2)	11.8	3.3	2.6	1.5	1.1
2.2 Wages	4.6	3.9	4.3	3.9	3.2
3. Balance (1-2)	-17.0	-2.8	-2.5	-0.2	0.7

Source: Argentina Ministry of Finance and Fund staff estimates

(1) Excluding expenditures for arrears clearance to pensioners, suppliers and provincial governments

(2) On an accrual basis

ISRAEL (General Government)

% GDP	1984	1985*	1986	1987	1988	1989
1. Total Revenues	61.0	71.1	68.7	61.6	58.9	54.2
1.1 Tax Revenue	37.1	44.4	46.8	45.3	44.1	39.1
2. Expenditures	74.8	70.4	64.1	61.5	61.6	59.6
2.1 Subsidies	6.3	4.8	3.1	3.1	3.4	3.0
2.2 Defense	14.3	12.7	11.0	11.0	10.7	10.3
3. Balance (1-2)	-13.8	0.7	4.6	0.1	-2.7	-5.4

Source: Bank of Israel

MEXICO (Public Sector)

% GDP	1986	1987*	1988	1989	1990	1991
1. Total Revenues	28.8	29.5	29.0	27.9	27.3	25.9
1.1 Tax Revenue	9.1	8.7	10.9	12.0	10.4	10.7
2. Expenditures	43.7	43.9	39.9	32.9	30.1	26.5
2.1 Interest	16.4	19.8	18.0	13.2	10.3	5.6
2.2 Wages	5.8	5.6	6.1	5.8	5.7	6.3
3. Balance (1-2)	-14.9	-14.4	-10.9	-5.0	-2.8	-0.6

Source: Banco de Mexico

URUGUAY (Central Government)

% GDP	1977	1978*	1979	1980	1981	1982
1. Total Revenues	15.0	14.2	14.6	16.2	17.4	15.2
1.1 Tax Revenue	11.2	10.9	10.1	11.8	12.3	10.6
2. Expenditures	16.3	15.6	14.3	16.1	17.5	23.9
2.1 Interest	1.0	0.8	0.6	0.4	0.3	0.6
2.2 Wages	6.8	6.1	5.2	5.7	6.4	7.4
2.3 Soc. Secur.	3.0	2.9	2.9	5.0	5.6	9.4
3. Balance (1-2)	-1.3	-1.4	0.3	0.1	-0.1	-8.7

Source: Central Bank of Uruguay

Note: An asterisk indicates the year in which the stabilization plan began.

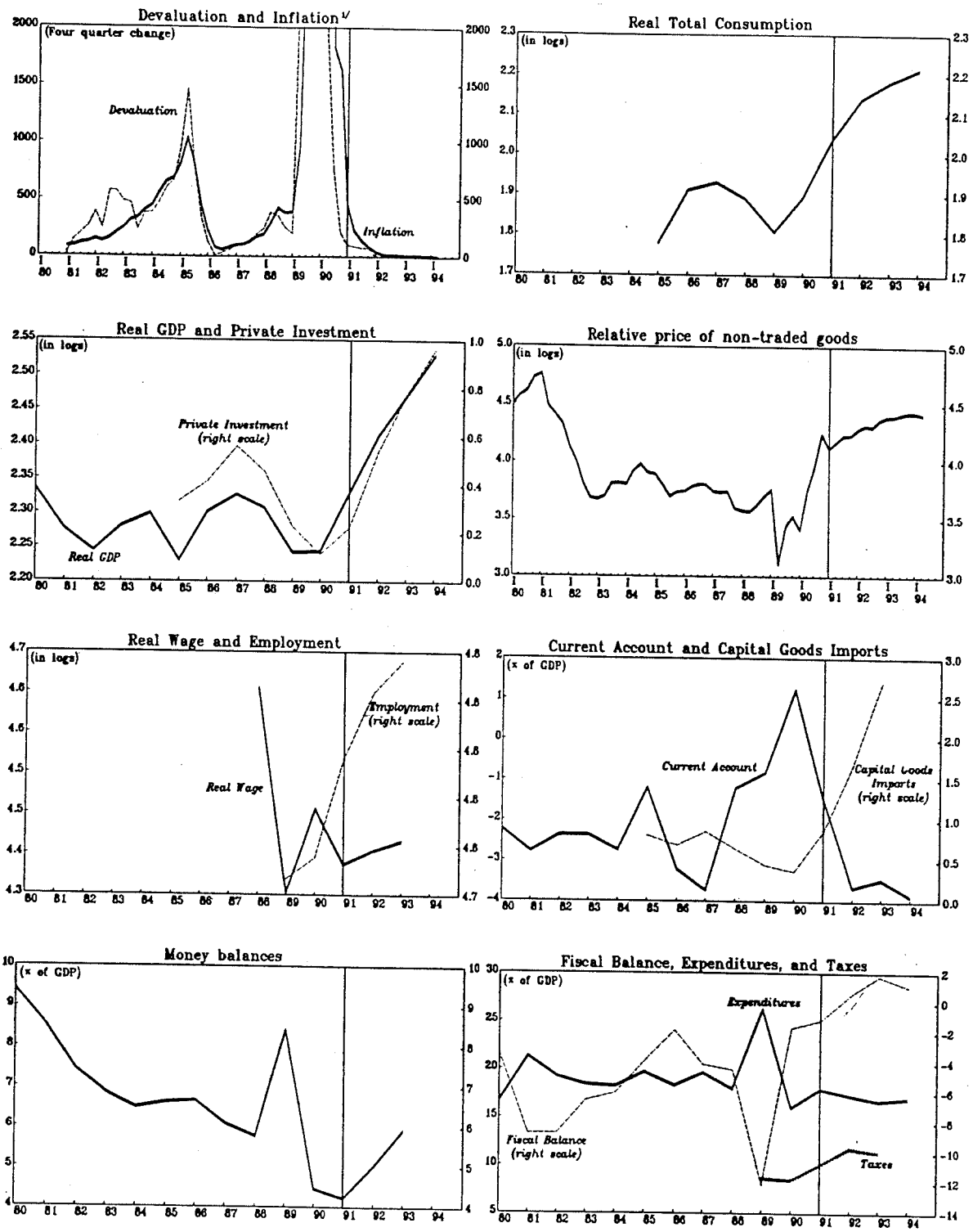
TABLE 5

MAJOR STABILIZATIONS:
CHANGES IN SELECTED VARIABLES

Programs		**Relative Price of Non-Tradables (% increase)**	**Real Wage (% increase)**	**Private Consumption (% increase)**	**Private Investment (% increase)**	**Real GDP (% increase)**	**Employment (% increase)**	**Trade Deficit (% of GDP)**
Argentina,	Effect after one year	17.6	1.7	15.7 (*)	11.6	8.9	4.2	2.8
1991.2-1994.2	From beginning to peak	36.3	2.9	37.6 (*)	133.7	33.0	7.1	6.1
Israel,	Effect after one year	10.9	-2.4	14.1	-0.2	3.6	1.4	-3.5
1985.3-1990.2	From beginning to peak	16.6	15.4	37.3	33.1	21.4	10.5	0.7
Mexico,	Effect after one year	24.3	-2.0	2.1	8.8	1.2	0.0	5.0
1988.1-1992.4	From beginning to peak	57.3	26.3	27.3	69.3	16.6	2.2	11.4
Uruguay,	Effect after one year	14.5	-9.6	5.4	43.1	6.2	1.4	4.7
1978.4-1982.3	From beginning to peak	78.8	-7.8	17.2	71.3	14.7	7.4	5.5

Source: IFS and National Authorities.
Notes: The period chosen comprises the quarters in which the program was in effect. If a program started late in a quarter, the following quarter is taken as the first quarter. For Israel and Mexico duration has been arbitrarily set to 5 years. For Argentina end of period reflects data availability. Changes were computed from beginning of the program to highest value during period (lowest value for the trade balance).
(*) In the case of Argentina the data reported corresponds to total consumption instead of private consumption.

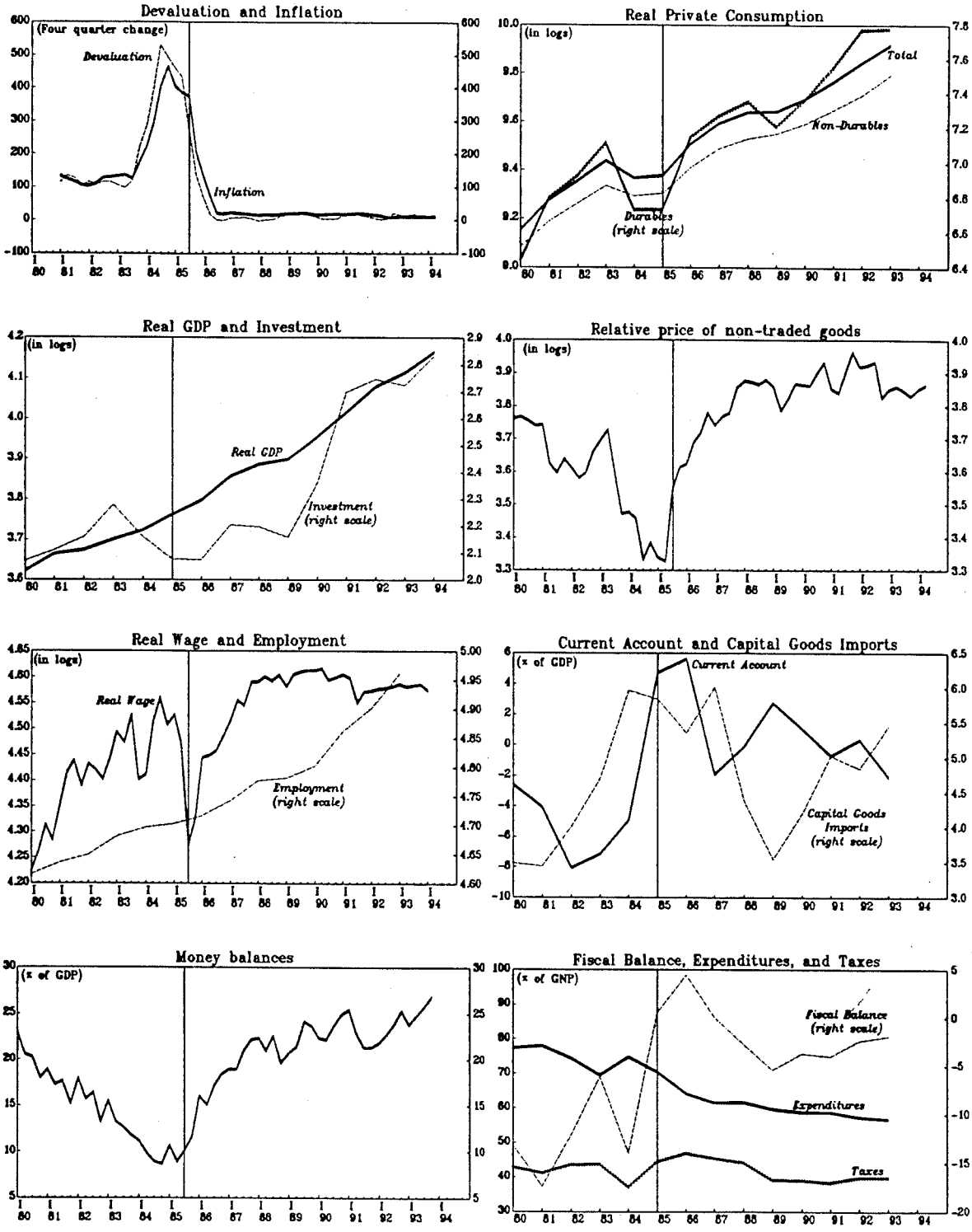
Figure 1. Argentina: 1991 Convertibility Plan.



1/ The inflation rate in 1990Q1 was 14000 percent and in 1990Q2 8720 percent. The devaluation rate in 1990Q1 was 29325 percent.

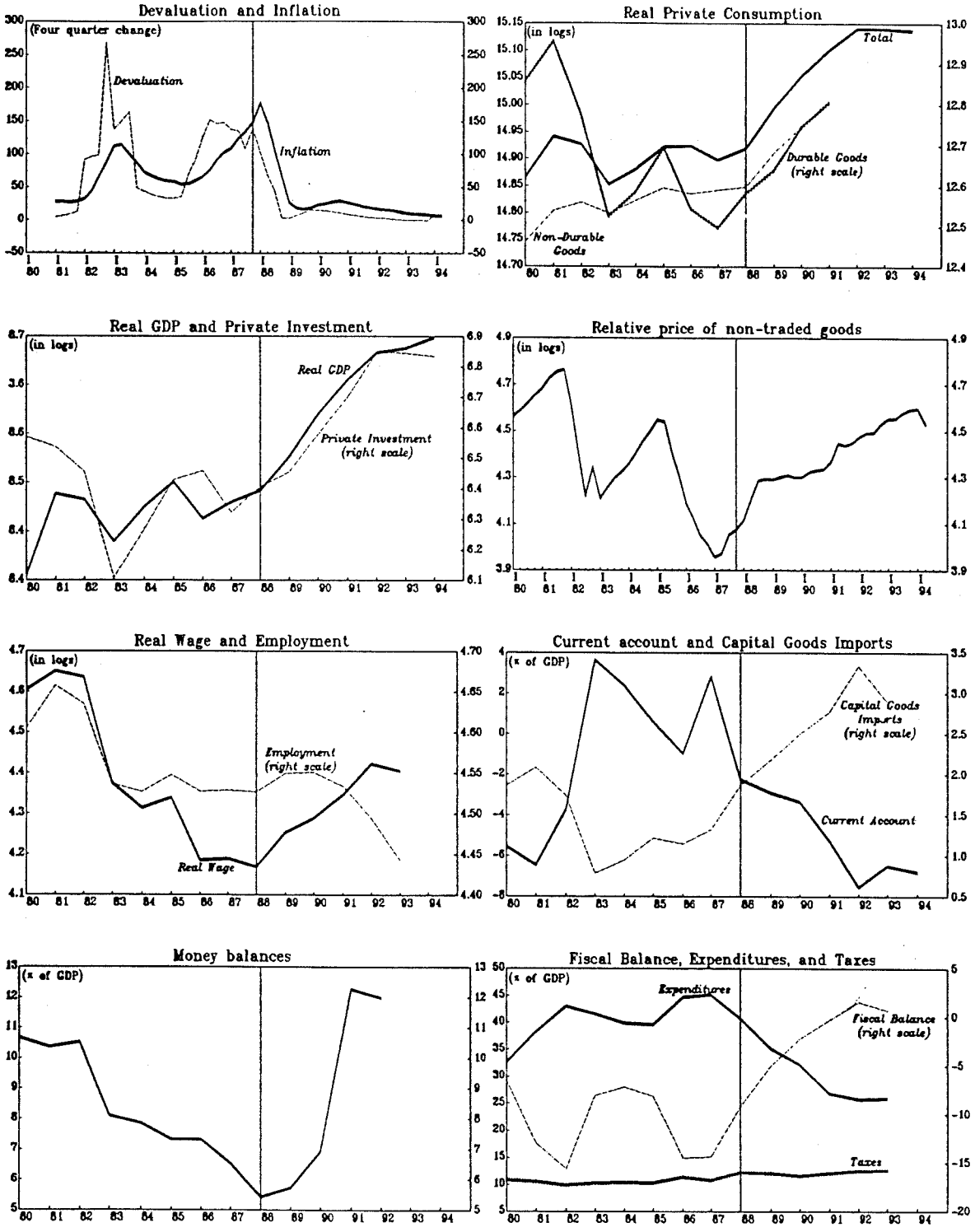
Sources: IFS and national authorities.

Figure 2. Israel: July 1985 Stabilization Plan.



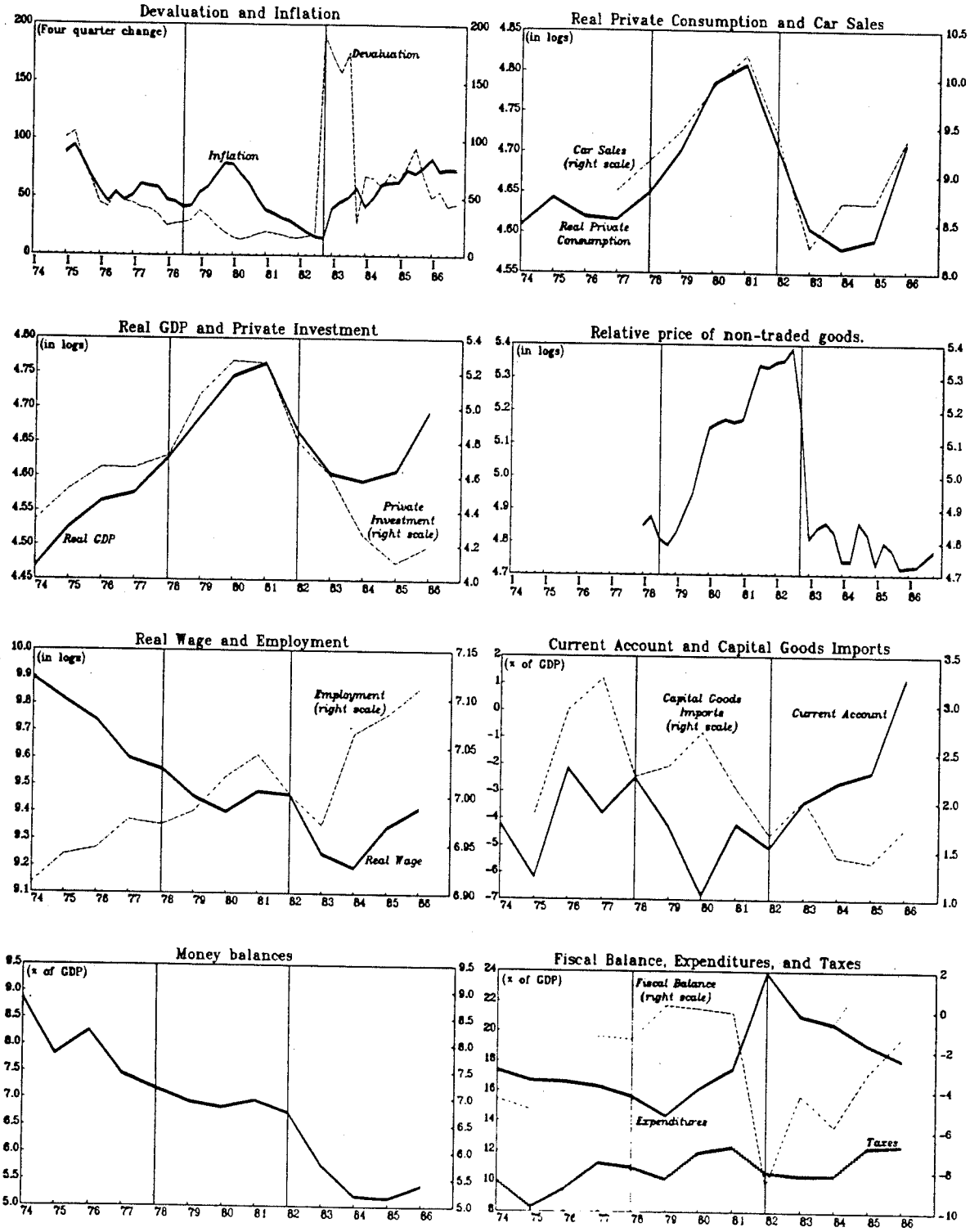
Sources: IFS, Bank of Israel, and national authorities.

Figure 3. Mexico: 1987 Stabilization Plan.



Sources: IFS and Banco de Mexico.

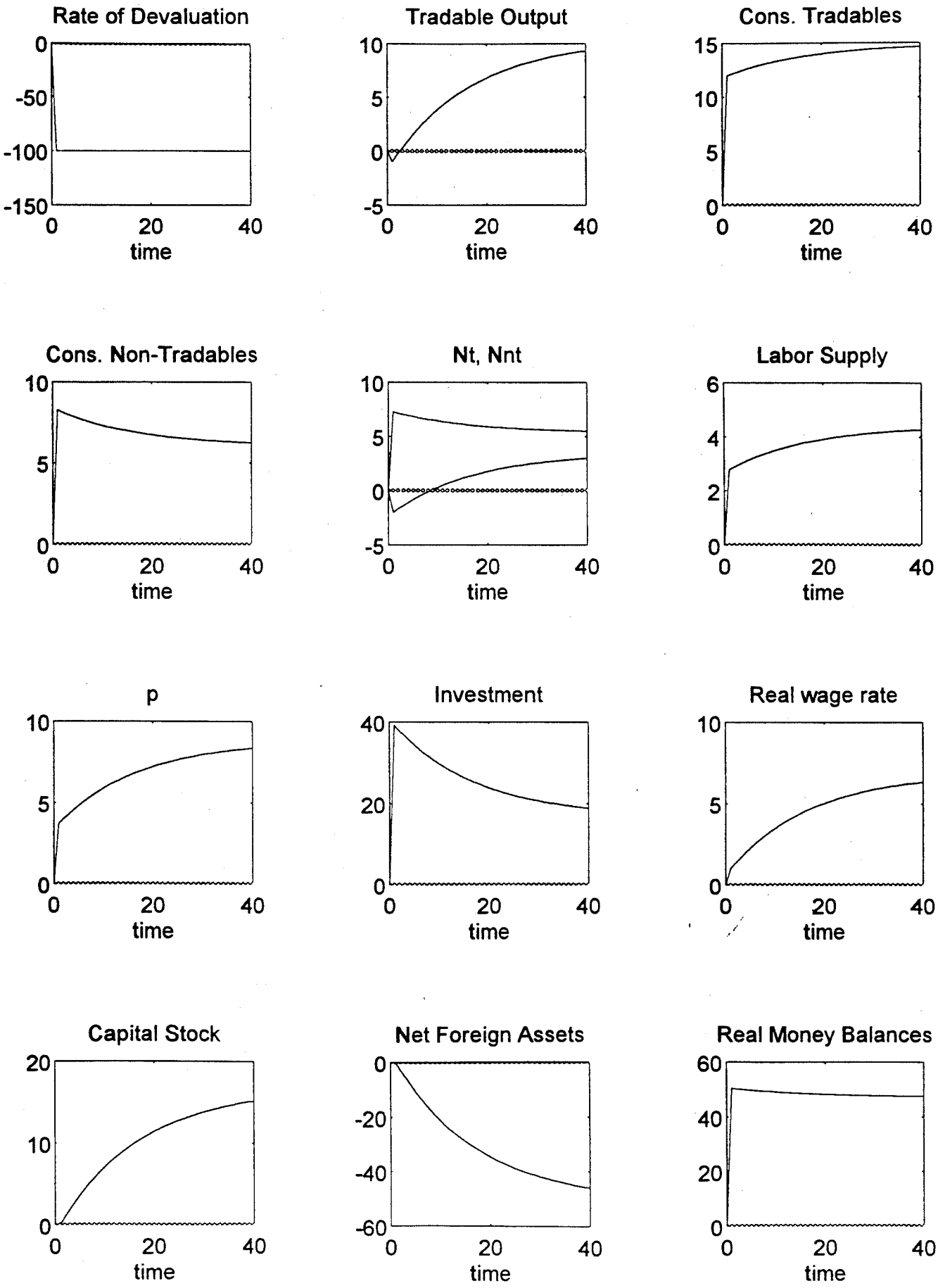
Figure 4. Uruguay: October 1978 Stabilization Plan.



Sources: IFS and Central Bank of Uruguay

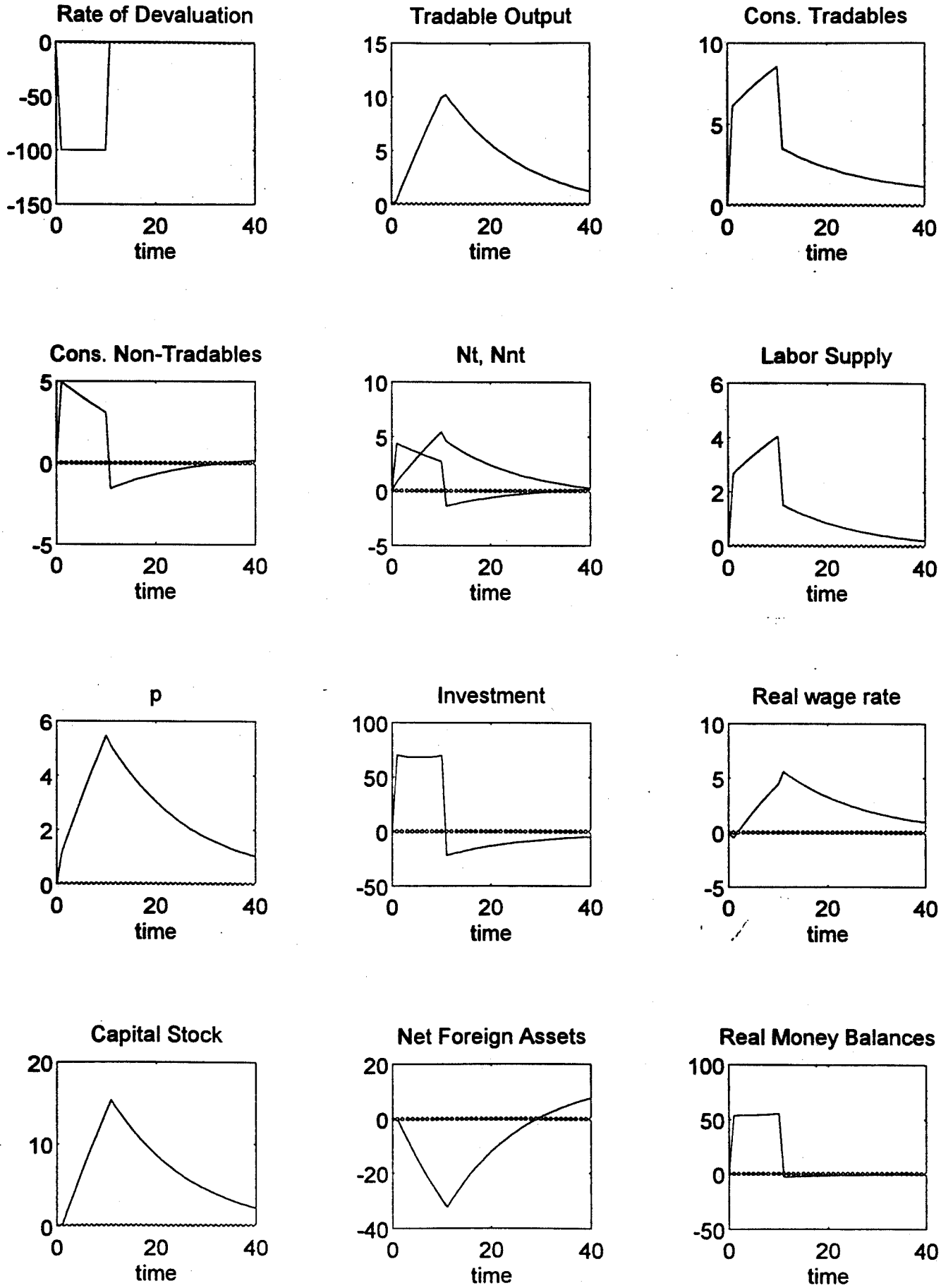
Note: The vertical bars indicate the beginning and end of the stablization plan.

Figure 5: Permanent 100% Decline in the Rate of Devaluation



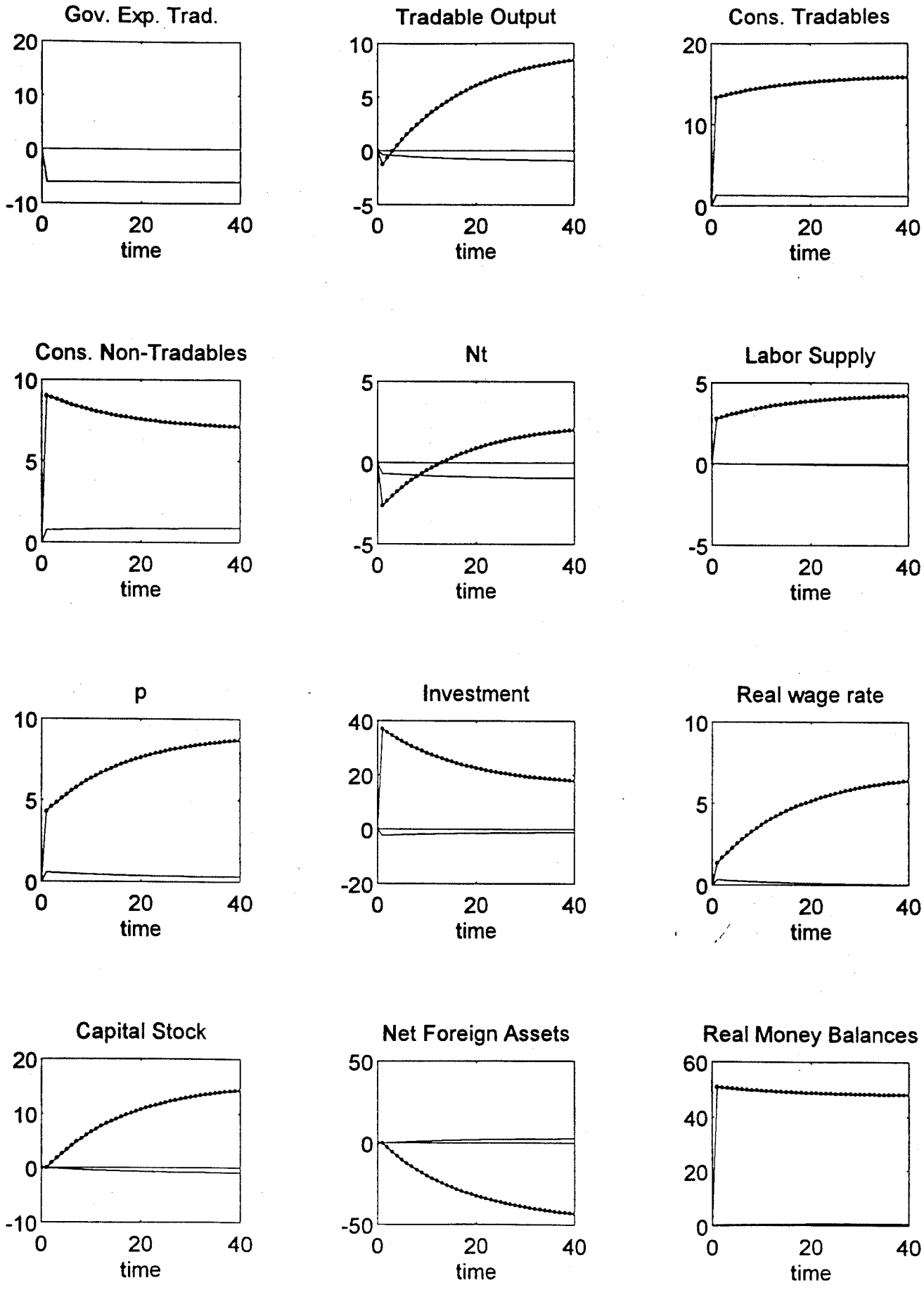
All the effects are expressed as percentage deviations from the pre-stabilization steady state.

Figure 6: Temporary 100% Decline in the Rate of Devaluation



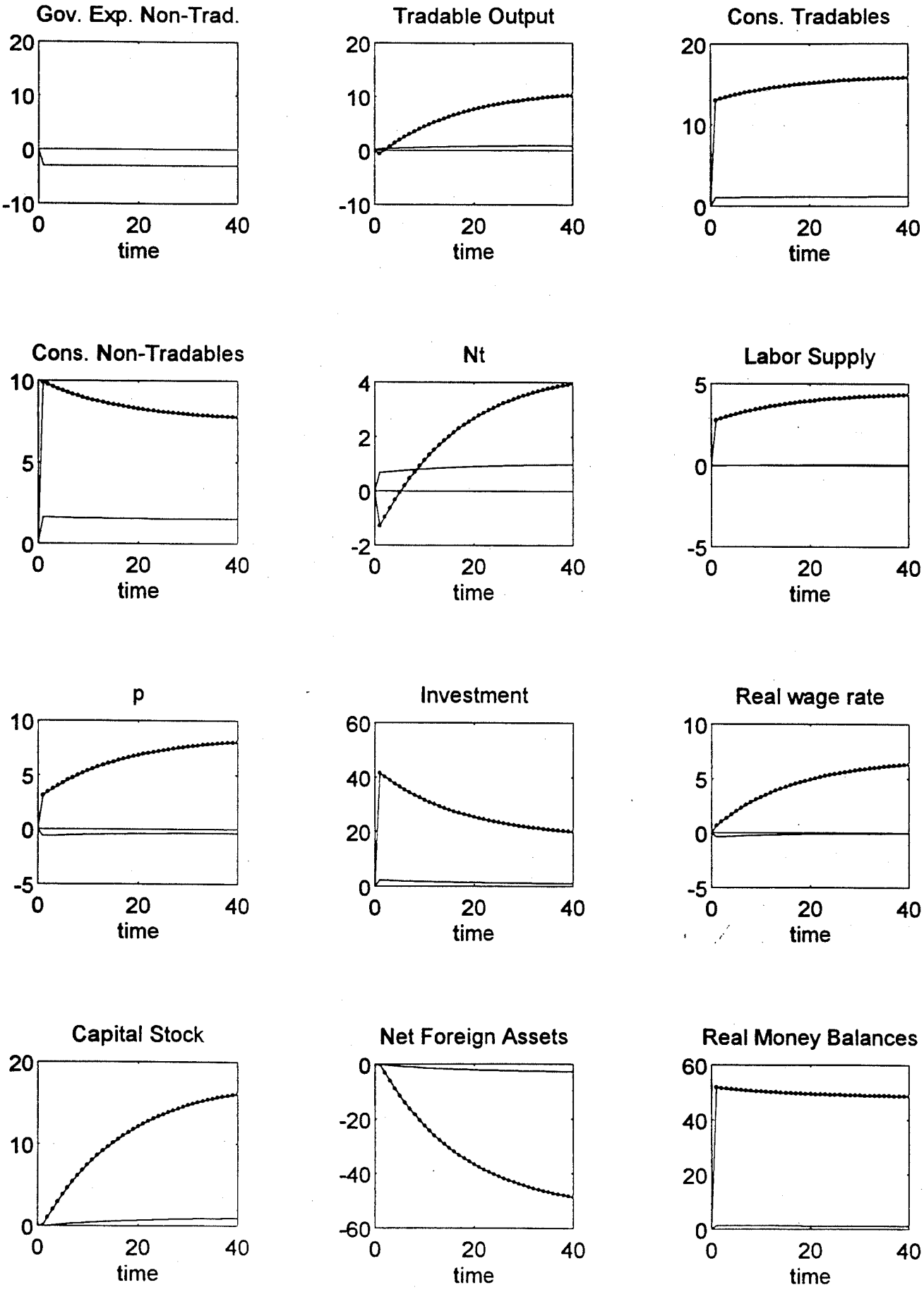
All the effects are expressed as percentage deviations from the pre-stabilization steady state.

Figure 7: Permanent 6% Decline in Government Expenditures on Tradable Goods



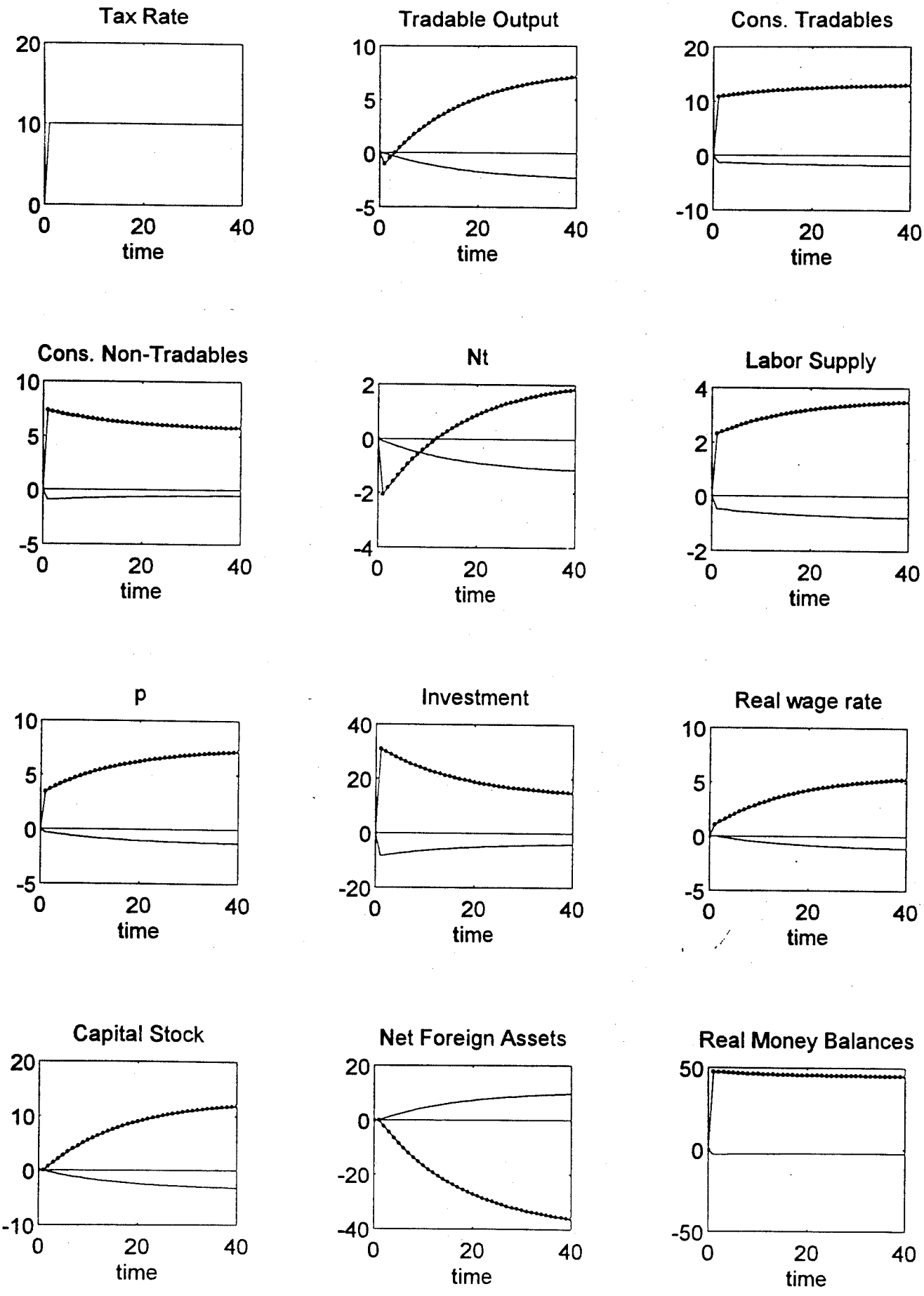
All the effects are expressed as percentage deviations from the pre-stabilization steady state

Figure 8: Permanent 3% Decline in Government Expenditures on Non-Tradable Goods



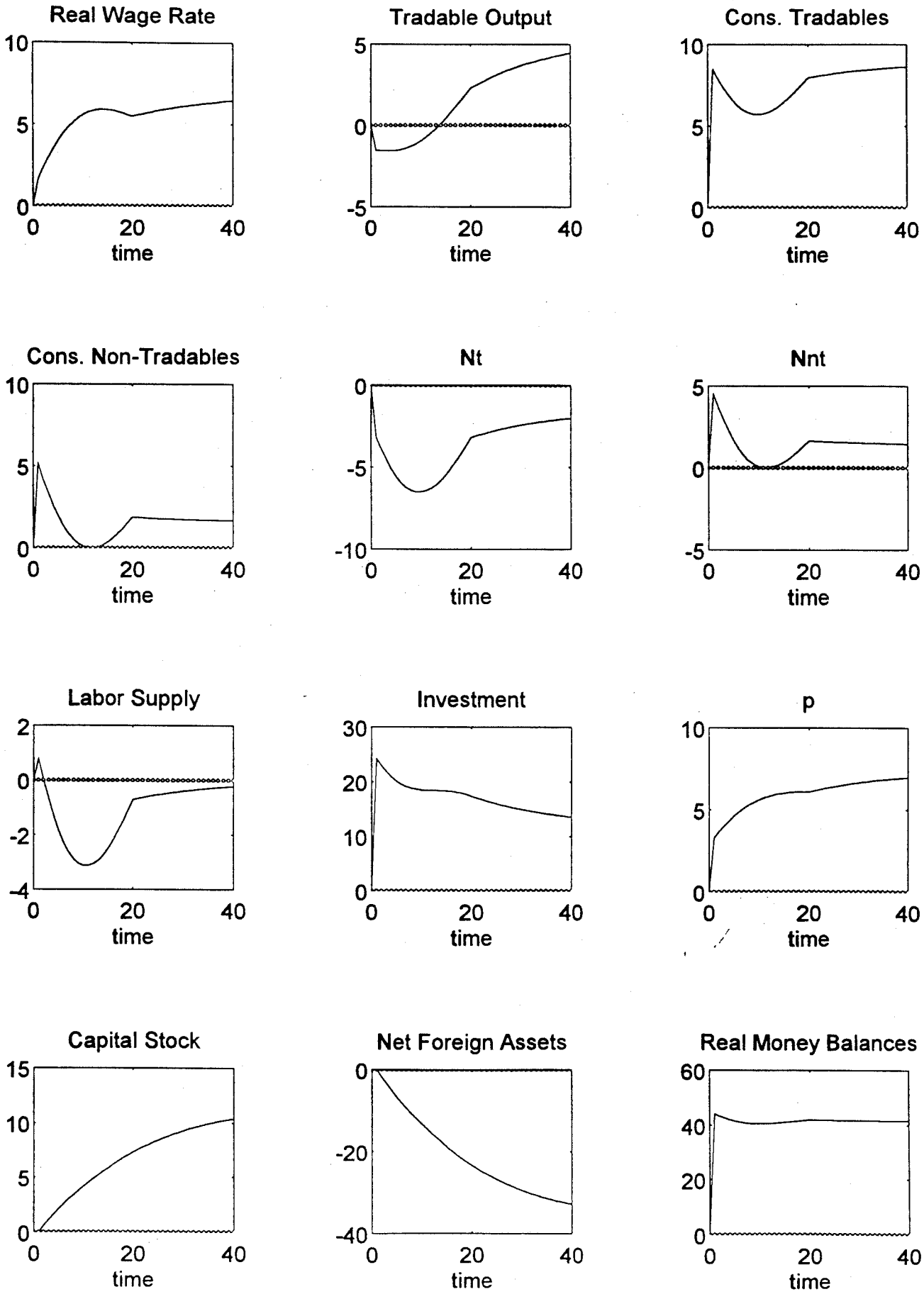
All the effects are expressed as percentage deviations from the pre-stabilization steady state

Figure 9: Permanent 10% Increase in the Output Tax Rate



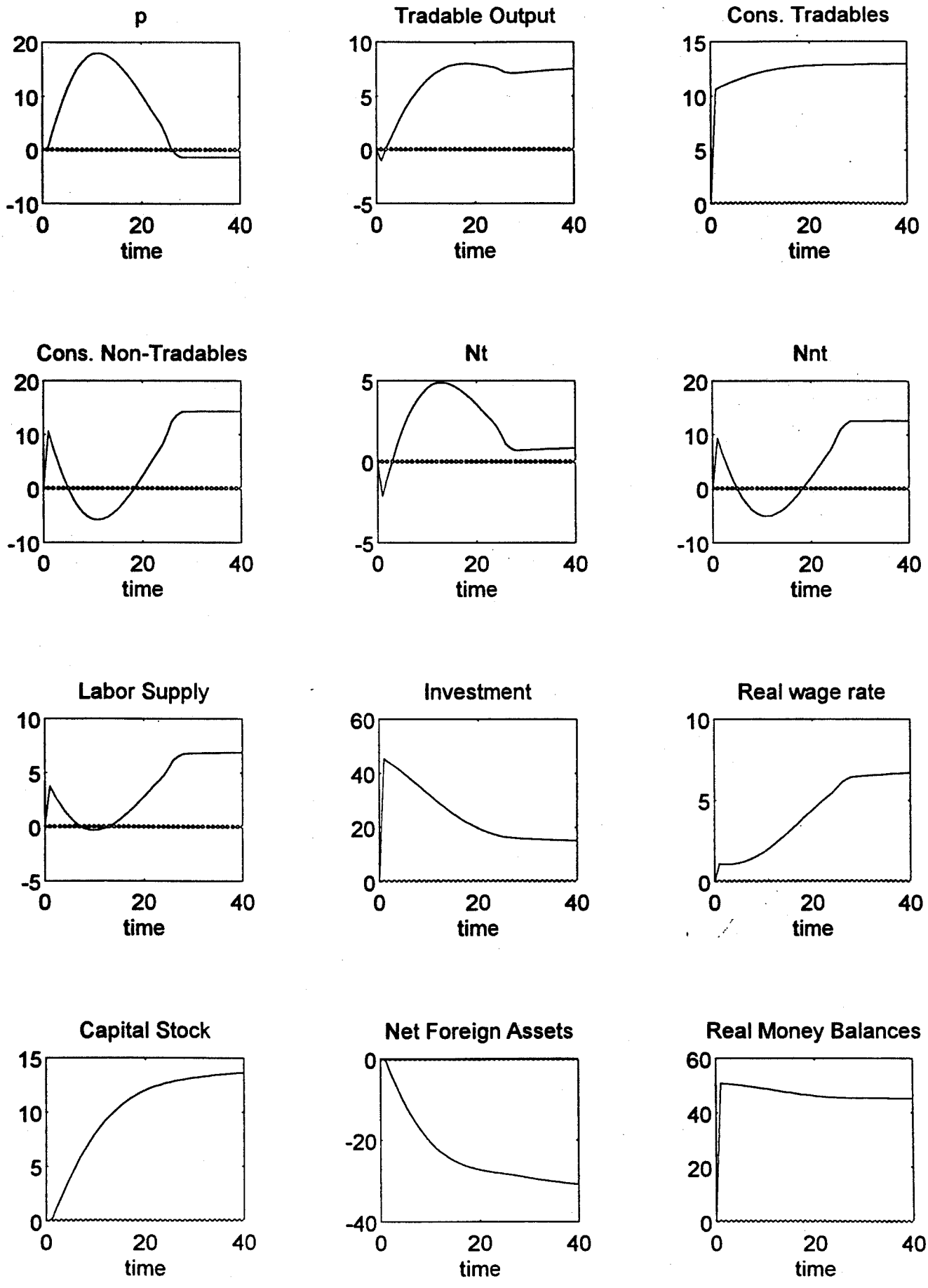
All the effects are expressed as percentage deviations from the pre-stabilization steady state.

Figure 10: Permanent Decline in the Rate of Devaluation with Nominal Wage Rigidities



All the effects are expressed as percentage deviations from the pre-stabilization steady state.

Figure 11: Permanent Decline in the Rate of Devaluation with Sticky Inflation



All the effects are expressed as percentage deviations from the pre-stabilization steady state.