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On Credible Disinflation

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Abstract

We study the effects of a credible, gradual exchange rate based disinflation program in a two sector economy. After an initial real exchange rate depreciation, the reductions in the rate of devaluation reduce the monetary wedge generated by a cash in advance constraint, leading to a gradual increase in absorption that yields progressive real exchange rate appreciations and current account deficits. An initial boom in economic activity is not followed by a later contraction, as labor supply expands during the whole length of the program.

JEL Classification No.

F41

1/ This is a substantially revised version of Chapter V of my dissertation at the University of Rochester. I would like to thank Alan C. Stockman and Carlos A. Végh for many useful discussions on these issues. Comments by Carlos Asilis, José DeGregorio, Don Mathieson, Gian Maria Milesi-Ferretti and Julio Santaella are gratefully acknowledged. All errors are my own responsibility.

Contents

I. Introduction

The effect of disinflation on macroeconomic variables has been a concern of economists and policymakers, as well as the object of extensive research (see Kiguel and Liviatan, 1992 and Végh, 1992, for surveys on these issues). The reason for this concern is presumably the low success rate of these disinflation programs, together with some puzzles generated by exchange-rate based stabilizations in chronic inflation countries.

The main "stylized facts" from the attempts to stop chronic inflation using reductions in the rate of the devaluation are (Végh, 1992): (i) a slow convergence of the rate of inflation to the rate of devaluation, i.e., a sustained appreciation of the domestic currency; (ii) cumulative current account deficits; and (iii) increases in real activity at the beginning of the programs, followed by later contractions. These "stylized facts" stem basically from the failed Southern Cone stabilization programs of the late 70's--where schedules with future exchange rates, entailing falling devaluations, were preannounced for several months--as well as from heterodox programs in the 60's and 80's in Latin America and Israel.

Most explanations for these facts have relied upon the existence of backward-looking price-setting behavior (Dornbusch (1982), Rodriguez (1982), Calvo and Végh (1992)) or of credibility problems (Calvo (1983, 1986), Baxter (1985), Calvo and Végh (1990, 1991)). In an interesting paper, Obstfeld (1985) showed that some of those stylized facts could be obtained in an economy with continuous market clearing, rational expectations and no credibility problems. Obstfeld's model exploits the intertemporal substitution effects in consumption generated by a phased reduction in the rate of devaluation. Unfortunately, the predictions of his model depend strongly on whether money and consumption are complements or substitutes (i.e., on whether the cross-partial derivative u_{cm} is positive or negative). The progressively lower inflation rate induces increased holdings of real cash balances, and if money and consumption are substitutes, consumption initially rises to be reduced gradually as the program evolves. An initial real exchange rate appreciation and current account deficits are followed by progressive real depreciations and reduced deficits--which eventually become surpluses. If money and consumption are complements, the economy's short-run and long-run responses are completely reversed. It is somewhat disturbing that the qualitative behavior of real consumption and production depend so strongly on this feature of preferences.

To overcome this problem, rather than postulating that money somehow yields utility, in this paper we model directly money's role in transactions. We follow Obstfeld's techniques for the analysis of a gradual decline in the rate of devaluation, rather than the more traditional unexpected permanent reduction, but we assume that the representative agent faces a cash-in-advance constraint. The gradual reduction in the rate of devaluation constitutes a progressive reduction in the monetary "wedge" generated by the transactions technology. This yields an increasing path of consumption which in the case of the nontradable good can only be obtained with a protracted real exchange rate appreciation. An initial increase in net foreign assets allows consumption of the tradable good to increase over time even when its production is falling; hence, a progressive trade deficit (or reductions in the surplus) follows. This dynamic path for the economy is similar to the one obtained by Obsfeld when $u_{cm} > 0$, but in that case a high elasticity of intertemporal substitution in consumption is required, what is at odds with the empirical evidence (see Reinhart and Végh (1993)). Contrary to the case where money is introduced in the utility function, in our model that dynamic path arises here for <u>any</u> degree of intertemporal substitution in consumption.

We also have a more flexible supply side than Obstfeld's model, as we allow for a variable labor supply. The fact that intertemporal substitution in labor supply is reasonably high--indeed higher than that of consumption, has been stressed in the closed economy macro literature (see Hall (1991), Heckman (1993)). We exploit this effect in a two sector small open economy subject to a gradual disinflation program. The reduction in inflation increases the marginal value of wealth, inducing an increase in labor supply at the onset of the program. The progressive reductions in inflation further increase labor effort, as the implicit bias towards leisure that inflation induces gets removed from the system. 1/ This evolution of real activity contrast with the stylized fact (iii) as we do not obtain a recession in the later stages of the program.

Nevertheless, it should be noted that Kiguel and Liviatan (1992, p. 280) conclude that "the business cycle observed in exchange-rate-based stabilizations in chronic inflation countries results from the combination of using the exchange rate as the anchor and the lack of credibility in the program's success". As our exercise assumes full credibility, it is not surprising that a recession does not arise. Furthermore, in the Mexican stabilization of 1988-92 (one of the few successful ones), the initial boom has not been followed by a recession despite adverse external conditions (see Ortiz, 1991). Using several statistical tests, Rojas (1990) shows that credibility of the stabilization program was achieved by mid-1988; credibility problems were explicitly tackled with heterodox policies and with an overshooting of the fiscal stance (see Rojas-Suarez (1992)). The predictions of our model with regard to labor supply and real wages appear to be in accordance with the Mexican experience.

The paper is organized as follows. In the next Section we present the model, and the equilibrium is described in Section III. The impact effects and transitional dynamics of a gradual and fully credible disinflation experiment are discussed in Section IV and the main conclusions are drawn in Section V. The most technical derivations are relegated to Appendices A and B.

1/ In a broad sense, this can also include time devoted to portfolio management and hedging activities that is not negligible for chronic-inflation countries (see DeGregorio 1993).

II. The Model

Consider a small open economy that produces and consumes two goods, one of which is nontradable internationally. There is perfect arbitrage of tradable goods and their world price is normalized to one, such that $p^T = E$, where E is the nominal exchange rate. We define $p = p^N/p^T$ to be the relative price of the nontradable good, sometimes referred to as the inverse of the real exchange rate.

An infinitely-lived representative household obtains utility from the consumption of both goods as well as of leisure x:

$$U = \int_0^\infty u(c_t^T, c_t^N, x_t)\, e^{-\rho t} dt \tag{1}$$

where $u(c^T, c^N, x)$ is twice differentiable and concave. We assume that cash (more specifically, the buyer's currency) has to be held in advance of purchasing goods. The liquidity constraint that the household faces can be formalized as:

$$M_t \geq \alpha E_t\, (c_t^T + p_t c_t^N)$$

where M_t are units of domestic currency, and α represents the length of time that money has to be held to finance a given flow of total expenditure.

Individuals in this economy have access to an international capital market where a real bond is traded. Define b_t to be the net holdings of these bonds by domestic residents. The return on these bonds is the world interest rate r_t which is assumed to be equal to the rate of time preference ρ to eliminate any other dynamics outside those generated by the stabilization policy. Let $R_t = r_t + \pi_t$ be the domestic currency nominal interest rate, where π_t is the rate of devaluation. We focus our attention on an active crawling-peg exchange rate regime. Hence, although instantaneously pegged, the exchange rate can follow any path determined by the monetary authority, provided the appropriate interventions are undertaken in the foreign exchange market.

The representative household maximizes its objective (1) subject to the liquidity and budget constraints

$$m_t \geq \alpha(c_t^T + p_t c_t^N) \tag{2}$$

$$\int_0^\infty (c_t^T + p_t c_t^N + R_t m_t) e^{-\rho t} dt \leq m_o + b_o + \int_0^\infty (y_t^T + p_t y_t^N - \tau_t) e^{-\rho t} dt \tag{3}$$

where m_t are real cash balances, τ are lump-sum taxes and production of each good y^T, y^N, uses labor and a fixed factor specific to each sector--that is normalized to one. We substitute (2) into (3), assuming a positive nominal interest rate, and then we form the lagrangean

$$L = \int_0^\infty u(c_t^T, c_t^N, x_t) e^{-\rho t} dt + \lambda_o \left\{ m_o + b_o + \int_0^\infty (y_t^T + p_t y_t^N - \tau_t) e^{-\rho t} dt - \int_0^\infty [c_t^T + p_t c_t^N + R_t \alpha (c_t^T + p_t c_t^N)] e^{-\rho t} dt \right\} \tag{4}$$

to get the following efficiency conditions:

$$u_1(c_t^T, c_t^N, x_t) = \lambda_o(1 + \alpha R_t) \tag{5}$$

$$u_2(c_t^T, c_t^N, x_t) = \lambda_o(1 + \alpha R_t) p_t \tag{6}$$

$$u_3(c_t^T, c_t^N, x_t) = \lambda_o w_t \tag{7}$$

The term $(1+\alpha R_t)$ is the usual monetary "wedge" generated in cash-in-advance models, due to the fact that any form of wealth (except cash itself) has to be made liquid before goods can be consumed. This increases the effective price of consumption but not that of leisure (see Aschauer and Greenwood (1983)). Profit maximizing behavior by firms guarantee that total labor supply is allocated to each sector up to the point where the value of marginal products equal the real wage.

We assume the following isoelastic functional form for preferences, to be able to get a closed-form solution:

$$u(c^T, c^N, x) = \begin{cases} \frac{1}{1-\gamma}\left[c^{T\beta} c^{N1-\beta}\right]^{1-\gamma} + \frac{1}{1-\delta} x^{1-\delta}, & \text{if } \gamma, \delta \neq 1; \\ \beta \log c^T + (1-\beta)\log c^N + \log x, & \text{if } \gamma = \delta = 1. \end{cases} \quad (8)$$

The equivalents to equations (5)-(7) yield the following demand functions:

$$c_t^T = \left[\frac{\beta}{\lambda_o(1+\alpha R_t)}\right]^{1/\gamma} \left[\frac{1-\beta}{p_t \beta}\right]^{(1-\beta)(1-\gamma)/\gamma} \quad (9)$$

$$c_t^N = \left[\frac{\beta}{\lambda_o(1+\alpha R_t)}\right]^{1/\gamma} \left[\frac{1-\beta}{p_t \beta}\right]^{1/\gamma-\beta(1-\gamma)/\gamma} \quad (10)$$

$$x_t = \left[\frac{1}{\lambda_o w_t}\right]^{1/\delta} \quad (11)$$

We can observe that the path of consumption of both goods depends upon the exogenously given rate of devaluation π_t--through the nominal interest rate R_t--as well as upon the endogenously determined relative price p_t. The evolution of leisure--and consequently of labor supply--follows directly from the endogenously determined wage rate w_t. We also assume that production functions are Cobb-Douglas:

$$y_t^T = A\ell_t^{T\,a} \quad , \quad y_t^N = B\ell_t^{N\,b} \quad (12)$$

to simplify the supply side of the model.

III. Equilibrium

In the previous section we derived the individual plans for consumption and production, as functions of the policy variables π_t, τ_t, and the expected paths of p_t and w_t. In a perfect foresight equilibrium, those paths have to be consistent with continuous clearing of the market for nontradeable goods and of the labor market, as well as with the government's budget constraint.

Due to the foreign exchange market intervention of the Central Bank, it is convenient to consolidate the monetary and fiscal authorities budgets. We assume for simplicity that the government purchases only tradable goods, an assumption that will not affect our results as we will be assuming constant purchases. The exogenously given path of government spending g_t is financed by lump-sum taxes, domestic money creation and interest on foreign reserves h_t held by the Central Bank. Following Obstfeld (1985), we assume that the domestic credit expansion just compensates individuals for the real depreciation of their money holdings. This credit rule implies that all increases in desired real cash balances are satisfied through increases in reserves. Furthermore, lump-sum taxes are assumed to adjust endogenously to satisfy the government's instantaneous budget constraint:

$$g_t = \tau_t + \pi_t m_t + r h_t \tag{13}$$

Standard manipulations and the requirement of a smooth path for international reserves (see Roldós, 1988a), yield the following intertemporal budget constraint for the government sector:

$$\int_0^\infty g_t e^{-\rho t} dt \leq h_o + \int_0^\infty (\tau_t + \dot{m}_t + \pi_t m_t) e^{-\rho t} dt \tag{14}$$

where a dot over a variable means its time derivative. The present value of government spending is constrained by the initial value of reserves and by the present value of taxes--including the inflation tax.

The equilibrium condition in the nontradable good market

$$c^N (\lambda_o, p_t, \pi_t) = y^N (p_t, w_t)$$

holds at any point in time and implicitly defines a relative price of that good as a function of λ_o and π_t, $p_t = p_t(\lambda_o, \pi_t)$. As p_t evolves, not only the demand for labor moves but also the supply of labor is moving. This suggests the convenience of solving for the equilibrium wage changes first. Labor market equilibrium implies that total labor supply has to be employed in both sectors, i.e.

$$1 - x_t = \ell_t = \ell_t^T + \ell_t^N \tag{15}$$

and changes in wages are given by -see Appendix A for the derivations:

$$\text{dlog } w = \xi_N \text{dlog } p - \xi_x \text{dlog } \lambda_o \tag{16}$$

where

$$\xi_N = \frac{\lambda_N \eta_N}{\lambda_T \eta_T + \lambda_N \eta_N + \lambda_x \eta_x}, \qquad \xi_x = \frac{\lambda_x \eta_x}{\lambda_T \eta_T + \lambda_N \eta_N + \lambda_x \eta_x}$$
$$\lambda_i = \ell^i/\ell \quad \text{for } i = T,N; \qquad \lambda_x = x/\ell. \tag{17}$$

The η's are respectively the elasticities of the value of marginal products in sectors T and N, and the intertemporal elasticity of substitution of leisure. To the traditional variables that influence the response of wages in the specific factors model (see Jones, (1971), Mussa (1974)), we add the share of leisure in total hours worked λ_x and its elasticity of intertemporal substitution η_x. Both of these variables will play an important role on the dynamic and impact effects of gradual disinflation.

Going back to the equilibrium condition for the nontradable good market, we can obtain the evolution of its relative price as we gradually reduce the rate of devaluation:

$$\text{dlog } p_t = - D \ \text{dlog } (1 + \alpha R_t) \tag{18}$$

where $D = [1 + \beta(\gamma - 1) + \gamma b(1 - b)^{-1} (\xi_T + \xi_x)]^{-1} > 0$ implies a protracted real exchange rate appreciation. From the demand functions (9) and (10) it can be seen that a progressive reduction in π_t increases the demand for both goods over time. The only way in which an increased demand for nontradables can be satisfied is by a progressive increase in its relative price such that resources are pulled away from the tradable sector. When money is introduced into the utility function, a gradual decrease in π_t constitutes an increase in the relative price of both goods--as the price of money is falling; unless the degree of intertemporal substitution is large, that means a falling c_t^N, which requires a progressive real exchange rate <u>depreciation</u>.

Since the paths of taxes and of the demand for money in the household's budget constraint have to be consistent with those in the government's budget constraint, we can consolidate equations (3) and (13) to get the economy's intertemporal budget constraint:

$$\int_0^\infty c_t^T e^{-\rho t} dt \leq f_o + \int_0^\infty (y_t^T - g_t) e^{-\rho t} dt \tag{19}$$

The path of consumption of the tradable good is constrained by the initial level of foreign assets (both private and public, i.e. $f_o = b_o + h_o$) and by the path of production of the tradable good, net of government purchases. Substituting (9) into (19) we obtain the equilibrium shadow value of wealth

$$\lambda_o = \frac{\beta\left\{\int_0^\infty [1+\alpha(r+\pi_t)]^{-1/\gamma}\left[\frac{\beta}{1-\beta}p(\lambda_o,\pi_t)\right]^{(1-\beta)(\gamma-1)/\gamma} e^{-\rho t}dt\right\}^\gamma}{\left\{f_o + \int_0^\infty [y_t^T(p(\lambda_o,\pi_t)) - g_t]\, e^{-\rho t}dt\right\}^\gamma} \tag{20}$$

that can be calculated for any path of the rate of devaluation $\{\pi_t\}_0^\infty$ and/or of government spending $\{g_t\}_0^\infty$. In the absence of unanticipated shocks, this expressions holds at any time and can be used to obtain the path of the current account (see Obstfeld (1985) and Roldós (1988a)).

IV. <u>Gradual Disinflation</u>

A central feature of the stabilization policies in the countries of the Southern Cone was the preannouncement of a specified future path for the exchange rate (a so-called "tablita") entailing a decreasing rate of devaluation (see Corbo, de Melo and Tybout (1986), Baxter and Roldós (1986)). The same feature appears in the second stage of Mexico's stabilization program (see Ortiz, (1991)), with a daily depreciation of one peso per day starting in 1989, that was subsequently slowed to 0.8 pesos in May 1990, to 0.4 pesos in November 1990 and finally to 0.2 pesos per day since November of 1991.

Imagine then that the rate of devaluation has been constant at $\bar{\pi}$ and people expected it to remain at that level. Unexpectedly, at t=0 the government announces the disinflation program, i.e., that it will set a devaluation path $\{\pi_t\}_0^\infty$, with $\pi_o = \bar{\pi}$ and $\pi_t > \pi_{t+s}$ for s > 0. At the moment of the announcement, the shadow value of wealth λ_o changes to its new equilibrium level, the one that obtains if we replace in (20) a constant path $\bar{\pi}$ for the new preannounced path $\{\pi_t\}_0^\infty$. Following Obstfeld (1985), we define the right-hand side of (20) to be $\Omega(\lambda_o;\ \pi_t)$ in order to construct a diagram for the determination of λ_o. It is shown in the Appendix B that the elasticity of the $\Omega(\lambda_o;\ \pi_t)$ schedule is

$$\frac{d\log\Omega}{d\log\lambda_o} = \frac{(1-\beta)(1-\gamma)[1+\gamma b(1-b)^{-1}\xi_x]}{1+\beta(\gamma-1)+\gamma b(1-b)^{-1}(\xi_T+\xi_x)} - \frac{\gamma[1+\gamma b(1-b)^{-1}\xi_x]}{1+\beta(\gamma-1)+\gamma b(1-b)^{-1}(\xi_T+\xi_x)}\left[\frac{\int_0^\infty p_t(-\partial y^T/\partial p)e^{-\rho t}dt}{f_o-\bar{g}/r+\int_0^\infty y^T(p_t)e^{-\rho t}dt}\right] \tag{21}$$

The slope of $\Omega(\lambda_o;\ \pi_t)$ is then negative for $\gamma > 1$ and, when it is positive (for $\gamma < 1$) it is less than one. Figures 1 and 2 show both cases.

In order to determine the new value of λ_o, that generates the impact effects of the program, we have to see how the $\Omega(\lambda_o;\ \pi_t)$ schedule shifts with the new path of devaluations. By inspection of the right-hand side of (20), we can see that the progressive reduction of the monetary wedge increases the numerator of $\Omega(\lambda_o;\ \pi_t)$. In the previous section we showed that p_t rises over time, causing a gradual fall in the production of the tradable good. The effect of this rising p_t on the numerator of $\Omega(\lambda_o;\ \pi_t)$, depends on whether the elasticity of intertemporal substitution in consumption is large or small (i.e., on whether $\gamma < 1$ or $\gamma > 1$). If $\gamma > 1$, the intratemporal substitution between both goods at each point in time reinforces the increase in c_t^T due to the falling monetary wedge, and the numerator increases unambiguously. The $\Omega(\lambda_o;\ \pi_t)$ schedule shifts upwards in Figure 1, showing an increase in the shadow value of wealth. Notice that when money is introduced into the utility function and the degree of intertemporal substitution is low--the empirically relevant case--the negatively sloped $\Omega(\lambda_o;\ \pi_t)$ schedule shifts downwards with reductions in the rate of devaluation, yielding a <u>reduction</u> in the shadow value of wealth (see Obstfeld (1985)). This implies different impact effects from the model in this paper; we extend the discussion on this issue below.

If $\gamma < 1$, the intertemporal substitution effect dominates the intratemporal one, and c_t^T could fall as p_t rises over time. Nevertheless, from (9) and (18) we get that

$$\frac{d\log c^T}{d\log(1+\alpha R)} = -[1+b(1-b)^{-1}(\xi_T + \xi_x)]D < 0 \tag{22}$$

i.e., that the direct impact of a falling wedge outweighs that of the induced real exchange rate appreciation, and hence that the numerator of $\Omega(\lambda_o;\ \pi_t)$ increases for <u>any</u> degree of intertemporal substitution in consumption. The $\Omega(\lambda_o;\ \pi_t)$ schedule shifts upwards also for $\gamma < 1$ (see Figure 2) and λ_o increases unambiguously.

The increase in the shadow value of wealth λ_o has two basic effects --reflecting the gradual removal of the inflationary distortion in consumption. On the one hand, the latter causes an initial increase in economic activity, as the supply of labor increases to take advantage of the future consumption opportunities. On the other hand, consumption of both goods tends to fall, for the same reason--i.e., the anticipation of lower effective prices as the program progresses. Indeed, the instantaneous reduction in p_t together with the increase in labor supply makes the initial change in consumption of nontradables ambiguous:

$$\frac{d\log p}{d\log \lambda_o} = -\left[1+\gamma b(1-b)^{-1}\xi_x\right]D < 0 \tag{23}$$

$$\frac{d\log c^T}{d\log \lambda_o} = -b(1-b)^{-1}\left\{[\beta+\gamma(1-\beta)\xi_x + \xi_T\right\}D < 0 \tag{24}$$

$$\frac{d\log c^N}{d\log \lambda_o} = b(1-b)^{-1}\left[\beta(\gamma-1)\xi_x - \xi_T\right]D \gtrless 0 \tag{25}$$

A low intertemporal elasticity of substitution for consumption and a high one for leisure, contribute to yield an increase in c^N on impact. The evidence on the former is fairly low (see Hall (1988)) and Deaton (1992)) for the US economy, and a similar result was found by Reinhart and Végh (1993) for six chronic-inflation countries. The empirical evidence from micro studies (see Card (1991)), suggests that the elasticity of intertemporal substitution of labor supply is probably no higher than 0.20. However, two arguments downplay the relevance of those estimates. First, Hall (1991) convincingly argues that those estimates from panel data capture

Figure 1

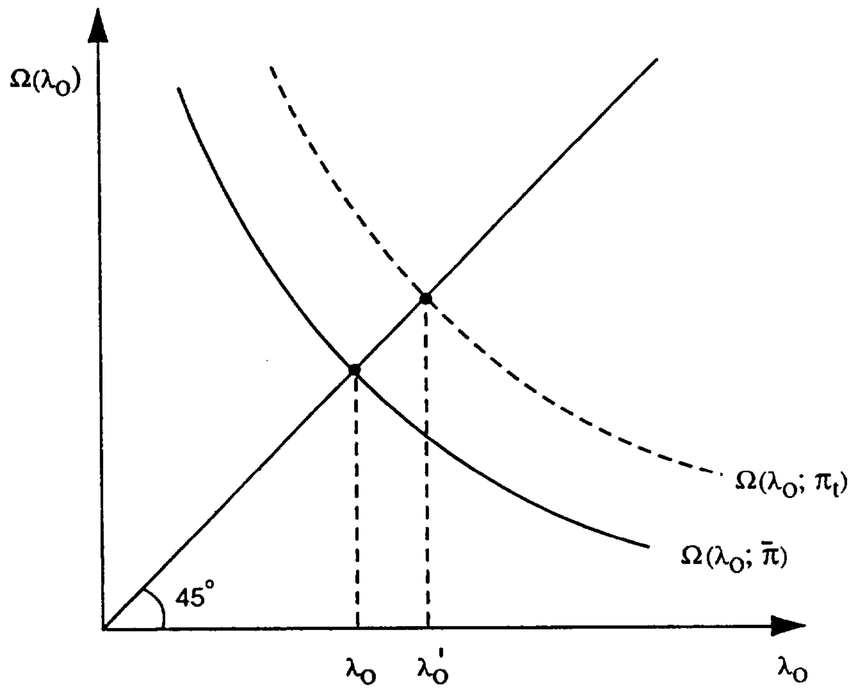
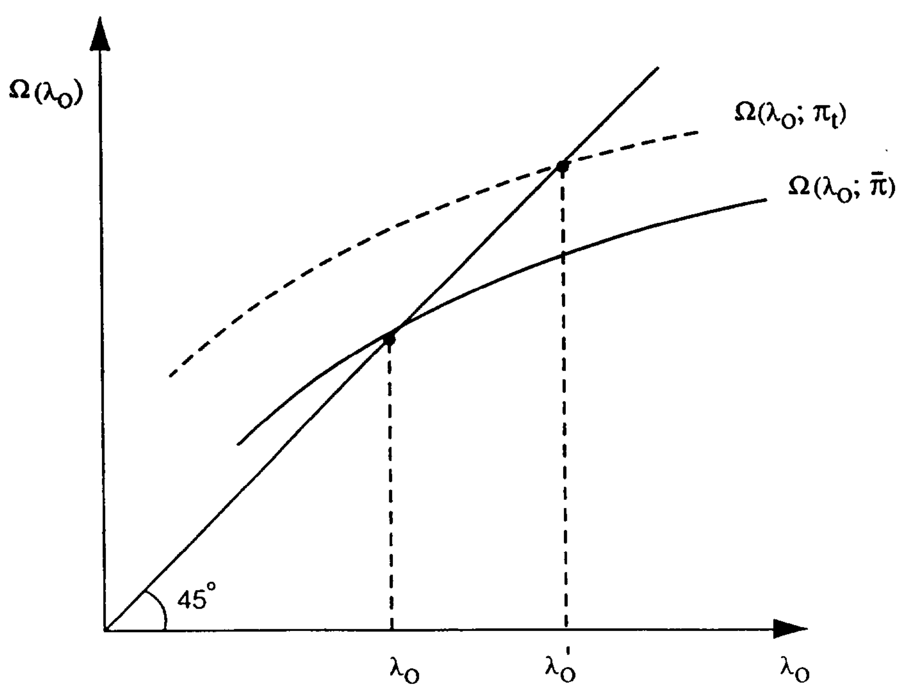


Figure 2



just life-cycle variations, and that the short-run elasticity can be much larger. Considering preferences that take into account past values of leisure--a particular case of those considered by Kydland and Prescott (1982), he concludes that the short run elasticity could be as much as nine times larger than the long run elasticity. Second, Heckman (1993) points out that most empirical studies on the elasticity of intertemporal substitution focus on hours of work of those who work sometime each year, whereas most of the variation in aggregate hours in the US data come from variations in employment. He concludes that "when entry and exit decision are incorporated as in George Alogoskoufis (1987) (a macro study of variation in employment), the empirical evidence shows much greater support for the intertemporal substitution hypothesis" (Heckman, 1993, p.119).

Taking Reinhart and Vegh's estimate of $\gamma = 5$ for chronic-inflation countries, as well as the rest of the parameter values ($\beta = 0.5$, $a = 0.61$, $b = 0.56$, $\lambda_T = 0.52$, $\lambda_N = 0.48$, $\lambda_x = 4$) from Stockman and Tesar (1990), we conclude that unless the degree of intertemporal substitution in leisure is less than 0.2--what is not likely given the discussion above--consumption of nontradables increases on impact. The corresponding increase in production of nontradables reinforces the one in the production of tradables, to deliver a boom in economic activity since the announcement of the disinflation program.

These impact effects as well as the gradual transition to a new steady-state are depicted in Figure 3. From an initial position on the original production possibilities frontier where production (P) equals consumption (C), the economy jumps on impact to points P' and C'. After the initial real exchange depreciation and trade surplus occur, absorption starts to grow towards C'' with the reductions on the rate of devaluation. Aggregate output continues to grow, as the implicit bias towards leisure that inflation creates gets removed from the system. Despite this increase in total labor effort, the increased demand for nontradables can only be satisfied with progressive increases in its relative price p_t that pull resources away from the tradable sector. Hence, protracted real exchange rate appreciations are accompanied with reductions in trade surpluses that eventually become deficits. These results follow from (18) and (22) as well as from the fact that:

$$\frac{d\log c^N}{d\log(1+\alpha R)} = -b(1-b)^{-1}(\xi_T+\xi_x)D < 0 \tag{26}$$

$$\frac{d\log x}{d\log(1+\alpha R)} = (1/\delta)\xi_N D > 0 \tag{27}$$

$$\frac{d\log y^T}{d\log(1+\alpha R)} = a(1-a)^{-1}\xi_N D > 0 \qquad (28)$$

When money and consumption are complements (i.e., when $u_{cm} > 0$), Obstfeld (1985) gets the same dynamics for the real exchange rate and the current account as we have just described. 1/ But that scenario requires an elasticity of intertemporal substitution of consumption greater than one, what is at odds with the empirical evidence (see Reinhart and Végh (1993)). When that parameter is less than one, the model with money in the utility function yields opposite impact and dynamic effects. Obstfeld himself puts it in these terms (1985, p.622):

> "...the direction of disinflation's expenditure effect hinges on whether the marginal utility of consumption increases or decreases as real balances rise. It is somewhat disturbing that the model's predictions depend so strongly on this sign. A superior approach would model money's role directly, rather than simply postulating that real balances somehow yield utility."

The cash-in-advance constraint (2) may seem a bit restrictive, but it does model money's role in transactions directly. And it does provide real dynamic effects under gradual disinflation, which are broadly consistent with the data, and that work under a variety of assumptions about the economic structure, in particular, for any degree of intertemporal substitution in consumption.

Furthermore, by allowing for a more flexible supply side, we mitigate the initial fall in absorption that is somewhat counterfactual. The uninterrupted expansion in economic activity seems at odds with the stylized fact iii) mentioned in the introduction. However, one should note that most of those stylized facts come from failed stabilizations, where the "temporariness" hypothesis (Calvo (1986), Calvo and Végh (1990, 1991)) may be more appropriate. Moreover, the Mexican case is one of the few successful stabilizations and it has not experienced a recession despite adverse external conditions. An increase in the participation rate (i.e., economically active population as percentage of population 12-years and over) from 51.6 in 1988 to 53.3 in 1991 (see O.E.C.D., 1992, Table 10) suggests that the increase in labor supply during the program may be an empirically relevant phenomenon. 2/ Even though some of the features of the Mexican stabilization are not in our model--i.e., the preannounced

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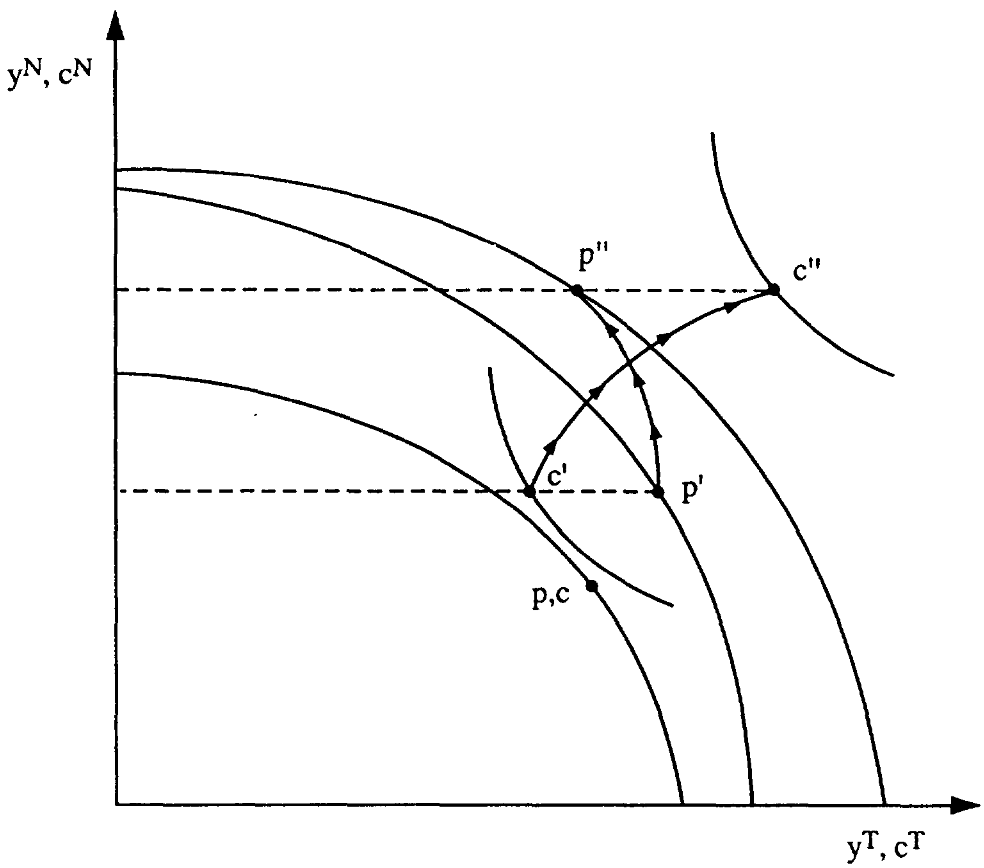
1/ Feenstra (1986) shows how a cash-in-advance economy can be approximated by another with a utility function with a positive cross derivative between goods and money.

2/ The more recent Argentine stabilization also shows an important increase in labor force participation.

Figure 3
Production and Consumption
During Gradual Disinflation



crawling peg started after one year of an exchange rate-wage-price freeze, a fiscal "overshooting", etc., these measures helped to achieve an important degree of credibility by mid-1988, as has been demonstrated by Rojas (1990). 1/ For another successful stabilization experience, the Israeli case of 1985, Fischer (1991) argues that the recession of 1988-89 need not had happened had real wages not been allowed to increase back to their pre-stabilization levels. The flexibility of the Mexican labor market has been recognized as a key factor in the low cost of their stabilization effort (see OECD 1992). In our model, wages fall as part of the impact effects of the program, to then increase during the gradual transition to full stabilization; this is roughly consistent with the evolution of wages in the Mexican case (see Végh, 1992). 2/

V. Conclusion

We cannot expect a highly stylized model like the one presented in this paper to account accurately for the movements of the major macroeconomic variables during a stabilization program. It is certainly the case that initial rigidities and credibility problems are present to a certain extent in most stabilization experiences. Nevertheless, the real effects that gradual disinflation generates in our cash-in-advance economy with variable labor supply are broadly consistent with several stylized facts of exchange-rate based stabilization programs--protracted real exchange rate appreciation, current account deficits, an initial boom in economic activity--especially with those successful ones like the Mexican program of December of 1987.

One of the lessons that we learn from this paper's experiment is that one should not be surprised by large swings in real exchange rates, current accounts and the composition of production during a gradual disinflation program. Even when credibility has been achieved, intertemporal substitution in consumption as well as in labor supply can yield those swings as an equilibrium phenomenon. Although the impact effects of our model may seem a bit counterfactual, one should have in mind that many other structural reforms are usually undertaken simultaneously to the stabilization effort. In particular, in the Mexican case a trade liberalization effort was under way; Rojas (1990) shows that though credibility on the disinflation program was achieved early on, that was not the case with the trade liberalization. As is well known (Calvo 1987, 1989), this can lead to large deficits and appreciations. Also, a strong fiscal contraction was underway, with a temporarily high government spending having similar effects on relative prices and the external balance.

1/ See Ortiz (1991), Rojas-Suarez (1992) and Lustig (1992) for detailed descriptions and analysis of the Mexican stabilization experience.

2/ When calculated in terms of an utility-based CPI, real wages fall during the transition of our model. This is actually what happened in Mexico during 1990-91 if we adjust real wages for productivity gains that are not considered in our model.

Finally, one missing element of the model is the lack of capital and/or durable goods. The anticipation of durable-goods purchases is an important element of stabilization programs, and De Gregorio, Guidotti and Végh (1992) have shown how it can generate a boom-recession cycle. Reductions of inflation in a cash-in-advance economy would cause increases in the capital stock (see Stockman (1981), Roldós (1988b, 1992, 1993), Uribe-Echevarria (1993)), and induce current account deficits and appreciations from the very beginning of the programs.

When the intertemporal elasticity of substitution in labor supply is larger than that in consumption, as appears to be plausible (see Hall 1991), we obtain an initial boom in the production of both tradables and nontradables. It is worth mentioning that this boom is obtained together with lower real wages at the onset of the program, as was the case in the initial phases of the Mexican experience. The flexibility of the Mexican labor market is usually stressed as a key reason for the success of their stabilization efforts (see OECD, 1992). It appears that stopping chronic inflations may have a positive impact on economic activity--through factor supply response, as opposed to the usual Phillips-curve type of arguments applied to moderate inflations. Cooley and Hansen (1987) and DeGregorio (1993) show the existence of a negative correlation between employment and inflation for different cross-sections of countries. The fact that labor force participation increased in a nontrivial way in some stabilization programs is suggestive that those positive effects on factor supplies can be relevant at business cycles frequencies. A final assessment of this channel of effects remains an open agenda for further empirical research.

APPENDIX A

In this Appendix we discuss the determination of real wages in a specific-factors model with endogenous labor supply. We redefine the equilibrium condition for the labor market (15) in terms of unit labor requirements a_{Li}:

$$a_{LT}y^{T} + a_{LN}y^{N} = \ell \tag{A1}$$

and we define the elasticities of substitution of the marginal product schedules as (see Jones (1971), Mussa (1974)):

$$\eta_N = -\frac{\hat{a}_{LN} - \hat{a}_{KN}}{\hat{w} - \hat{p}}, \qquad \eta_T = -\frac{\hat{a}_{LT} - \hat{a}_{KT}}{\hat{w}}; \tag{A2}$$

where a "^" over a variable z denotes dz/z. From (A1) and (A2) we get the usual result that

$$\hat{w} = \left[\frac{\lambda_N\eta_N}{\lambda_T\eta_T + \lambda_N\eta_N}\right]\hat{p} - \left[\frac{1}{\lambda_T\eta_T + \lambda_N\eta_N}\right]\hat{\ell}, \tag{A3}$$

whereas from the demand for leisure (10) we obtain the response of labor supply:

$$\hat{\ell} = \left[\frac{1-\ell}{\ell}\right]\left[\frac{1}{\delta}\right](\hat{w} + \hat{\lambda}_o) = \lambda_x\eta_x(\hat{w} + \hat{\lambda}_o) \tag{A4}$$

Combining (A3) and (A4) and rearranging we get that

$$\hat{w} = \left[\frac{\lambda_N\eta_N}{\lambda_T\eta_T + \lambda_N\eta_N + \lambda_x\eta_x}\right]\hat{p} - \left[\frac{\lambda_x\eta_x}{\lambda_T\eta_T + \lambda_N\eta_N + \lambda_x\eta_x}\right]\hat{\lambda}_o, \tag{A5}$$

which is the expression in the text.

APPENDIX B

In this Appendix we derive the slope of the $\Omega(\lambda_o;\pi_t)$ schedule. If we differentiate logarithmically the right-hand side of (16), we obtain

$$\frac{d\log \Omega}{d\log \lambda_o} = \gamma \frac{d(\text{NUMER.})/d\log \lambda_o}{\int_0^\infty [1+\alpha R]^{-1/\gamma}\left[\frac{\beta p}{(1-\beta)}\right]^{(1-\beta)(\gamma-1)/\gamma} e^{-\rho t}\, dt} - \gamma \frac{d(\text{DENOM.})/d\log \lambda_o}{f_0 + \int_0^\infty [y^T(p) - g_t]\, e^{-\rho t}\, dt} \tag{A6}$$

where NUMER. and DENOM. stand for the integrals in the numerator and the denominator of $\Omega(\lambda_o;\pi_t)$ respectively. Working on the first term of the right-hand-side of the above expression we get

$$\frac{d(\text{NUMER.})}{d\log \lambda_o} = -(1-\beta)(\gamma-1)\,[1+\gamma b(1-b)^{-1}\xi_x]\, D/\gamma * \\ * \int_0^\infty [1+\alpha R]^{-1/\gamma}\left[\frac{\beta p}{1-\beta}\right]^{(1-\beta)(\gamma-1)/\gamma} e^{-\rho t}\, dt \tag{A7}$$

Working on the second term, we get

$$\frac{d(\text{DENOM.})}{d\log \lambda_o} = -\,[1+\gamma b(1-b)^{-1}\xi_x]\, D \int_0^\infty p\, \frac{dy^T(p)}{dp}\, e^{-\rho t}\, dt \tag{A8}$$

Plugging these results back into (A6), we finally get the expression in the text.

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