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INFLATION STABILIZATION AND THE CONSUMPTION OF DURABLES

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Abstract

Exchange rate-based stabilizations in chronic-inflation countries have often been characterized by an initial consumption boom (which is most evident in the behavior of durable goods) followed by a later contraction. This paper provides an explanation for such a boom-recession cycle based on the timing of purchases of durable goods. The initial fall in inflation results in a wealth effect which induces many consumers to bring forward their purchases of durable goods, thus generating an aggregate consumption boom. Since most consumers replenish their stock of durable goods at the beginning of the program, a later slowdown follows.

I. INTRODUCTION

According to conventional wisdom, inflation can only be brought down at the cost of a recession. The only source of controversy lies in the magnitude of the contractionary effect. Thus, estimates for the United States of the "sacrifice ratio" (defined as the cumulative percent output loss per percentage point reduction in inflation) lie anywhere from 3 to 18 (Sachs, 1985). Furthermore, the contraction is expected to occur irrespective of whether the money supply or the exchange rate is used as the nominal anchor (Fischer, 1986).

The conventional wisdom has not gone unchallenged. The most famous dissenter is probably Sargent (1982) who argued, based on the European hyperinflations of the 1920's, that if a stabilization is accompanied by a credible change in regime, inflation should come down with only minor costs. Even if the notion that hyperinflations have been stopped at virtually no costs is accepted (which some would not), hyperinflations are usually regarded as extreme episodes whose relevance for more mundane inflations is unclear.

A relatively less well-known--but potentially more relevant--challenge to conventional wisdom has emerged from the experiences of disinflationary programs in chronic-inflation countries. In the late 1970's, exchange rate-based programs in Argentina, Chile, and Uruguay--the so-called "tablitas"--were accompanied by an initial output/consumption boom (Figure 1). [1] The contractionary effects usually associated with inflation stabilization appeared only later in the programs (Figure 1). [2] The same phenomenon was observed in the exchange rate-based programs of the mid-1980's in Argentina, Brazil, Israel (Figure 2), and Mexico (Figure 3). [3] More recently, the Argentine Convertibility Plan of March 1991 also generated an initial boom; the first signs of a slowdown are appearing one and half

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1 Vertical bars indicate the beginning and (when applicable) the end of the programs.

2 It should be borne in mind that the "tablitas" were implemented together with structural reforms, most notably, financial liberalization (see, for instance, Ramos (1986)). These reforms are likely to be important for a full understanding of the dynamics of consumption, but will be ignored in this paper.

3 In Mexico, the late contraction has not been observed.

years later. Indeed, Kiguel and Liviatan (1992) argue that a boom/recession cycle in private consumption has characterized most exchange rate-based programs in chronic inflation countries, regardless of whether the programs have succeeded.

The boom in consumption has been particularly evident in the behavior of durable goods, as suggested by Dornbusch (1986) and Drazen (1990). In Chile, for instance, from the beginning of the program to the quarter in which consumption peaked, consumption of durable goods tripled, while total consumption increased by "only" 44 percent (Figure 1). In Israel (Figure 2), consumption of durable goods doubled in the same period while total consumption increased by 35 percent. A similar story holds for Brazil (Figure 2) and Mexico (Figure 3). Not surprisingly, the contraction in durable goods consumption is usually more severe than that in total consumption, as is particularly evident for the cases of Chile (Figure 1) and Israel (Figure 2).

Inspired by the Argentine tablita of December 1978, Rodriguez (1982) provided an early explanation for the business cycle associated with exchange rate-based stabilization. In his model, a reduction in the rate of devaluation does not immediately reduce inflationary expectations because agents have adaptive expectations. Hence, the fall in nominal interest rates generates a reduction in real interest rates, which results in an expansion in aggregate demand. At a later stage, the real appreciation of the domestic currency induces an output contraction. The main problem with Rodriguez (1982) is that it critically relies on a decline in real interest rates, which was not observed in the heterodox programs of the mid-1980's in Argentina, Brazil, Israel, and Mexico. Furthermore, under utility-maximizing behavior and backward indexation, an initial recession, rather than a boom, may ensue (see Calvo and Végh (1992)).

Influenced by the short-lived character of many Latin American stabilization experiences, Calvo (1986) argued that lack of credibility could explain the business cycle associated with exchange rate-based stabilization. In Calvo's (1986) model, lack of credibility is identified with temporary policy. The public expects the program to be discontinued in the future and therefore acts on the belief that the policy is temporary. A reduction in the rate of devaluation leads to fall in the nominal interest rate and, thus, in the effective price of consumption, because the opportunity cost of holding money is part of the cost of consuming (through a cash-in-advance constraint). Since the fall in the effective price of consumption is perceived as temporary, intertemporal substitution leads to a temporary increase in consumption. If an additional (home) good and staggered-prices are introduced into the picture, Calvo and Végh (1991) show that the "temporariness" hypothesis captures the overheated economy, the inflation inertia, and the gradual real appreciation that have characterized the initial stages of most exchange rate-based stabilizations in chronic-inflation countries. The model also predicts a late recession occurring when or before the plan is expected to be abandoned.

While some analysts (most notably, Kiguel and Liviatan (1992)) have heralded the temporariness hypothesis as the most convincing explanation for the boom-recession cycle associated with exchange rate-based stabilization, others remain skeptical. [4] However, in view of the recent successful stabilizations of Israel and Mexico, such an explanation may not be satisfactory since it would imply that expectations are biased toward pessimism regardless of the success of the program. Bruno (1992), for instance, argues that there is evidence indicating that the Israeli plan was credible, and attributes the initial boom to a wealth effect caused by the increased value (as perceived by the public) of government bonds. In Bruno's (1992) view, the recession associated with inflation stabilization was simply delayed by this initial wealth effect. In the cases of the Chilean and Uruguayan tablitas, it has been argued that, since the fiscal accounts were in balance at the time the programs were implemented, there is no reason why agents should have been pessimistic about the future sustainability of the plan. In fact, casual observation suggests that even in some unsuccessful programs, lack of credibility emerged only later in the programs. Thus, some observers have often attributed the initial boom to

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[4] The temporariness hypothesis has also been criticized on the grounds that intertemporal elasticities of substitution are rather low. In effect, Reinhart and Végh (1992) show that large declines in nominal interest rates are required for the temporariness hypothesis to be quantitatively important. For further discussion of the pros and cons of the temporariness hypothesis, see Végh (1992) and the references therein.

a sense of monetary stability and well-being brought about by the initial fall in inflation, especially when the stabilization package is accompanied by profound structural reforms, such as the Convertibility plan and the Chilean "tablita" (for the Chilean experience see Dornbusch (1986)). These perceptions translate in a positive wealth effect that increases consumption. [5] The late recession has often been attributed to the cumulative effects of the real appreciation. It has also been argued that exogenous shocks (i.e., terms of trade and foreign interest rate shocks in the "tablitas" and the Intifada in Israel) may have been responsible for the late recession.

The purpose of this paper is to provide an alternative explanation for the boom-recession cycle observed in exchange rate-based stabilizations, which does not rely on the assumption of policy temporariness. Quite to the contrary, the boom-recession cycle turns out to be an unavoidable consequence of the very success of the program. The focus of the analysis is on the behavior of the consumption of durable goods which, as indicated earlier, have exhibited a more pronounced cycle than total consumption. [6] As mentioned above, several authors have argued in favor of wealth effects to explain the initial consumption expansion. Our explanation, however, goes beyond that mechanism by exploiting the difference between individual and aggregate behavior of durable consumption, which can account for the entire boom/recession cycle.

The key idea behind our analysis is that the presence of transaction costs implies that individuals purchase durable goods only at discrete intervals of time. At an aggregate level, the flow of sales (and thus production) of durable goods is continuous since consumers buy durable goods at different times. Suppose that a stabilization plan is implemented which, through an immediate fall in inflation, generates

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[5] Giavazzi and Pagano (1990) also report a consumption boom in the stabilization of 1982 in Denmark and of 1987 in Ireland. There is also evidence of a posterior consumption slowdown. They also attribute an important role to wealth effects, mainly resulting from fiscal consolidation, in explaining these facts. It is interesting to note that those stabilizations also used the exchange rate as the nominal anchor.

[6] While some models have also focused on durable goods, the key driving force has still been temporariness (see, for example, Calvo (1988) and Drazen (1990)).

a wealth effect. [7] The wealth effect induces many consumers--which would otherwise have waited--to bring forward the purchase of durables. In addition, consumers spend more than they had planned to. In other words, next year's Honda becomes today's new Mercedes. [8] The resulting "bunching" in the timing of purchases generates an initial aggregate consumption boom. Interestingly, the initial consumption boom sows the seeds of the future recession. Since so many consumers bring forward their purchases of durable goods--and it is only after some time that these new durable goods will need to be replaced--an inevitable slowdown follows shortly after the initial boom simply because consumers need not buy durable goods (i.e., no Mercedes will be sold when next year comes along).

Formally, it is assumed that consumers follow (S,s) rules for the purchase of durable goods. Each new purchase consists of D units of the durable good and then the next purchase is done when d units of the durable goods remain (it depreciates at a positive rate), and has no resale value. While individual behavior is "lumpy", aggregate consumption could be smooth. As noted by the Caplin and Spulber (1987), in the context of menu cost models, sticky prices at the individual level may be consistent with monetary neutrality. A key assumption underlying this conclusion, however, is that the economy is in steady state and the shocks are such that they do not move the economy from this steady state (i.e., the distribution of individuals in the state space remains unchanged). Recent work by Caballero and Engel (1991) has dealt with this problem and provided a framework to analyze the aggregate dynamics of an economy with microeconomic "lumpiness" out of the steady state. [9] Our framework, however, simplifies significantly the stochastic structure. We assume that the economy

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7 The channel through which the fall in inflation generates a wealth effect is not essential for our story. In the model, the fall in inflation reduces effective labor costs which increases output and thus household's income (since households own the firms).

8 As noted by Bar-Ilan and Blinder (1992) expenditure in durable goods during a given period of time is the product of the average of individuals' purchases and the number of individuals that buy durable goods during that period. Fluctuations in the latter, as a response to income changes, could account for most of the variability of aggregate durable expenditures. The earliest discussion of this issue, in the context of inventories behavior, is in Blinder (1981).

9 See also Bertola and Caballero (1990) and Caplin and Lehay (1991).

starts in the steady state, where aggregate consumption is constant over time, and then an exchange rate-based stabilization is implemented. The only shock that affects the economy is the unanticipated change in the rate of devaluation. This simplification--intended to focus in an abrupt change of regime where individual shocks and other perturbations are of second order--allows us to obtain explicit solutions to the optimal trigger points (*D* and *d*) and the evolution of aggregate consumption. These solutions in turn can be used to perform comparative statics.

The model thus generates a boom-recession cycle in consumption which is unrelated to the public's pessimistic expectations about future policy. Quite to the contrary, it is precisely the fact that the stabilization plan is successful and thus generates a wealth effect that leads to the initial boom and later slowdown. In the context of this model, the recessionary period would look particularly puzzling for observers--as was the case in Israel--since it is unrelated to any contemporaneous government policies or external factors. As a result, policymakers could be forced to take some actions when in reality the slowdown is the unavoidable consequence of their success in reducing inflation.

The paper is organized as follows. Section II sets up the basic model. Section III analyzes the durables consumption cycle which follows an exchange-rate-based stabilization plan. Section IV concludes.

II. THE BASIC MODEL

1 The Consumer Problem

Consider a consumer who derives utility from the flow of services of a durable good--which, for simplicity, is assumed to be the only good--and leisure. The flow of services is assumed to be proportional to the stock of durables, denoted by *D*. Thus, the intertemporal utility function is given by:

$$U = \int_{t}^{\infty} \left[\log D_s + v(1 - \ell_s) \right] e^{-\rho(s-t)} \, ds \tag{1}$$

where ℓ_s denotes labor at time s and ρ is the (constant) rate of time preference. The individual is assumed to have one unit of time available; hence, $1 - \ell_s$ denotes leisure at time s. The function $v(\cdot)$ is the instantaneous utility of leisure and is assumed to be twice-continuously differentiable with positive and decreasing marginal utility. Instantaneous utility from durables consumption has been assumed to be logarithmic for convenience, although most of the results analyzed in this section holds for a CRRA utility function.

It is assumed the stock of durables depreciates at an exponential rate δ. Moreover, each time a new durable is bought, a transaction cost is incurred; specifically, it is assumed that the old durable good becomes totally obsolete and has no resale value. Unlike the case of no transaction costs, the presence of a transaction cost in the purchase of durable goods implies that consumers will not buy continuously goods (e.g., Bar-Ilan and Blinder, (1987); and Grossman and Laroque, (1990)).

We assume that the consumer follows an (S,s)-type rule for the purchase of durables; namely, the individual buys a durable good, D, and keeps it until it reaches a lower value of d. Since there is no uncertainty, this is equivalent to assume that, in a steady-state equilibrium, the consumer buys D after a period of time of length T has elapsed from the previous purchase, where $T = \log(D/d)/\delta$. Therefore, in a steady-state equilibrium, we will be able to characterize the utility derived from durables consumption only as a function of D and T.

We now turn to characterize formally the consumer's decision problem under the assumption that consumption of durables follows the above-mentioned (S,s)-type rule. Moreover, we will focus on a steady-state equilibrium where all exogenous variables are constant over time. The individual starts at time t with a stock of durables D_t and has to decide when to start following the optimal rule of buying D every time-interval of length T. Denote by τ the period in which the first durable good is bought. In other words, the first purchase is done after $\tau - t$ time has elapsed from the beginning of the planning period. Of course, as it will be shown below, an individual starting with $D_t = D$ will buy the new good when $\tau - t = T$. Figure 4 illustrates the timing of this problem.

Utility function (1) can be written as:

$$U(D,T,\tau,\ell) = \int_t^\tau [\log D_t - \delta(s-t)]e^{-\rho(s-t)}\,ds + \int_\tau^{\tau+T} [\log D - \delta(s-\tau)]e^{-\rho(s-t)}\,ds + \int_{\tau+T}^{\tau+2T} [\log D - \delta(s-\tau-T)]e^{-\rho(s-t)}\,ds + \ldots\ldots + \int_t^\infty v(1-\ell_s)e^{-\rho(s-t)}ds. \qquad (2)$$

Consider next the consumer's intertemporal budget constraint. It is assumed that the individual can lend and borrow freely at an interest rate equal to ρ. In addition, the consumer is assumed to receive a flow income of y throughout his life--in the steady state-equilibrium, y is constant over time. Income, y, is composed of wage earnings, $w\ell$--where w denotes the real wage rate--profits from firms, Π, and government transfers, g, all expressed in real terms. Since the individual starts purchasing D at time τ ($> t$), and then repeating the same purchase every T period of time, the present discounted value--as of time t--of expenditure in durable goods is given by:

$$De^{-\rho(\tau-t)} + De^{-\rho(T+\tau-t)} + \ldots = D\frac{e^{-\rho(\tau-t)}}{1-e^{-\rho T}}. \qquad (3)$$

Finally, since from the last purchase incurred before time t the individual has not carried out any expenditure, income received during that period of time has been saved at a yield ρ. Consequently, the total value of assets accumulated at time t equals:

$$W_0 \equiv \int_{t-x}^{t} y_0 e^{-\rho(s-t)}ds = \frac{y_0}{\rho}\left(e^{\rho x} - 1\right), \qquad (4)$$

where a subscript 0 is used to indicate the value that variables take before time t and, hence, are given as of time t. In principle, we allow for possible changes in the value of exogenous variables before and after time t. This will be useful for the ensuing discussion. The length of time x in equation (4) is related to the amount of durables bought in the last purchase before time t, D_0, and to the stock of durables at time t, D_t, by the following equation:

$$x = \frac{1}{\delta}\log\left[\frac{D_0}{D_t}\right]. \tag{5}$$

Using equations (3) and (4), the consumer's intertemporal budget constraint is given by:

$$\frac{y_0}{\rho}\left(e^{\rho x} - 1\right) + \int_t^{\infty} (w_s \ell_s + \Pi_s + g_s) e^{-\rho(s-t)} ds = \frac{D e^{-\rho(\tau - t)}}{1 - e^{-\rho T}}, \tag{6}$$

Therefore, the consumer problem is to maximize utility function (2) subject to equation (6). This optimization problem may be solved in two stages. In the first stage the labor supply choice is solved, while the characterization of the optimal steady-state (S,s)-rule for the consumption of durable goods is solved in the second stage.

The first-order condition which determines the labor supply is:

$$\mathrm{v}'(1 - \ell) = w, \tag{7}$$

which implies that, as long as the real wage is constant over time, ℓ is constant over time as well. Thus, assuming for the time being that Π and g are constant over time, y $(\equiv w\ell + \Pi + g)$ is constant over time as well.

Given y, budget constraint (6) becomes:

$$W \equiv W_0 + \frac{y}{\rho} = \frac{D e^{-\rho(\tau - t)}}{1 - e^{-\rho T}}. \tag{8}$$

By taking into account equation (7), utility function (2) is given by:

$$U[D,T,\tau,v'^{-1}(w)] = \log D_t \frac{1-e^{-\rho(\tau-t)}}{\rho} + \log D \frac{e^{-\rho(\tau-t)}}{\rho} - \frac{\delta}{\rho^2} + \frac{\delta(\tau-t)}{\rho} e^{-\rho(\tau-t)} + \frac{\delta T}{\rho} \frac{e^{-\rho(T+\tau-t)}}{1-e^{-\rho T}} + \frac{v[v'^{-1}(w)]}{\rho}. \tag{9}$$

Substituting D from equation (8) into equation (9), the optimal choice of T, and τ follows from maximizing:

$$\log\frac{D_t}{\rho} - \frac{\delta}{\rho^2} + \frac{e^{-\rho(\tau-t)}}{\rho}\left[\log W + (\rho+\delta)(\tau-t) - \log D_t + \log(1-e^{-\rho T}) + \frac{\delta T e^{-\rho T}}{1-e^{-\rho T}}\right]. \tag{10}$$

Having obtained optimal T and τ, optimal D is found from equation (8). By equation (10), it can be easily observed that optimal T is found by maximizing the last two terms inside the square brackets. Therefore, optimal T depends only on ρ and τ; in particular, it is independent on the value of wealth. The first-order condition which yields optimal T implies that:

$$\frac{\rho+\delta}{\rho} = \frac{\delta T}{1-e^{-\rho T}}. \tag{11}$$

The Appendix shows (Result 1) that equation (11) has a unique interior solution--optimal $T > 0$, and optimal T is decreasing in ρ and δ.

The relationship of optimal T with δ and ρ is intuitive. If the rate of depreciation increases, then the consumer will hold the durable good less time. By equation (8), this implies that the increase in the frequency of purchases is offset by a reduction in the size of the purchase. Similarly, higher impatience leads to more frequent purchases.

The first-order condition associated with the choice of τ, together with equation (11), imply:

$$\log W - \log D_t + (\rho+\delta)(\tau-t) + \log(1-e^{-\rho T}) - \delta T = 0. \tag{12}$$

Equations (8), (11), and (12) determine optimal T, τ, and D.

At a steady-state equilibrium in which $y_0 = y$, and $D_0 = D$, equations (4), (5), and (8) imply that:

$$\frac{De^{-\rho T}}{1 - e^{-\rho T}} = \frac{y}{\rho}, \tag{13}$$

$$\tau - t = T - \frac{1}{\delta}\log\left[\frac{D}{D_t}\right] = T - x. \tag{14}$$

If $D_t = D$, then $\tau - t = 0$, as one would expect, since the individual finds it optimal to continue on its steady-state optimal (S,s)-rule. Equation (14) can be interpreted by examining Figure 4. It says that the next purchase will occur once the current durable good, D_t, reaches a value equal to $De^{-\delta T}$, which is the value at which the durable good is replaced. Since the lowest value for D_t is the value at which the durable is replaced, $De^{-\delta T}$, the expression $(1/\delta)\log(D/D_t)$ is always less than T.

When one allows for an unanticipated change in income at time t--namely, when y_0 is different from y--then τ-t may be negative. This, as will be discussed in detail in the next section, will be the basis for generating bunching in purchase of durables.

2 Firms, Government, and General Equilibrium

It is assumed that firms produce durable goods using labor as the only input, according to a production technology, $f(\ell_s^d)$, which is assumed to be strictly concave, twice-continuously differentiable, with a positive and decreasing marginal product of labor. (A superscript d stands for "demand".) Moreover, it is assumed that firms are required to hold cash in order to pay wages. Thus, firms are subject to the following cash-in-advance constraint:

$$m_s \geq \alpha w_s \ell_s^d, \tag{15}$$

where m_s denotes real cash balances, and α is a constant parameter. Notice that, by equation (15), firms are the only ones that demand money. (Of course, it would be straightforward--although it would serve no specific purpose--to add a demand for money from the consumer's side.)

Firms' demand for labor follows from profit maximization. Firm profits are given by:

$$\Pi_s = f(\ell_s^d) - w_s \ell_s^d - i_s m_s, \tag{16}$$

where i_s is the nominal interest rate at time s and, hence, $i_s m_s$ is seigniorage. The economy is small and completely integrated in international capital markets. Therefore,

$$i_s = \rho + \epsilon_s, \tag{17}$$

where ϵ_s is the rate of exchange rate devaluation--henceforth assumed constant over time--and the international interest rate is equal to ρ. The price of durables is given by PPP; hence, ϵ is also the domestic rate of inflation.

Firms determine their labor demand to maximize profits in equation (16) subject to the cash-in-advance constraint (15). The demand for labor is determined by the following first-order condition:

$$f'(\ell^d) = w[1 + \alpha(\rho + \epsilon)]. \tag{18}$$

Equation (18) shows that the costs of labor to firms includes the inflation tax; namely, the *effective* real wage equals the real wage plus the inflation tax associated with holding currency needed to pay wages, $\alpha\omega(\rho + \epsilon)$. Notice that, in the absence of government transfers, consumers in this model would pay the inflation tax through lower real wages and dividends.

In equilibrium, $\ell = \ell^d$. Thus, the equilibrium level of employment is determined by equations (7) and (18). Moreover, by equations (7), (18), and the production function, it can be easily shown that output, $f(\ell)$, is a decreasing function of the domestic rate of inflation, ϵ.

It will be assumed that the government rebates the inflation tax to the consumer. Therefore,

$$g = (\rho + \epsilon)m. \tag{19}$$

The economy's general equilibrium is completed by assuming that there is a continuum of individuals, distributed uniformly over the time-interval of length T. By suitable normalization, the mass of consumers at each point in time is assumed to equal 1. Therefore, aggregate consumption of durables at each point in time equals D. This steady-state equilibrium serves as the benchmark for the analysis carried out in the following section.

In the absence of net aggregate foreign assets, the economy in the benchmark case is at a steady state-equilibrium where $f(\ell) = D$; i.e., aggregate production of durable goods equals their aggregate consumption. Although each individual follows an (S,s)-rule whereby he purchases an amount D of durable goods every T lapse of time, the presence of a continuum of individuals with unitary mass ensures constant aggregate consumption of durable goods equal to D. Thus, the lumping of consumption which occurs at the micro level vanishes at the aggregate level in this steady-state equilibrium.

We now turn to analyze the effect of inflation stabilization on aggregate consumption of durable goods. Inflation stabilization implies lowering the rate of inflation (devaluation) from ϵ_0 to ϵ. This policy will be assumed to be unanticipated and permanent. Since it can be easily verified that, in equilibrium, consumer's income equals output--i.e., $y = w\ell + \Pi + gm = f(\ell)$, then consumer's income is a decreasing function of inflation, ϵ--$y = y(\epsilon)$, and $y'(\epsilon) < 0$. Thus, inflation stabilization implies an increase in consumer's income.

III. INFLATION STABILIZATION AND DURABLES CONSUMPTION BOOM

This section consider the effects of a permanent and unanticipated decrease in the inflation (and devaluation) rate from ϵ_0 to ϵ. As mentioned earlier this implies a permanent and unanticipated increase in consumer's income from y_0 to y. We start the analysis assuming that the economy is at the benchmark steady-state equilibrium described in the previous section, buying an amount of D_0 of durable goods every T period of time, for an income level equal to y_0. (Recall that we assume that the consumer will jump to the new steady state (S,s) rule.)

Suppose that inflation stabilization occurs at time t. From the previous section we know that optimal T is independent of the level of income. Therefore, in the new steady-state equilibrium, optimal T will remain unchanged in response to the increase in y.

The consumption level in the new steady-state equilibrium, D, however, will be different. Moreover, individuals must decide at time t when to purchase the new durable and, hence, when to start with the new steady-state (S,s)-rule. This implies that individuals will choose an optimal τ in response to the change in income. To these issues we now turn.

From equations (4), (5), and (12), it follows that:

$$\tau - t = T - \frac{\delta x}{\rho + \delta} - \frac{1}{\rho + \delta} \log\left[\frac{y}{y_0} + e^{\rho x} - 1\right], \tag{20}$$

where T is given by equation (11), and x is given by equation (5). At time t, individuals are indexed by x--namely, by how depreciated is their durable good at the time of the change in income. Equation (20) is a central piece of analysis. For values of the R.H.S. of the equation which imply that $\tau - t \geq 0$, equation (20) shows that optimal $\tau - t$ is a decreasing function of both x and the ratio y/y_0. Moreover, since $x \leq T$ and $y/y_0 > 1$, we have that $\tau - t < T - x$. [10] This implies that every individual will *anticipate* the purchase of their new durable, D, in response to the increase in income. (Recall that in the initial steady-state equilibrium, $\tau - t = T - x$, as indicated by equation (14).) The anticipation of the purchase of the new steady-state level of durables is intuitive, given that the increase in income prompts the consumer to move to a higher consumption equilibrium. Indeed, the higher is the increase in income the lower is $\tau - t$. The negative relation between $\tau - t$ and x is also intuitive.

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[10] Note that, since in the initial steady-state equilibrium individuals were renewing their durable every T period of time, then $x \leq T$. Otherwise, it would contradict optimality.

A higher x implies that the old durable is more depreciated; hence, it implies a lower transaction cost, since the transaction cost equals the value of the durable good.

The Appendix shows (Result 2) that, since $x \in (0, T]$, the R.H.S. of equation (20) is necessarily negative for individuals with high x. Moreover, the higher is the ratio y/y_0 the higher is the portion of the continuum of individuals for which the R.H.S. of equation (20) is negative. Since it must be true that $\tau - t \geq 0$, then those individuals for which the R.H.S. of equation (20) is negative have a corner solution at $\tau - t = 0$. These individuals--i.e., those who decide to purchase the new durable at time t--generate "bunching" in the consumption of durable goods. This "bunching" effect is at the center of the boom in aggregate consumption.

The individuals who bunch at time t are those which suffer the smaller loss in switching from the old (S,s)-rule to the new one. Among these, those with higher x are the richest, since they have the most assets accumulated at time t. (Of course, the counterpart of these assets is that they will throw away an "old durable".) Therefore, the new steady-state consumption level for those individuals who bunch at time t--which will be denoted by D_B--is an increasing function of x.

Formally, the watershed which divides consumers between those who bunch and those who don't is given by the level of x which makes the R.H.S. of equation (20) equal to zero--henceforth denoted by x^*. By equation (20), x^* solves:

$$T = \frac{\delta x^*}{\rho + \delta} + \frac{1}{\rho + \delta} \log \left[\frac{y}{y_0} + e^{\rho x^*} - 1 \right], \qquad (21)$$

where T is given by equation (11). For $x \in [x^*, T]$, the new consumption level is given by equation (8); i.e.,

$$D_B = \mathrm{D_B}(x) \equiv \left[\frac{y}{\rho} + \frac{y_0}{\rho}(e^{\rho x} - 1) \right] (1 - e^{-\rho T}), \qquad (22)$$

where T is given by equation (11). From equation (22), it is clear that $\mathrm{D_B}'(x) > 0$.

For those individuals who do not bunch--i.e., those for which $x \in (0, x^*)$--the new consumption level--henceforth denoted by D_N--and corresponding τ are given by equations (8) and (20). From equations (8) and (20), it follows that:

$$D_N = \mathrm{D_N}(x) \equiv \mathrm{D_B}(x) \left[\frac{y}{y_0} + e^{\rho x} - 1 \right]^{-\frac{\rho}{\rho + \delta}} e^{\rho T - \frac{\delta \rho x}{\rho + \delta}}. \tag{23}$$

Moreover,

$$\mathrm{D_N}'(x) = -\left(1 - e^{-\rho T}\right) e^{\rho(\tau - t)} \delta(y - y_0) < 0. \tag{24}$$

Notice that, in principle, there are two effects at work in determining the sign of $\mathrm{D_N}'(x)$. On the one hand, a higher x implies higher wealth at time t, which would tend to imply a higher D_N. On the other hand, a higher x implies that the consumer anticipates more the purchase of the new steady-state stock durable goods--i.e., higher x implies lower τ - t--, which tends to imply a lower D_N. By equation (24), the latter effects dominates.

By previous considerations, the new consumption level of durables, D, is given by:

$$D = \mathrm{D}(x) \equiv \begin{cases} \mathrm{D_N}(x), & x < x^* \\ \mathrm{D_B}(x), & x \geq x^*. \end{cases} \tag{25}$$

The function D(x) is depicted in Figure 5. We now turn to calculate the effect of inflation stabilization on the aggregate level of consumption--henceforth denoted by D^A.

At the initial steady-state equilibrium, a continuum of individuals of length T existed, with mass equal to one. Hence, aggregate consumption before inflation stabilization was constant over time and equal to D_0. Formally, we index individuals by x. [11] Define the population in any interval $[0, \bar{x}]$ by the uniform distribution $F(\bar{x})$, where:

$$F(\bar{x}) = \int_0^{\bar{x}} dx = \bar{x}, \tag{26}$$

and $F'(\bar{x}) = 1$.

The new steady-state aggregate consumption is defined by a mapping from calendar time in $[t, t+T]$ to the real line. Using equation (25) and the fact that, for $x < x^*$, there is a unique value of s at which a new purchase will occur--given by optimal τ in equation (20)--and, for $x \geq x^*$, the new purchase of durables occurs at time $s = t$, we can define D in equation (25) as a function of s. Formally, $D_B(s = t) = D_B(x)$ for $x \geq x^*$; $D_N(s) = D_N[x(s)]$ for $s \in (t, t+t_M]$, where $x(s)$ is obtained by inverting equation (20) after substituting τ by s; $D_N = 0$ for $s \in (t_M, t+T]$. Thus, aggregate consumption is given by the function $D^A(s)$: $[t, t + T] \rightarrow R_+$, such that:

$$D^A = D^A(s) \equiv \begin{cases} \int_{x^*}^{T} D_B(x)dx, & s = t \\ D_N(s)h(s), & s \in (t, t_M] \\ 0, & s \in (t_M, t + T], \end{cases} \tag{27}$$

where t_M corresponds to the individual with $x = 0$--that is, the individual that just bought a durable and, hence, will be the last to renew it--and is given by:

[11] Note that there is a one-to-one correspondence between x and calendar time (s) before t. That is, we can indistinctly index individuals by $x \in [T, 0]$ (the time elapsed since the previous purchase) or by the time when they made the previous purchase, which belongs to the interval $[t - T, t]$ (see Figure 1, or recall that, by equation (14), $x = t - s$ for any $s \in [t - T, t]$).

$$t_M \equiv t+T - \frac{1}{\rho + \delta}\log\left[\frac{y}{y_0}\right] < t+T, \tag{28}$$

and h(s) represents the population mass at time s in the aftermath of stabilization. The Appendix derives h(s) and shows that h(s) > 1 (Result 3). Hence, in response to a lowering of inflation at time t, there is an initial "bunching" of consumption at time t, there is an increase in population mass and aggregate consumption in the subsequent period $s \in (t, t_M]$, and there is no population mass and, hence, no consumption in the period $s \in (t_M, t + T]$. This implies that inflation stabilization results in a consumption boom initially, as individuals not only increase but also anticipate their consumption of durable goods. However, the anticipation of consumption and a consequent synchronization of consumption patterns by a portion of the population results in a recession later on. Interestingly, the recession in aggregate consumption follows from the presence of (S,s) rules in durables consumption, rather than from contemporaneous government policies.

Since output increases permanently, the cyclical behavior in consumption imparted by the presence of (S,s)-rule type behavior generates a current account deficit initially and a current account surplus in the recession period. Without additional sources of uncertainty the model would predict a repetition *ad infinitum* of the cycle in consumption. While we do not pursue the issue of "de-bunching" in the present paper, one should keep in mind that a stochastic version of this economy with idiosyncratic shocks would generate de-bunching of consumption and, hence, smoothing of the consumption cycle (see Caballero and Engel, (1991)). In addition, de-bunching could result from changes in T across individuals. Given our assumption of log-utility function, T does not change after the wealth shock, only D. Therefore, a more general specification of utility can generate changes in T (as a function of x) that will tend to eliminate the cycle in the long run.

IV. FINAL REMARKS

Exchange rate-based stabilizations in chronic-inflation countries are often accompanied by an initial consumption boom followed by a later recession. This boom-recession cycle is particularly evident in the behavior of durable goods. This paper has suggested an explanation for this phenomenon based on the timing of purchase of durable goods. The initial fall in inflation generates a wealth effect which induces many consumers to bring forward purchases of durable goods which, in the aggregate, results in a consumption boom. This initial bunching in purchases of durable goods sets the stage for a later slowdown, as most consumers will not need to replenish their stock of durable goods for a while.

Unlike the temporariness hypothesis--which relies on expectations of future abandonment of the stabilization plan to generate the boom-recession cycle--the explanation offered in this paper does not rely on the assumption of perceived policy changes. The policy interpretations and implications are therefore radically different. Under the temporariness hypothesis, the boom-recession cycle is a clear indication that policymakers have not done enough to convince the public that the program will be sustained over time. In sharp contrast, under the explanation proposed in this paper, the boom-recession cycle is a direct consequence of the ability of policymakers to implement a credible and successful plan. Hence, while the boom-recession cycle should be cause for much concern under the temporariness hypothesis, it should be viewed as the natural adjustment process to lower inflation under this alternative interpretation. [12]

Two aspects of the model are worth discussing. The first refers to the distinction between money-based and exchange rate-based stabilization. In contrast to exchange rate-based stabilizations, both theory and evidence suggest that money-based programs are contractionary. This feature could be easily incorporated into the analysis by assuming that the consumer is subject to a cash-in-advance

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12 Of course, in many actual experiences the decline in consumption may have been the consequence of some other problems, such as loss of competitiveness, but our model suggests that the consumption decline by itself may not necessarily reflect underlying problems.

constraint. Under predetermined exchange rates, money is endogenous so that the presence of the cash-in-advance constraint would not alter any of the results. Under money-based stabilization, however, the cash-in-advance constraint would prevent the boom from taking place (assuming sticky prices) because the real money supply would be given on impact. In conclusion, our model could easily capture the distinction between exchange rate- and money-based stabilization.

A more challenging issue is the wealth effect that puts into motion the consumption cycle. Clearly, the consumption-cycle (which follows from the (S,s) rule) is independent of how this wealth effect comes about. In our model, the fall in inflation reduces the effective wage paid by firms (because firms must use cash to pay wages), which increases labor and output. Since consumers own the firms, larger output implies higher income. This mechanism is very convenient analytically, and serves to illustrate how any wealth effect would work. However, we feel that our results are more general in that they should hold under other, perhaps more realistic, scenarios. Specifically, we believe that, in practice, liquidity constrains are bound to play an important role. For instance, when inflation is falling, backward-looking indexation would result in higher real wages which, if consumers are liquidity-constrained, would lead to higher disposable income and thus generate the boom-recession cycle in durable goods. In a similar spirit, one could assume that consumers face a financial liquidity constrained whereby cash is needed to pay interests on consumer debt. Then a fall in nominal interest rate, by reducing interest payments, would provide the consumer with more liquidity and allow him or her to bring forward purchases of durables.

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Appendix: Main Results
Result 1: Second order conditions and effects of δ and ρ on optimal T.

The first order conditions of the consumer problem can be written as:

$$1+\frac{\delta}{\rho}-\frac{\delta T}{1-e^{-\rho T}} = 0, \tag{A.1}$$

hence, the second order conditions require that the following expressions be negative:

$$SOC \equiv \frac{d}{dT}\left[1+\frac{\delta}{\rho}-\frac{\delta T}{1-e^{-\rho T}}\right]. \tag{A.2}$$

After some manipulations it can be shown:

$$SOC = -\delta\left[\frac{1}{1-e^{-\rho T}} + \frac{\rho T e^{-\rho T}}{(1-e^{-\rho T})^2}\right] < 0. \tag{A.3}$$

Because *SOC* is negative for all *T*, optimal *T* exists and is unique.

Now we can differentiate the first order conditions with respect to δ to show that *T* is a decreasing function of δ. Differentiating the first order conditions with respect to δ we obtain:

$$\frac{1}{\rho}-\frac{T}{1-e^{-\rho T}} + SOC\,\frac{\partial T}{\partial \delta} = 0, \tag{A.4}$$

since SOC is less than zero and the first two terms are equal to -1/δ by the first order conditions we have that,

$$\frac{\partial T}{\partial \delta} = \frac{1}{\delta\ SOC} < 0. \tag{A.5}$$

Finally to show that an increase in ρ reduces optimal *T*, we can differentiate now the first order conditions with respect to ρ:

$$-\frac{\delta}{\rho^2}-\frac{\delta T^2 e^{-\rho T}}{(1-e^{-\rho T})^2} + SOC\,\frac{\partial T}{\partial \rho} = 0, \tag{A.6}$$

which can be rewritten as:

$$\frac{\partial T}{\partial \rho} = \frac{\delta}{soc\,\rho^2}\left[1-\frac{(\rho T)^2 e^{-\rho T}}{(1-e^{-\rho T})^2}\right]. \tag{A.7}$$

It is easy to check that the term in square brackets is greater than 0 and less than 1, because the function $z^2e^{-z}/(1-e^{-z})^2$ is decreasing in the interval [0,1] for all *z* greater or equal than zero. Therefore, we have that:

$$\frac{\partial T}{\partial \rho} < 0. \tag{A.8}$$

Result 2: Existence of bunching ($x^* < T$).

Equation (20) implies that τ-t is equal to zero for $x = x^*$, which is given by equation (21). Note that for $y_0 = y$, $x^* = T$. To show that $x^* < T$ for $y_0 > y$, first note that the expression $\log(y/y_0 + e^{\rho x} - 1)/(\rho + \delta)$ is greater than $x\delta/(\delta + \rho)$, and, therefore, it is greater than T at $x = T$. To recover the equality at τ-t equal to zero the RHS must decrease. This is achieved with a reduction in x since the RHS of (2) is decreasing in x. Consequently, $x^* < T$.

Result 3: Characteristic of h(s).

The variable s represents the time at which a new purchase will occur for an individual who is buying the good after t. s is given by:

$$s = T - \frac{\delta x}{\rho + \delta} - \frac{1}{\rho + \delta} \log\left[\frac{y}{y_0} + e^{\rho x} - 1\right], \tag{A.9}$$

where x is uniformly distributed in the interval $[0, x^*)$. Define Ψ in the interval $[0, t_M]$, where t_M is given by equation (28). According to (6) s is a monotonic transformation of x. Both variables can be treated as random variables. Denoting the inverse of (6) as $x = G(s)$, one can find the distribution of s starting from the distribution of x (uniform):

$$\begin{aligned} F_s(\sigma) &= \text{Prob}(s \le \sigma) \\ &= \text{Prob}\left[T - \frac{\delta x}{\rho+\delta} - \frac{1}{\rho+\delta}\log\left(\frac{y}{y_0} + e^{\rho x} - 1\right) \le \sigma\right] \\ &= \text{Prob}(x \ge G(\sigma)) \\ &= 1 - \frac{G(\sigma)}{x^*}. \end{aligned} \tag{A.10}$$

Therefore, the density of the random variable s at a value σ is equal to $-G'(\sigma)/x^*$. Since in the whole there are x^* individuals, the mass of individuals per unit of time will be given by:

$$h(s) = -G'(s). \tag{A.11}$$

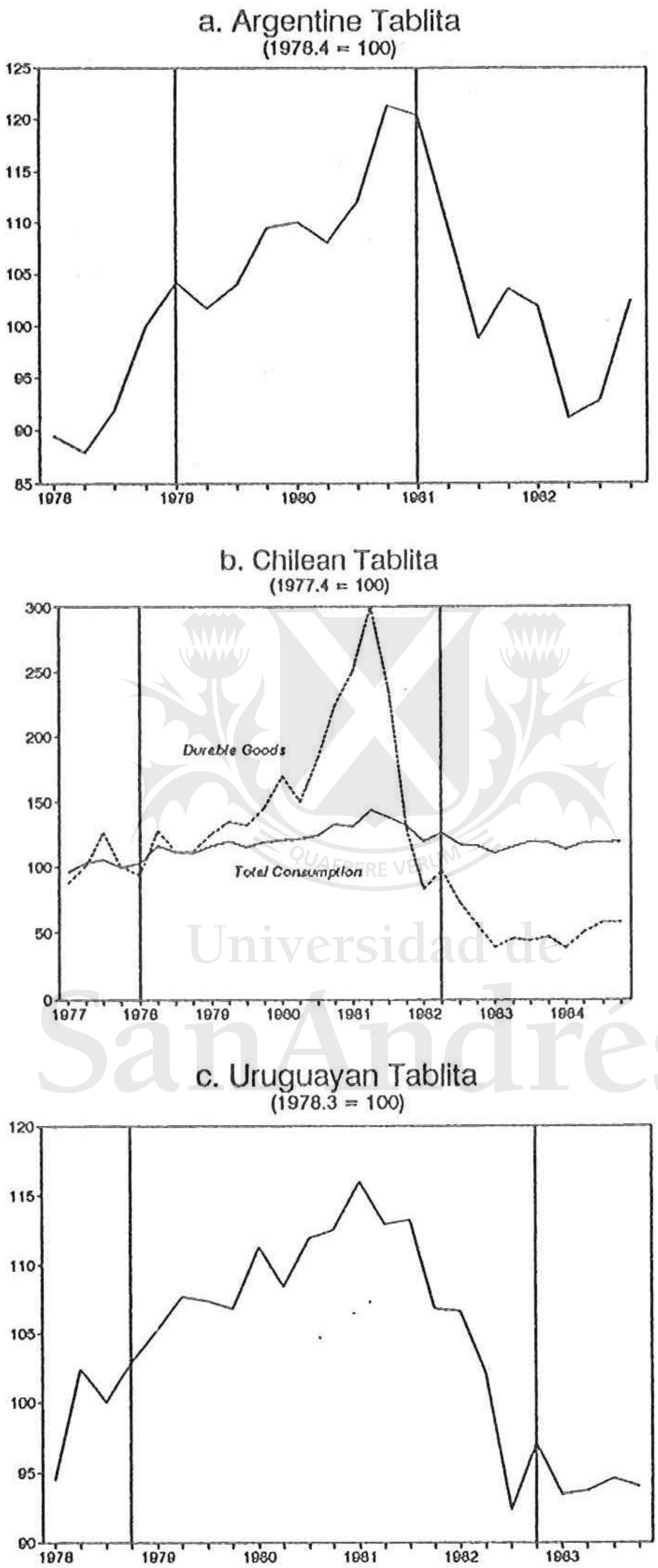
Note that h($\cdot$) is not constant, as was the case for the distribution pre-stabilization. Pre-stabilization there was a unitary mass of people per unit of time. Now we will show that the mass of individuals is greater than 1 ($h(s) > 1$). The function G(s) is defined implicitly as:
which after implicit differentiation yields:

$$s = T - \frac{\delta \ \mathrm{G}(s)}{\rho+\delta} - \frac{1}{\rho+\delta}\log\left[\frac{y}{y_0} + e^{\rho\,\mathrm{G}(s)} - 1\right], \tag{A.12}$$

$$-\mathrm{G}'(s) = (\delta+\rho)\left[\delta + \rho\,\frac{e^{\rho\,\mathrm{G}(s)}}{e^{\rho\,\mathrm{G}(s)} + \dfrac{y}{y_0} - 1}\right]^{-1}. \tag{A.13}$$

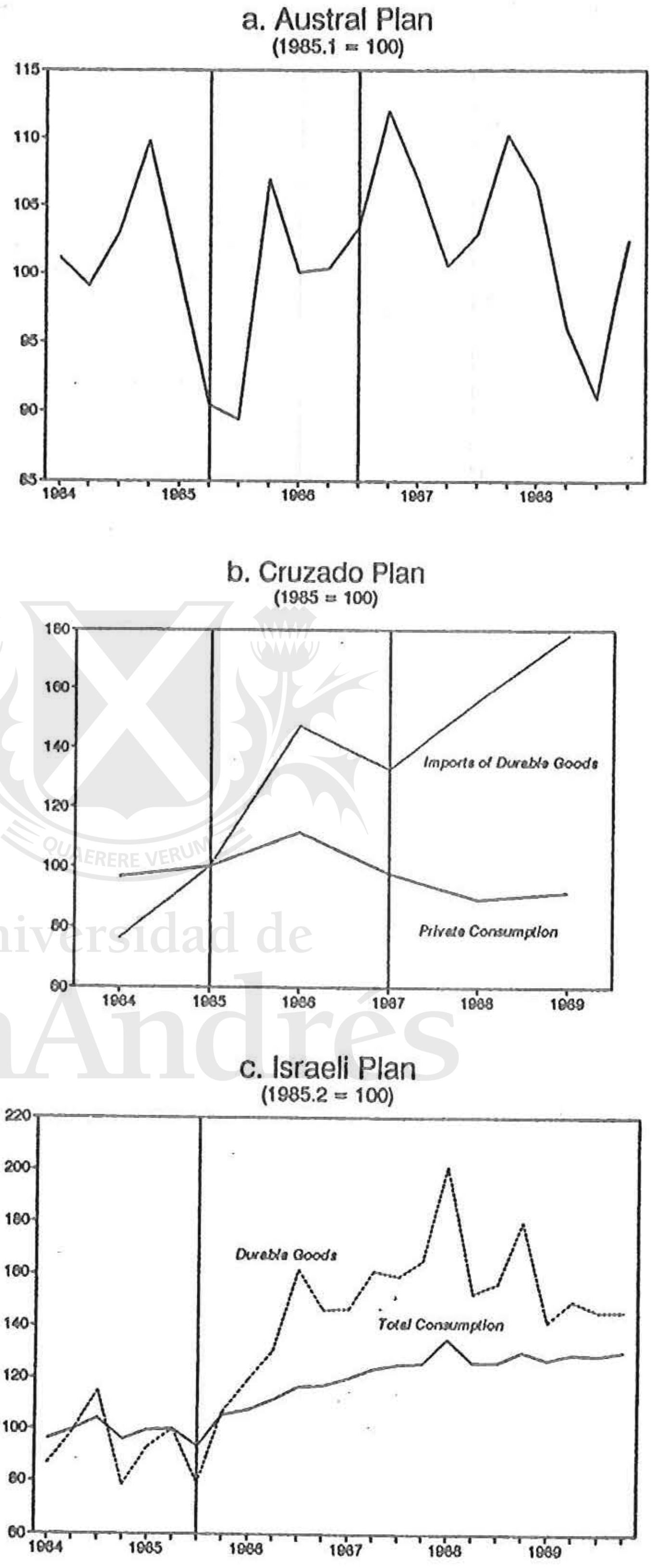
Clearly, the term in square brackets is less than one, hence, -G′(s) is greater than one, which completes the proof that h(s) is greater than 1.

Figure 1. Southern-Cone Stabilizations: Private Consumption



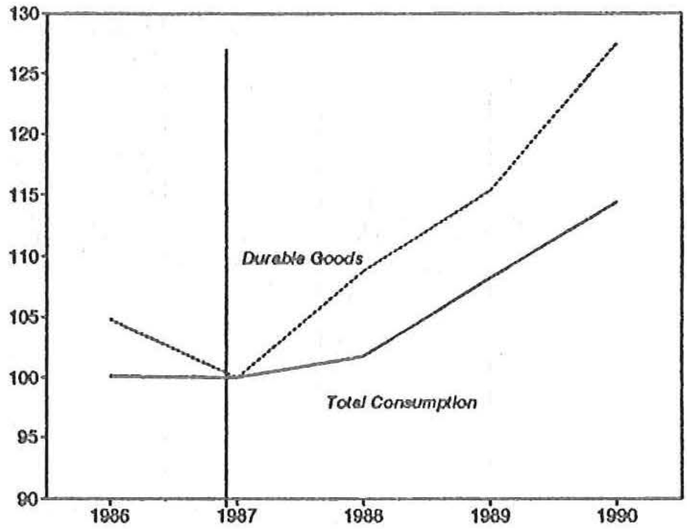
Sources: IMF and national sources.

Figure 2. Heterodox Stabilizations: Private Consumption



Sources: IMF and national sources.

Figure 3. Mexican Plan: Private Consumption
(1987 = 100)



Source: INEGI.

Figure 4: Timing

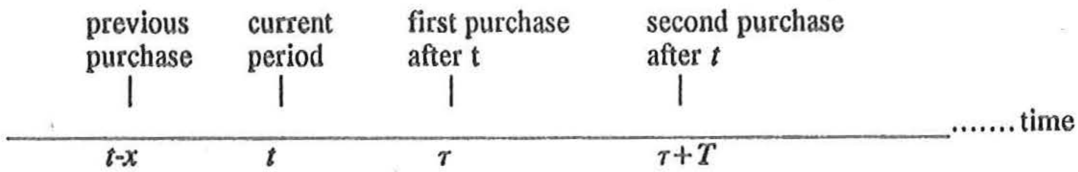


Figure 5: Consumption of Durables, D(x) (equation (25))