

Essays on Financial Innovation and Stabilization

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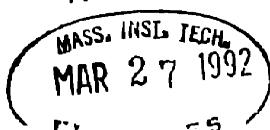
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To my parents,

Paola, María Francisca, Bernardita and Josefina.

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Abstract

This Thesis consist of three essays on financial innovation and stabilization theory. The first chapter deals with the stylized fact on post-stabilization economies that getting the fundamentals right, even though necessary, is not sufficient to ensure a prompt resumption of growth.

In those Latin American economies actually stabilizing, repatriation of private assets provides a crucial source of financing. Uncertainty whether stabilization can in fact be sustained confers an option value to postponing investment in domestic real assets. This uncertainty derives from the possibility that the government will be unable to withstand pressures against program continuation if living standards (which increases in the amount of capital repatriation) do not recover rapidly. This positive externality on the probability of policy continuation coupled with the positive effect of a lower likelihood of program failure on the returns to domestic real assets can generate multiple expectational equilibria. In particular, a *pessimistic* zero-repatriation trap and a Pareto-superior *optimistic* high investment equilibrium may co-exist.

The fact that the economy may get trapped, as a result of a coordination failure, in the pessimistic equilibrium provides a rationale for government intervention during the transition: investment subsidies to early comers, public investment and real wage stabilization policies, among others, can be used to coordinate private expectations on the good equilibrium. The *income redistribution* brought about by funding policies domestically may counteract their original objectives. Foreign financial assistance (or debt relief) can thus play a central role by funding policies without impact on the distribution of income, in addition, of serving as a *signal* of donor confidence in the sustainability of the program, which may by itself be sufficient to coordinate expectations on the optimistic equilibrium. The same applies to measures on international integration (e.g., the proposed Mexican-US free trade agreement), which by raising the cost of policy reversion may serve as a coordinating device intended to overcome the decentralized economy tendency to wait.

In the second essay, which is a joint paper with Federico Sturzenegger, we study the well recognized fact, that has puzzled economists for a long time, that countries often postpone the adjustment to policies which are unsustainable in the long run and/or socially inefficient. We concentrate on the issue of inflation stabilization

and model delayed stabilizations as the rational outcome of a distributional conflict between two risk averse interest groups in the presence of post-stabilization payoff uncertainty and costly policy reversion. It may be the case that in the initial stages of an extreme inflationary episode, there is a bias towards the actual inefficient but certain revenue collection system which may prevent the adoption of the required adjustment program. The access of those with higher income to a financial adaptation technology will increase the average rate of inflation for any given government deficit, raising the welfare costs of not reaching an agreement to stabilize and redistributing the burden increasingly to those with lower income. This process, if deep enough, may trigger the necessary political support for the required fiscal adjustment. Delayed stabilization will lead the poor to end up accepting conditions that they did not find optimal before. In this sense, we formalize the long recognized stylized fact that stabilizations are delayed until "things get really bad".

A central planner that disregards social conflict will never engage in financial innovation so that delays are not possible. The fact that individuals may *ex-post* realize that they are made worse off by the shift of fiscal regime opens the possibility of program collapses which reduces the irreversibility associated with policy reform. As collapses (experimentation) becomes less costly the likelihood of reaching an agreement in the early stages of the inflationary process increases.

Finally, the third chapter presents empirical evidence for the Argentinian and Chilean economies on the effects of financial adaptation on the stability of money demand. Since mid 1984 the Chilean economy has experienced a phenomenon similar to that observed in the U.S. economy in the mid 1970s, known as "the case of the missing money". Conventional money demand equations systematically overpredict the actual real money balances thereafter. The time series-data for Chile suggests a permanent downward level shift in the long run money demand function after the third quarter of 1984.

Equivalent evidence is suggested by the time series-data for Argentina for the period of financial deregulations implemented by Martinez de Hoz during 1976-77. The break in money demand is detected at mid 1976, before the deregulations of domestic capital markets, but together with the liberalization of the capital account and with the "endogenous financial adaptation" process associated with the extreme inflation episode of the mid 1970s. This evidence together with the observed evolution of other monetary and financial aggregates suggest that during the high inflation episode of the mid 1970s there was a substitution away from non-interest-bearing money (as well from interest-bearing money) to foreign assets, in part favored by the liberalization of the capital account of the Balance of Payments. Given the negativity of real interest rates, foreign assets were the best financial investment alternative available. In late 1977, the relative stability of money demand together with the observed increase in the $M2$ to $M1$ ratio is explained by a shift of portfolio from foreign currency holdings to interest-bearing deposits. Further instability of the money demand is observed during 1985 when the inflation rate reached a record high and with the following implementation of the Austral plan.

This chapter presents evidence that in many cases the observed non-stationary behavior of the estimated residuals from a cointegration regression can just be the

result of a structural change in the deterministic part of the model that has not been accounted for. We derive some asymptotic convergence properties for the least-squares estimators of the coefficients of the cointegration equation and we tabulate critical values to test for cointegration in the presence of a once-and-for-all known shift in the intercept of the cointegration equation.

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Chapter 1

Capital Repatriation And The Costly Transition From Stabilization To Growth

1.1 Introduction

Evidence¹ on the economic performance of post-stabilization economies suggests that getting the *fundamentals* right, though necessary, is not sufficient to ensure a prompt resumption of growth. The traditional prediction that the negative impact of contractionary fiscal policies on output growth will be, at least partially, offset by an expansion of net exports does not seem to work in the short run. According to Dornbusch (1991b), the most difficult stage of stabilization is the transition to growth. This fact is well illustrated by the experiences of Bolivia, Mexico, Chile and even Israel today, and by that of many East European economies actually undergoing a deep process of reconstruction. The same is to be expected for Argentina, Brazil and Peru, once they stabilize.

In Chile the welfare costs of the adjustment and restructuring initialized in 1974, in

¹I would like to thank Rudiger Dornbusch, Richard Eckaus, Stanley Fischer, Paul Krugman, Roberto Perotti, Federico Sturzenegger, Holger C. Wolf and participants of the MIT International seminar for helpful suggestions and discussion. The usual caveat applies.

terms of real wages cuts and employment losses², were probably too high and lasting to have been sustained in a democratic regimen. In Bolivia, even after its 1985 stabilization has become an established fact, persistently low levels of investment, especially private, has prevented the economy from growing³. Mexico faces a similar situation, with per-capita income today more than 17% below its level of 1981 and real wages in manufacturing below the level of the early 1970s.

Despite that by mid-1987 the Israel's stabilization program seemed a completely success, the economy entered into a two year recession (Bruno and Meridor (1991)). Equivalently, extremely high transition costs have accompanied transformation and stabilization in Eastern Europe. For example, real wages in Poland declined by 29.8% between the summer of 1989 and that of 1990; in East Germany the adjusted unemployment rate reached 19.5% on March 1991; and although economic restructuring in Hungary and Czechoslovakia is just under way, output has already shrunk and seems certain to fall further.

Prolonged and costly transitions are often associated with political distress, popular loss of confidence in the government's ability to withstand pressures against program continuation, and significant income redistribution. Increased vulnerability of the political system and income redistribution effects are often a central cause of program failures or abandonment. Thus, a rapid recovery of living standards seems to be a prerequisite for a successful stabilization.

I present here a two-sector small open economy model of fiscal stabilization. Pre-stabilization, the government finances purchases of non-traded goods completely by foreign borrowing. This episode is associated with an aggregate demand induced

²In Chile the average rate of unemployment went from 6.5% in the 1960s to 19.5% in the period 1974-85, reaching back a single digit figure only by 1988, on top of an initial real wage drop of more than 14%. There is also evidence suggesting a worsening of income distribution: For example, the consumption of the 20% of the families with higher income (in Santiago) increased relative to that of the rest, if we compare 1969 with 1978, and even further when compared with 1988. There has also been a significant reduction in government spending in health, education, housing and social security, when we compare the levels for the period 1974-87 with that of 1970.

³The rate of growth of per-capita GDP has been negative for the entire 1985-90 period with the only exemption of 1988 when it was zero. Private investment as a percentage of GDP decreased from 5.2% on average for the period 1980-83 to only 2.7% for 1986-88, following the hyperinflation episode of 1984-85.

boom in the home goods sector which leads to a real appreciation of the exchange rate, an increase in real wages and a drop in real profitability of domestic capital, which is assumed to be accumulated only in the traded goods sector. This leads to an accumulation of foreign assets by local capitalists (*capital flight*) and a decapitalization of the domestic economy, so that when stabilization is attempted the real wage level sustainable at balanced budget is lower than that attainable at the beginning of the real appreciation episode. Stabilization is associated with a real devaluation, an initial drop in real wages and, in the absence of frictions, with a shift from an aggregate demand driven growth in the home goods sector to *supply side* induced growth in the traded goods sector, a prediction that does not seem to fit well with the above mentioned facts.

Latin America economies actually stabilizing have few sources of funds to finance their growth recovery: it is very unlikely that they will be able to attract massive inflows of foreign capital, since following the debt crisis of the early 1980s they lost access to voluntary international credit markets and today they must compete for funds (loans as well as direct foreign investment), with the newly reforming East European economies. Significant domestic public financing is unlikely in the first stages of stabilization. Thus, to restore growth in the near future, these economies will require the support of domestic capitalist, through repatriation of capital⁴. There is also a key role for debt relief or suspension, which I discuss later. I concentrate here on the incentives for a massive reflow of private assets during the transition (*noisy period*) and on the actual commitment of these resources to real investment at home.

A common problem facing many of these economies in the aftermath of stabilization is the lack of any significant private capital reflow. Moreover, when capital does come back it is placed in highly liquid domestic assets rather than in physical capital, as in the cases of Argentina and Mexico, despite the presence of *ex-ante* highly profitable real investment projects. I conjecture that uncertainty about the ability

⁴The amounts of private capital outflows from the region during periods of instability have been very significant. Dornbusch (1991b) present estimates for capital flight for several Latin American economies: For the period 1979-82 (1983-87), we have an accumulated in Billion of dollars for Argentina 22.4 (6.8), Brazil 5.8 (24.8), Mexico 25.3 (35.3) and for Venezuela 20.7 (18.9).

of the government to withstand pressures against the continuation of the program is a central factor keeping potential domestic investors on the side-lines. Since stabilization means real spending cuts and an initial drop in real wages it is politically costly. If during the transition period the economy were to experience a severe unexpected deterioration of living standards, the government may be forced to abandon the program.

Domestic investors, fearing that the *ex-post* yield on their investments may turn out to be lower than expected due to policy reversal may find it optimal to remain liquid despite sacrificing current returns. As long as the opportunity to invest remains available in the future, this strategy allows them to postpone commitment of resources until some of the program uncertainty is resolved. The possibility of deferring commitment is lost when they exercise this option by repatriating their assets and undertaking irreversible real investment at home. This asymmetry between financial and real capital confers a (call) *option* value to foreign liquid assets, even for risk neutral entrepreneurs⁵.

Post-stabilization, how fast real wages recover (i.e., how likely the program continue) depends on the response of investors. An increase in the aggregate amount of private capital reflow in the aftermath of stabilization will reduce the transitional welfare costs, making it more likely that the government can successfully carry out its adjustment program. Since individual investors, with *uncoordinated* decision-making, ignore the presence of this positive aggregate externality we expect, under reasonable conditions, the privately optimal level of asset reflow under program uncertainty to be too low when compared with the centralized economy solution (i.e., *under-investment* at home).

This positive macroeconomic externality on the probability of policy continuation coupled with the positive feedback of a lower likelihood of program failure on the return to domestic real assets (strategic complementarity), can generate multiple expectational equilibria, which can be Pareto-ranked according to increasing levels of

⁵In this model, information is endogenous and uncertainty decreases over time. Even if uncertainty did not decline the option value can remain non-negative (see, Dixit (1990) and Pindyck (1990)).

capital repatriation during the initial noisy period. In particular, a *pessimistic* zero-repatriation trap and a Pareto-superior *optimistic* high investment equilibrium may co-exist. The predictions associated to both equilibria can prove to be *self-fulfilling* prophecies. Thus how likely the program will succeed depends on private sector speculation, and we may even have the case that despite correct fundamentals, the program may collapse simply because of an initial generalized lack of public support for it.

The fact that individual investors do not internalize this externality and the possibility of the economy getting stuck, as a result of a coordination failure, in the pessimistic equilibrium provides a rationale for government intervention during the transition. Investment subsidies to early comers, public investment and other social infrastructure (social emergency funds), and real wage stabilization policies (e.g. wage indexation), among others, can be used to coordinate private expectations in the good equilibrium. The scope for such policies is, however, restricted by the need to finance the subsidies and transfers. If no foreign assistance is available, the income redistribution generated by funding requirement may undo the benefits of the policies themselves: if investment subsidies are financed by taxing workers, transitional disposable income is pushed down, increasing the likelihood of policy reversion and potentially *lowering* the expected return to domestic real assets. This suggests caution against the indiscriminate use of subsidies as a coordination device.

Foreign financial assistance (or debt relief or suspension) can thus play a central role by funding policies without impact on income distribution. In addition, standby loans and letters of intent, by signalling confidence on behalf of donors, can by themselves be sufficient to bring about the optimistic outcome. The same applies to measures on international integration (The proposed Mexican-US free trade agreement represents a case in point), which by raising the cost of policy reversion may serve as a coordinating device to overcome the decentralized economy tendency to wait.

1.2 A Model Of The Under-Investment Trap

I now present a short run model of private investment choice based on the interdependence between uncoordinated individual investment decision and the likelihood of program reversal. The model takes the form of a *noncooperative* game that may exhibit multiple (*subgame-perfect*) Nash equilibria which can be Pareto-ranked according to increasing levels of physical investment at home (i.e., capital repatriation) in the aftermath of stabilization. In our set-up the post-stabilization economy is characterized by *strategic complementarity* (Cooper and John (1988)): For each individual investor the expected return from investing at home in the initial noisy period increases with the total amount of capital repatriation simultaneously undertaken by other entrepreneurs.

Consider a small open economy that produces a nontraded (N) and an exported (X) good and that is populated by two types of agents: workers and investors. Workers are assumed to consume both the home good and an imported (M) good, which is the numeraire. Investors only consume the imported good. Domestic capital markets do not exist.

The world prices for both traded goods are given to the economy and normalized to unity, so that their domestic prices are $P_M = P_X = e$, where e is the exchange rate. Thus, the country faces exogenously given terms of trade equal to one. The nontraded good Q_N is assumed to be produced with a constant unit labor requirement⁶ $Q_N = L_N$. Assuming perfect competition we have that $P_N = W$, where P_N is the price of home goods and W is the wage rate, so that the real wage in terms of the nontraded good is always equal to one. On the other hand, the exported good is produced with a constant returns to scale technology, using both capital and labor $Q_X = F(L_X, K)$. Firms in the export sector can sell their output at the exchange rate e , so they have profits⁷ equal to

⁶For our results to hold we only require the production of the home good to be more labor intensive than that of the exported good.

⁷Free entry ensures that profits net of capital compensation are zero.

$$V_X = eF(L_X, K) - WL_X \quad (1.1)$$

Perfect competition and profit maximizing behavior ensures that labor in the export industry is adjusted to equate the wage rate with its value marginal product in this sector

$$w = \frac{W}{e} = F_{L_X}(L_X, K) \quad F_{L_X}(\cdot) > 0, \quad F_{L_X K}(\cdot) > 0 \quad (1.2)$$

If $F(\cdot)$ is monotonically increasing, equation (1.2) can be inverted to yield the derived demand for labor in the exported good sector $L_X = f(w)K$, with $f_w(\cdot) < 0$ and where w is the real wage in dollars (also equal to one over the real exchange rate $\frac{e}{P_N}$). From (1.2) we see that an increase in the capital-labor ratio in the exported good sector leads to an increase in the wage in dollars (i.e., real appreciation of the exchange rate).

The services of installed capital can be rented to the exported good sector at its value marginal product

$$r = \frac{R}{e} = F_K(L_X, K) \quad F_K(\cdot) > 0 \quad (1.3)$$

where r is the gross rate of return to the services provided by one unit of capital in the production of the exported good, expressed in terms of the numeraire. For simplicity, physical capital is assumed not to depreciate.

Let $b_0 \geq 0$ be the initial stock of external government debt and $g_N = \frac{P_N}{e} C_N^g$ the pre-stabilization real value of the purchases of nontraded goods carried out by the government. Let us assume that the budget deficit is completely financed by foreign borrowing⁸, thus

$$g_N + r^* b_0 = b_1 - b_0 \quad (1.4)$$

⁸An extension to the case where the budget deficit is financed by both taxes and foreign borrowing can be found in Laban (1991a).

where r^* is the world interest rate, assumed constant. Private agents are assumed not derive utility from public consumption.

Assume a representative worker supplying inelastically L units of labor at a given real wage w , consuming her entire net income each period and allocating each period a fixed proportion $\gamma < 1$ of her spending to the consumption of the home good and $(1-\gamma)$ to that of the imported good (i.e, instantaneous consumption is Cobb-Douglas). Her budget constraint prior to stabilization, in terms of the imported good, is given by

$$\frac{P_N}{e} C_N^w + C_M^w = wL \quad (1.5)$$

Assume that there are T identical risk neutral investors, each having initially a wealth composed of $\frac{K_0}{T}$ units of domestic irreversible real capital and one unit of foreign liquid assets⁹. Domestic residents can not borrow abroad. We assume that $0 \leq r_b < \rho = r^* < r_g$ for all relevant k^{10} , where r^* is a constant risk free rate of return paid on foreign liquid assets each period (equal to that paid on public foreign borrowing), ρ is the rate of time preference and r_b and r_g are the rates of return, in terms of the numeraire, of investing one unit of capital in domestic *irreversible* real capital if the program is reversed or continued, respectively. Furthermore, we assume that pre-stabilization it will be optimal for entrepreneurs to invest all their net income in foreign assets (*capital flight*¹¹), so that $r^* > r_b$ ($r^* - r_b > \beta G()$ ¹²) if investors find it optimal (non-optimal) to enter in the aftermath of stabilization. Consumption will always be delayed into the last period. Domestic real investment is assumed that can be reversed without any cost at the beginning of the third period.

Pre-stabilization, the optimal aggregate behavior of investors is summarized by

⁹The initial aggregate level of foreign assets being held by domestic residents is $F_0 = T$.

¹⁰The assumption that $r^* < r_g$, implies that, under certainty and full capital repatriation, if the country could borrow freely it would be optimal to do so. This reflects the common presumption that developing countries are characterized by capital scarcity and relative high marginal product of capital, so that they should be net foreign borrowers during the development process.

¹¹For the issue of capital flights, see Tornell and Velasco (1990), Alesina and Tabellini (1989), Eaton and Gersovitz (1989), Khan and Haque (1986) and Van Wijnbergen (1985).

¹²Where $\beta > 0$ is the discount factor and $G()$ is to be defined later.

$$TC_{M_1}^c = 0 \quad (1.6)$$

$$K_1 - K_0 = 0 \quad (1.7)$$

$$F_1 - F_0 = r^* F_0 + r_b K_0 \quad (1.8)$$

where equation (1.6) gives the pre-stabilization aggregate level of imported goods consumption and equations (1.7) and (1.8) represent the aggregate accumulation of both assets in the period preceding the stabilization attempt.

Pre-stabilization, equilibrium in the nontraded good sector requires that total demand for home goods $D_N = C_N^g + C_N^w$ be equal to total production $Q_N = L_N$, so that the derived demand for labor in the home good sector is given by

$$L_N = \gamma L + \frac{1}{w} \psi = \phi(w), \quad \text{with } \phi'(\cdot) < 0 \quad (1.9)$$

which is a decreasing function of the wage in dollars and where $\psi = b_1 - (1 + r^*)b_0$ is the net world income that is allocated by the government to the consumption of the home good. The equilibrium in the labor market prior to stabilization is thus given by

$$L = L_N + L_X = \frac{K_0 f(w^*) + (\frac{1}{w^*})\psi}{(1 - \gamma)} \quad (1.10)$$

An increase in government spending will, for a given level of domestic aggregate capital stock, increase the equilibrium wage in dollars (i.e., a real appreciation), inducing a boom in the nontraded good sector and a contraction in the export industry (i.e., labor is reallocated toward the production of home goods), raising the capital-labor ratio in the export sector, and thus reducing the profitability of domestic real capital.

Thus, during the overvaluation episode, labor gains at the expenses of capital. Nevertheless, if physical capital did depreciate or domestic investment was reversible,

the initial gain in real wages will be partially dampened by a decline in the capital stock, so that the equilibrium level of real wages sustainable at balanced budget will be lower than that in the period when real appreciation started (see, Dornbusch (1989a)).

Pre-stabilization, we assume the economy to be running a current account deficit (i.e., the economy is borrowing as a whole)¹³.

At the beginning of period one, the government implements a fiscal stabilization program which stipulates a complete elimination of public spending¹⁴¹⁵, and investors without knowing the magnitude of the adjustment cost decide whether to repatriate their capital or to remain holding foreign assets. The private sector believes that with probability $q < 1$ the government will sustain its commitment not to increase its spending, while with probability $1 - q$ the program will collapse (government restores the pre-stabilization level of spending, totally financed by foreign borrowing¹⁶). For simplicity, we assume that at the beginning of period two program uncertainty is completely resolved and investors decide once more whether to repatriate their assets.

While taken as given by individual investors, q is endogenous, depending positively on the *aggregate* amount of capital repatriation in the aftermath of stabilization (*aggregate positive externality*¹⁷). Specifically, q is assumed to be a twice continuously differentiable, strictly increasing and concave function of the aggregate level of first period capital repatriation, k_2 . If no investment occurs in the first period, the program is expected to collapse with probability one ($q(k_1) = 0$).

The probability q of policy continuation measures the government's ability to

¹³The external equilibrium is given by $[(1 - \gamma)Lw - Q_X] + r^*b_0 = (b_1 - b_0) - (F_1 - F_0)$.

¹⁴All what we need is a reduction in C_N^g with respect to the pre-stabilization level. I am assuming that the government chose in an optimal way its adjustment effort level (i.e., spending cuts), minimizing a lost function as in Dornbusch (1991a). Only as a normalization we set $C_N^g = 0$. See also, Blejer and Ize (1989).

¹⁵We assume that if the implemented policy is not reverted, $b_{t+1} - b_t = r^*b_t$ so that interests are fully financed with new loans and principal is not repaid.

¹⁶The way of financing the budget deficit is not relevant for the point we want to make here. Allowing for tax financing (see Velasco (1991) and Laban (1991a)) would introduce a second positive aggregate externality due to the possibility of "increasing fiscal returns", which would strength our results but would complicate the analysis.

¹⁷For a survey of models with this kind of macroeconomic externalities, see Cooper and John (1988), who have labelled them as models of *coordination Failures*.

generate sufficient political support to sustain its preannounced stabilization program. The political support in turn depends on the decline in the transition standard of living¹⁸. Let us assume that during the transition period there exists a minimum real wage level \underline{w} below which the government will find it politically impossible to continue the adjustment program¹⁹. A sufficiently large adverse shock to real wages during the transition will thus lead to a policy shift. Thus, let ϵ be a shock to real wages during the transition which is assumed to be independently drawn from a cumulative distribution function $H(\epsilon)$ with support on $[\underline{\epsilon}, \bar{\epsilon}]$. The probability of program continuation is thus given by

$$q(k_2) = Prob[\epsilon \leq w(k_2) - \underline{w}] = \int_{\underline{\epsilon}}^{w(k_2) - \underline{w}} h(\epsilon) d\epsilon \quad (1.11)$$

where $h(\epsilon)$ is the density function of ϵ , assumed to be strictly positive and decreasing for all values of ϵ . Thus

$$\frac{\partial q}{\partial k_2} = h(w(k_2) - \underline{w}) F_{LXK}(k_2) > 0 \quad (1.12)$$

The probability of program failure decreases with the *aggregate* amount of investment in the aftermath of stabilization, since the larger the supply response (i.e., crowding in) to the adjustment measures, the lower the social costs of transition will be²⁰.

We solve for the sub-game perfect equilibria of the game among private investors by *backward induction*: first, we derive the optimal individual investor behavior in period two once uncertainty is resolved. Then, conditional on this behavior, we find

¹⁸While we model the decline in the standard of living as a fall in real wages, an analogous argument can be made in terms of increased unemployment by introducing real wage rigidity. Most episodes (Chile in the 1970s) of course present a combination of both.

¹⁹Since we are concerned with the government's *political* ability to carry out the program we concentrate on the *commitment* equilibrium for the game between the government and private agents, assuming that the government can credibly precommit not to abandon the program if wages remain above the threshold level (see, Blejer and Ize (1989) and Dornbusch (1991b)). Nevertheless, the solution to the game between private investors, conditional in this behavior rule for the government, will still be sub-game perfect.

²⁰For alternative ways to justify, in the present context, the presence of this positive externality, see Dornbusch (1991a), Eaton and Gersovitz (1989) and Rodrick (1989).

the optimal investment decision in the noisy period.

1.2.1 Optimal Capital Repatriation Decision in Period Two

If the program succeeds once uncertainty is resolved, the economy is assumed to converge to the full-repatriation equilibrium independent of the level of domestic investment achieved in the initial noisy period²¹ ($r_g(k_3^g) > r^*$), where K_3^g is equal to $(1 + r_g)K_2$ or $(1 + r_g)[K_2 + F_2]$, if there was full or zero capital repatriation in period one, respectively. If the program collapses, it is optimal not to enter in period two ($r^* > r_b(k_3^f)$), where $K_3^f = K_2$; thus no further domestic investment takes place in the second period.

1.2.2 Optimal Investment Decision During the Transition

Define V_1 as the expected present discounted value of income (EPDV) of repatriating and investing at home one unit of physical capital at the beginning of period one, and V_{0n} as the EPDV associated with the decision to wait *given* that holding foreign assets permits deferring commitment until the uncertainty is resolved. Defining $\beta > 0$ as the discount factor, assuming returns and tax rate to be small enough and ignoring salvage value, the value of these two assets (common to all entrepreneurs) are given by

$$V_1(k_2) = r_g(k_2) + \beta [q(k_2)r_g(k_3^g) + (1 - q(k_2))r_b(k_3^f)] \quad (1.13)$$

$$V_{0n}(k_2) = r^* + \beta [q(k_2)r_g(k_3^g) + (1 - q(k_2))r^*] \quad (1.14)$$

Once the program has been implemented each investor will allocate her initial wealth to maximize its expected value $V_n^*(k_2)$

$$V_n^*(k_2) = \max [V_1(k_2), V_{0n}(k_2)] \quad (1.15)$$

²¹We assume returns to be sufficiently small to permit linear approximations.

Equation (1.15) implicitly defines the critical *minimum* aggregate mass of capital (k_{2n}^*), assumed to be strictly positive, that must be expected by investors in order to switch from the liquid to the irreversible asset before the realization of ϵ . From equations (1.13) and (1.14) we can solve for k_{2n}^* ²²

$$0 = G(k_{2n}^*) = [r_g(k_{2n}^*) - r^*] - \beta [(1 - q(k_{2n}^*))(r^* - r_b(k_{2n}^*))] \quad (1.16)$$

where $G(k_{2n}^*) = V_1(k_{2n}^*) - V_{0n}(k_{2n}^*)$ is the difference in the valuation of the two assets when the aggregate amount of capital in period one is K_{2n}^* and the foreign asset allows deferment of precommitment.

PROPOSITION 1.2.1 *Provided that $\beta \frac{\partial q}{\partial k_2}(r^* - r_b) > |\frac{\partial r_g}{\partial k_2} + \beta(1 - q)\frac{\partial r_b}{\partial k_2}|$, for all k , this (non-cooperative) game exhibits strategic complementarity.*

Proof See Appendix 1.

In what follows we will assume that the model does indeed exhibit strategic complementarity, i.e. that the positive externality from an increase in the stock of capital on the probability of policy continuation dominates the effect on the marginal product of capital²³, so that, $G(k_2)$ is an increasing function of k_2 .

Equation (1.16) is consistent with the Bernanke's (1983) *Bad News Principle*: An increase in the expected spread between r^* and r_b (an increase in the expected value of bad news) will increase the threshold level of aggregate capital under proposition 2.1. On the other hand, an increase in the expected value of good news (a rise in the spread between r^* and r_g) will have no effect since investors by not repatriating in period one do not lose the option to do so at the beginning of period two, if the program were to succeed.

PROPOSITION 1.2.2 *Provided that the condition for strategic complementarity and*

²²Since no new domestic investment takes place if the program collapses, all variables are evaluated at k_{2n}^* .

²³If in the case of a policy reversion a proportion of the increase in government expenditure was financed by taxes, the possible positive externality of an increase in the stock of capital on the tax rate per unit of capital will make it more likely that the model would exhibit strategic complementarity.

the boundary conditions [i] $G(k_1) < 0$ and [ii] $G(\bar{k}_2) > 0$, where $\bar{k}_2 = \frac{(K_1 + F_1)(1 + r_g)}{L_x}$, are satisfied, this non-cooperative game has two (corner) sub-game perfect expectational equilibria.

Proof See Appendix 1.

PROPOSITION 1.2.3 *The equilibrium with full-investment in the noisy period Pareto-dominates the zero-investment equilibrium and is efficient.*

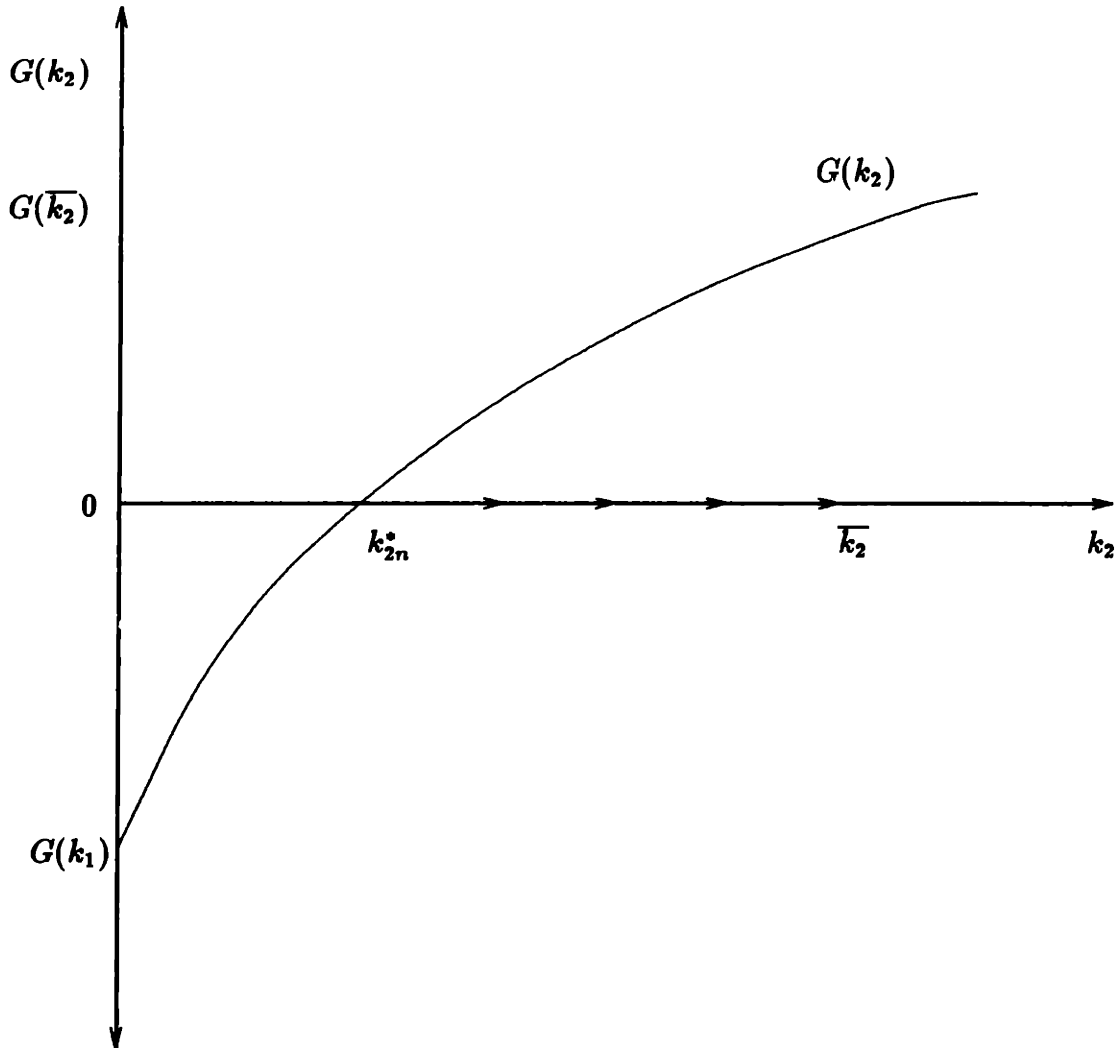
Proof See Appendix 1.

Thus the model can generate multiple equilibria pareto rankable by increasing levels of first period aggregate investment. The boundary conditions [i] and [ii] imply the optimality of entering (not entering) if all other investors remain out (come in), since the front-end premium more (less) than compensate the expected value of *bad news*. The zero-investment trap ($k_2 = k_1$) is associated with entrepreneurs' pessimistic expectations about the ability of the government to withstand pressures against the continuation of the adjustment program while the Pareto-superior full-investment equilibrium ($k_2 = \bar{k}_2$) is associated with optimistic forecasts (Figure 1-1²⁴).

Assumptions [i] and [ii] imply that both expectational equilibria can co-exist. In this case, although it is not optimal for any individual investor to repatriate by herself, coordinated reflow of assets, by raising the likelihood of the program succeeding, increases expected profits to a level sufficiently high that all agents will be willing to exercise the option to wait. Thus the expectation of full-repatriation becomes *self-fulfilling*: if investors were to forecast at least k_{2n}^* to be repatriated, the risk assessment associated with investing at home would drop enough that every agent will find it optimal to enter. As a result *all* assets will return, the economic growth will be restored and the prospects of the program surviving will be high. Analogously, expected capital repatriation below k_{2n}^* renders waiting optimal. As a result, policies will be reversed validating the initial scepticism. Thus "fundamentals" may be insufficient to ensure a prompt restoration of growth in the presence of generalized lack

²⁴In Figure 1-1 we have assumed that $G(k_2)$ is a concave function of k_2 .

Figure 1-1: Optimistic and Pessimistic Expectational Equilibria



of confidence in the government's ability to succeed: the economy needs an (expectational) *big push* (see, for example, Murphy et al (1989)). As the market cannot solve the coordination problem, the possibility of getting stuck in the zero-privatization trap provides a rationale for government intervention during the transition, targeted at reducing the likelihood of the pessimistic equilibrium occurring.

Optimistic private speculation will increase the likelihood that the government will succeed with its fiscal adjustment program. Thus, a policy maker trying to stabilize in the presence of a generalized lack of confidence in its ability to succeed, should try in addition of introducing the right policy measures (getting the fundamentals right), to changes entrepreneurs' perceptions by issuing optimistic forecasts (as they always

do), which should prove to be self-sustainable.

PROPOSITION 1.2.4 *Uncertainty about the sustainability of the program, coupled with the assumption that investment opportunities do not disappear if not undertaken immediately and that investment in physical capital is irreversible, confers a non-negative (call) option value to the liquid asset even in the presence of risk neutrality.*

proof See Appendix 1.

The option value that holding the liquid foreign asset acquires in such circumstances has previously been recognized by Dornbusch (1991a) and Van Wijnbergen (1985) and it is discussed with more detail in Laban (1991b).

Extending the model to allow for some source of heterogeneity among investors or projects (Laban (1991a)), while not affecting the main results, introduces the possibility of additional equilibria with intermediate levels of capital repatriation during the transition. In this case, while the equilibrium with the highest level of first period investment continues to Pareto-dominate the other equilibria, it will in general no longer be efficient since individual investors do not internalize the effect of their decision on the likelihood of a policy reversion. This inefficiency gives rise to a second role for active government intervention: even if the economy is initially at the optimistic equilibrium, welfare can be increased by inducing small deviations from equilibrium and thereby overcoming the *under-investment* distortion. We now turn to a discussion of economic policy in the presence of coordination failure.

1.3 Economic Policy During the Transition

The rationale for government intervention is straightforward: by coordinating private expectations on the optimistic outcome policy can prevent the economy from getting trapped in the zero-investment equilibrium, thus overcoming the market economy's tendency to wait and hence accelerating the transition process.

This goal can either be achieved by increasing the return to domestic real capital in specific or in all states or by lowering the probability of program failure. The

former strategy relies predominantly on subsidies to investors, the latter works by limiting losses suffered by workers during the adjustment process, and preventing the burden of adjustment being borne by them from becoming or being perceived as politically unstable, which will ultimately limit the supply side response to the adopted policies. In assessing relative effectiveness, the financing implications of alternative policy programs must be explicitly taken into account.

1.3.1 Investment Subsidies to Early Comers

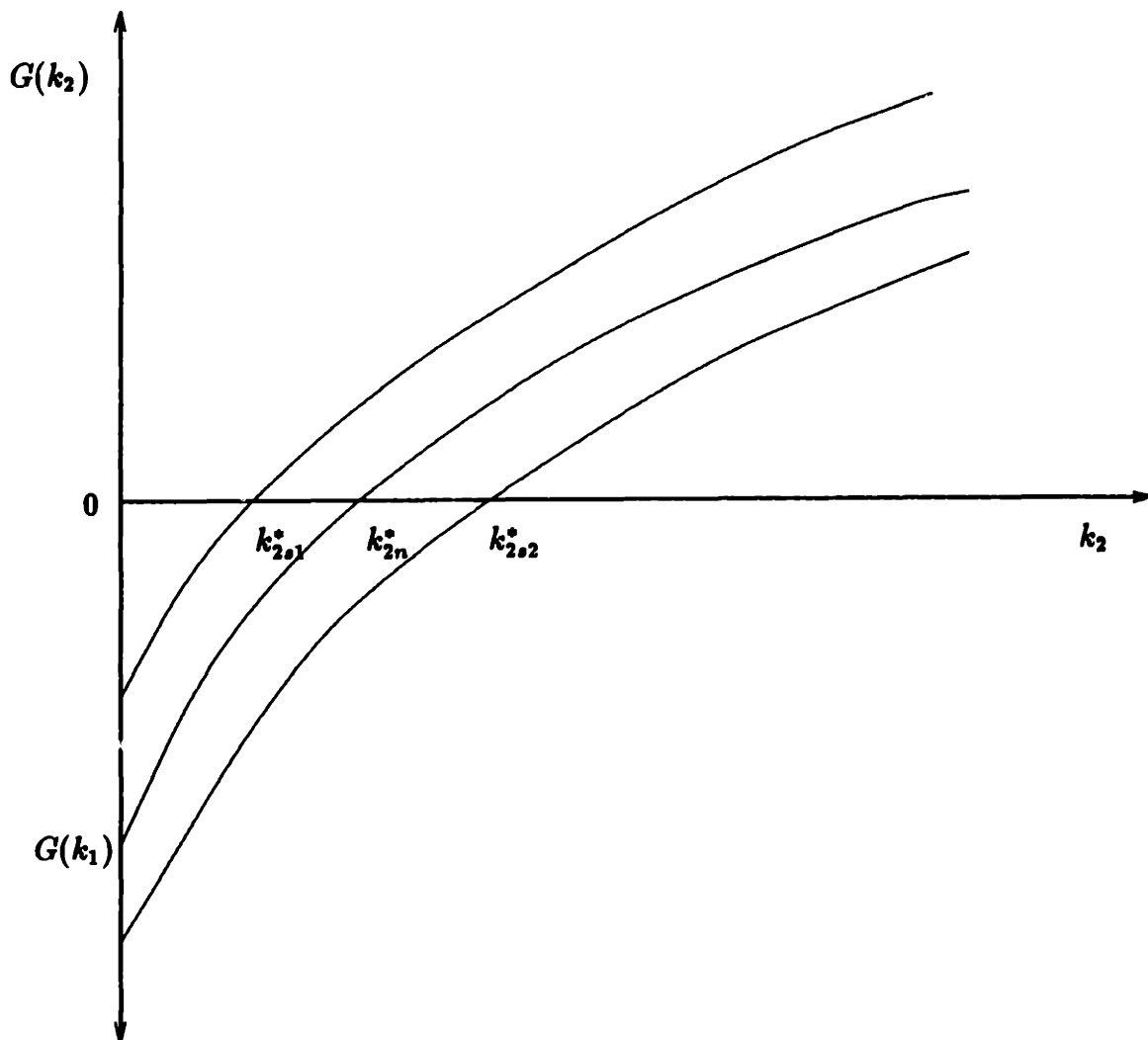
Assume that the government provides a subsidy at a rate s per unit of capital invested at home in the aftermath of stabilization, in terms of the numeraire, which is fully financed by a lump-sum tax levied on all agents at a rate t^{25} . The demand for nontraded goods is now equal to $C_N^w = L_N = \gamma L(1 - t) < \gamma L$ (the demand for home goods if no subsidy is provided) for any $0 < t < 1$. For any initial capital stock the subsidy will reduce the equilibrium real wage and raise the equilibrium gross return to domestic capital. The probability of policy continuation is thus given by $q_s(k_2, t) = H(w(k_2(t))(1 - t) - \underline{w}) < q(k_2)$ for any given k_2 and $t > 0$ and increases in t^{26} , since in addition to the initial drop in real wages due to fiscal contraction, workers' transitional disposable income is reduced even further as a result of reduction in private consumption of non-traded goods. Thus, for any given aggregate level of domestic capital in the noisy period, this *redistribution* of income toward capitalists increases the likelihood of program failure, lowering the expected return to investment. If the subsidy succeeds in attracting more investors, the *income* gain may however dominate the redistribution loss, increasing the *after tax* income of labor. The condition for the critical level of capital is now given by:

²⁵Holdings of foreign assets are exempt from taxation.

²⁶For any given k_2 and given that $t < 1$ and $F_{L_x k_2} > 0$

$$\frac{\partial q_s}{\partial t} = -h'(w(k_2) + \frac{\gamma(1-t)}{1-\gamma(1-t)} F_{L_x k_2} k_2) < 0$$

Figure 1-2: Investment Subsidies During the Transition



$$0 = G(k_{2s}^*) = [r_g(k_{2s}^*) + s - r^*] - \beta[(1 - q_s(k_{2s}^*))(r^* - r_b(k_{2s}^*))] \quad (1.17)$$

The effect of the subsidy on the threshold level of expected aggregate capital bringing about the optimistic equilibrium is ambiguous (Figure 1-2). While the subsidy by itself reduces the critical level, the tax required to finance the subsidy, by lowering the transitional real wage, increases the likelihood of a policy reversion and thus raises the critical level.

If the direct effect dominates, the critical level of aggregate capital declines ($k_{2s,1}^* < k_{2n}^*$), increasing the range on which only optimistic expectations are self-fulfilling. In

the extreme, subsidies may rule out the zero-investment equilibrium altogether so that only optimistic forecasts will prevail. Formally, the optimal subsidy ruling out the pessimistic equilibrium (s^*) is defined by $0 = G(k_1, s) = [r_p + s^* - r^*] - \beta[r^* - r_b]$, which is strictly positive given the boundary conditions for the existence of the zero-investment trap. The optimal discount equals the front-end premium required for investors to exercise the option to wait if the economy is initially trapped in the pessimistic equilibrium.

If, on the other hand, the indirect effect on the probability of policy reversion dominates the direct effect, the threshold level increases ($k_{2,2}^* > k_{2n}^*$) and thus the range on which optimistic expectations dominate decreases. If popular support for the adjustment program is highly sensitive to the real wage, the introduction of subsidies financed by labor may thus achieve the opposite of the initial objective. In the extreme, subsidies may eliminate the optimistic equilibrium altogether and trap the economy permanently in a low investment state. The latter possibility suggests caution regarding a reflex reliance on investment subsidies in politically vulnerable economies.

1.3.2 The Role of Foreign Financing

The role of foreign financing and adequate foreign-exchange reserves in explaining several successful stabilization has long been recognized (see, for example, Dornbusch (1991b), Morales (1991) and Liviatan (1988)). Foreign assistance can help transitional economies to attain the optimistic equilibrium both by providing financial support and by transmitting a signal of confidence to investors.

Presently, as justified in the introduction, it is very unlikely that many Latin American economies in the process of stabilization will be able to count on massive inflows of foreign capitals to support their adjustment programs. Aside from private capital reflow, debt relief or suspension may constitute the only source of financing available for these countries to restore growth in the short run²⁷.

²⁷According to Morales (1991), the suspension by Bolivia of its external debt service with commercial creditors was equivalent to a self-administered foreign loan.

Foreign aid and (long term) loans provide financing for supply side policies such as investment subsidies without generating the potentially offsetting effects on domestic income distribution mentioned above. Alternatively, such funds can be used to provide compensation schemes for workers in the case of unexpectedly large transition costs, increasing disposable income in the worst case scenario and thus lowering the probability of a policy reversion²⁶. They may also finance public investment or social infrastructure, or allow central banks to accumulate foreign reserves (not considered here) which, by shielding the economy from adverse external shocks, can help build up confidence in the sustainability of the program.

To illustrate this point, suppose that the economy receives in the aftermath of stabilization a foreign grant or debt relief (which can be modelled here as a reduction in interest payments on foreign debt) which is used to finance an investment subsidy program or compensation scheme for workers during the transition. In both cases this implies an upward shift of the $G(k_2)$ locus in Figure 1-1, in the former case due to an increase in returns to investment and in the latter to an decrease in the probability of program collapse. In both cases the threshold level of capital required for the economy to converge to the optimistic equilibrium decreases, as does the range on which investors' scepticism dominates. In the best case scenario, the availability of foreign resources rules out the pessimistic equilibrium, so that the economy converges to the full-investment equilibrium with probability one for *any* positive expected aggregate level of capital repatriation.

The second beneficial effect of foreign financing (or an IMF Letter of Intent) arises from its signal of confidence by donors in the sustainability of the program which may, by coordinating private expectations on the optimistic equilibrium, actually be sufficient to bring about the high capital repatriation outcome. Similar effects can be brought about by IMF endorsement of policies (the Korean case) or highly publicized steps towards increased integration in the world economy. The prospective free trade agreement between Mexico and the US illustrates how an as yet unrealized but highly

²⁶The Bolivian Social Emergency Fund, a broad program of poverty alleviation financed by international donations, illustrates the case (Morales (1991)).

symbolic policy measure can dramatically change the attitude of foreign as well as of domestic investors.

1.3.3 Income Policies

We now analyze a second class of policies aimed at limiting the loss of disposable income suffered by workers during the transition, which, by reducing the likelihood of policy reversion, increases the expected return to domestic investment, and thus encourages capital repatriation. It may thus be in the best (collective) interest of entrepreneurs to raise workers real wage above their marginal value product during the transition period in order to ensure policy continuation.

This less familiar policy menu encompasses real wage stabilization via transfers from capital to workers, wage indexation²⁹ and social emergency funds.

To illustrate this point, suppose that the government subsidizes workers during the noisy period at a rate s_w , fully financed by a lump-sum tax on capital income at a rate t_w . For any k_2 the subsidy increases workers disposable income and thus their willingness to support the continuation of the program, since now the probability of the program succeeding is given by $q_{s_w}(k_2, s_w) = H(w(k_2)(1 + s_w) - \underline{w}) > q(k_2)$ for any $s_w > 0$. Furthermore, $q_{s_w}(k_2, s_w)$ increases in s_w . For any given level of first period capital repatriation the *redistribution* of income toward workers (due to the subsidy and the increase in private demand for home goods) increases the likelihood of policy continuation. The condition for the critical expected level of capital is now given by

$$0 = G(k_{2s_w}^*) = [r_g - t_w - r^*] - \beta[(1 - q_{s_w})(r^* - r_b)] \quad (1.18)$$

where all variables are evaluated at $k_{2s_w}^*$. Analogously to the investment subsidy, the effect of the labor subsidy on the threshold level of capital bringing about the

²⁹In assessing the desirability of introducing wage indexation schemes during stabilisation we must consider other complications (e.g, response to real shocks) not captured in the model. Nevertheless, we present an argument suggesting that under given conditions its introduction (in an optimal degree) may be beneficial, which is more likely the case when the political support for the program is initially very weak.

optimistic equilibrium is ambiguous³⁰: while the subsidy decreases it by raising the likelihood of policy continuation, the tax on capital, by lowering the transitional return to capital repatriation, increases it.

Laban and Wolf (1991), comparing the optimal subsidy to early comers with the optimal subsidy to workers for the case in which both rule out the pessimistic equilibrium, have shown that, at the margin, investors are indifferent between receiving compensation for bearing a higher risk of a policy reversion or paying a subsidy to workers to ensure a higher probability of continuation, since the optimistic equilibrium occurs with probability one in both cases.

1.3.4 Public Investment and Social Infrastructure

Public investment, specially if complementary to the private one (e.g., in infrastructure) by raising the profitability of domestic capital formation and social services by preventing workers from suffering excessive losses during the transition, may trigger a virtuous cycle allowing for a rapid restoration of growth.

Thus, not all fiscal contractions are the same and the *quality* of spending cuts is important: even though, a reduction in government's purchases of non-traded goods may be desirable, a reduction on public investment³¹ as well as in other social services³², especially if financed by foreign adjustment loans or aid, may not be so.

1.4 Conclusions

Evidence on post-stabilization economies suggest that getting the *fundamentals* right, although necessary, is not sufficient to ensure a prompt and costless resumption of growth. I show that uncertainty concerning the political sustainability of the stabi-

³⁰This ambiguity can be solved if the policy is funded with external resources, as discussed earlier.

³¹Public investment in Bolivia decreased from an average of 8.1% of GDP during the period 1980-83 to 3.1% for the period 1986-88 following the hyperinflation episode of 1984-85. In Mexico it has been decreasing constantly since 1986, at a rate that more than compensate the increase in private investment.

³²Dornbusch (1991b) and Morales (1991), recognize the importance of such programs in explaining the recovery of real income of workers in Bolivia. In Chile, as already mentioned, there was a significant reduction in social spending worsening the situation for those with lower income.

lization program may be a key factor keeping investors at bay. Uncertainty about future policies coupled with the irreversible nature of real investment confers an option value to liquid assets.

The positive externality going from the aggregate amount of asset repatriated in the aftermath of stabilization to the likelihood of policy continuation together with the positive feedback of a lower probability of collapse on the returns to domestic investment can generate multiple expectational equilibria. In particular, a *pessimistic* zero-repatriation trap and a Pareto-superior *optimistic* high investment equilibrium may co-exist.

The fact that individual investors do not internalize this externality, and the possibility of the economy getting trapped in the pessimistic equilibrium as a result of a coordination failure, provide a rationale for government intervention during the transition. Both *supply-side* policies (investment subsidies) and *income* policies (transfers to workers, wage indexation and social emergency funds) can bring about a shift to the good equilibrium. However, while policies financed by foreign transfers (or debt relief) and long term loans unambiguously reduce the likelihood of a policy reversion, domestically financed policies generally have a hidden offset working via changes in the income distribution that may reverse the original policy objective.

Chapter 2

Distributional Conflict, Financial Adaptation and Delayed Stabilizations

2.1 Introduction

Economists¹ have for a long time strictly abided by the paradigm of individual rationality. At the same time relatively little work has been done in developing an equally rigorous framework for understanding government behavior. Policy action has been usually understood to respond to the principles of social welfare maximization. A recent strand of literature has concentrated in the implications of the political process on policy making. This has improved substantially our understanding on how governments make decisions and why some actions which are difficult to justify from an economic point of view, may still be implemented. In particular, economists have for a long time been puzzled by the fact that countries often postpone the adjustment to policies which are unsustainable in the long run and/or socially inefficient.

In this paper we concentrate on the issue of inflation stabilization. Even though

¹This chapter is a joint paper with Federico Sturzenegger. We would like to thank Alberto Alesina, Roland Benabou, Vittorio Corbo, Alan Drasen, Rudi Dornbusch, Stan Fischer, Roberto Perotti, Joe Ramos and Salvador Valdes for helpful comments and discussion. The usual caveat applies.

long before stabilization is actually attempted there seems to be a widespread agreement on the economic costs associated with inflationary financing of large budget deficits, many countries nevertheless have been unable to implement in the early stages of the inflationary episode the needed fiscal adjustment measures which could have prevented the instability of the inflationary process.

It has been argued extensively (see, for example, Dornbusch et. al. (1991) and Alesina and Drazen (1989)) that even though from an economic point of view an early stabilization may be preferred, at moderate levels of inflation there is not enough political support for adjustment, since many individuals visualize the process as a negative sum game for *them*. Early attempts to stabilize are often blocked by different interest groups. As inflation reaches extremely high levels, the total disruption of normal economic life generates the required political support that will be the basis of a successful stabilization program. This line of argumentation suggests that an economic crisis (for example a hyperinflation) may be needed for an economy to attain stabilization².

Despite the extreme importance of this issue, there are very few formal models which try to explain why stabilizations are delayed without having to rely on the assumption of *irrationality* of the government or private agents. To date, the central contribution is that of Alesina and Drazen (1989), in which two groups with conflicting interests have to decide on the timing of stabilization. In their model, adjustment is postponed as a result of a war of attrition between these groups and which do not know how costly inflation is for their opponent (i.e. there is asymmetric information). As inflation hurts both parties there is an incentive to stabilize, but at the same time whichever group moves first is assumed to pay a higher fraction of the increase in taxes needed to balance the budget. Thus, it may be optimal for each group to delay stabilization in an attempt of inducing the opponent to "give in" first (therefore revealing his type), and consequently imposing on him a higher share of the stabilization costs. Time dependency is incorporated in the model, because as

²The benefits of economic crisis in order to build the necessary support for introducing major reforms is discussed in Drazen and Grilli (1990) and Hirschman (1985).

times goes by without any group conceding, information is being revealed about the possible types of the other agent.

We believe this story is unappealing since the way in which inflation affects different groups is well known by all agents. A main tenet since the Baumol-Tobin hypothesis regarding income elasticity of money demand has been the strong regressivity of the inflation tax. In addition, the costs of inflation are not stationary but change over time, both in its intensity and in its distribution across agents. Access by some agents to financial adaptation (in general those with higher income) will, for a given level of required seigniorage collection, increase through time the average rate of inflation and redistribute its burden increasingly to those who do not engage in this technology. Financial innovation therefore plays a critical role, by incorporating both time dependency into the framework and regressivity of inflation taxation (see, Sturzenegger (1991)), which implies that as time passes (i.e., stabilization is delayed) the poor will be progressively in a relatively weaker bargaining position and may end up accepting conditions that they were not willing to accept before.

The Alesina-Drazen setup also rules out any possibility of negotiated settlement among agents, which seems to be a central component of many successful stabilization programs and plays a critical role in the timing and characteristics of the implemented policies. Finally they disregard the issue of failed attempts to stabilize and of program collapses, two extremely common features of stabilization experiences and which are central in evaluating the benefits of attaining stabilization.

In deciding when to stabilize the dominating source of uncertainty is that concerning the post-stabilization payoffs for the different parties. This uncertainty may arise because of post-stabilization instrument uncertainty, (see for example, Alesina and Cukierman (1991)), or because of uncertainty on the resolution of the negotiation process. Dornbusch (1991), incorporates instrument uncertainty into the evaluation of the ex-ante benefits of stabilization or of economic reform. Fernandez and Rodrik (1990), for example, incorporate payoff uncertainty and show that it may generate a bias towards the *status quo*, with people voting down policies which are overall welfare improving due to the risk concerning the future position of each agent. Unfortunately,

even though these setups can derive a justification for government *inaction*, they do not introduce any kind of time dependency, and consequently cannot generate delays.

A well recognized stylized fact associated with delayed stabilizations is that the situation has to deteriorate enough, at least for some group(s), in order for stabilization to be attempted. For example, Maier (1975) discussing the German stabilization of the 1920's recognizes the importance of the high welfare costs associated with extreme inflation in inducing different groups to agree upon stabilization. The same has been argued with respect to the Bolivian experience in the 1950's (see Eder (1958)), and to the hyperinflation of the 1980's (see Morales (1991)) and for the post-war Argentinian experience (see Mallon and Sourrouille (1975) and Heymann (1991)).

As already mentioned, long before the adjustment program is actually implemented there seems to be a widespread consensus that it is economically beneficial to achieve stabilization, but in the political debate there is disagreement over how the burden of higher taxes and expenditure cuts should be allocated among the different groups. An extensive discussion of the importance of the distributional conflict in understanding the *policy-making* in the Latin American experiences with populist expansionary policy can be found in Sachs (1988). Several stabilizations were only achieved after the political consolidation of an interest group, the formation of national unity governments, or emergency powers being given to the government. For example, the successful stabilization of France in 1926 came together with the consolidation of power of the right. The Israel's stabilization of 1985 was attained with a National Unity government in power. In Mexico the *Pacto de Solidaridad* of December 1987 was central to achieve a sustained stabilization before annual inflation reached 200%. Dornbusch and de Pablo (1988) attribute the failure of Argentina to stabilize to political polarization and the inability of any party to consolidate its power. Heymann (1991) argues that underlying the successive stabilization failures in Argentina was a deficient tax system and the lack of a socially acceptable cut in expenditures. According to Morales and Sachs (1989), in Bolivia the *Pacto de Democracia* was central in allowing a negotiated and political supported reduction in the government deficit.

Another interesting feature which is common to several delayed stabilizations is the fact that before a successful stabilization there may be several similar but failed attempts. This may happen because some programs are implemented and then reversed or because plans are proposed but blocked by some groups or by the government. On the other hand, in many cases some of the group(s) end up accepting conditions that earlier they found unacceptable. In general it is the lower classes which, as they are increasingly hurt by inflation, eventually reduce their demands on the post-stabilization agreement. For example, the Israel's stabilization of mid 1985 was different from earlier failed attempts in that a heavier burden was placed on workers (see Alesina and Drazen (1989)). In Argentina, during the second Peronist government, the successive stabilization attempts during 1974-75 were increasingly biased against the lower income classes (see DiTella (1983)).

We model delayed stabilizations as the *rational* outcome of a distributional conflict among different socio-economic groups. Changes in economic policy, even though enhancing the overall efficiency of the economy, are often associated with redistribution of income. In our setup different groups have the possibility of blocking those changes in policy which are expected to affect them in a negative way. Two groups are assumed to bargain over the expected level of post-stabilization government spending. Stabilization is here associated with a shift from distortionary inflation financing to legislated taxation, which is efficient but subject to *ex-ante* instrument uncertainty. We think of this uncertainty as related not only to the technical process of tax collection but also to the ability of the government to enforce the agreed upon level of transfers. Since this tax reform reduces overall distortions it generates scope for agreement.

We show that the interplay of post-stabilization uncertain payoffs under risk aversion³, costly policy reversion and distributional conflict, may generate delays as well as changing conditions of stabilization in the presence of fully informed and rational agents.

³If there are fixed costs of attaining stabilization delay may still be achieved in the presence of risk neutrality.

In the initial stages of the inflation episode it may be an equilibrium strategy for both groups not to reach an agreement to stabilize and avoid distortionary taxation, since the costs of inflation may not compensate the risk of engaging in a negotiation with uncertain payoffs. Delay is incorporated through the time dependency introduced by the fact that some group finds optimal, in the presence of a positive inflation, to engage in financial adaptation. This process will on the one hand increase the rate of inflation and therefore the incentives to stabilize for both groups, but on the other, it will concentrate the burden of inflation on the poor. This redistribution of costs induces them to accept conditions that they were not prepared to accept before. If the financial adaptation process is deep enough that it leads to extremely high rates of inflation associated with high welfare costs it may well be the case that even though it was not optimal to stabilize in the first period it may be so now.

So financial adaptation may in some cases be beneficial in the sense that it may trigger the *economic crisis* required to build the political consensus for a successful stabilization⁴. Thus, we formalize the idea, which until now was regarded as *irrational*, that stabilization will be delayed until “things get really bad”.

On the other hand, the fact that one of the group may *ex-post* realize that they are made worse off with stabilization opens the possibility for collapses of stabilization programs. This optimal reaction should be incorporated in deciding how desirable is it to stabilize. We show that the possibility of policy reversion, at some cost, will increase the likelihood of attaining stabilization in the early stages of the inflationary process, since it reduces the irreversibility associated with the fiscal reform.

2.2 The Model

Lets assume a two period economy⁵ populated by two fully rational representative individuals or social groups, called poor (p) and rich (r). These groups differ in two

⁴It is important to mention that in assessing the desirability of financial innovation we are here only concerned with short run stabilization issues and not with long run growth. On this last topic see Dornbusch and Reynoso (1989).

⁵The model can be easily extended to have an infinite horizon.

dimensions: (i) in the fixed endowment, which they receive each period: e_p and e_r , respectively, with $e_p \leq e_r$, and (ii) the rich have access to a financial adaptation technology in the second period which allows them to reduce in an optimal way the base over which they pay the distortionary tax. For the poor this technology is assumed not available or too costly.

Both individuals are assumed to consume all their net endowments each period. At the beginning of each period they have to decide whether to stabilize and, if they do so, to bargain on the expected post-stabilization level of government expenditure (i.e., the expected level of income redistribution). Additionally, the rich have to decide in the second period on the optimal degree of (inefficient) financial adaptation if stabilization is not achieved, which implies convex costs in resources of $c(F)$, where F is the level of financial innovation, with $c'(F) > 0$, $c''(F) > 0$, $c(0) = 0$ and $c'(0) = 0$.

We conceptualized stabilization as a shift from distortionary taxation (inflation) to legislated taxation (i.e., balanced government budget). Any agreement to stabilize requires unanimity between both groups⁶. Initially, we assume that there is no policy reversion⁷.

There is perfect information and no pre-stabilization uncertainty. The only source of risk in the model is due to instrument uncertainty, i.e., agents do not know *a-priori* how effective the government will be in collecting legislated taxes and/or in enforcing the stabilization program agreed by both groups. We assume that this uncertainty is only resolved after the stabilization program has actually been implemented.

The model is solved by backward induction in three steps: first, for the second period, we find the optimal degree of financial adaptation chosen by the rich under the assumption that there is no agreement to stabilize (which gives the tax base over which the inflation tax in period two is collected) and, taking this as given, we find (if it exists) the range of agreement possibilities for this period. We then derive the

⁶The political set-up we have in mind is one where this tax reform can only be approved by Congress.

⁷Which is equivalent to assume that taxes can, after being legislated, also only be changed by unanimity.

conditions required for there to exist an empty set of agreement possibilities for the first period.

In the pre-stabilization economy the budget constraint for the government in each period is given by:

$$g = \pi(e_p + e_r - F). \quad (2.1)$$

Where g is government spending, which we assume to be completely transferred to the poor and completely financed by distortionary taxation on both agents. Even though ours is a non monetary economy we can make a parallel with inflation financing where g is seignorage collection and π the inflation tax rate. In the absence of stabilization the poor pay a proportion θ of the distortionary taxation and the rich bear $(1 - \theta)$, with

$$\theta = \frac{e_p}{e_p + e_r - F}, \quad (2.2)$$

where F , the part of the endowment of the rich that is exempt of distortionary taxation, is zero in period one and chosen optimally in period two, if stabilization is rejected.

This process of endogenous financial adaptation implies that for any given level of required seignorage collection the rate of inflation is endogenous and the burden of inflation falls more heavily on the poor as the rate of inflation increases (i.e., inflation taxation is increasingly regressive with time). Let $\phi(\pi) > 0$ for $\pi > 0$ represents the distortion cost of inflation for each individual, with $\phi'(\pi) > 0$.

Pre-stabilization, the utilities for poor and rich in each period are

$$U_p = U(e_p + g - \theta g - \phi(\pi)), \quad (2.3)$$

$$U_r = U(e_r - (1 - \theta)g - c(F) - \phi(\pi)), \quad (2.4)$$

where $U(\cdot)$ is assumed to be a constant absolute risk aversion utility function, with

risk aversion coefficient $\gamma > 0$. The redistribution scheme is assumed to be such that there is no class reversion (i.e. the post-transfer income of the poor is still smaller than that of the rich).

We assume only for simplicity that legislated taxes fall completely on the rich. The expected level of post-stabilization redistribution of income (g^e) is the result of a bargaining process between the two groups. Since there is instrument uncertainty agents will negotiate on the basis of expected values. We conceptualize instrument uncertainty in the following way

$$\tilde{g}^e = te_r - \alpha, \quad (2.5)$$

where α is a random variable with zero conditional mean and variance σ_α^2 . Thus expected transfers in the post-stabilization economy, conditional on the information available before stabilizing is $g^e = E(\tilde{g}^e) = te_r$.

If stabilization is achieved, expected utilities in each period, conditional on the information available prior to the implementation of the program⁸, are for each group, under the assumption of a small risk⁹, given by equations:

$$EU(e_p + \tilde{g}_p^e) = U(e_p + \bar{g}_p^e) \quad (2.6)$$

$$EU(e_r - \tilde{g}_r^e) = U(e_r - \bar{g}_r^e), \quad (2.7)$$

⁸The information set available pre-stabilization is the same in both periods since we have assumed that no information arrives prior to the implementation of the stabilization program.

⁹Under the assumption of a small risk we can approximate the expected utilities evaluated in the random levels of consumption by the utilities evaluated in their certainty equivalent. In the case of a quadratic utility function or normal distributed shocks this approximation will be exact. With an absolute risk aversion utility function the certainty equivalents for the poor \bar{g}_p^e and that for the rich \bar{g}_r^e can be obtained by taking a second order Taylor series expansion of both the certain equivalent and the true stochastic levels of consumption around their mean. For example, for the rich we have that

$$c_{er} - \bar{c}_r = \frac{U''(\bar{c}_r)}{U'(\bar{c}_r)} \frac{\sigma_\alpha^2}{2}$$

where c_{er} and \bar{c}_r are their certain and mean levels of consumption and $-\frac{U''(\bar{c}_r)}{U'(\bar{c}_r)} = \gamma$. Thus, $c_{er} = e_r - te_r - \frac{\gamma\sigma_\alpha^2}{2}$. The fact that the utility is of the CARA type implies that the certainty equivalents of equations (2.8) and (2.9) do not depend on the agent's net endowments.

with

$$\bar{g}_p^* = te_r - \frac{\gamma\sigma_\alpha^2}{2} \quad (2.8)$$

$$\bar{g}_r^* = te_r + \frac{\gamma\sigma_\alpha^2}{2}, \quad (2.9)$$

where $\frac{\gamma\sigma_\alpha^2}{2}$ is the risk premium both agents are willing to pay to avoid uncertainty concerning the outcome of the stabilization program (i.e. for the poor to receive \bar{g}_p^* and for the rich to pay \bar{g}_r^* with probability one).

PROPOSITION 2.2.1 (i) *Given the assumptions on $c(F)$ and $U(\cdot)$ and provided that*
(ii) $e_p > \phi'(\pi_2)$, *if stabilization is not achieved in period two (i.e., $\pi_2 > 0$) we have that*

- (a) $F^* > 0$ *(Positive equilibrium level of financial adaptation)*
- (b) $\theta_2 > \theta_1$ *(Regressive impact of financial innovation)*
- (c) $\pi_2 > \pi_1$ *(inflation endogenously increases for any given $g > 0$).*

Proof

In the beginning of period two if an agreement has not been attained the rich decide on the optimal level of financial adaptation, for which they maximize the following objective function:

$$\max_F U\left(e_r - g\left(\frac{e_r - F}{e_p + e_r - F}\right) - \phi(\pi_2) - c(F)\right), \quad (2.10)$$

with first order condition equal to¹⁰

$$U'(\cdot) \left[g\left(\frac{e_p - \phi'(\pi_2)}{(e_p + e_r - F^*)^2}\right) - c'(F^*) \right] = 0 \quad \text{If } F^* > 0 \quad (2.11)$$

For $F^* = 0$ to be a solution to this maximization problem, the first order condition should be non positive. Thus $F^* = 0$ can not be optimal, since as long as (ii) is satisfied the first term is strictly positive and $c'(F^*) = 0$, when evaluated at $F^* = 0$.

¹⁰The concavity of the utility function together with the convexity of $c(\cdot)$ are sufficient to insure that the second order condition is satisfied.

Given that $F^* > 0$ we can see from (2.1) and (2.2) that in the second period the base on which inflation is collected is reduced and thus, for any given required level of collection, inflation increases and the poor bears a higher proportion of it. **QED.**

If the optimal amount of investment by the rich on the financial innovation technology was equal to zero, our problem would be stationary, and thus delays would not be possible. If the conditions of proposition 2.2.1 are satisfied, the optimal degree of financial adaptation will be strictly positive and such that the marginal benefits of investing in this technology, given by the reduction in the inflation tax paid by him $U'(\frac{e_p \pi_2}{e_p + e_r - F^*})$ is equal to its marginal disutility, due to the increase in the distortion costs of inflation and the marginal cost of resources wasted by engaging in this technology $U'(\frac{\phi'(\pi_2)\pi_2}{e_p + e_r - F^*} + c'(F^*))$, as specified by equation (2.11).

PROPOSITION 2.2.2 *Provided that $\gamma\sigma_\alpha^2 \leq 2\phi(\pi_2) + c(F^*)$ there exist a non-empty set of possible agreements to achieve stabilization in period 2.*

Proof

The poor and the rich will want to stabilize in any period as long as their expected life time utility with stabilization is greater than that without stabilization. Using (2.8) and (2.9) in (2.6) and (2.7) we obtain that for both agents to be willing to stabilize in the second period it must be the case that:

$$U(e_p + g_{p2}^{\bar{}}) = U(e_p + t_2 e_r - \frac{\gamma\sigma_\alpha^2}{2}) \geq U(e_p + (1 - \theta_2)g - \phi(\pi_2)) \quad (2.12)$$

$$U(e_r - g_{r2}^{\bar{}}) = U(e_r - t_2 e_p - \frac{\gamma\sigma_\alpha^2}{2}) \geq U(e_r - (1 - \theta_2)g - c(F^*) - \phi(\pi_2)) \quad (2.13)$$

For there to be a non empty set of possible expected tax rates which both the rich and the poor will accept in order to achieve stabilization in period two we need that the maximum expected tax rate that the rich are willing to pay in order to stabilize be higher than the minimum expected transfer level the poor are willing to accept, i.e. $t_{2p} < t_{2r}$, where t_{2p} and t_{2r} satisfies (2.12) and (2.13) with equality (i.e., they

are indifferent between stabilization or the lack of it), respectively. Given that $U(\cdot)$ is a monotonic strictly increasing function the range on which both are willing to negotiate is given by

$$(1 - \theta_2)g - \phi(\pi_2) + \frac{\gamma\sigma_\alpha^2}{2} \leq t_2 e_r \leq (1 - \theta_2)g + c(F^*) + \phi(\pi_2) - \frac{\gamma\sigma_\alpha^2}{2} \quad (2.14)$$

Thus, for the existence of a non-empty agreement area we need that

$$\gamma\sigma_\alpha^2 \leq 2\phi(\pi_2) + c(F^*) \quad (2.15)$$

QED

The intuition behind this proposition is that for there to be incentives to stabilize it must be the case that the economy-wide gains from trade (reduction in distortions or waste) must compensate the risk premium of engaging in this reform with uncertain outcome required by both individuals. It is straightforward to show that the larger the distortion cost of inflation for the economy as a whole, the deeper the process of financial innovation, the lower the risk aversion or instrument uncertainty¹¹, the more likely that an agreement will be reached in the second period.

We assume that the equilibrium expected level of transfers $t_2^* e_r$ is obtained by a Nash bargaining: it divides the aggregate surplus from trade (stabilization) in one half for each interest group. So that $t_2^* e_r$, which belongs to the agreement set given by equation (2.14), is the implicit solution to

$$U(e_p + t_2^* e_r - \frac{\gamma\sigma_\alpha^2}{2}) - U(e_p + t_{2p} e_r - \frac{\gamma\sigma_\alpha^2}{2}) = U(e_r - t_2^* e_r - \frac{\gamma\sigma_\alpha^2}{2}) - U(e_r - t_{2r} e_r - \frac{\gamma\sigma_\alpha^2}{2}), \quad (2.16)$$

which by continuity of the utility function is unique. By the implicit function theorem it is easy to show that an increase in the cost of financial adaptation or in

¹¹A mean preserving spread of the distribution of α will reduce the area of possible agreements for the second period.

the pre-stabilization share of the inflation tax being paid by the rich will lead to an increase in $t_2^* e_r$. A decrease in the net transfers received by the poor previous to stabilization implies that $t_2^* e_r$ will be lower.

We have assumed that the distortion costs of inflation affects both groups equally by $\phi(\pi)$. Two possible extensions that do not change the qualitative result of proposition 2.2.2 are first, that inflation may redistribute increasingly the distortion costs towards the poor, and second, that as the rate of inflation increases, and the poor suffer a higher share of inflation taxation there is an increased cost for the rich, because in extreme inflation situation there is the risk of social unrest and uncertainty over property rights. The first extension, shifts the agreement area of proposition 2.2.2 towards the left, reducing the reservation level of expected taxes demanded by the poor in order to stabilize, and reducing the taxes the rich are willing to offer. The intuition is straightforward, inflation not only distributes the burden of the inflation tax on the poor, but also shifts the distortion costs towards them. Their demands on post-stabilization government spending decrease together with the worsening of their relative position. The second extension works in the opposite direction, i.e. moving the agreement area towards the right. If inflation increases the risk of social unrest, the rich are likely to try to avoid intense social conflict by being willing to finance a higher level of government spending. Similarly, the poor perceive that they are better off, and therefore demand a higher expected level of post-stabilization transfers.

To solve for the first period, we will assume that such a non-empty area of agreement for stabilization in the second period exists and that $t_2^* e_r$ prevails.

PROPOSITION 2.2.3 *Given that $U(\cdot)$ is strictly increasing and $F^* > 0$, if $\pi_2 > 0$ then $t_{2p} < t_{1p}$.*

Proof See Appendix B.

This proposition implies that the poor in period two, due to the process of financial adaptation, are willing to accept a lower expected level of transfers to agree upon stabilization than in period one. If stabilization is not attained in either period, the

poor will unambiguously be made worse off since they will bear a higher proportion of the inflation tax (i.e., they will receive a lower net transfer) and there will be an increase in the cost of distortionary taxation. Furthermore, it is easy to show that t_{1p} can be smaller or greater than t_2^* . This implies t_2^* may not be in the optimal set of negotiation of the poor in the first period.

PROPOSITION 2.2.4 *Given that $U(\cdot)$ is strictly increasing and $F^* > 0$ if $\pi_2 > 0$, then t_{1r} may be greater or smaller than t_{2r} .*

Proof See Appendix B.

If stabilization is not achieved the rich will improve their relative position in the second period due to the fact that they can optimally chose the level of financial innovation. For example, if we give all the bargaining power to the poor (i.e., $t_{2r} = t_2^*$), we have that $t_{1r} > t_{2r} = t_2^*$. The rich will be willing to pay in the second period less than in the first, which is equivalent to a strengthening of their bargaining position. The ambiguity arises from the fact that we are comparing his reservation level for period 1 (t_{1r}) with the Nash bargaining outcome for period 2 (t_2^*), which is, except when the poor have complete bargaining power in period 2, preferred to the reservation level of expected taxes for the rich in the second period (t_{2r}), so that by waiting (delaying) and not settling down at t_{1r} the rich can make a gain (the difference between t_{2r} and t_2^*), so that he may actually be willing to pay less in the first period.

PROPOSITION 2.2.5 *Even in the case that there exists a non-empty set of possible agreements to stabilize in period 2 and there is perfect information it may still be an equilibrium strategy to delay stabilization in period 1.*

Proof

The reservation expected level of transfers which leave the poor indifferent between both revenue collection systems in period 1 is given by t_{1p} and is the implicit solution to

$$(1 + \delta)U(e_p + t_{1p}e_r - \frac{\gamma\sigma_\alpha^2}{2}) = U(e_p + (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_p + t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}), \quad (2.17)$$

where δ is the discount factor. Equivalently the rich will be indifferent in period 1 between stabilization or the lack of it if

$$(1 + \delta)U(e_r - t_{1r}e_r - \frac{\gamma\sigma_\alpha^2}{2}) = U(e_r - (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_r - t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}), \quad (2.18)$$

where t_{1r} is the maximum expected level of transfers the rich are willing to offer the poor in order to stabilize in the first period. In order to prove this proposition we take a first order Taylor series expansion of both right hand side terms in equations (2.17) and (2.18) around their respective left hand side, under the assumption of small distance between the net endowments under different fiscal regimes¹². This allows us to obtain an approximate solution for t_{1r} and t_{1p} given by:

$$t_{1r}e_r(1 + \delta) = (1 - \theta_1)g + \phi(\pi_1) - \frac{\gamma\sigma_\alpha^2}{2} + \delta t_2^*e_r, \quad (2.19)$$

$$t_{1p}e_r(1 + \delta) = (1 - \theta_1)g - \phi(\pi_1) + \frac{\gamma\sigma_\alpha^2}{2} + \delta t_2^*e_r. \quad (2.20)$$

The area of possible agreements to obtain stabilization in period one is given by:

$$\frac{1}{1 + \delta}((1 - \theta_1)g - \phi(\pi_1) + \frac{\gamma\sigma_\alpha^2}{2} + \delta t_2^*e_r) \leq t_1^*e_r \leq \frac{1}{1 + \delta}((1 - \theta_1)g + \phi(\pi_1) - \frac{\gamma\sigma_\alpha^2}{2} + \delta t_2^*e_r). \quad (2.21)$$

For delayed stabilization in this case, we require $t_{1r} < t_{1p}$. Which implies from equation (2.21):

¹²This assumption gives sufficient (not necessary) conditions for the existence of stabilization delays. In Appendix C we provide an existency proof for the general case, based on a numerical simulation of our model.

$$\gamma\sigma_{\alpha}^2 > 2\phi(\pi_1) \quad (2.22)$$

QED.

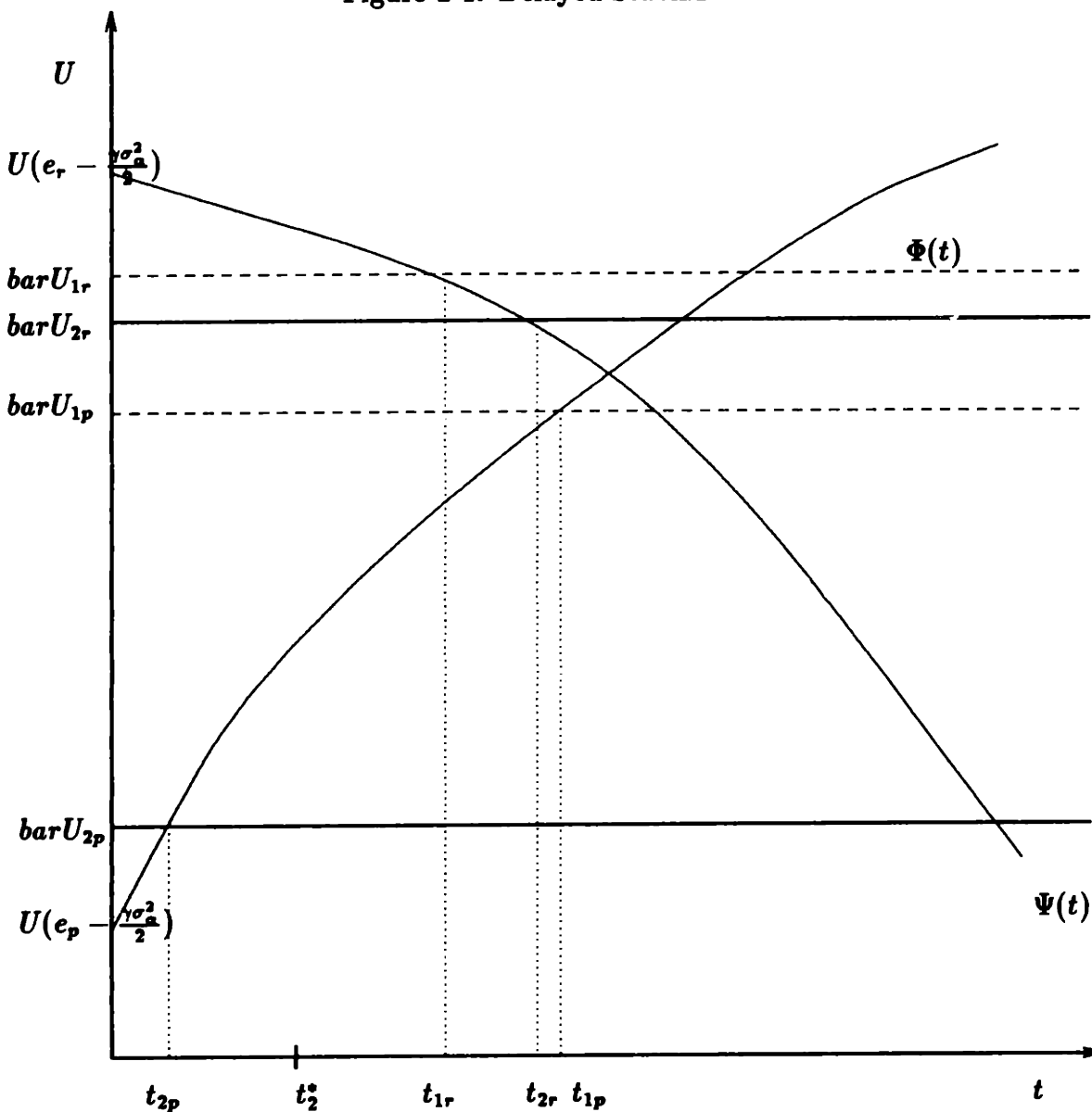
Given our assumptions the market economy will not stabilize in the first period even though agents anticipate a regime shift in the second period if the distortion costs of inflation are smaller than the risk of engaging in this process.

Delayed stabilization takes place when one of the two agents finds the offer made by the other at the beginning of period 1 not convenient (i.e., $t_{1p} > t_{1r}$) but that made in period 2 optimal (i.e., $t_{2p} < t_{2r}$). To some extent this result looks strikingly counter-intuitive: how can it be that if everybody knows the future evolution of the economy, and furthermore even when they anticipate that stabilization will be implemented next period they cannot agree in period one on a stabilization program? If inflation is distortionary would it not be optimal given that stabilization will be implemented, to do so from the beginning? The intuition relies on the fact that risk aversion incorporates a cost to stabilize and that agreements are at least partially irreversible¹³. In the second period the process of financial adaptation increases inflation if no agreement is reached. The distortion cost induced by inflation financing affects the opportunity set of agents in such a way that if condition (2.15) is satisfied, stabilization will then be implemented. This condition is likely to hold if the inflation is high.

Now consider the first period problem. The agents know that stabilization will take place in the second period, and furthermore they know the exact agreement that will prevail, and for the poor this implies recognizing that their relative position will be weakened. But the cost of engaging in the risky stabilization process is compared to the distortion costs of not stabilizing today but only tomorrow. If inflation today is small enough, the groups may find it not optimal to incur the risk of stabilization in the first period and getting stuck, with an ex-post “extremely” adverse outcome (i.e., with a realization for the level of transfers that does not belong to the equilibrium

¹³Until now we have assumed complete irreversibility. As we will show lately this result may still hold in the presence of costly “reversions”.

Figure 2-1: Delayed Stabilization



agreement set of period 1).

Immediately it is apparent that the result does not hold without risk aversion, given that in that case agents care only about expected values. As long as there are distortion costs of inflation the economy will stabilize from the start, as the agents can share the reduction of inflationary distortions in expected value.

Figure 2-1¹⁴ presents a graphical interpretation of the agreement areas. $\Phi(t)$ represents the utility from stabilization for the poor. It increases with the negotiated

¹⁴We kindly thank Roland Benabou for suggesting this graph to us.

transfers. If these transfers equal zero then their expected utility equals $U(e_p - \frac{\gamma\sigma_a^2}{2})$. $\Psi(t)$ is the utility for the rich in the stabilization equilibrium, it obviously decreases with the amount of transfers they have to finance. Similarly, if transfers are zero, the rich consume their whole endowment minus the risk premium, i.e. $U(e_r - \frac{\gamma\sigma_a^2}{2})$. The concavity of $\Phi(t)$ and $\Psi(t)$ derives from that of the utility function.

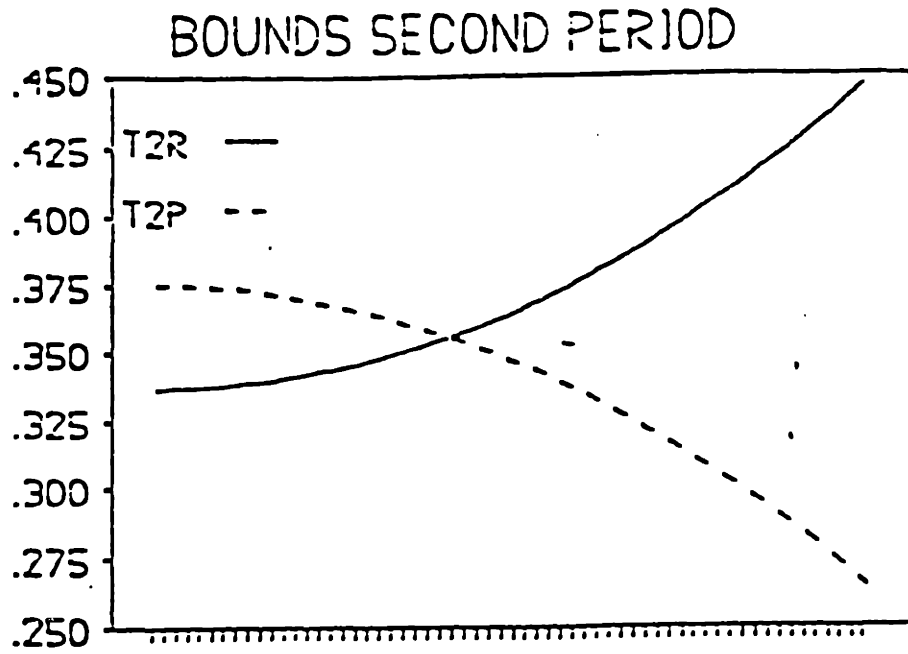
\bar{U}_{ip} and \bar{U}_{ir} is the utility in the case of no stabilization for poor and rich in period i . Consider, for example, the second period. The poor will accept any transfer which gives them a level of utility higher than \bar{U}_{2p} . In the figure this is depicted as all t above t_{2p} . The rich accept all transfers below that which gives an utility equal to \bar{U}_{2r} . Given that t_{2r} is to the right of t_{2p} a non-empty agreement set exists. The agreed upon level of transfers is t_2^* , previously defined.

Consider now period 1: from proposition 2.2.3 we know that t_{1p} is to the right of t_{2p} . By proposition 2.2.4 we know that t_{1r} is to the right of t_2^* and to the right or left of t_{2r} . Under the configuration of the figure $t_{1r} < t_{1p}$, i.e. that the transfer the rich are willing to pay is smaller than the minimum the poor are willing to accept. The agreement set is empty in the first period: there is delay.

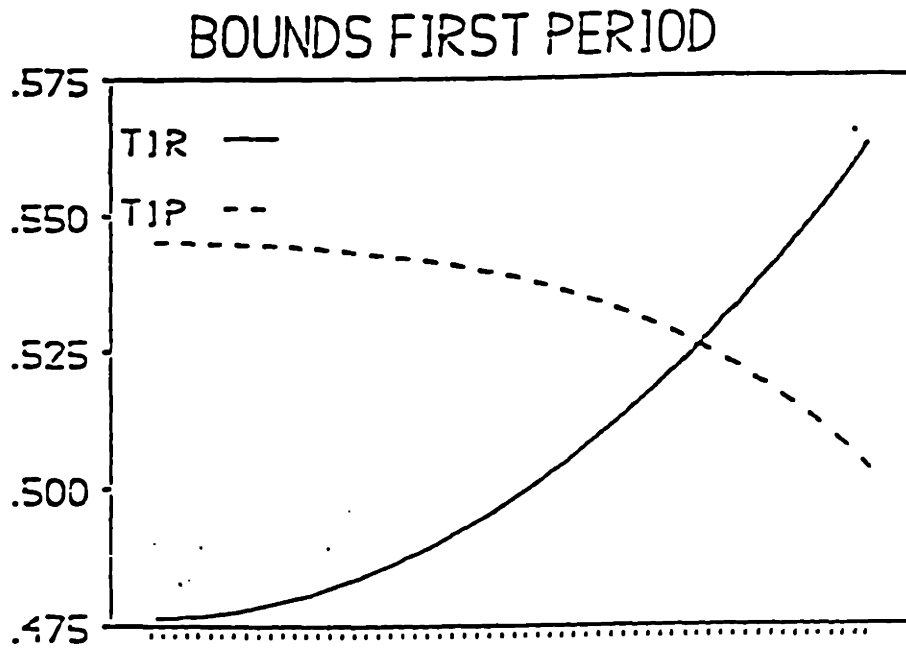
Further intuition is provided by some numerical simulations. Consider a change in the variance of fiscal policy, σ_a^2 , as shown in Figure 2-2. As we move to the right, instrument uncertainty decreases, making stabilization more appealing for both groups. The upper panel shows the offers of poor and rich in the second period. The lower panel shows the corresponding offers in the first period. If the offer of the rich is larger than those of the poor, stabilization is implemented in that period. The figure shows that initially for high enough variance (risk) the economy does not stabilize, either in the first or second period, with the demands of the poor exceeding the offers of the rich. Eventually the economy finds optimal to stabilize in the second period but stabilization remains not optimal in the first. For the variance of fiscal policy sufficiently low, stabilization becomes convenient even in the first period. The example, shows a clear pattern, in which the stabilization choice follows several stages, with an intermediate phase with policy delays.¹⁵

¹⁵Similar results can be obtained for comparative static of other parameters of the model, such

Figure 2-2: An Increase in Instrument Uncertainty and The Timing of Stabilization



Instrument Uncert.



Instrument Uncert.

2.3 The Social Planner Problem

The previous section developed a model in which the political equilibrium generates delays in the implementation of stabilization policies. We discuss now how that solution changes if we consider a central planner who maximizes a weighted sum of the individual utilities of agents in the economy and is subject to the same instrument uncertainty than the market economy but which is not subject to the distributional conflict pressures of the decentralized economy¹⁶: In the decentralized economy it would be optimal, if financial innovation was not possible, for the poor to set the level of net transfers equal to e_r . For the rich, if the financial adaptation technology was costless, it will be optimal to set $F = e_r$. Both corner solutions are prevented since financial adaptation is present but costly. The solutions will be different because the central planner will internalize the effects of financial adaptation on the poor. When the rich decide on the optimal degree of financial innovation, they consider the savings of inflation taxation they are subject to relative to the costs of resources $c(F)$ and the increase in the distortion cost they suffer due to this action. For the social planner the savings for the rich are just a transfer from the poor, therefore, after appropriate weighting, he will be left with the net distortion costs of inflation and the cost of resources wasted by investing in the financial innovation technology. In general the social planner's choice of financial adaptation will be different than that from the market economy.

In order to concentrate on the same issues considered in section 2.2, we take into account the case where the central planner has the utility function:

$$W = w_p(u_p^1 + \delta u_p^2) + w_r(u_r^1 + \delta u_r^2), \quad (2.23)$$

where the weights are such that the transfers in the pre-stabilization market economy (g) maximizes W , i.e.:

as the amount of government spending and the costs of financial adaptation. In all cases the results are available upon request.

¹⁶Notice that either a risk neutral social planner or one which does not face instrument uncertainty would stabilize immediately, as was the case in the political equilibrium.

$$w_p u'_p(g) = w_r u'_r(g), \quad (2.24)$$

where the marginal utilities correspond to those specified in Section 2.2 and are evaluated at net transfers for the first period. The central planner chooses the level of financial adaptation and how to finance these transfers.

The central planner in deciding the level of financial adaptation in the second period maximizes W respect to F :

$$\frac{\partial W}{\partial F} = \delta((w_p u'_p - w_r u'_r)(-\frac{\partial \theta_2}{\partial F} g) - (w_p u'_p + w_r u'_r) \phi' \frac{\partial \pi_2}{\partial F} - w_r u'_r C'(F)) \leq 0, \quad (2.25)$$

where the utilities correspond to those in the second period, with strict inequality holding in the case where the optimal degree of financial adaptation is zero. The last two terms of equation (2.25) are negative and represent the net loss for society of the process of financial adaptation. On the one hand it increases the rate of inflation therefore increasing the distortions losses for the economy. Secondly, some resources are diverted to the financial sector, without any net benefit to society. The first term captures the transfer effect of the financial adaptation process. The only possibility for the optimal degree of financial adaptation chosen by the social planner to be greater than zero is if this first term is positive and large enough to compensate the other two. But $\frac{\partial \theta_2}{\partial F} > 0$, so for the first term to be positive it is required that the marginal utility of the poor be smaller than that of the rich. But from (2.24) the first term vanishes and (2.25) holds with strict inequality. This implies that the optimal F chosen by the central planner is equal to zero, regardless of weights.

In this case the central planner does not engage in financial adaptation, and therefore the equilibrium inflation rate is identical across periods. The condition for policies will then be time invariant and no delays are possible: either she stabilizes in the first period, or stabilization is not implemented at all. This is a stark difference with the political equilibrium.

The central planner will stabilize if:

$$u(e_p + \bar{g} - \frac{\gamma\sigma^2}{2}) + u(e_r - \bar{g} - \frac{\gamma\sigma^2}{2}) \geq u(e_p + \bar{g} - \phi(\pi_1)) + u(e_r - \bar{g} - \phi(\pi_1)), \quad (2.26)$$

where we have used the fact that both before and after stabilization the amount of transfers is given by \bar{g} (i.e., $\bar{g} = (1 - \theta_1)g = e_r t$). The left hand side of (2.26) is greater than the right hand side as long as:

$$\gamma\sigma_\alpha^2 < 2\phi(\pi_1). \quad (2.27)$$

Notice that the central planner compares the risk premium $\gamma\sigma_\alpha^2$ with the distortion cost generated by the inflation rate in the *first* period.

It is likely that the social planner would find himself in a situation where he is stuck in a low inflation equilibrium, not finding optimal to stabilize (i.e. $\gamma\sigma_\alpha^2 > 2\phi(\pi_1)$) but where the rate of inflation is constant through time implying that (2.27) will never hold. The condition for stabilization for the central planner is the same as for the political equilibrium in the first period, but the later eventually may implement stabilization, because if the financial adaptation process is deep enough it will increase the rate of inflation to a point where a consensus is reached on the benefits of stabilization.

2.4 Program Collapses

The previous sections assumed implicitly that if a program is implemented no policy reversion was possible. This was justified by the fact that the realization of the random variable α benefits one group *ex-post*, and therefore this group would block any further changes in the implemented policy. In this section we extend our model to allow for the possibility that *ex-post* if the outcome is sufficiently bad for some group it will be in a position to undo the fiscal reform.

Assume initially that the two groups can induce a reversion of the policy in the case in which the outcome of α exceeds those which induce a gain for both groups (i.e. does not belong to the agreement set). Furthermore, suppose that there are no

costs of reversion. It is easy to show that in this case stabilization will always be attempted, since assuming that reversions are costless is equivalent to assuming that agents can freely observe (experiment) the realization of α . Once risk is eliminated we obtain that stabilizations is never delayed, because only the welfare gains of distortion reduction remains.

Nevertheless, the collapse of a stabilization program is not costless. A time lag usually takes place between the realization of the random variable and the response of the corresponding group. We capture this fact by assuming a time lag between the possibility of reversal and the implementation of the stabilization program. This framework, keeps the equilibrium described earlier for period two unchanged, given that no reversals are possible within the same period. For period one, the agreement area is obviously affected by the possibility of collapses. The previous condition (2.17) and (2.18), is now replaced for the poor and the rich by:

$$U(e_p + t_{1pc}e_r - \frac{\gamma\sigma^2}{2}) + \delta\tilde{U}_p = U(e_p + (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_p + t_2^*e_r - \frac{\gamma\sigma^2}{2}), \quad (2.28)$$

$$U(e_r - t_{1rc}e_r - \frac{\gamma\sigma^2}{2}) + \delta\tilde{U}_r = U(e_r - (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_r - t_2^*e_r - \frac{\gamma\sigma^2}{2}) \quad (2.29)$$

The fact to notice is that $\tilde{U}_p \geq U(e_p + t_{1pc}e_r - \frac{\gamma\sigma^2}{2})$ and $\tilde{U}_r \geq U(e_r - t_{1rc}e_r - \frac{\gamma\sigma^2}{2})$ because $\tilde{U}()$ is the utility obtained in the second period and which *includes* the option of not persisting with the stabilization program, i.e. with t_1^* . Equations (2.28) and (2.29) immediately imply that $t_{1pc} \leq t_{1p}$ and $t_{1pr} \geq t_{1p}$. This implies that the area of agreement in the first period unambiguously increases due to the existence of the possibility of collapse. The intuition is straightforward: the uncertainty involved in the stabilization process was what generated the possibility of no agreement. Now in the first period, this uncertainty is strongly reduced, because an extreme realization of the random variable α can be reverted in the second period. The risk involved is therefore substantially smaller and consequently the incentive to stabilize becomes

bigger inducing a widening of the set of possible bargaining solutions in the initial stages of the inflationary process.

2.5 Conclusions

This paper shows that it is possible to understand delays in policy implementation as the result of distributional conflict between different interest groups in the presence of post-stabilization payoff uncertainty and costly policy reversion.

In section 2.2 we developed a model which highlighted the importance of instrument uncertainty coupled with risk aversion in a model where two groups have to agree on the level of government transfers. Delays were generated because stabilization implies a cost in terms of risky outcomes. In the first period inflation is moderate and therefore the costs of inflation are small. Agents cannot match their relative demands, and stabilization is not agreed upon. In the second period, the rich have access to a financial adaptation technology. The use of financial innovation increases the equilibrium rate of inflation if stabilization is not attained and redistributes the burden of inflation taxation to the poor. The increase in the level of inflation raises the costs of not reaching an agreement and stabilization is therefore more likely to occur.

Three well recognized stylized facts on delayed stabilizations are accounted for by our model. First, that things have to get "bad" before any action is taken. Hyperinflation, wars and political crises are usually a catalytic for change. Our model, gives a framework which allows to understand why this may be so without having to rely on irrational behavior of economic agents: only an extreme situation, e.g. an economic crisis, may trigger the necessary political consensus for reform.

Secondly, that as the rate of inflation rises, the relative position of the poor worsens. Progressively they are willing to accept less favorable conditions in order to stabilize. The contribution of this paper is to show that the knowledge of the future deterioration in their relative position may not be strong enough to change their present demands to a point in which stabilization is unambiguously immediately achieved.

In the third place, the fact that one of the groups may *ex-post* realize that they are made worse off with stabilization opens the possibility for collapses of stabilization programs. We show that the possibility of policy reversion, at some cost, will increase the likelihood of implementing stabilization in the early stages of the inflationary process, since it reduces the irreversibility associated with the fiscal reform.

Section 2.3 considered a central planner that faces the same instrument uncertainty but which disregards the distributional conflict of the market economy. The policy maker would avoid the use of financial adaptation, removing the time dependency from the model and ruling out delays. The centralized economy could therefore get stuck in a low inflation equilibrium, with the central planner not risking stabilization, but were things do not worsen through time. The political process would on the other hand, through the financial innovation process increase the rate of inflation, perhaps to the point where stabilization is finally implemented. The process of extreme inflation may then be beneficial for the economy, because it triggers the political support for radical reform. It is convenient to point out though that the relative positions of both groups would nevertheless be significantly different in the central planner's low inflation equilibrium than in the stabilization agreement achieved after an extreme inflationary episode.

Finally we consider the possibility of collapses, these by making the realization of the random variable less permanent or more easily reversible, increases the incentives for stabilization in the early stages of the inflationary process.

Chapter 3

Financial Innovation And The Stability Of Money Demand: Evidence From Argentina And Chile

3.1 Introduction

Since¹ the third quarter of 1984 the Chilean economy has experienced phenomenon similar to the one observed in the U.S. economy in the mid-70s, known as "the case of the *missing money*", after the famous paper by Goldfeld (1976). Between the third quarter of 1984 and the second one of 1986, Chile's real money balances (seasonally adjusted, real M1) decreased by 11%. In the same period, Gross Domestic Product grew by 12.3% and the short-term interest rate systematically decreased. Conventional money demands have proved to be unable to provide a consistent explanation of this behavior. Abnormal prediction errors of conventional money demand functions has been detected by Laban (1987), Larrain and Larrain (1988), Matte and Rojas

¹I would like to thank Ben Bernanke, Jose De Gregorio, Rudi Dornbusch, Stan Fischer, Felipe Larrain, Danny Quah, Diego Rodriguez, Federico Sturszenegger and Jeff Wooldridge for helpful suggestions and discussion. The usual caveat applies.

(1989) and Arrau and De Gregorio (1990).

The increasing empirical evidence coincide in suggesting that there was a downward shift in the long run transaction money demand for real balances in the third quarter of 1984. Conventional money demand equations systematically overpredict actual real money balances thereafter, which is the principal symptom of the *missing money* phenomenon. This fact is even more surprising if we consider the empirical regularity between business cycle and the performance of conventional money demands reported by Goldfeld for the U.S. economy: Given that this period is clearly one of recovery for the Chilean economy we will expect, according to this evidence, a systematical underprediction of the effective real money balances by estimated money demand equations.

Among the hypotheses of more acceptance as an explanation of this phenomenon for the U.S. economy is that of financial innovations and deregulations². For Chile, Larrain and Larrain associate the observed structural change in the money demand with the hypothesis of financial innovation. Matte and Rojas explain this unexpected drop of the real money by two effects. A transitory one associated with expectations of devaluation and increases in import tariffs which induced a speculative substitution out of money toward tradeable goods and assets denominated in foreign currencies. And a more permanent one associated with a shift in preferences toward other assets that substitute efficiently traditional money.

This last hypothesis is not inconsistent with the financial innovation one, since even if the drop in real money was induced by expectations of devaluation and changes in preferences, this portfolio adjustment was made possible, at least in part, by the development of the financial and monetary sectors with the adoption of multiple financial innovations. As a proxy for the gain of efficiency of the Chilean financial system we observe a significant reduction in the spread between nominal lending and borrowing rates, which averaged 22.7% in 1978, 9.4% in 1980 and 18.2% in 1982 and

²The belief that the process of financial innovation and deregulations has been responsible for producing a structural change in the money demand during the mid 1970s and another at the beginning of the 1980s has substantial empirical support. See for example, Roley (1985), Judd and Scadding (1982) and Goldfeld and Sichel (1990).

decline to 7.8% in 1985, 7.4% in 1987 and to 6.1% by 1988.

Inferences based on conventional money demand models also suggest, looking to prediction errors, that this downward shift was only temporary and that it was reversed after mid 1986, puzzling those who associate this shift in money demand with financial innovations, if we understand this process as an irreversible one³. However, this evidence is not conclusive against this hypothesis since an unexpected upward jump in the observed real money can just be, for example, a realization of an abnormal nominal money supply shock which can, at least in the short run, induce to an accumulation of real balances higher than the long run desired levels, once expectations adjust to reality. We see that only with few exceptions, the estimated money demands continue to overpredict the actual real money balances. Stability of money demand is recovered when *M1A* is used as the monetary aggregate (see, Matte and Rojas (1989)).

Equivalent evidence of instability of money demand is suggested by the time series-data for Argentina during the period of financial deregulations and capital account liberalization implemented by Martinez de Hoz during 1976-77⁴. By the end of the financial repression episode, real interest rates were significantly negative, which constituted an important means of financing the budget. With the financial reform there was a need for a change in the mode of financing the deficit, which involved a heavier reliance on bond financing, so that the government became a more important actor on credit markets, whose demand for funds in 1977 reached 10% of GDP. Also, the dramatic fall in the cost of holding interest-bearing money⁵ came together with a significant increase in the ratio of interest-bearing deposits to GDP⁶ and in the ratio

³The process of financial innovation is not necessarily irreversible. For example, financial institutions may choose in an optimal way the level of financial adaptation, which may depend among others in the rate of inflation. Thus, following a high inflation episode they may find it optimal to undo many of the innovations they previously introduced. See, for example, Dornbusch and Reynoso (1989).

⁴By late 1976, foreign exchange transactions were completely liberalized on capital account and in the third quarter of 1977 a banking and financial reform was implemented. See, for example, Dornbusch and de Pablo (1990) and Calvo (1986).

⁵The real ex-post interest rate on deposit which was -72.4% in 1975 decreased to -6.3% by 1977 and to -4.3% by 1980. Thus, the opportunity cost of holding interest-bearing money (measured by the negative real interest rate on deposits) fell around 80% from 1975 to 1978. See, Calvo (1986).

⁶Interest-bearing deposits as a fraction of GDP went from 4.7% in 1975 to 6.0% in 1977 and to

of $M2$ to $M1$.

Nevertheless, the break detected in the long-run money demand is at the end of 1976, before the implementation of the financial deregulations, but associated to the liberalization of the capital account and with the period in which the inflation rate attained its maximum level of the 1970s. This suggests that, in an attempt to avoid inflation taxation, private agents substituted away from non-interest-bearing money ($M1$), most likely to foreign currency (legally, now facilitated by the capital account liberalization or illegally), which dominated any other type of liquid investment during that period. Lately, with the liberalization of domestic financial markets the portfolio shift toward interest-bearing deposits came mainly from a reduction in foreign assets (see, Calvo (1986)).

Applying the cointegration approach to time series econometrics to the study of the transaction money demand for Argentina and Chile between 1974 and 1988, a stable long run *equilibrium* relationship between the narrowly defined stock of real money balances, interest rates or inflation rates and real output as a proxy of the real economic activity or volume of transactions is not consistent with the time-series data for either one.

Testing the hypothesis of structural change in the long run transaction money demand, I allow for a once-and-for-all *level* shift in the fourth quarter of 1976 for Argentina and in the third quarter of 1984 for Chile. For this purpose I introduced a data-based *dummy* variable into the regression and tested for the existing of a cointegrating vector (up to a shift)⁷. In this case I was not able to accept the null of non-cointegration.

In the case of Chile, the speculated reversion after 1986:III of this function to its pre-mid 84 level was not supported by the data. Thus the time series-data for Chile suggests a *permanent* downward *level* shift in the long run money demand after the third quarter of 1984⁸.

17.1% by 1980. See, Calvo (1986).

⁷A second approach could have been to test for cointegration before and after the hypothesized break. The problem is that, in the present case, it does not leave enough observations neither before nor after the break.

⁸Similar results are reported for the U.S. economy in the mid-70s by Hafer and Hein (1982), using

For Argentina, we could not reject the null of non-cointegration for the sub-periods 1974-85 and 1977-88. A break in money demand was detected at the end of 1976 (during 1985) associated with the liberalization of the capital account (the implementation of the Austral plan) and with the “endogenous financial adaptation” process due to the extreme inflation episode of the mid 1970s and 1980s. This evidence contradicts the findings by Melnick (1990) of a stable long run money demand function for Argentina for the period 1978-87.

The remainder of this paper is organized as follows: In section 3.2, I give a brief description of the model to be used. In section 3.3, I test for the existence of a stable long-run transaction money demand function for Chile and Argentina, for the period 1974 to 1988. Section 3.4, I derive some asymptotic convergence properties of the least-squares estimators of the parameters of the cointegration vector that are relevant for our study and section 3.5 concludes and summarizes the principal results.

In appendix D, I provide a description of the data. In appendix E, I present the results of a Monte Carlo type simulation experiment with 5,000 replications to derive the empirical distributions and confidence intervals for the statistics used in testing for cointegration in the presence of a *known* once-and-for-all *level* shift in the intercept of the *cointegration equation*. In this appendix, I also tabulated the critical values, for different significance levels, for the Sargan and Bhargava test for cointegration, for the case of constancy in the parameters of the cointegration equation, that are relevant for the present analysis.

3.2 The Model

In this paper I will concentrate on the estimation and analysis of a long run transaction money demand function for the Argentinian (Chilean) economy using quarterly data for the period 1974:I to 1988:I (1988:III)⁹. The transaction demand for real money

conventional money demand models.

⁹For Chile the necessary data for 1988:4 is actually available. This quarter is left out since it is the only observation, of the complete sample period in which Chile was under presidential elections. The results reported below are robust to the incorporation of this observation into the analysis, but

balances can be represented in terms of a Baumol-Tobin inventory model, which can be described as

$$m_t^* = F(b_t, TV_t, c_t) \quad (3.1)$$

where m_t^* denotes the desired stock of real money balances, b_t represents the real cost of transforming money in to other assets, TV_t stands for the volume of real transactions and c_t corresponds to the nominal rate of return on an alternative asset, all at time t . Due to the lack of precise measures of these theoretical variables, in empirical applications of equation (3.1) we require the choice of directly observed ones.

Given that this motive for demanding money gives emphasis to money as a *medium of exchange* the definition of money to be used is that restricted only to those means frequently used to carry out transactions. I will use $M1$ as the monetary aggregate, which is composed only by currency plus checkable deposits of the private non financial sector. This series was deflated by the consumer price index (CPI).

As a *prozy* for the real level of transactions I use the actual real GDP (y_t), under the assumption that the relation between both of them did not change significantly (i.e., it is stationary) over the period being studied. To represent the nominal opportunity cost of holding money I use the short term nominal rate paid by banks on 30-90 days deposits (r_t) for Chile and the inflation rate for Argentina. The components of $M1$, in both Argentina and Chile, earns no interest, so there is not an own-interest rate variable to be considered.

Given the difficulties associated with quantifying the real cost of transforming money into other assets¹⁰, as time deposits, it is commonly assumed to be constant over the estimation period. No one really believes in the reality of this assumption, but no convincing way of overcoming this drawback has been suggested.

The specification of the long run money demand to be used in this study is in the

the estimation error for this last quarter was around 25%. Much more significant than any other.

¹⁰It may include brokerage costs, cost of trips to the bank, the value of the time waiting in line to carry out the transaction, etc..

spirit of that suggested by Cagan (1956)¹¹,

$$\ln m_t^* = \beta_0 + \beta_1 \ln y_t + \beta_2 r_t, \quad \text{with } \beta_1 > 0, \beta_2 < 0 \quad (3.2)$$

In terms of this specification, any other potential explanatory variables are left out of the model or assumed constant. In particular, the real cost of transaction is replaced by a constant and associated with β_0 .

In the present model, financial innovation¹² can be conceptualized as a reduction in real transaction costs: It lower the real cost of transforming financial assets into money or we can finance the same volume of transactions with less money, once the financial sector has modernized. Thus, the introduction of financial innovations induce, *ceteris paribus*, a reduction in the desired quantity of real money balances being held.

It is important to mention, before proceeding, two potential problems that must be considered in any study of money demand if we want to be rigorous. In the first place, depending in the theoretical model being used, there is the eventually jointly endogeneity of real money, real output and interest rates. On the other hand, it is very likely that we will face a *measurement error* problem given that we are estimating the model using observed *prozy* variables instead of the true *theoretical* ones.

If our variables were stationary and ergodic, the OLS estimators of the coefficients of equation (3.2) would be biased and inconsistent, since both of these problems imply that the crucial orthogonality assumption between regressors and the error term implicit in least squares regression analysis may not be satisfied. Appropriate techniques to deal with these simultaneity and measurement error biases are then required. A common practice in almost every applied study of money demand equations has been neither to mention nor to test for them. As is shown in Phillips and Durlauf (1986) and in Park and Phillips (1988), conventional measurement error and simultaneity

¹¹Empirical evidence in favor of this specification for Argentina is presented by Melnick (1990) and for Chile by Corbo (1982), Larrain and Larrain (1988) and Matte and Rojas (1989).

¹²A potential definition of financial innovation is, everything that affects in a significant way the organisation of the financial markets. Thus, for example, the creation of time deposits, credit cards, mutual funds, electronic transference, etc. are expected to affect the demand for money.

bias do not generally arise in regressions between integrated processes.

3.3 A Stable Long-run Money Demand Function For Argentina and Chile: 1974-88

The first stage in testing for cointegration between a set of time-series variables is to determine the order of integration of each individual series. Using standard unit root tests¹³ (Dickey-Fuller (τ), Normalized Bias Dickey-Fuller (*NBDF*), Augmented Dickey-Fuller ($A\tau(4)$)¹⁴ and Normalized Bias Augmented Dickey-Fuller (*NBADF*)), which are reported in Table 3.1, we see that the evidence strongly support the null hypothesis that the *levels* of the log real GDP and nominal interest rates for Chile and of log real GDP and inflation rate for Argentina are well characterized by data-generating processes with a unit root ($I(1)$ processes), and that their *first differences* are well represented by stationary processes ($I(0)$ processes)¹⁵.

Therefore, since the regressors of our money demand functions are generated by $I(1)$ processes, the application of traditional least squares regression analysis to it will in general lead to misleading results. Their precise properties will depend, in a significant way, on whether the system is cointegrated or not.

To test for cointegration¹⁶ (i.e., test for the existency of a long run equilibrium relationship) between the money demand variables for Argentina (Chile) during 1974:I to 1988:I (1988:III), the cointegration regression expressed in levels

$$\ln m_t^* = \beta_0 + \beta_1 \ln y_t + \beta_2 r_t + \nu_t \quad (3.3)$$

is estimated by least squares. We then test whether our estimated residuals $\hat{\nu}_t$ are generated by an $I(1)$ process or not. The test of the null hypothesis that $\hat{\nu}_t$ has a unit

¹³See, Fuller (1976) and Dickey and Fuller (1979, 1981).

¹⁴For the Augmented Dickey-Fuller test 4 lags were used, but only those statistically significant were considered.

¹⁵All these results are robust for significance levels of 1% and 10%.

¹⁶An extended discussion of this subject can be found in Granger (1986) and Engle and Granger (1987).

Table 3.1: Testing For A Unit Root In The Log Real GDP, Nominal Interest Rate And Inflation Rate: 1974-1988

	τ^a	$NBDF^b$	$A\tau^a$	$NBADF^b$
Argentina				
Levels				
Log real GDP	0.16	0.01	0.05	0.01
Inflation rate	-2.30	-10.44	-1.11	-4.99
First differences				
Δ Log real GDP	-12.68	-81.52	-7.68	-52.98
Δ Inflation rate	-11.18	-75.87	-7.55	-88.21
Chile				
Levels				
Log real GDP	-0.82	-2.29	-1.53	-3.40
Nominal interest rate	-1.49	-4.52	-1.07	-3.32
First differences				
Δ Log real GDP	-7.53	-59.05	-5.54	-36.71
Δ Nominal interest rate	-8.12	-62.13	-9.63	-85.07
5% critical values	-2.93	-13.30	-2.93	-13.30

b and c: Fuller (1976), Empirical cumulative distributions of τ and of $T(\rho - 1)$, $H_0: \rho = 1$, for $T = 50$, Table 8.5.2 and 8.5.3, respectively, pages 371-3.

root (i.e., that $\ln m_t$, $\ln y_t$ and r_t are non-cointegrated) can be based, among others, on the *CRDW* (cointegrating regression Durbin-Watson), τ or $A\tau$ test statistics.

In testing for cointegration the *DF* and *ADF* tests were found to have more stable critical values than the *CRDW* test. The critical values for the *CRDW* statistic depend significantly on the number of regressors in the cointegration equation, see Engle and Yoo (1987) and Phillips (1986). This is not the case when used for testing for integration in an univariate process where they are exact, if there is not autocorrelation of higher order. Thus, inferences based on them must be made with caution. Exact critical values using Monte Carlo experiments for a given data-generating process (DGP) can be computed but they are not generally applicable to other experiments. Critical values for the *CRDW* test statistic for the case of two regressors, for a sample size of 50 observations and different significance levels are tabulated in appendix E.

Results for the standard model are reported in Table 3.2. The evidence fails to reject the null of non-cointegration for both, Argentina and Chile: time series-data does not support the existence of a stable long run money demand function for the narrowed defined stock of real money m_1 , as conventionally specified, for the period under consideration. Therefore, conclusions and inferences derived from past studies of money demand that have ignored the presence of a unit root in $\ln m_t$, $\ln y_t$ and r_t ¹⁷ and the non-cointegrated relationship among them, when assuming constant cointegrating parameters, are in general misleading.

In terms of the model presented in section 3.2 we can interpret this result as follows: If equation (3.1) correctly represents the long run transaction demand for money and if the real cost of transaction cannot be regarded as a constant, cointegration is expected to hold when we incorporate b_t or an observable proxy (after testing for a unit root in its DGP) to our model. In this case the exclusion of the *relevant* variable b_t prevents the rejection of the null of non-cointegration between the remaining variables¹⁸. Thus the statistic properties of our *misspecified equation* (3.2)

¹⁷Given that $\ln y_t$ and r_t are generated by $I(1)$ processes and that we assume that $\ln m_t^*$ is generated by equation (3.3), then $\ln m_t^*$ will also have a unit root.

¹⁸It is not necessarily true that excluding an integrated time series variable from a cointegrated system will prevent the remaining variables from being individually cointegrated.

Table 3.2: Testing For Cointegration Between Money Demand Variables For Argentina And Chile

	<i>CRDW</i>	<i>DF</i> (τ)	<i>ADF</i> (τ)
	Argentina		
Basic Model (74:I-88:I)	0.16	-2.53	-2.29
Basic Model (74:I-85:I)	0.19	-1.63	-1.34
Basic Model (77:I-88:I)	0.95	-3.48	-3.91
Dummy 1976:IV (74:I-85:I)	1.43	-4.85	-4.16
Dummy 1985:II (77:I-88:I)	1.34	-4.77	-4.38
	Chile		
Basic Model (74:I-88:III)	0.55	-3.38	-2.54
Basic Model-Dummy 1984:III-88:III	1.16	-5.16	-4.79
Basic Model-Dummy 1984:III-86:II	0.73	-4.01	-3.33
5% Critical Value			
Engle-Yoo ($N = 3$) ^a	0.96	-4.11	-3.75
Laban ($N = 3$) ^b	0.98	-4.36	-3.94

NOTES: a: Engle and Yoo (1987), $T = 50$, for 3 variables in the system, Tables 2, 3, 4, pages 157 and 158. For $N = 3$ and $T = 50$, the *CRDW* statistic critical value is tabulated in Appendix E.
b: Critical values tabulated in Appendix E.

are those presented by Phillips (1986) for the case of spurious regressions.

In this case, OLS estimators of the parameters of our model are inconsistent and have non standard distributions and the distributions of the regression t and F statistics actually diverge as $T \Rightarrow \infty$ and hence there are no asymptotically correct critical values for them. The Durbin-Watson statistic is shown to converge to zero as $T \Rightarrow \infty$ and R^2 to have a non-degenerated limiting distribution. Also standard hypothesis testing statistics as the LM , LR and Wald tests do not yield asymptotically χ^2 distributions.

On the other hand, the increasing empirical evidence supports the hypothesis of a downward *level* shift in the long run equilibrium relationship between real $M1$, interest rates and real GDP in the third quarter of 1984 for the Chilean economy. To test this hypothesis, I introduced a dummy variable into equation (3.3) and tested for cointegration in the presence of a known once-and-for-all shift in the intercept of the cointegration equation¹⁹,

$$\ln m_t^* = \alpha_0 + \alpha_1 D_t + \alpha_2 \ln y_t + \alpha_3 r_t + e_t \quad (3.4)$$

where D_t is equal to 0 between the first quarter of 1974 and the second one of 1984 and equal to 1 otherwise. Results are also reported in Table 3.2.

With the critical values tabulated by Engle and Yoo (1987), these results strongly reject the null of non-cointegration under this specification. However, if we account for a shift that is part of the *true* model we will tend to reject the null of non-cointegration more often with these values. Thus, if we want to be rigorous new critical values must be tabulated. This is done in Appendix E and the 5% critical values for the different test statistics are reported in Table 3.2. As expected they are larger (in absolute value) than those reported by Engle and Yoo, for the same DGP but assuming constant cointegrating parameters.

Our results are robust to these new critical values. Therefore, a downward shift

¹⁹To be able to remove the shock that produced this shift (e.g., financial innovation) from the noise function and model it as changes in the deterministic part of the model, we need to assume that it was not a realization of the underlying DGP of the different time-series variables considered. A further discussion of this exogeneity assumption can be found in Perron (1989).

in the long run *equilibrium* relationship among these variables in the third quarter of 1984 is supported by the time-series data for Chile. The estimated *equilibrium* equation is,

$$\ln m_t^* = -6.18 - 0.23D_t + 1.42\ln y_t - 0.05r_t, \quad T = 59 \quad R^2 = 0.89 \quad (3.5)$$

Standard errors are not presented since they are inconsistent and have degenerated asymptotic distributions.

In the case of Argentina, no stable relationship between these variables was found for the sub-periods 1974:I-85:I and for 1977:I-88:I, as can be observed in Table 3.2. Allowing for a break at mid 1976, D_t was set equal to 0 between the first quarter of 1974 and the third one of 1976 and equal to 1 otherwise, and we then tested for cointegration. The results, which are also reported in Table 3.2, show that a downward shift in the long-run money demand in the fourth quarter of 1976 is supported by the time-series data. If instead the break is assumed in 1977:IV, together with the deregulations of financial markets, we are unable to reject the null of non-cointegration. Furthermore, testing for a shift in money demand during 1985, D_t was set equal to zero until 1975:I and 1 otherwise. In this case the null of non-cointegration was rejected. The estimated *equilibrium* equation are for the sub-period 1974:I-85:I and 1977:I-88:I, respectively, given by

$$\ln m_t^* = -4.17 - 0.87D_t + 1.47\ln y_t - 2.36r_t, \quad T = 45 \quad R^2 = 0.84 \quad (3.6)$$

$$\ln m_t^* = -6.29 - 0.17D_t + 1.61\ln y_t - 2.68r_t, \quad T = 45 \quad R^2 = 0.72 \quad (3.7)$$

A central question is whether or not the OLS estimators of the parameters of the *equilibrium* equation will be consistent given the eventual failure of the least squares

assumption that requires the error term to be uncorrelated with the regressors, due to the potential jointly endogeneity of our right hand side variables and/or to a measurement error problem.

As it is shown in the next section, for the present case, if cointegration is satisfied and we prevent our regressors ($\ln y_t$ and r_t) from being individually cointegrated, OLS estimation procedures produce consistent coefficient estimates of the slope parameters which converge at a faster rate $Op(T^{-1})$ than in conventional regression theory, and that those of the intercept and of the dummy variable coefficient will also be consistent but convergence will be attained at the usual rate $Op(T^{-\frac{1}{2}})$. Results from testing for cointegration between our regressors indicates that we are not able to reject the null of non-cointegration between $\ln y_t$ and r_t for the Chilean economy ($DF(\tau) = -3.18$) nor for Argentina ($DF(\tau) = -3.62$), where the 5% critical value reported by Engle and Yoo (1987) is -3.67. Thus measurement error and/or simultaneity bias are not expected to arise in either case.

In the next section we also prove that if the *true* long-run equilibrium relationship between a set of cointegrated variables is subject to a known once-and-for-all *level* shift, as in equation (3.4), and we do not account for it but instead estimate by least squares a relationship like equation (3.3), we will still get consistent estimates of the *true* slope parameters which converge at the usual rate $Op(T^{-\frac{1}{2}})$, but the OLS estimator of the intercept will converge to a random variable with a non-standard asymptotic distribution. Additionally, assuming a stationary $AR(1)$ process for the *true* equilibrium perturbances e_t , Laban (1991c) shows that the estimated first order autoregression coefficient of the OLS residuals of the misspecified equation (equation (3.3)) and the estimated Durbin Watson (DW) statistic will converge asymptotically to random variables with non-standard distributions. Preliminary empirical simulations show that the distribution of the estimated $AR(1)$ coefficient is centered above the true value, and as the size of the omitted break increases this distribution degenerates at one. The estimated distribution of the DW statistic tends to be centered below its true value, and as the size of the break being omitted increases this distribution converges to a distribution with mass one at zero.

If we add these results to the generally poor power properties of tests for cointegration it can result almost impossible to reject the null of non-cointegration in finite samples. Therefore, the residuals of a cointegration equation can seem to be generated by an $I(1)$ process only as consequence of structural change in the deterministic part of the model that has not been accounted for.

To test for the speculated reversion of this function in Chile to its pre-shift level, I regressed equation (3.4) again with the dummy variable D_t but taking a value of one only between the third quarter of 1984 and the second one of 1986. As can be observed in Table 3.2, the null of non-cointegration cannot be rejected even with the critical values tabulated by Engle and Yoo. This result support the view that the downward level shift in the money demand equation can be associated with financial innovations.

A short run money demand function (which according to Granger's representation theorem has an *error correction form*) for Chile which is consistent with this specification is derived in Laban (1991d).

3.4 Testing For Cointegration In The Presence Of Structural Change

Let $\{y_t\}_1^\infty$ be a uni-dimensional time series generated by

$$y_t = \mu + \alpha D_t + \beta x_t + u_t, \quad (3.8)$$

with $\alpha \neq 0$ and where the random variable $\{x_t\}_1^\infty$ is generated by

$$x_t = x_{t-1} + v_t, \quad (3.9)$$

with x_0 (the initial value) any random variable, in particular a constant. The dummy variable D_t satisfies

$$D_t = \begin{cases} 0 & \text{from } t = 1, 2, 3, \dots, T_b \\ 1 & \text{from } t = T_b + 1, \dots, T \end{cases} \quad (3.10)$$

where $T_b = \lambda T$ and T is the sample size. We define $w'_t = (u'_t, v'_t)$ and we assume that the partial sum process $S_t = \sum_1^t w_j$ constructed from the innovation sequence $\{w_t\}_1^\infty$ satisfies a multivariate invariance principle. More specifically, if for $r \in [0, 1]$ we define

$$X_T(r) = T^{-\frac{1}{2}} S_{[Tr]}, \quad (3.11)$$

then we require

$$X_T(r) \Rightarrow B(r), \quad \text{as } T \rightarrow \infty. \quad (3.12)$$

The symbol " \Rightarrow " implies weak convergence of the associated probability measures, and $B(r)' = (B_u(r), B_v(r))$ is a 2-vector Brownian motion with covariance matrix

$$\Omega = \begin{bmatrix} \sigma_u^2 & \sigma_{uv} \\ \sigma_{uv} & \sigma_v^2 \end{bmatrix} = \lim_{T \rightarrow \infty} T^{-1} E(S_T S_T') = \Sigma + \Lambda + \Lambda', \quad (3.13)$$

where $\Sigma = \lim_{T \rightarrow \infty} T^{-1} \sum_1^T E(w_t w_t')$ and $\Lambda = \lim_{T \rightarrow \infty} T^{-1} \sum_{t=2}^T \sum_{j=1}^{t-1} E(w_j w_t')$. For simplicity, we further assume that $\{w_t\}$ is strictly stationary and ergodic with finite fourth-order moments. Thus the time series $\{x_t\}$ is integrated of order one $I(1)$ and, with the assumption of stationarity, $\Sigma = E(w_1 w_1')$ and $\Lambda = \sum_2^\infty E(w_1 w_j')$. Additionally, we presume none of the common exogeneity conditions and allow for contemporaneous correlation of the form $E x_t u_t' \neq 0$ ²⁰. The model defined by equations (3.8) and (3.9) clearly implies that the time series $\{x_t\}$ and $\{y_t\}$ are cointegrated in the sense of Engle and Granger (1987).

From Phillips (1986), Park and Phillips (1988) and Perron (1989) we know that

²⁰For our results to hold in the case of a multi-dimensional $\{y_t\}$ and/or multiple regressors $\{x_t\}$ we further require to prevent $\{y_t\}$ or $\{x_t\}$ from being individually cointegrated. See, Phillips (1986).

$$T^{-\frac{1}{2}} \sum_1^T x_t \Rightarrow \int_0^1 B_v(r) dr \quad (3.14)$$

$$T^{-2} \sum_1^T x_t^2 \Rightarrow \int_0^1 B_v(r)^2 dr \quad (3.15)$$

$$T^{-\frac{1}{2}} \sum_1^{T_b} x_t \Rightarrow \int_0^\lambda B_v(r) dr \quad (3.16)$$

$$T^{-1} \sum_1^T x_t u_t \Rightarrow \int_0^1 B_v(r) B_u(r) dr + \Delta_{uv} \quad (3.17)$$

Suppose that instead of estimating the model defined by equations (3.8) and (3.9) we do not account for the structural change in the constant term and we estimate by least-squares the following *misspecified* model

$$y_t = \gamma + \delta x_t + w_t, \quad (3.18)$$

with the random variable $\{x_t\}$ being generated by equation (3.9). We can thus derive the following set of propositions. For notational convenience we use B_v and B_u instead of $B_v(r)$ and $B_u(r)$, respectively.

Thus if the true model is defined by equations (3.8) and (3.9), the least-squares estimators $(\hat{\mu}, \hat{\alpha}, \hat{\beta})$ satisfies:

$$T(\hat{\beta} - \beta) \Rightarrow \frac{\lambda(1-\lambda)(\int_0^1 B_v B_u dr + \Delta_{uv}) - \lambda \int_0^1 B_u dr \Psi + \int_0^\lambda B_u dr \Pi}{\lambda(1-\lambda) \int_0^1 B_v^2 dr - \lambda \int_0^1 B_v dr \Psi + \int_0^\lambda B_v dr \Pi} \quad (3.19)$$

where $\Psi = [\int_0^1 B_v dr - \int_0^\lambda B_v dr]$ and $\Pi = [\lambda \int_0^1 B_v dr - \int_0^\lambda B_v dr]$. Lets define $T(\hat{\beta} - \beta) \Rightarrow \eta$.

$$T^{\frac{1}{2}}(\hat{\mu} - \mu) \Rightarrow \frac{\int_0^\lambda B_u dr [(1-\lambda) \int_0^1 B_v^2 dr - \int_0^1 B_v dr \Psi] + (1-\lambda) \int_0^\lambda B_v dr (\int_0^1 B_v B_u dr + \Delta_{uv})}{\lambda(1-\lambda) \int_0^1 B_v^2 dr - \lambda \int_0^1 B_v dr \Psi + \int_0^\lambda B_v dr \Pi} \quad (3.20)$$

Lets define $T^{\frac{1}{2}}(\hat{\alpha} - \alpha) \Rightarrow \pi$.

$$T^{\frac{1}{2}}(\hat{\alpha} - \alpha) \Rightarrow \frac{1}{(1-\lambda)}[\pi + \eta \int_0^1 B_v dr + \int_0^1 B_u dr] \quad (3.21)$$

Thus least-squares estimation procedures produce consistent coefficient estimates of the slope parameters which converge at a faster rate $Op(T^{-1})$ than in conventional regression theory, and that those of the intercept and of the dummy variable coefficient will also be consistent but convergence will be attained at the usual rate $Op(T^{-\frac{1}{2}})$.

These asymptotic properties can be obtained by deriving the OLS estimators of the parameters of equation (3.8), normalizing by some power of the sample size and applying the weak joint convergence of partial sums specified by equations (3.14) to (3.17).

Furthermore, provided that the true model is that defined by equations (3.8) and (3.9) and that the above assumptions are satisfied, the least-squares estimators of the parameters of the misspecified equation (3.18) $(\hat{\gamma}, \hat{\delta})$ satisfies:

$$T^{\frac{1}{2}}(\hat{\delta} - \beta) \Rightarrow \alpha \frac{\lambda \int_0^1 B_v dr - \int_0^\lambda B_v dr}{\int_0^1 B_v^2 dr - [\int_0^1 B_v dr]^2} \quad (3.22)$$

and

$$(\hat{\gamma} - \mu) \Rightarrow \alpha \frac{(1-\lambda) \int_0^1 B_v^2 dr - \int_0^1 B_v dr \Psi}{\int_0^1 B_v^2 dr - [\int_0^1 B_v dr]^2} \quad (3.23)$$

As we can see, even though we estimate by least-squares the misspecified model (3.18), we will still obtain a consistent estimator of the true slope parameter ($\hat{\delta}$ converges in probability to β at the traditional rate $Op(T^{-\frac{1}{2}})$), but the estimated constant term will converge to a random variable. Also if $\alpha = 0$ we recover the traditional asymptotic results found by Park and Phillips (1988), Stock (1987) and Phillip and Durlauf (1986).

These asymptotic properties are obtained by first deriving the OLS estimators of the parameters of misspecified equation (3.18), replacing y_t by its true DGP (equation (3.8)), normalizing adequately and by applying the weak joint convergence of partial sums specified before.

3.5 Conclusions and Main Results

Previous money demand studies suffer several common deficiencies that have led them to misleading results and inferences by applying least squares regression analysis. They have ignored the presence of a unit root in real balances, real GDP and nominal interest rates. They have not tested to determine the validity of the *a priori* constraints imposed by the assumed long run equilibrium equation. Furthermore, even though not studied here, the *ad-hoc* short run dynamic representation commonly used has been shown not to be adequate in this context, see, for example, Stock (1987) and Laban (1991d).

The time-series data for both Argentina and Chile do not support the existence of a stable long run money demand function for the narrowed defined monetary aggregate *M1*, for the period 1974 to 1988, as specified by conventional studies.

For Chile, the hypothesis of a known once-and-for-all structural change in the long run equilibrium relationship between real *M1*, nominal interest rates and real GDP, as a proxy for the volume of transactions, in the third quarter of 1984 is supported by the data. No reversion to its pre-change level is detected in mid-86. This findings support the view of those who associate the phenomenon of *missing money* experienced by Chile with financial innovations, if we understand this process as a non reversible one, in the context of relatively stable macroeconomic environment.

For Argentina, we could not reject the null of non-cointegration for the sub-periods 1974-85 and 1977-88. A break in money demand was detected at the end of 1976 (during 1985) associated with the liberalization of the capital account (the implementation of the Austral plan) and with the "endogenous financial adaptation" process due to the extreme inflation episode of the mid 1970s and 1980s. No further break was detected in the third quarter of 1977, during the deregulation of domestic capital markets.

We have shown that the OLS estimation procedures produce consistent coefficient estimates of the slope parameters which converge at a faster rate $Op(T^{-1})$ than in conventional regression theory, and that those of the intercept and of the dummy

variable coefficient will also be consistent but convergence will be attained at the usual rate $Op(T^{-\frac{1}{2}})$.

This study presents evidence that suggest that in many cases the observed non stationary behavior of the estimated residuals from the cointegration regression can just be the result of a discrete structural change in the deterministic part of the model that has not been taken care of, which can lead to the misleading result that a set of integrated time series variables do not stochastically trend together in the long run. In other words, not considering for the break in many cases will led us to accept the null of non-cointegration when it really fails. In these cases the cointegrating vector will not be constant.

Critical values available for the different statistics used to test for cointegration, constructed under the null of constancy of the parameters of the cointegration equation, will not be applicable if we decide to account for these breaks, since with them we will tend to reject the null of non-cointegration more often. Thus new critical values are required. This is done in Appendix E, for our particular case. As expected these new values are higher (in absolute value) than those provided by Engle and Yoo (1987) for the same DGP, but under the constant parameters assumption.

Appendix A

Proofs of Propositions of Chapter 1.

A.1 *Proof of Proposition 1.2.1 (Strategic Complementarity)*

The model exhibits strategic complementarity iff the marginal utility for any individual investor associated with the decision to enter in period one ($G(k_2) = V_1(k_2) - V_0(k_2)$) increases in the amount of capital repatriation undertaken by the other investors:

$$\frac{\partial G(k_2)}{\partial k_2} = \frac{\partial V_1(k_2)}{\partial k_2} - \frac{\partial V_{0n}(k_2)}{\partial k_2} = \beta \frac{\partial q}{\partial k_2} (r^* - r_b) + \frac{\partial r_g}{\partial k_2} + \beta(1-q) \frac{\partial r_b}{\partial k_2} > 0 \quad (\text{A.1})$$

The term $r^* - r_b$ denotes the (positive) excess return on the foreign asset in the bad state. The partial derivative $\frac{\partial q}{\partial k_2}$ is positive from equation (12) and $\frac{\partial r}{\partial k_2}$ is negative, in both states, under standard conditions. If the model is to exhibit strategic complementarity it must thus be the case that $\beta \frac{\partial q}{\partial k_2} (r^* - r_b) > |\frac{\partial r_g}{\partial k_2} + \beta(1-q) \frac{\partial r_b}{\partial k_2}|$. **QED**

A.2 Proof of Proposition 1.2.2 (Existence of Multiple Equilibria)

Recall that k_{2n}^* is defined by $G(k_{2n}^*) = 0$. If expected aggregated capital in the noisy period falls short of this threshold level ($k_2 < k_{2n}^*$), then $G(k_2) < 0$ by continuity and the economy will remain stuck at the *zero-investment trap* (i.e., $k_2 = k_1$). On the other hand, if investors expect a capital stock level of at least k_{2n}^* to be achieved ($k_2 \geq k_{2n}^*$), then $G(k_2) \geq 0$ again by continuity: immediate capital repatriation is the optimal strategy and the economy converges to the *full-investment* outcome (i.e., $k_2 = \bar{k}_2$). **QED**

A.3 Proof of Proposition 1.2.3 (Pareto-ranking and Efficiency of Equilibria)

The equilibrium with full-investment is strictly Pareto-preferred to the one with zero if a movement from the latter to the former leaves no one worse off and makes at least one individual better off. Since $w(k)$ is a monotonically increasing function of the capital-labor ratio ($F_{LK}(k) > 0$), workers' real income increases with the aggregate level of domestic investment in the noisy period. For investors to find it optimal to deviate from the zero investment equilibrium conditional on all other investors also deviating it must be the case that $V_1(\bar{k}_2) \geq V_{0n}(k_1)$. Since $V_1(\bar{k}_2) - V_{0n}(\bar{k}_2) > 0$ in order for the full-investment equilibrium to exist, and given that $V_{0n}(\bar{k}_2) > V_{0n}(k_1)$, it follows directly that $V_1(\bar{k}_2) - V_{0n}(k_1) > V_1(\bar{k}_2) - V_{0n}(\bar{k}_2) > 0$.

Efficiency of the optimistic equilibrium follows directly from the fact that, given the assumption on returns, a central planner disregarding uncertainty and internalizing the externality will repatriate all holding of foreign assets at the beginning of the first period, replicating the optimistic equilibrium. **QED**

A.4 Proof of Proposition 1.2.4 (The Option Value of Waiting)

The option value¹ conferred to foreign assets can be computed by comparing $V_n^*(k_2)$ with the maximum value of wealth attainable *without* the possibility of deferring precommitment, $V_c^*(k_2)$. In this case an investor remaining liquid in period one must decide whether to invest in period two *before* uncertainty is resolved. Again ignoring salvage value, the value of this program (common to all agents) and the individual investor's optimization problem are now given by

$$V_{0c}(k_2) = r^* + \beta \max [q(k_2)r_g(k_3^*) + (1 - q(k_2))r_b(k_3^*), r^*] \quad (\text{A.2})$$

$$V_c^*(k_2) = \max [V_1(k_2), V_{0c}(k_2)] \quad (\text{A.3})$$

Solving $V_c^*(k_{2c}^*) = V_1(k_{2c}^*) = V_{0c}(k_{2c}^*)$ yields the threshold aggregate level of capital k_{2c}^* required for the economy to converge to the optimistic equilibrium without the deferment option.

In order to sign $[k_{2n}^* - k_{2c}^*]$ we compare $V_{0n}(k_2)$ with $V_{0c}(k_2)$, which is equivalent to comparing $A = [qr_g + (1 - q)r^*]$ with the argmax $[qr_g + (1 - q)r_b, r^*]$, for any given aggregate capital stock. $A > r^*$ and $A > qr_g + (1 - q)r_b$ since by assumption entry (non entry) is optimal if the program is maintained (reversed). Thus $V_{0n}(k_2) > V_{0c}(k_2)$ for all k_2 , implying that $k_{2n}^* > k_{2c}^*$: if waiting were possible at k_{2c}^* it would be optimal to do so. Without deferment the range on which only optimistic forecasts are self-sustainable is thus increased: investors are willing to commit at a lower expected level of capital repatriation. **QED**

¹For a graphical illustration of this proposition, see Laban (1991b).

Appendix B

Proofs of Propositions of Chapter 2

B.1 *Proof of Proposition 2.2.3*

The poor will be willing to stabilize at the beginning of the first period if

$$U(e_p + t_1 e_r - \frac{\gamma \sigma_a^2}{2})(1 + \delta) \geq U(e_p + (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_p + t_2^* e_r - \frac{\gamma \sigma_a^2}{2}) \quad (\text{B.1})$$

where t_{1p} satisfies this condition with equality (i.e., the minimum expected transference level the poor is willing to accept in order to attain stabilization in the first period, provided that it will be attained in the second one) and $\delta > 0$ is the discount factor. Thus, we have that

$$U(e_p + t_{1p} e_r - \frac{\gamma \sigma_a^2}{2})(1 + \delta) = U(e_p + (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_p + t_2^* e_r - \frac{\gamma \sigma_a^2}{2}) \quad (\text{B.2})$$

then

$$U(e_p + t_{1p}e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) > U(e_p + (1 - \theta_2)g - \phi(\pi_2)) + \delta U(e_p + t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}) \quad (\text{B.3})$$

since from proposition 2.2.1 we know that $\theta_2 > \theta_1$ and that $\pi_2 > \pi_1$, then $[(\theta_2 - \theta_1)g + (\phi(\pi_2) - \phi(\pi_1)) > 0]$, and given that $U'() > 0$. From equation (2.12) we have that

$$t_{2p}e_r = (1 - \theta_2)g - \phi(\pi_2) + \frac{\gamma\sigma_\alpha^2}{2} \quad (\text{B.4})$$

and since $t_2^* > t_{2p}$, we have that

$$U(e_p + t_{1p}e_r - R)(1 + \delta) > U(e_p + t_{2p}e_r - R) + \delta U(e_p + t_2^*e_r - R) > (1 + \delta)U(e_p + t_{2p}e_r - R) \quad (\text{B.5})$$

where $R = \frac{\gamma\sigma_\alpha^2}{2}$. Again from the continuity of $U()$ we have that $t_{2p} < t_{1p}$. **QED**

B.2 Proof of Proposition 2.2.4

For the rich to be willing to negotiate in the first period t_1 must satisfy

$$U(e_r - t_1e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) \geq U(e_r - (1 - \theta_1)g - \phi(\pi_1)) + \delta U(e_r - t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}) \quad (\text{B.6})$$

where t_{1r} satisfies this condition with equality. Since $F^* > 0$ and $U'() > 0$

$$U(e_r - (1 - \theta_2)g - c(F^*) - \phi(\pi_2)) > U(e_r - (1 - \theta_1)g - \phi(\pi_1)) \quad (\text{B.7})$$

since $e_r - (1 - \theta_1)g - \phi(\pi_1)$ is the net endowment of the rich in the second period, as well as in the first one, if he decides not to engage in the process of financial adaptation. Then

$$U(e_r - t_{1r}e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) < U(e_r - (1 - \theta_2)g - c(F^*) - \phi(\pi_2)) + \delta U(e_r - t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}) \quad (\text{B.8})$$

but, by the definition of t_{2r} we have that

$$U(e_r - t_{2r}e_r - \frac{\gamma\sigma_\alpha^2}{2}) = U(e_r - (1 - \theta_2)g - c(F^*) - \phi(\pi_2)) \quad (\text{B.9})$$

thus

$$U(e_r - t_{1r}e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) < U(e_r - t_{2r}e_r - \frac{\gamma\sigma_\alpha^2}{2}) + \delta U(e_r - t_2^*e_r - \frac{\gamma\sigma_\alpha^2}{2}) \quad (\text{B.10})$$

and given that $t_{2r} > t_2^*$

$$U(e_r - t_{1r}e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) > U(e_r - t_{2r}e_r - \frac{\gamma\sigma_\alpha^2}{2})(1 + \delta) \quad (\text{B.11})$$

so t_{1r} may be greater or smaller than t_{2r} . **QED**

Appendix C

Numerical Simulation of the Model of Chapter 2

This appendix describes the numerical simulation results presented in Figure 2-2. The numerical example was constructed satisfying the assumptions utilized in the chapter.

The utility function was assumed to be of the CARA type $U(c) = -\frac{1}{\alpha}c^{-\alpha}$, with $\alpha > 0$. The cost of financial adaptation was assumed a convex function¹:

$$C(F) = \mu F + \frac{F^2}{\phi} \quad (\text{C.1})$$

We assume the Nash bargaining solution discussed previously in the chapter. A benchmark example was constructed to show existence of delays. The simulations of key parameters of the model were ran around this example. It was assumed that the coefficient of risk aversion, α equals .375. The discount factor equals .96. The endowment of the poor equals 11 and for the rich 15. σ_α^2 was taken equal to 7. The seignorage collection equals 12. Finally μ was equal to .007 and ϕ equal to 44.

Figure 2-2 shows how the boundaries varies with changes in σ_α^2 . As we move to the right the model is solved for smaller values of σ_α^2 .

¹This cost function is less restrictive than the used in the proof of Proposition 2.2.1, given that $C'(0) \neq 0$

Appendix D

Description of Data for Chapter 3

Nominal *M1*; Argentina: for 1974-80, from Domenech (1987), 1980-88 from *Indicadores de Coyuntura*, FIEL. Chile: for the 1974-85 period, by Vial and Marin (1986). For 1986-88 this series is extrapolated using its monthly rate of change, presented by the Central Bank of Chile.

CPI; Argentina: from *Indicadores de Coyuntura*, FIEL. Chile: the index prepared by Cortazar and Marshall (1980) and by The Central Bank of Chile were used.

GDP; Argentina 1974-80, from Domenech (1987), then from *Indicadores de Coyuntura*, FIEL. Chile: for the period 1974-85, the data of real GDP comes from Arrau (1986). For 1986-88 this series was extrapolated using the monthly rate of variation published by the Central Bank of Chile.

Nominal interest rate: *Boletin Mensual*, Central Bank of Chile.

Inflation: *Indicadores de Coyuntura*, FIEL

Appendix E

Monte Carlo Experiment

Critical values are tabulated to test for cointegration in the presence of a *known* once-and-for-all shift in the intercept of the cointegration equation.

To be applicable to our current analysis I assume a sample size of 60 observations, 3 variables in the system (2 regressors in the cointegration equation) and that the break occurs after 70% of the observations.

Lets assume that the time-series (y_t) is generated by the following model,

$$y_t = \beta_0 + \beta_1 D_t + \beta_2 x_{1t} + \beta_3 x_{2t} + \omega_t \quad t = 1, 2, 3, \dots, T_b, \dots, T \quad (\text{E.1})$$

and that that the DGP for our regressors x_{1t} and x_{2t} are given by

$$z_t = z_{t-1} + \epsilon_t \quad \text{with } z_0 = 0 \text{ and } \epsilon_t \sim IN(0, I_2) \quad (\text{E.2})$$

$$D_t = \begin{cases} 0 & \text{from } t = 1, 2, 3, \dots, T_b \\ 1 & \text{from } t = T_b + 1, \dots, T \end{cases} \quad (\text{E.3})$$

such that $\frac{T_b}{T} = 0.70$ and $T = 60$ and D_t is a data-based dummy variable.

To test for cointegration, the OLS estimated residuals from equation (E.1) v_t (that under the null hypothesis of non-cointegration are assumed to have a unit root) are used to construct test statistics as the θ , $A\theta$ and the CRDW.

The τ and $A\tau$ are obtained respectively as the t-statistic of θ in the following least

squares regressions,

$$\Delta \hat{v}_t = \hat{\theta} v_{t-1} \quad (\text{E.4})$$

$$\Delta \hat{v}_t = \hat{\theta} v_{t-1} + \sum_{i=1}^p v_{t-i} \quad (\text{E.5})$$

and the CRDW test uses the standard DW statistic obtained from the cointegration regression (equation (E.1)).

Critical values are reported in Table E.1 for these different test statistics derived from a simulation experiment with 5,000 replications, under the null of non-cointegration, a once-and-for-all shift in the intercept of the cointegration equation and with the time series variables generated by random processes as in equation (E.2). As a benchmark for comparison I present the critical values tabulated by Engle and Yoo (1987) for the same DGP, for $T = 50$, under the null of non-cointegration and of constancy of the parameters of the cointegration equation. For the case of the Ar a value of $p = 4$ was assumed. The same value is assumed by Engle and Yoo (1987). Critical values for different values for the relevant parameters can be found in Laban (1991a).

The critical values for the CRDW test statistic under the null of constant parameters was not available for $N = 3$ (2 regressors) and for a sample size of 50-60 observations in Engle and Yoo (1987). The only values available are for $N = 2$ and $T = 100$. Since the critical level for this test statistic is itself a function of the number of regressors we needed to construct them here. The same experiment was followed but without incorporating the dummy variable and for $T = 50$. Results for different significance levels are also reported in Table E.1.

Table E.1: Critical Values To Test For Cointegration In The Presence Of Structural Change

$(T = 60, N = 3, \frac{T}{N} = 70\%, \text{ under } H_0 : (\rho - 1) = \theta = 0)$

SIGNIFICANCE LEVEL	1%	5%	10%
CONSTANT PARAMETERS			
<i>DF</i> (τ) ^a	-4.84	-4.11	-3.73
<i>ADF</i> ($A\tau$) ^a	-4.45	-3.75	-3.36
<i>CRDW</i>	1.18	0.96	0.85
STRUCTURAL CHANGE			
<i>DF</i> (τ)	-5.05	-4.36	-4.06
<i>ADF</i> ($A\tau$)	-4.50	-3.94	-3.65
<i>CRDW</i>	1.19	0.98	0.87

NOTE: a: The critical values for the *DF*(τ) and *ADF*($A\tau$) test statistics come from Engle and Yoo (1987). Those for the *CRDW* test statistic are tabulated here.

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