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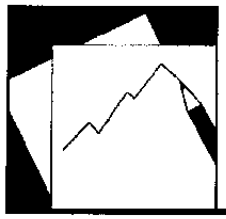

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Exchange-Rate-Based Stabilization: A Model of Financial Fragility

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Exchange-Rate-Based Stabilization: A Model of Financial Fragility

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Abstract

Interactions between banks and open capital account are investigated as rationalizations for empirical regularities characterizing disinflation programs anchored by the exchange rate. The financial system is characterized by bank dominance and lending externality – banks do not internalize the effect of their lending on other banks' information about potential borrowers. Model dynamics simulation shows that remonetization in the wake of disinflation increases loanable funds supply and translates into bank credit expansion financed by capital inflows. A credit-driven boom results, accompanied by overvaluation and current account deficits generating financial fragilities and vulnerability to a shock that can trigger banking and balance-of-payments crises.

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I. INTRODUCTION

Stabilizing high inflation by fixing the exchange rate has gained new prominence as a result of its widespread use in the previously centrally planned economies of Eastern Europe and the former Soviet Union. Exchange-rate-based stabilization (ERBS) programs also have a long history in many countries in Latin America.

There are a number of reasons why an exchange-rate-based stabilization may be preferable to a money-based stabilization. Unlike the money supply, a nominal exchange rate anchor is readily observed by all participants in the economy and may be more effective in reducing high inflation in the face of unstable money demand, large movements in velocity, and a high degree of dollarization. A fixed exchange rate also may induce greater financial discipline on the part of the authorities since it places their foreign reserve holdings at risk. Indeed, evidence presented by Sahay and Végh (1996) suggests that exchange rate anchors have generally been superior to money anchors in reducing inflation in Eastern Europe. On the other hand, if the underlying fiscal and political conditions are not right, a fixed exchange rate strategy can quickly lead to major distortions and defeat the basic objective of the program.

Yet even well-engineered ERBS programs that succeed in bringing inflation down for a sustained period—a year and more—may set in motion a dynamic process that can lead to a financial crisis and the program's collapse. These disruptive dynamics can be summarized as an "exchange-rate-based stabilization syndrome": an initial expansion in economic activity, financed largely by capital inflows and accompanied by sharp real appreciation and widening external imbalances, is followed by a balance-of-payments crisis and forced devaluation. The most recent illustration of this phenomenon is the collapse of the Mexican peso in December 1994.

Three major explanations emerged from a large literature that sought to rationalize the empirical regularities observed in ERBS programs: (1) the lack of credibility (or temporariness) theory; (2) the sticky inflation (or nominal rigidities) theory; and (3) the wealth effects (or equilibrium) theory. None of these theories posited a role for the banking sector in disinflation programs or explained the behavior of important financial sector variables such as broad money and banking credit. Indeed, the existing theories have largely rationalized the ERBS syndrome by relying on imperfect credibility and nominal rigidities in an otherwise classical framework where markets are complete and market failures are absent. In a classical world, money has no real effects and the financial sector becomes irrelevant.[2]

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[2] Several studies—notably Goldfajn and Valdés (1997), Edwards and Végh (1997), Kaminsky and Reinhart (1996), McKinnon and Pill (1996), and Velasco (1987)—have focused on financial intermediation in a broader context of exchange rate crises. However, none of them analyzed the ERBS syndrome as such. Also, none of them examined the substitution between inside and outside money or the externality in the lending process that we examine in this paper.

Yet the financial system in developing countries is characterized by two critical imperfections: incomplete financial markets and an externality in the bank lending process. Financial markets are incomplete in the sense that bank loans are the dominant source of external finance for nonfinancial firms, and bank deposits are the most important form of household savings. The bank lending externality arises because individual banks do not internalize the effect of their lending decisions on the quality of information about potential borrowers received by other banks, and therefore extend more credit than they otherwise would. Accounting for the role of the banking sector can therefore help to explain why even well-designed ERBS programs may end up in financial and balance-of-payments crises.

This paper develops an alternative explanation for the ERBS syndrome. It emphasizes the role of the domestic banking system as the major conduit for capital inflows in economies undertaking exchange-rate-based stabilization and market-oriented structural reforms. In particular, the paper shows that, in financial systems where banks dominate and there is an externality in the lending process, an initial increase in the supply of loanable funds resulting from remonetization of the economy in the wake of disinflation—i.e., a rise in real holdings of domestic money—can translate into a rapid expansion of bank credit financed by short-term capital inflows. A credit-driven boom results, accompanied by a currency overvaluation and current account deficits even within an environment of perfect credibility and price flexibility. Together, these generate systemic financial fragilities and make the economy vulnerable to a small shock that can trigger banking and balance-of-payment crises.[3]

The paper is organized as follows. Section II presents a brief overview of the stylized facts of ERBS programs and theories that have been advanced to explain them. Section III offers an alternative explanation with financial intermediation playing a central role. Section IV shows how financial intermediation can be incorporated within a dynamic general equilibrium model with multiple monetary aggregates. Section V reports quantitative properties of the model, and Section VI concludes.

II. Empirical Evidence and Existing Theories

A. Stylized Facts of ERBS Programs

The key empirical regularities that have characterized exchange-rate-based stabilization programs in high inflation countries during the past 30 years include:[4]

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[3] The response of the economy to fixing the exchange rate developed in this paper can be viewed as a subset of a more general case where financial fragilities result from the interactions between pegged exchange rates, capital inflows, and financial system imperfections.

[4] These have been documented in Khamis (1996), Rebelo and Végh (1995), Reinhart and Végh (1995b), Kiguel and Liviatan (1992), and Végh (1992). See also Hamann (1999).

1. Remonetization of the economy occurs, accompanied by a strong increase in private sector credit even when measured relative to real economic activity.

2. The rate of inflation converges slowly to the new lower rate of devaluation, and is accompanied by a rise in the relative price of nontraded goods—that is, an appreciation of the real exchange rate.

3. The trade balance and the current account of the balance of payments deteriorate, with the current account deficits being financed by large capital inflows.

4. There is an initial expansion in economic activity (output and investment) relative to trend, which is accompanied by a private consumption boom and an increase in real wages.

5. There is a boom-bust "cycle" in the sense that the stabilization program, more often than not, culminates in a financial crisis, capital flight, and forced devaluation of the currency followed by a severe recession.

Figure 1 on page 30 presents the representative dynamics associated with exchange-rate-based stabilization. The dynamics were derived by calculating the averages of ten major ERBS programs: Brazil, March 1964; Argentina, March 1967; Uruguay, May 1968; Chile, February 1978; Uruguay, October 1978; Argentina, December 1978; Israel, July 1985; Mexico, December 1987; Uruguay, January 1991; and Argentina, April 1991.[5]

B. Existing Theories

Lack of Credibility

According to this theory, pioneered by Calvo (1986), economic agents expect the disinflation program to be discontinued in the future. The anticipated future higher inflation in the context of a nominal interest rate fixed by interest parity lowers the effective price of consumption now versus consumption later. Via intertemporal substitution, this induces an initial consumption and output boom, and produces real appreciation.[6]

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[5] The average for each series was calculated as a mean of the observations available in year $t+k$ where t is the first year of the program and integer $k \in [-3,5]$, and in year $T+j$ where T is the last year of the program and integer $j \in [1,3]$. All index numbers were normalized to unity in year $t=0$. (The program duration for Israel was set to six years—the average duration of a stabilization program.)

[6] Calvo and Végh (1994a) and Calvo and Végh (1993) extend the basic model to incorporate currency substitution and sticky prices.

Reinhart and Végh (1995a) assess the empirical relevance of the lack of credibility hypothesis in a perfect foresight framework. They conclude that, given low intertemporal elasticities of substitution in consumption, sharp declines in nominal interest rates—larger than have been registered in several programs—are needed to produce consumption booms of the order of magnitude that has been observed.[7]

Sticky Inflation

According to this theory, first proposed by Dornbusch (1982) and Rodriguez (1982), fixing the exchange rate reduces the nominal interest rate as a result of the interest parity arbitrage condition. Persistent inflation arising from adaptive expectations and backward-looking indexation and contracts then reduces the real interest rate.[8] This in turn causes an aggregate demand boom. Higher demand, plus the inertia in inflation rates combined with the currency peg, results in overvaluation of the domestic currency. Overvaluation in turn causes output to decline and, eventually, leads to a speculative attack on the exchange rate.

Calvo and Végh (1994b) question the explanatory power of this hypothesis from an analytical perspective. They argue that the initial fall in the real interest rate will cause an initial expansion only if the intratemporal elasticity of substitution between traded and nontraded goods is lower than the intertemporal elasticity of substitution in consumption, which they claim to be empirically implausible. From an empirical standpoint, Khamis (1996) points out that ex-post real interest rates rose sharply upon the initiation of heterodox[9] stabilization plans in the mid-1980s, which undermines the main building block of the sticky inflation hypothesis.[10] Moreover, backward-looking contracts may themselves only persist when the disinflation policy lacks credibility.[11]

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[7] Mendoza and Uribe (1996) improve on the quantitative predictions of the temporariness hypothesis by relaxing the perfect foresight assumption. They model the lack of credibility as the probability of abandoning the currency peg with the date of collapse being a random variable with finite support.

[8] See Fischer (1986) for a theoretical analysis of the effects of indexation on macroeconomic stability and the problem of disinflation.

[9] The so-called *heterodox* ERBS programs include incomes policies to control prices and wages as opposed to *orthodox* ERBS programs that rely exclusively on the nominal exchange rate.

[10] Dornbusch and Werner (1994) use the notion of sticky inflation to analyze the 1987 Mexican heterodox stabilization. On a similar note, see Dornbusch and Edwards (1994).

[11] One could contrast persistent backward-looking expectations with the rapid fall in inflation at the end of the German hyperinflation following credible institutional reform.

Wealth Effects

According to this theory, the dynamics of a disinflation program anchored by fixing the nominal exchange rate are driven by wealth effects generated by one of the following mechanisms: (1) intergenerational redistribution of wealth (as in Helpman and Razin (1987)); (2) fiscal consolidation (as in Rebelo (1994)); and (3) supply-side response (as in Roldós (1995)).

(1) Helpman and Razin (1987) examine a model where individuals have finite horizons, and hence Ricardian equivalence does not hold. In that setting, freezing the nominal exchange rate reduces the inflation tax and provides the generation currently alive with a capital gain that is not offset by future tax liabilities. As a result, higher consumption by the current generation, which future generations pay for in the form of lower consumption, brings about a real exchange rate appreciation and worsening of the current account.

(2) Rebelo (1994) considers a situation where the initial fiscal position is unsustainable in the long run. A fiscal adjustment undertaken in conjunction with adopting a fixed exchange rate strategy then creates a positive wealth effect by lowering the present value of future tax liabilities perceived by private agents. These liabilities represent the real resources the government eventually would have to extract from the private sector to bring the fiscal situation under control. As a result of the wealth effect, economic expansion takes place in spite of increased tax rates, and is accompanied by real appreciation and deterioration of the trade balance.[12] Reinhart and Végh (1995b) make a tentative conclusion that the fiscal effects explanation may be discarded based on its poor predictive power and the fact that fiscal policy varied greatly across stabilization plans.

(3) Roldós (1995) assumes a differential supply response in the traded goods sector vis-à-vis the nontraded goods sector, with capital being used and accumulated only in the traded goods sector. A permanent reduction in the devaluation rate leads to a higher real rate of return on domestic assets, and thus to a higher desired consumption and capital stock in the long run. Upon implementation of the policy, the increase in capital accumulation and consumption produces a real exchange rate appreciation and current account deficit. Subsequently, new capital installed in the traded goods sector attracts labor away from the nontraded goods sector, and thus leads to further real appreciation. At the same time, the trade balance continuously improves as tradables output increases in response to the growing capital stock. Thus, in transition to a new steady state, the economy experiences improving trade balances along with persistent real exchange rate appreciation.[13] This hypothesis

[12] See Drazen and Helpman (1988) and Drazen and Helpman (1987) for a closely related analysis of the effects of anticipated changes in fiscal policy on ERBS dynamics.

[13] See also Roldós (1997) and Uribe (1995).

therefore views real appreciation and current account deficits as an equilibrium response of the economy to a credible disinflation. Viewing them as equilibrium responses, however, makes an occurrence of financial or balance-of-payments crises highly unlikely.

III. An Alternative Mechanism

A. Money Matters

As the foregoing discussion suggests, the existing theories have largely rationalized the ERBS syndrome by relying on imperfect credibility and nominal rigidities in an otherwise classical framework where markets are complete and market failures are absent. In a classical world, the competitive outcome is Pareto efficient: the optimization problem is equivalent to a single representative agent optimizing subject to a real resource constraint, and, since money has no real effects, the financial sector becomes irrelevant. Indeed, as shown in Calvo (1986), a permanent reduction in the rate of devaluation would be entirely neutral in a model of the representative household in an economy with flexible prices and fully credible policies: the economy would remain at the initial steady state, and inflation would adjust immediately to the lower equilibrium level.

Yet the financial system in developing countries is hardly free from significant market imperfections; and when it is not, money is no longer just a "veil". As the model developed in Section IV shows, in financial systems characterized by imperfections such as incomplete markets and an externality in the lending process, an initial increase in the supply of loanable funds resulting from remonetization of the economy in the wake of disinflation can translate into a rapid expansion of bank credit financed by short-term capital inflows. A credit-driven boom results, accompanied by a currency overvaluation and current account deficits, even within an environment of perfect credibility and price flexibility.[14] Together, these generate systemic financial fragilities and make the economy vulnerable to a small shock that can trigger banking and balance-of-payment crises. These results stand in stark contrast to the predictions of a classical model. Incomplete financial markets and an externality in the lending process are both critical for the results obtained in this paper.

The rest of this section discusses the market imperfections that characterize the financial system in developing countries. It then develops an alternative explanation for the ERBS syndrome in which banks play a major role as financial intermediaries. The section concludes by discussing the systemic financial fragilities produced by a bank lending boom, and the possible channels through which banking and balance-of-payment crises can occur.

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[14] In the context of this paper, perfect credibility is defined as the belief on the part of private agents that the government will carry out its commitment to maintaining the exchange rate peg. This implies, *inter alia*, that the government follows a set of consistent policies and the fiscal position at the outset of stabilization is sound.

B. Incomplete Markets and the Special Role of Banks

The weak state of the legal framework and the inadequate accounting standards in developing countries do not allow investors to evaluate corporate cash flow and thus the creditworthiness of most potential borrowers. Hence, the potential pool of issuers is not large enough to create a liquid market for nonbank liabilities such as commercial paper. As a result, there are no issuers of perfect substitutes for bank deposits such as mutual funds. At the same time, liquidity becomes a primary proof of solvency because the deficient legal and accounting systems make other forms of evaluating creditworthiness difficult. Consequently, investors prefer to hold short-term liquid assets, and borrowers—who are forced by lenders to remain liquid—are restricted to short-term funds.

Banks constitute the payments system and are the only nongovernmental issuers of liquid short-term liabilities that are also accepted as a means of payment. Banks therefore are uniquely positioned to intermediate between borrowers and lenders and thus to provide liquidity transformation services to portfolio investors.[15] As a result, bank loans are the dominant source of external finance for nonfinancial firms, and bank deposits are the most important form of household savings. This explains why equity and corporate bond markets are insignificant in developing countries and commercial banks play the dominant role in the financial system.[16]

C. Externality in Bank Lending

Banks rely on market signals and private information about their borrowers to evaluate creditworthiness and make lending decisions. In developing countries, the weak state of accounting and information disclosure frameworks limit the ability of banks to collect and process information. Furthermore, market signals received by individual banks can be misleading during periods of buoyant economic activity. Credit-market booms therefore hinder the ability of banks to appraise loans and credit risks.

In a competitive market for bank services, each bank does not take account of the effect its lending decisions have on the quality of information received by other banks. Specifically, liquidity is the primary proof of solvency in financial systems with inadequate legal and accounting infrastructures. If borrowers can prove to banks they are liquid, and the

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[15] For example, in APEC developing countries, portfolio flows—of which bond issues account for a dominant share—have accounted for a high and rising portion of total private capital inflows. Commercial banks have been the major issuers of international bonds in these countries: from 1990 to 1994, banks accounted for 33 percent of total issues. (See Ishii and Dunaway (1995).)

[16] See Rojas-Suárez and Weisbrod (1995) for a more detailed exposition.

source of liquidity is not observable, they can effectively prove they are solvent. However, when more credit is available, it is easier for borrowers to remain liquid.

This is the information externality in bank lending stressed by Gavin and Hausmann (1996): banks do not internalize the adverse impact of their lending on other banks' information, and therefore extend more credit then they otherwise would. As a result, the aggregate amount of loans granted by the banking system is excessive.

D. Propagation and Amplification[17]

Suppose a country embarks on a well-designed stabilization program anchored by fixing the nominal exchange rate.[18] The ensuing disinflation increases the demand for domestic monetary assets and improves the liquidity position of the banking sector. A remonetization of the economy occurs, increasing the supply of loanable funds. Consequently, bank lending rises—but, because of the lending externality, the aggregate amount of loans granted by banks is excessive. The resulting increase in inside money and bank lending are associated with increasing investment, output, and consumption demand for both traded and nontraded goods. In response to the increase in the demand for nontraded goods, labor used to produce nontradables has to rise. The increase in the total labor supply would not be sufficient to meet the increased demand for nontraded goods even if it were all allocated to the production of nontradables. As a result, the relative price of nontraded goods has to rise to shift labor from the traded to nontraded goods sector—that is, the real exchange rate appreciates.

The appreciation of the real exchange rate and the movement of labor out of the traded goods sector reduce the production of tradables. Together with the increase in consumption, this results in a deterioration of the trade balance, with the resulting current account deficit being financed by capital inflows intermediated through the banking system.

The private expenditure boom also increases the demand for bank deposits as a medium of exchange, and further stimulates inside money creation.[19] This process of rising

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[17] In what follows, we assume that there are no capital controls (or they are ineffective) and there is no sterilization of capital inflows (or it is ineffective).

[18] By "well-designed" we mean that monetary and fiscal policies have also been adjusted to support the fixed exchange rate. This implies that, from the outset, the disinflation program is perceived by the private agents as credible.

[19] *Inside money* is money such as bank deposits that is based on private sector debt created through lending to private sector borrowers. *Outside money* includes currency and private bank reserves. It represents claims on central bank assets such as government debt and foreign exchange reserves.

expenditure, financed by capital inflows intermediated through the banking system, can continue until the real currency appreciation and monetary expansion reach levels threatening domestic financial stability.[20]

At this stage, however, a financial crisis need not emerge. Real currency appreciation and multiple expansion of the banking system's balance sheet do not generate a crisis by themselves. Rather, they render the banking system fragile and make the economy as a whole vulnerable to a small shock that can trigger banking and balance-of-payments crises through a number of mechanisms described below.

Financial Fragilities

1. Suppose the central bank can act as a lender of last resort to avert a banking crisis. If there is a negative liquidity shock to the banking system (an adverse shock to the demand for deposits, for instance), discount-window loans to troubled banks will expand the monetary base relative to holdings of foreign exchange. Given the past inflation record, central bank lending to the banking system is likely to rekindle inflationary expectations and cause a loss of confidence in the exchange rate peg. This will in turn lead to capital outflows and depletion of international reserves. As soon as the lower stock of international reserves becomes widely known, devaluation will be considered unavoidable, provoking a speculative attack against the domestic currency.

2. Now suppose that the ability of the central bank to act as a lender of last resort is limited by a credible commitment to a currency board.[21] Under such circumstances, the inability of a single bank to honor its liabilities (say, because of default by a large debtor) can trigger a bank run. The run on banks will immediately translate into a run against the domestic currency as investors will fear that the real costs of the impending banking system collapse will force the government to abandon the currency board and extend domestic credit to prevent massive bank insolvency.[22]

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[20] It is worth mentioning here that the expenditure boom may also produce a boom in the real estate market, and a rise in the prices of assets that are used as a collateral for bank loans, thus further facilitating borrowing. This particular aspect of market behavior is not considered in this study.

[21] That is, the commitment to maintain a constant ratio between the domestic monetary base and foreign reserves prevents the central bank from altering the monetary base.

[22] This scenario effectively requires that the central bank lacks credibility with the international community. Otherwise, as in the case of Argentina in March 1995, an emergency financing loan might be extended to allow the exchange rate to be maintained.

3. Real exchange rate appreciation, which can cumulate into overvaluation, reduces the profitability and debt-servicing capacity of bank borrowers, and thus raises the probability of bank default.[23] This degrades the quality of bank assets, and makes the occurrence of a crisis through the first two mechanisms more likely.

4. Finally, irrespectively of whether the central bank acts as a lender of last resort or not, an external shock—such as a rise in interest rates in industrial countries, a change in the perception of the country's fundamentals, or an adverse shift in investor confidence caused by contagion effects in emerging markets—can trigger both currency and banking crises if the real exchange rate is overvalued. An overvalued currency requires the current account deficit to be offset by continued capital inflows, which makes the economy highly vulnerable to a sudden cessation or reversal of the inflows. When a shock causes capital inflows to cease or reverse, a drop in the demand for the domestic currency produces a sharp contraction of bank deposits, downward pressure on the exchange rate, and hence pressure to devalue. A fear of devaluation and an incipient speculative attack provokes a run against liabilities denominated in the domestic currency, and hence a run on banks.[24]

Since bank and currency runs go hand in hand in all the cases described above, the liquid domestic liabilities of commercial banks—the amount of monetary assets that economic agents fleeing the domestic currency will try to convert into foreign exchange—represent a contingent claim on the foreign exchange reserves of the central bank. However, the preceding rapid expansion of banks' balance sheets will produce a stock of broad money greatly in excess of the stock of foreign exchange reserves. The government then has two options when a speculative attack gets under way: either to devalue or to endure a deep and prolonged recession caused by a banking system collapse.[25] Since it is rather unlikely that the government will choose the latter option, the exchange rate peg has to be abandoned and a balance-of-payments crisis follows.

In all the cases, the fragile state of the banking system circumscribes the ability of the central bank to defend the domestic currency with higher interest rates. Higher interest rates

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[23] Since some real appreciation is equilibrating (e.g., the Balassa-Samuelson effect), there is inevitably a high degree of uncertainty in the financial markets as to whether the currency is overvalued. One can consider the real exchange rate overvalued if the current account is deemed unsustainable in the long run.

[24] The run on banks will occur if: (1) there is a lack of confidence in the soundness of the banking sector adversely affected by currency overvaluation and a rise in nonperforming loans; or (2) deposits denominated in a foreign currency are not allowed.

[25] Assuming the third option of an emergency financing loan from the international community is not available.

will adversely affect bank borrowers' cash flow and debt-servicing capacity, and thus can precipitate increases in loan losses and raise the probability of a systemic failure of the banking system.

Modeling a crisis is beyond the scope of this paper which shows only the transition of the economy from an initial (pre-stabilization) steady state to a new dynamic equilibrium characterized by high financial fragilities.

IV. THE MODEL

A small open economy is populated by a large number of infinitely-lived households. Apart from households, the economy also contains nonfinancial firms and commercial banks. Perfect competition, goods, and capital mobility are assumed to prevail. There are two goods-producing sectors. The first sector produces a tradable good that can be consumed or invested. The second sector produces a nontradable good that can be used for consumption only.[26] The banking sector produces demand deposits and makes loans to finance working capital and purchases of investment goods. Households supply labor that is perfectly mobile across sectors.

The nominal exchange rate is defined as the domestic currency price of foreign currency. The foreign currency price of the traded good is given exogenously by the foreign price of the good. For convenience, the foreign price of the traded good is assumed constant, and is normalized to unity.[27] The real exchange rate is defined as the relative price of nontraded goods in terms of traded goods.

A. Nonfinancial Firms

Purchases of goods and labor services by firms are subject to money-in-advance constraints. As discussed in Section III.B financial markets are incomplete and firms are restricted to borrowing from domestic banks. To pay for inputs—labor and capital—in advance of production, firms borrow from banks at the beginning of the period. The nominal interest rate paid by firms on bank loans is r_t^l.

The Traded Goods Sector

The technology for producing tradable goods is given by

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[26] We can think of the nontradable good as services, including housing and utilities.

[27] This follows from the assumptions that the open economy is small and the external inflation rate is zero.

$$Y_t^T = T_t(K_t)^{\alpha}\left(N_t^T\right)^{1-\alpha} \tag{1}$$

where $T_t > 0$ is a level parameter, $\alpha \in (0,1)$, and K_t and N_t^T denote time t inputs of capital and labor into production of tradables, respectively.

The representative firm maximizes its time t profits, Π_t^T, defined as sales revenue minus bank loan repayments:

$$E_t Y_t^T - \left(1+r_t^l\right)\left(E_t K_t + w_t N_t^T\right) \tag{2}$$

by choice of K_t and N_t^T subject to (1), and taking the nominal wage rate, w_t, as given. Here, E_t denotes the nominal exchange rate. Under the assumptions of small open economy, zero external inflation, and perfect goods mobility, E_t is also the domestic currency price of the traded good. The total supply of tradables—both imported and domestically produced—is thus infinitely elastic.

For simplicity, the stock of capital is assumed to depreciate completely at the end of the period. The capital stock is therefore equal to the investment flow.[28]

The Nontraded Goods Sector

The production technology for nontradables reflects the fact that the nontraded goods sector requires significant investments in infrastructure with long gestation lags. For simplicity, the stock of infrastructure capital is taken as fixed. Therefore, the supply of nontradables is inelastic—at least in the short to medium run—relative to tradables. The production function is given by

$$Y_t^N = H\left(N_t^N\right)^{\xi} \tag{3}$$

where $H > 0$ is a level parameter, $\xi \in (0,1)$, and N_t^T is time t labor employed in the nontraded goods sector.

[28] Roldós (1995) studies the effects of capital accumulation on ERBS dynamics in a different model. While including such dynamics in our model would alter quantitatively the adjustment path to a shock, accounting for these effects is not central to our main concern.

The representative firm maximizes its time t profits, Π_t^N, defined as sales revenue minus bank loan repayments:

$$P_t^N Y_t^N - \left(1+r_t^l\right) w_t N_t^N \tag{4}$$

by choice of N_t^N subject to (3), and taking w_t as given. Here, P_t^N denotes the domestic currency price of the nontraded good. Since labor is assumed to be perfectly mobile, the wage rate w_t is perfectly flexible and equalized across the sectors.

At the end of the period, firms sell their output to households and use the revenue to discharge their liabilities to banks. The representative household owns both firms and receives the profits at the end of the period. Under the assumption of perfect competition, the equilibrium profits of the traded goods sector are zero. Since the production technology for nontradables exhibits decreasing returns to scale, the equilibrium profits in the nontraded goods sector are equal to the return to the infrastructure capital:

$$\Pi_t^N = (1-\xi) P_t^N Y_t^N \tag{5}$$

B. Commercial Banks

Banks intermediate between households (lenders) and firms (borrowers) taking the number of banks in the banking sector, n_t, and the prevailing interest rates—lending rate, r_t^l, and deposit rate, r_t^d —as given. Assume all banks are identical so that in equilibrium $n_t \tilde{Z}_t = Z_t$, where $\tilde{Z}_t$ is an individual bank variable and Z_t is the banking sector total.

Each period, banks decide how much of the domestically available funds to put aside as reserves, and how much to lend to firms. If the sum of loans, $\tilde{L}_t$, and reserves, $\tilde{R}_t$, chosen by banks—banks' assets—exceeds the banks' domestic liabilities, $\tilde{D}_t$, banks borrow abroad to close the financing gap by issuing one-period bonds, $\tilde{B}_{t+1}$, denominated in foreign currency.

If banks survive through the period, they earn interest on their loans and pay foreign lenders the principal plus interest at the time invariant rate r^*.[29] Foreign lenders are willing

[29] The cost of borrowing abroad is inconsequential if banks can roll over debt indefinitely. Hence the simplifying assumption of the constant interest rate r^*. What matters is that foreign lending may abruptly go to zero at any interest rate. This will be assumed to occur

(continued...)

to lend as long as the banks pay off their last period's debt. If banks do not survive through the period because of a banking or currency crisis, their loans will not mature, they will be unable to service their debt, and foreign lenders will not be willing to lend to them in the next period. Therefore, the constraint on bank borrowing abroad is a nonzero probability that foreign funds will not be forthcoming in the next period. The availability of funds depends in turn on the probability of banks' surviving through the period as defined below.

As discussed in Section III.D bank and currency runs go hand in hand: one triggers the other. A bank run can be triggered directly by a single bank failure, or it can be triggered indirectly by a run against the currency and hence on deposits denominated in the domestic currency.

Profit maximizing banks account for the effect of their own lending decisions on the probability of their own failure stemming from their domestic operations by choosing the ratio of reserves to deposits, $\tilde{R}_t/\tilde{D}_t$.[30] However, in a competitive bank market, each bank takes the ratio of base money to broad money, $M0_t/M2_t$, which is also a function of the equilibrium level of $\tilde{R}_t/\tilde{D}_t$, as given. This captures the externality in bank lending discussed in Section III.C: banks do not internalize the effect of their lending decisions on the total stock of loans outstanding in the economy and hence on the monetary aggregates, which is observationally equivalent to the situation where banks do not internalize the adverse impact of their lending on other banks' information.

Furthermore, the bank survival probability depends on the sustainability of the current account position as measured by the ratio TB_t/F_t, where TB_t is time t net exports and $F_t \equiv B_{t+1} - B_t - r^* B_t$ is net capital inflow in period t less interest payment on the stock of foreign liabilities outstanding at the beginning of the period. The ratio TB_t/F_t is used as a proxy for the sustainability of the current account:[31] the lower the ratio, the lower the survival probability.[32]

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beyond the time horizon for our model—that is, we model the development of a crisis situation but not what actually happens when the crisis hits and in its aftermath.

[30] There is no reserve requirement $\tilde{R}_t \geq \delta \tilde{D}_t$ built into the model, where δ is the required reserve ratio. In case $\tilde{R}_t > \delta \tilde{D}_t$, such a requirement would be redundant. Otherwise, the banks would just hold the required reserves and the money multiplier would be lower. This would slow down the domestic credit creation—so the fragility in the system would take longer to build up—but would not change qualitatively the model's dynamics. Therefore, for simplicity, the required reserve ratio was assumed zero.

[31] Note that the model is solved in terms of percentage deviations of the decision variables from their pre-stabilization steady state values (see Section V.A). This does not allow us to

(continued...)

The sustainability of the current account thus depends on the cost of servicing the banking sector's debt, r^*B_t, which is directly affected by banks' borrowing decisions, and on net exports, TB_t. Yet, in a perfectly competitive market, banks take net exports as well as other banks' borrowing and lending decisions as given: they recognize that the probability of collapse increases with deterioration in the current account position (which incorporates real appreciation)—but each bank, being small in the market, rationally ignores the effect of its lending on economy-wide variables.

Explicitly, the survival probability of an individual bank is given by

$$\rho_t = \frac{a\left(1 - e^{-c\left(\frac{\tilde{R}_t}{\tilde{D}_t} + \varphi\frac{M0_t}{M2_t} + \psi\frac{TB_t}{\tilde{F}_t + (1-1/n_t)F_t}\right)}\right)}{a + be^{-c\left(\frac{\tilde{R}_t}{\tilde{D}_t} + \varphi\frac{M0_t}{M2_t} + \psi\frac{TB_t}{\tilde{F}_t + (1-1/n_t)F_t}\right)}} \tag{6}$$

where φ and ψ are level parameters. The function $\rho_t(\cdot)$ is twice continuously differentiable, and lies in the interval $[0,1)$ for a nonnegative argument. The structural parameters a, b, and c represent a wide range of paths for the probability of survival. At this stage of the analysis, we have only examined the special case $a = b = c = 1$.

$\tilde{F}_t$ is determined from the bank's balance sheet:[33]

$$\tilde{F}_t = \frac{\tilde{L}_t + \tilde{R}_t - \tilde{D}_t}{E_t} \tag{7}$$

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use the direct measure of the current account, $TB_t - r^*B_t$, because both current and capital accounts of the balance of payments are zero in a steady state.

[32] The solution technique employed in the study precludes sign switching in situations where the trade balance, for instance, goes from surplus to deficit.

[33] Note that this eliminates $\tilde{B}_{t+1}$ from the list of decision variables, and makes the banking sector's problem static.

Banks are assumed to operate costlessly. A bank's losses in case a run occurs are limited to its reserves $\widetilde{R}_t$. The representative bank's problem is to maximize its time t expected profits

$$\rho_t\left(\widetilde{R}_t, \widetilde{L}_t, \widetilde{S}_t, n_t\right) \cdot \left(r_t^l \widetilde{L}_t - r_t^d \widetilde{S}_t\right) - (1-\rho_t)\widetilde{R}_t \tag{8}$$

subject to (6) and (7) by choice of $\widetilde{R}_t$, $\widetilde{L}_t$, and $\widetilde{S}_t$.[34] Here, $\widetilde{S}_t$ denotes households' interest-bearing deposits with the bank.

Under the assumption of perfect competition, expected profits are zero in equilibrium:

$$\rho_t\left(\widetilde{R}_t, \widetilde{L}_t, \widetilde{S}_t, n_t\right) \cdot \left(r_t^l \widetilde{L}_t - r_t^d \widetilde{S}_t\right) - (1-\rho_t)\widetilde{R}_t = 0 \tag{9}$$

The representative household owns the bank and receives bank profits at the end of the period. Since entry into the banking sector occurs until *expected* profits are zero, in periods when banks survive, profits will be strictly positive:

$$\Pi_t^B = n_t\left(r_t^l \widetilde{L}_t - r_t^d \widetilde{S}_t\right) \tag{10}$$

C. The Central Bank

The only function of the central bank in this model is to engage in nonsterilized intervention.[35] That is, the central bank ensures costless conversion of foreign currency into domestic currency (and vice versa) at any moment at the specified exchange rate, E_t, which evolves according to

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[34] By choosing $\widetilde{S}_t$, banks effectively choose $\widetilde{D}_t$ but the equilibrium condition $n_t\widetilde{D}_t = n_t\widetilde{S}_t + w_t N_t^M$ (see (19) on page 21) is redundant by Walras law.

[35] This assumption is motivated by the fact that sterilization—the exchange of domestic (public) bonds for foreign exchange—may not be a viable policy option, especially in the longer term, because it entails high interest rates and large quasi-fiscal costs stemming from the difference between the interest paid on domestic bonds and the return earned on foreign reserves invested in international financial markets. In addition to sterilization conducted through open market operations, the central bank can conduct sterilization by increasing reserve requirements. High reserve requirements, however, lead to financial disintermediation and lax lending standards (see Rojas-Suárez and Weisbrod (1995)). In transition economies, sterilization may not be feasible because of the lack of financial instruments.

$$E_{t+1} = (1+\varepsilon_{t+1})E_t \tag{11}$$

where ε_{t+1} is the rate of devaluation preannounced by the central bank.

The monetary base, $M0_t$, defined as the sum of currency held by households, M_t, and bank reserves, R_t, is therefore determined by the central bank's stock of foreign exchange reserves, X_t, at the beginning of the period:[36]

$$M0_t \equiv M_t + R_t = E_t X_t \tag{12}$$

Broad money, $M2_t$, is defined as the sum of currency and total bank deposits:[37]

$$M2_t \equiv M_t + D_t \tag{13}$$

The time t flow of foreign exchange reserves at the central bank is determined by the balance of payments:[38]

$$X_{t+1} - X_t = B_{t+1} - B_t + TB_t - r^* B_t \tag{14}$$

The fixed exchange rate regime commits the central bank to exchange domestic money for foreign exchange. Therefore, the central bank—the "government" in this model—effectively owns all foreign liabilities, B_t, and has to raise tax to redeem them with interest. Specifically, there is a central bank (government) budget constraint:

$$\tau_t + E_t B_{t+1} + \pi_{t+1}(M_{t+1} + S_{t+1})\frac{P_t}{P_{t+1}} = E_t\left(1+r^*\right)B_t \tag{15}$$

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[36] This is equivalent to a currency board arrangement.

[37] The only distinction between checking and interest-bearing (saving) accounts in this model is that the latter earn interest. Therefore, $M2$ and $M1$ in the model are the same. $M2$ was chosen over $M1$ to facilitate calibration (see Section V.B).

[38] For simplicity, it is assumed that the central bank earns no interest on its foreign exchange reserves, pays no interest on bank reserves, and incurs no operating costs.

Part of the tax revenue comes from the inflation tax on households' nominal asset holdings, $M_{t+1}+S_{t+1}$. Households also effectively pay the balance in the form of a lump sum tax τ_t.[39] Here, P_t denotes time t price level defined as

$$P_t = (E_t)^{\gamma}\left(P_t^N\right)^{1-\gamma} \tag{16}$$

where γ is the share of tradables consumption expenditure in total consumption expenditure, and π_{t+1} is the rate of inflation given by $P_{t+1}/P_t - 1$.

D. Households

The representative household seeks to maximize its discounted lifetime utility defined over sequences of consumption of traded goods, C_t^T, and nontraded goods, C_t^N, using a time separable utility function:

$$\sum_{t=0}^{\infty}\beta^t \frac{\left[\left(C_t^T\right)^{\gamma}\left(C_t^N\right)^{1-\gamma}\right]^{1-1/\sigma}-1}{1-1/\sigma} \tag{17}$$

where $\beta \in (0,1)$ is the time discount factor, $\sigma > 0$ is the elasticity of intertemporal substitution in consumption, and $\gamma \in (0,1)$ is a share parameter.

The household enters the period with nominal assets in the form of currency holdings, M_t, and interest-bearing demand deposits, S_t, which earn interest at the rate r_t^d.

The household divides N units of time supplied inelastically each period into time spent working in the marketplace, N_t^M, and time spent acquiring consumption goods, N_t^S:

$$N = N_t^M + N_t^S \tag{18}$$

Labor income is deposited by firms directly into households' checking accounts at the beginning of the period. Hence, total nominal checkable (demand) deposits of the

[39] The legal incidence of the tax could be on firms or commercial banks but, ultimately, only households—the owners of firms and banks—pay the tax.

representative household are the sum of interest-bearing deposits, S_t, and labor income, $w_t N_t^M$:

$$D_t = S_t + w_t N_t^M \tag{19}$$

Households use currency, demand deposits, and time to purchase consumption goods. The amount of time spent shopping, N_t^S, is an increasing function of total consumption expenditure, $E_t C_t^T + P_t^N C_t^N$, and a decreasing function of both nominal currency holdings, M_t, and demand deposits, D_t. The transactions technology is given by[40]

$$N_t^S = J\left(\frac{E_t C_t^T + P_t^N C_t^N}{M_t^{\theta} D_t^{1-\theta}}\right) \tag{20}$$

where $J > 0$ is a level parameter, and $\theta \in (0,1)$ is a share parameter.

The representative household's end of period flow budget constraint is

$$E_t C_t^T + P_t^N C_t^N + M_{t+1} + S_{t+1} = M_t + \left(1 + r_t^d\right) S_t + w_t N_t^M + \Pi_t^N + \Pi_t^B - \tau_t \tag{21}$$

The household's problem is to maximize (17) subject to (18), (19), (20), and (21) by choice of sequences of C_t^T, C_t^N, N_t^M, M_{t+1}, and S_{t+1} for $t > 0$.

E. Market Clearing Conditions

The equilibrium conditions for the goods, labor, and loan markets are given by the equality of the supply and demand for

Traded goods:

$$Y_t^T - TB_t = C_t^T + K_t \tag{22}$$

Nontraded goods:

$$Y_t^N = C_t^N \tag{23}$$

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[40] This specification of the transactions technology is used by Chari *et al.* (1995).

Labor:

$$N_t^M = N_t^T + N_t^N \tag{24}$$

Loans:

$$L_t = E_t K_t + w_t N_t^M \tag{25}$$

Equilibrium in the market for bank reserves is determined by equations 12 and 14 (supply) and the banking sector's optimality conditions (demand).

V. Quantitative Properties of the Model

A. Approximate Solution Procedure

The model does not have a closed form solution for the decision variables. To investigate the behavior of the model, this paper employs the method suggested by King *et al.* (1988), which obtains an approximate solution by linearizing the Euler equations around the steady state. The solution results are then expressed as percentage deviations of the decision variables from their steady state values. Using the approximate optimal paths for the decision variables, other variables of interest can then be expressed as percentage deviations from their steady state values.

As in Rebelo and Végh (1995), the numerical approximation procedure involves linearizing the model around a steady state to which the economy never returns. This feature of the solution method compromises how much emphasis can be put on quantitative predictions of the model. The linearization gives the direction of movement (first derivative) away from an initial steady state. However, the further the economy moves away from that steady state, the less accurate the linear approximation becomes. The ultimate extent of the movement depends on the behavior of the nonlinear system (that is, on higher order derivatives).

In the initial steady state, all real variables are constant and all nominal variables are growing at the rate of inflation equal to the rate of devaluation. The steady state for the economy follows from zero profit condition 9, the central bank's balance sheet 12, the balance of payments 14, the set of resource constraints 18, 19, 20, 21, market clearing conditions 22, 23, 24, 25, and a set of optimality conditions for labor and consumption allocation between the sectors and the ratio of currency to deposits that follow from the Euler equations.

B. Parameter Values

To simulate the linearized model, it is necessary to assign values to the model structural parameters. The model was calibrated to the Argentine economy, which experienced high nominal volatility during the decade prior to the 1991 Convertibility Plan. Argentina nevertheless was chosen as the reference country because the Convertibility Plan did not rely on price and wage controls and obligated the central bank to issue the domestic currency against foreign exchange reserves at a fixed exchange rate. These two features of the Convertibility plan fit well with the model's assumptions of perfect price flexibility and the use of a currency board as a policy rule for base money creation.

A natural reference period for the calibration exercise would be the period between the 1982 Latin American debt crisis and the introduction of the Convertibility Plan in the second quarter of 1991. However, 1983, 1989, and 1990 were discarded as they were years of extreme volatility in nominal variables.

The model was calibrated as follows. The values for the capital share in the tradables sector, α, labor share in the nontradables sector, ξ, time discount factor, β, the consumption share parameter, γ, the elasticity of intertemporal substitution in consumption, σ, and the foreign real rate of interest, r^*, were taken from Rebelo and Végh (1995).

Inflation, lending, and deposit rates—π, r^l, and r^d, respectively—were set to the sample averages of the corresponding variables calculated using data from the IMF, *International Financial Statistics* (IFS). The transactions technology share parameter, θ, the survival probability level parameters, φ and ψ, and the model period[41] were set using the equations reported in Section V.A so that the steady state properties of the model replicate the average values of some key ratios for the Argentine economy during the mid-1980s that were calculated using data from the IFS. (The value of ψ, which is a free parameter in the model, was adjusted so that the model transversality condition is satisfied.[42] This guarantees uniqueness and boundedness of the solution.) The household's non-leisure time endowment, N, was normalized to unity with 95 percent of the time, N^M, spent working in the marketplace. The number of banks in the banking sector, n, was set at approximately half the number of the largest banks in the mid-1990s reported in IMF (1995).

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[41] The model period, expressed as a fraction of a year, is approximately the inverse of the number of transactions made by households in this model economy during a year.

[42] The transversality condition is satisfied if the eigenvalues of the state-costate transition matrix which are greater than 1 in absolute value are less than $1/\sqrt{\beta}$ in modulus.

Finally, the values for the level parameters in the tradables and nontradables production functions, T and H, and the transactions technology level parameter, J, were set given the parameter values discussed above.[43]

The model structural parameters and the quantitative properties of the pre-stabilization steady state are reported in Table 1 on page 29. The variables with time dimension are expressed at annual rates. Prior to solving and simulating the model, they were converted to units corresponding to the model period.

C. Simulation Results

This section presents the dynamic response of the model economy to a credible disinflation anchored by fixing the exchange rate: first in isolation, and then coupled with a productivity increase in the traded goods sector. The model was simulated over 40 model periods, which is approximately 5 years. In period 0, the economy is at its pre-stabilization steady state. The stabilization is not anticipated but is perfectly perceived once it is implemented in period 1.[44] The results are expressed as percentage deviations of the variables of interest from their pre-stabilization steady state values. All nominal variables were converted into real values using the price level P_t as the deflator.

The solid lines in Figure 2 (see pages 31 - 33) depict the response of the economy to a permanent 100% reduction in the rate of devaluation.[45] Fixing the exchange rate leads to a drop in the rate of inflation and a rise in real currency holdings and demand deposits (page 31). The ensuing increase in the demand for domestic money improves the liquidity position of banks. The ratio of deposits to currency increases and bank loans rise in real terms (page 31). Consequently, the money multiplier, defined as the ratio of $M2$ to $M0$, and the ratio of $M2$ to GDP rise (page 31). The resulting increase in inside money and bank lending are associated with increasing investment, output, and consumption demand for both traded and nontraded goods (page 32). The increase in the total labor supply (not shown) is not sufficient to meet the increased demand for nontraded goods—even if it were all allocated to the production of nontradables—and the relative price of nontraded goods rises to shift labor

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[43] It should be noted that the model solution is invariant to the values of T, H, and J since they are incorporated into the values of Y^T, Y^N, and N^S, respectively.

[44] Initial drop or jump in period 1 in some variables reflects the impact effect of the shock. The linearized model then behaves monotonically from period 1 on.

[45] Note that the quantitative response of the economy to disinflation in the simulation exercise depends on the steady state values of the model structural parameters and key ratios which were calibrated to Argentina. This may compromise a direct quantitative comparison of the model's predictions with the average behavior shown in Figure 1.

from the traded to nontraded goods sector. As a result, the real wage rate rises, the rate of inflation in the nontraded goods sector (and hence overall inflation[46]) converges slowly to the rate of devaluation, and the real exchange rate appreciates (page 33). The consumption boom, together with the decline in the output of traded goods, causes a sharp deterioration of the trade balance accompanied by massive capital inflows to finance the resulting current account deficit (page 33).

Now suppose that, along with fixing the exchange rate, the authorities implement structural reforms—such as privatization, liberalization, and deregulation—that increase productivity in the traded goods sector. The dashed lines in Figure 2 show the response of the economy to a permanent disinflation combined with a permanent 5% productivity gain in the traded goods sector. The real economy adjusts immediately to the new level of productivity: in the impact period of the shock, the capital stock rises and labor moves into the traded goods sector. The output of tradables increases and the trade balance improves. In period 2, the dynamics associated with capital inflows and bank money creation set in. Qualitatively, from period 2 on, the model exhibits the same transition path as in the case of disinflation alone described above. Quantitatively, the economy's response to disinflation is amplified by the productivity gain.

The model thus replicates the stylized facts of ERBS programs described in Section II.A. Remonetization of the economy, the strong growth in bank credit, and the slow convergence of the inflation rate to the devaluation rate are evident from the panel charts on pages 31 and 33. The private consumption boom is shown on page 32. The panel chart on page 33 depicts the real exchange rate appreciation and the deterioration of the trade balance. The model reproduces the initial expansion in economic activity: real GDP and investment (page 32), and the real wage rate (page 33) rise in response to fixing the exchange rate.

The panel chart on page 33 shows the high degree of financial fragility and vulnerability of the economy to a reversal of the capital inflows.[47] The trade balance and the current account are in deficit and must be offset by continued capital inflows:[48] the stock of

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[46] Recall that π_t is determined from (16) as

$$(1+\varepsilon_t)^{\gamma}\left(1+\pi_t^N\right)^{1-\gamma}-1$$

where π_t^N is the rate of inflation in the nontraded goods sector.

[47] Financial fragility is also revealed by the financial sector ratios shown on page 31.

[48] Recall that the simulation results are expressed as percentage deviations of the variables from their steady state values. Since the capital account balance, $B_{t+1}-B_t$, is zero in the

(continued...)

net foreign liabilities grows without bound. (Note however that, since the transversality condition is satisfied (see Section V.B), the solution for the model's decision variables, and hence trade and current accounts, is unique and bounded.) The current account is definitely unsustainable in the long run, and the program is bound to collapse when the "right" shock comes along.[49]

A shortcoming of the model is myopic behavior on the part of households. Rational households would realize that there is only probability ρ_t of the economy surviving until the next period. They would maximize expected utility, and the determinants of ρ_t (in particular, the time of collapse and the values of the state variables at the time of collapse) would enter the household's maximization problem. If utility in the collapse state also depends on the values of the state variables at the time of collapse, then we would also need to model explicitly what happens in the collapse state. However, to do the full analysis of a financial meltdown, we would need to employ a different solution method. By linearizing the model around a steady state, we are focusing on how the system behaves as it moves away from the initial steady state. Since the onset of a crisis represents a regime switch, linearization would no longer suffice as a solution technique.

Another shortcoming of the model is that it does not address explicitly the subsequent downturn in economic activity documented in the later stage of ERBS programs. Kiguel and Liviatan (1992) point to the inability to finance the growing current account deficit as the immediate reason for the end of the boom. The beginning of the recessionary phase would thus coincide with the reversal of the capital inflows and the onset of banking and balance-of-payment crises along the lines described in Section III.D. The flight from domestic currency and the associated contraction of bank deposits would bring about a credit crunch and rising real interest rates, and cause a contraction in the real economy.

A possible extension of the model to address explicitly the late recession would be to introduce durable goods consumption which is closely linked to the financial sector. A credit boom might alleviate credit constraints for the household sector and trigger a wealth effect leading to a bunching of purchases of durable goods early in the program and a slowdown later.

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initial steady state, we cannot show the evolution of net capital inflows. Instead, we show the evolution of the stock of net foreign liabilities, B_t.

[49] Note that an inflationary shock—such as a once and for all increase in the rate of devaluation—would not trigger a forever expanding accumulation of foreign assets as this would violate the nonnegativity constraint on domestic money holdings.

VI. Summary and Conclusions

Disinflation programs in chronic inflation countries anchored by fixing the exchange rate have been characterized by a series of empirical regularities which can be summarized as an "exchange-rate-based stabilization syndrome": an initial expansion in economic activity, financed largely by capital inflows and accompanied by sharp real appreciation and widening external imbalances, is followed by a balance-of-payments crisis and forced devaluation. A number of theories have emerged from a large literature that sought to explain the stylized facts associated with ERBS programs, yet the role of the banking sector and its interactions with an open capital account have not received much attention.

This paper developed an alternative explanation for the ERBS syndrome. It emphasized the role of the domestic banking system as the financial intermediary and major conduit for capital inflows in economies undertaking exchange-rate-based stabilization and market-oriented structural reforms. The paper investigated the linkages between capital inflows and bank money creation within a dynamic general equilibrium model with multiple monetary aggregates and a financial system characterized by imperfections such as incomplete markets and an externality in the bank lending process. Financial markets are incomplete in the sense that bank loans are the sole source of external finance for nonfinancial firms, and bank deposits are the only form of household savings. The bank lending externality arises because individual banks do not internalize the effect of their lending decisions on the quality of information about potential borrowers received by other banks, and therefore extend more credit than they otherwise would.

Simulation of the model economy's equilibrium dynamics shows that an initial increase in the supply of loanable funds resulting from remonetization of the economy in the wake of disinflation can translate into a rapid expansion of bank credit financed by short-term capital inflows. A credit-driven boom results, accompanied by a currency overvaluation and current account deficits. Together, these generate systemic financial fragilities and make the economy vulnerable to a small shock that can trigger banking and balance-of-payment crises. The model is thus capable of replicating the empirical regularities observed in ERBS programs, and rationalizes the syndrome without relying on imperfect credibility or nominal rigidities.

The main conclusion of the paper is that the banking sector may play an important role in ERBS programs. Accounting for the role of the banking sector can help to explain why even well-designed disinflation programs may set in motion a dynamic process that can lead to a financial crisis and the program's collapse. Consequently, the policy implication for emerging market economies is that the authorities should pay attention not only to the design of monetary and exchange rate policies but also to the framework of monetary and financial institutions. In particular, the results of the paper suggest that diversifying the source of investment finance away from banks and reducing externalities associated with bank lending may be essential preconditions for implementing successful stabilization programs. In turn, these institutional changes would require appropriate structural policy measures such as reforming the legal, accounting, and disclosure frameworks of the financial system.

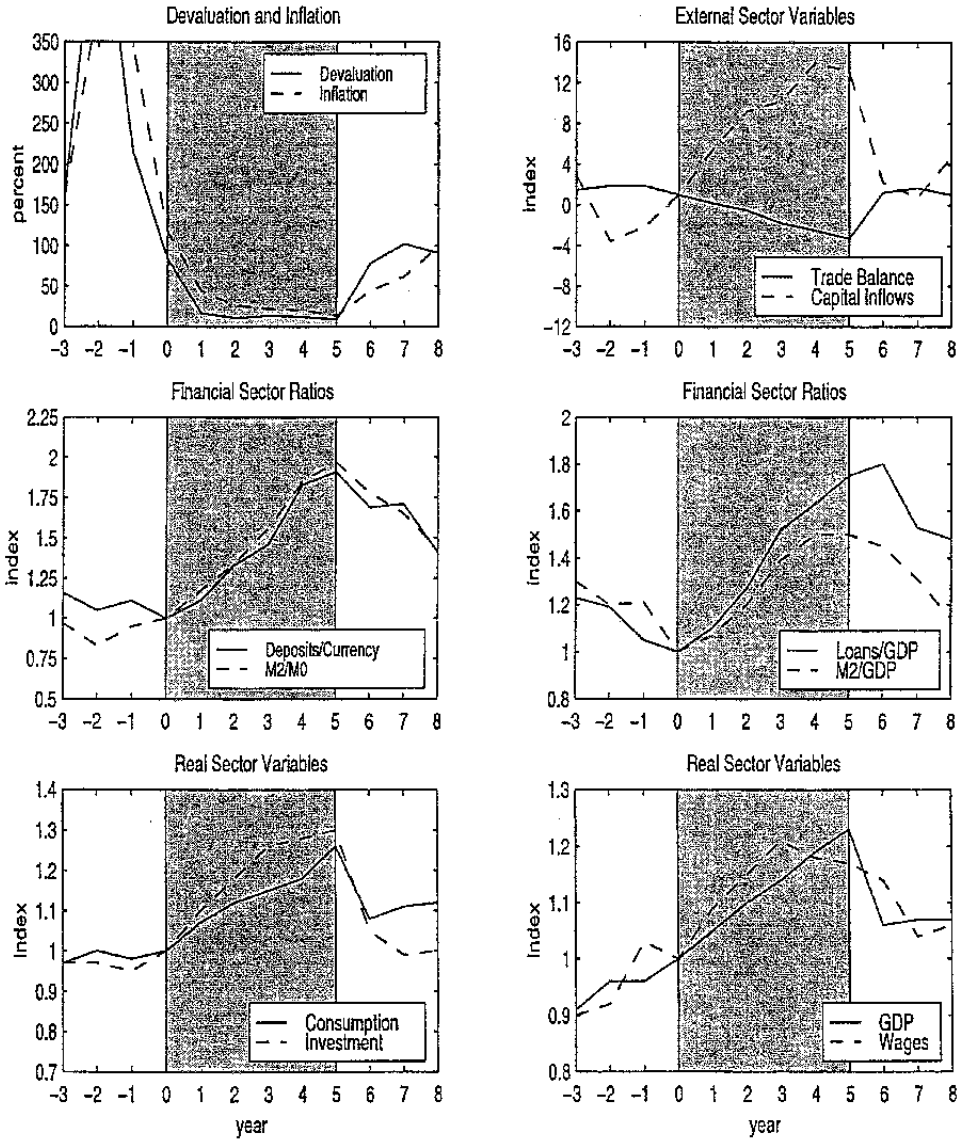
The policy implication for Fund surveillance is the need to encompass an assessment of the interactions of the institutional environment and regulatory framework in emerging market economies with macroeconomic and structural policies, including financial sector and capital account policies. The ability of the banking system to intermediate capital inflows and withstand their reversals is particularly important. Consequently, Fund surveillance should focus, *inter alia*, on the risks posed by a rapid accumulation of private short-term external debt and potential reversal of capital flows. The effectiveness of Fund surveillance in this area will depend critically on the timely availability of accurate information, including data on private short-term external debt and financial statistics that permit the analysis of banking sector issues. This argues for Fund encouragement of emerging market economies to improve their accounting and market disclosure standards and to facilitate a free flow of timely, accurate, and comprehensive information on the aggregate state of the economy.

Table 1. Model Parameter Values and
Quantitative Properties of Pre-Stabilization Steady State

PARAMETER	DESCRIPTION	VALUE
Model Structural Parameters:		
α	Capital Share, Traded Goods Sector Technology	0.52
β	Time Discount Factor	0.96
γ	Share Parameter, Momentary Utility	0.50
ξ	Labor Share, Nontraded Goods Sector Technology	0.63
σ	Elasticity of Intertemporal Substitution in Consumption	0.20
r^*	International Real Interest Rate	0.04
θ	Share Parameter, Transactions Technology	0.68
φ	Level Parameter, Bank Survival Probability	4.34
ψ	Level Parameter, Bank Survival Probability	0.26
T	Level Parameter, Traded Goods Sector Technology	152.5
H	Level Parameter, Nontraded Goods Sector Technology	1.00
J	Level Parameter, Transactions Technology	0.05
Quantitative Properties of Pre-Stabilization Steady State:		
π	Inflation Rate	3.70
r^l	Lending Rate	5.62
r^d	Deposit Rate	3.24
N	Household's Non-Leisure Time Endowment	1.00
N^M	Time Spent Working in Marketplace	0.95
n	Number of Banks in Banking Sector	10.0
TB/GDP	Ratio of Trade Balance to GDP	0.04
TB/Y^T	Ratio of Trade Balance to Output of Tradables	0.05
TB/C^T	Ratio of Trade Balance to Consumption of Tradables	0.08
S/D	Ratio of Interest-Bearing Deposits to Total Deposits	0.49
R/D	Ratio of Reserves to Deposits	0.30
L/D	Ratio of Loans to Deposits	0.67
M/D	Ratio of Currency to Deposits	0.26
$M/M0$	Ratio of Currency to Monetary Base	0.51
$M0/M2$	Ratio of Monetary Base to Broad Money	0.44

Note: Variables with time dimension expressed at annual rates
Model period (fraction of year): 0.13

Figure 1. Representative Dynamics of Exchange-Rate-Based Stabilization



Note: The shaded area represents the average duration of a stabilization program
Source: Author's calculations using data from IMF, *International Financial Statistics*, for programs listed in Section II.A

Figure 2. Response to a Permanent 100% Reduction in the Rate of Devaluation with a Permanent 5% Productivity Increase in the Traded Goods Sector (Percentage Deviation from the Pre-Stabilization Steady State)

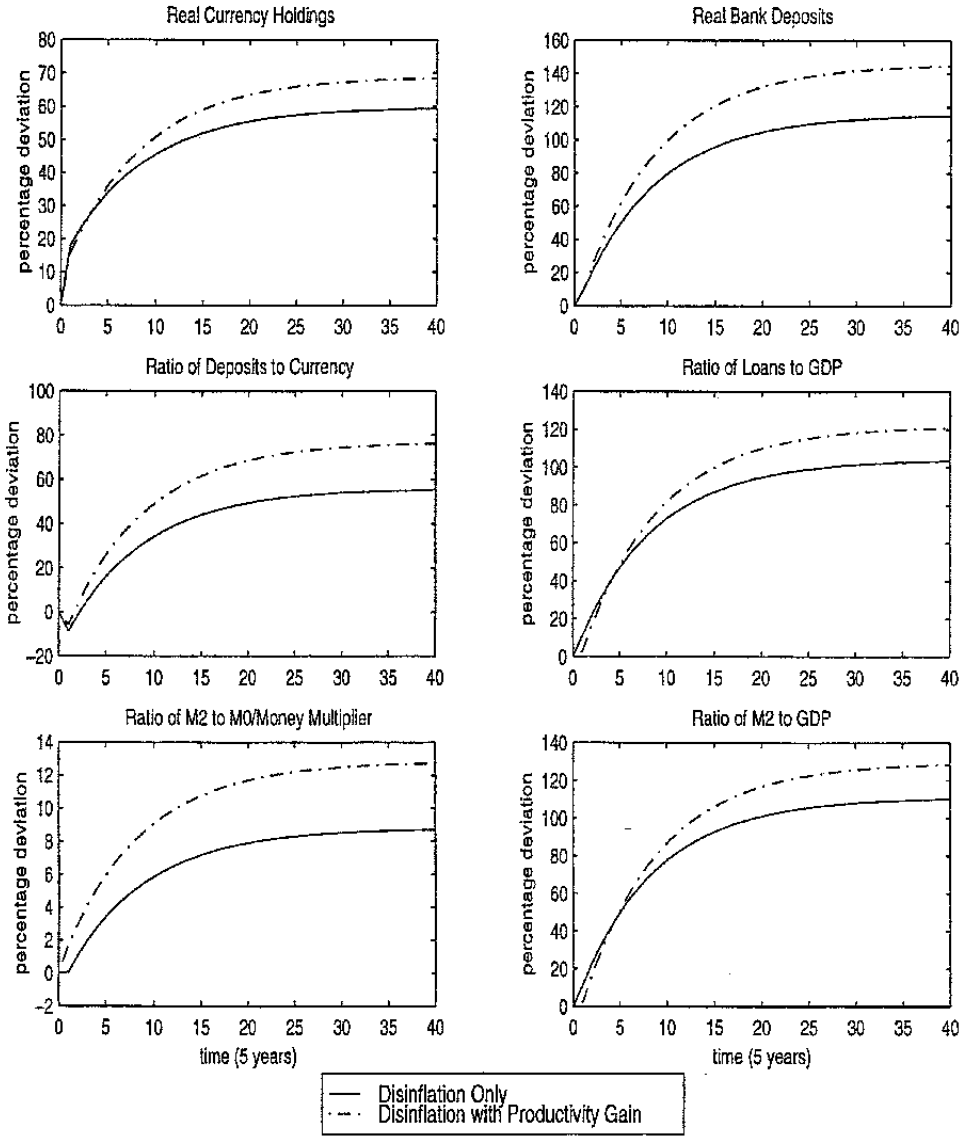


Figure 2. Response to a Permanent 100% Reduction in the Rate of Devaluation with a Permanent 5% Productivity Increase in the Traded Goods Sector (continued)
(Percentage Deviation from the Pre-Stabilization Steady State)

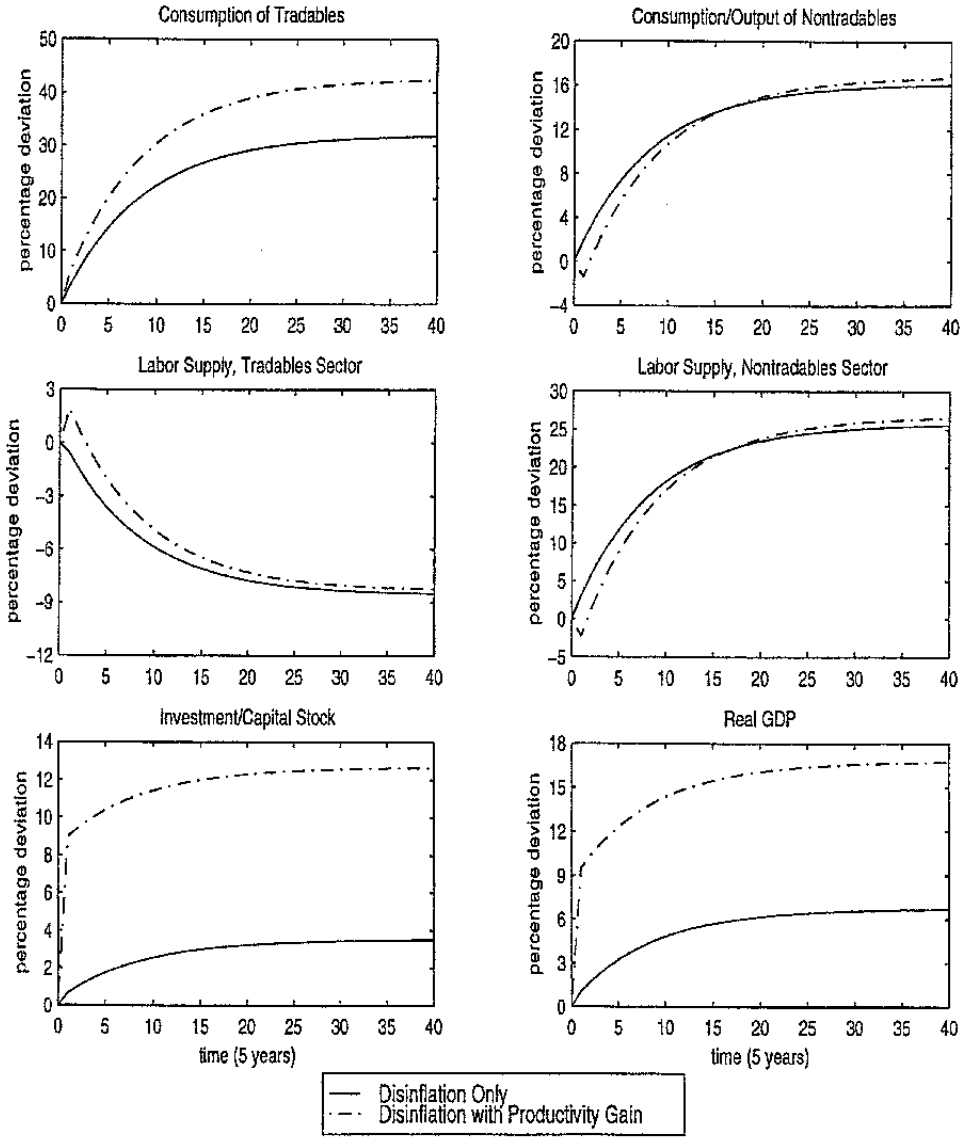
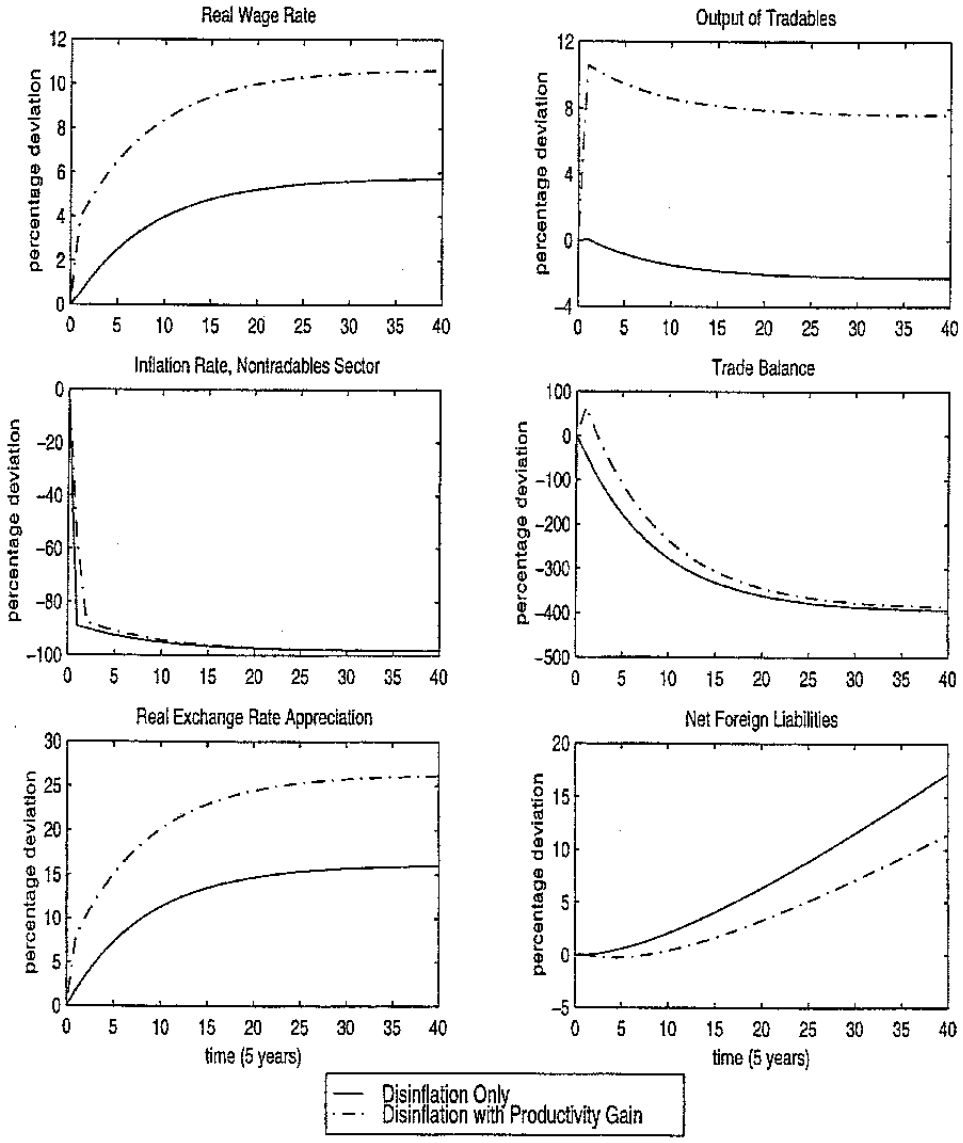


Figure 2. Response to a Permanent 100% Reduction in the Rate of Devaluation with a Permanent 5% Productivity Increase in the Traded Goods Sector (concluded)
(Percentage Deviation from the Pre-Stabilization Steady State)



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