Market Sentiment and Macroeconomic Fluctuations under Pegged Exchange Rates

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Abstract

The effects of an adverse change in market sentiment, defined as a temporary increase in the premium faced by domestic borrowers on world financial markets, are studied in an intertemporal optimizing framework with imperfect capital mobility. Firms' demand for working capital is financed by bank credit. The shock leads to a rise in domestic interest rates, capital outflows and a drop in official reserves, a reduction in bank deposits and loans, a contraction in output, and an increase in unemployment. These predictions are consistent with Argentina's economic downturn in the immediate aftermath of the Mexican peso crisis of December 1994.

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1 Introduction

Crises in individual countries have shown a growing tendency in recent years to translate into turbulence in international financial markets and severe economic downturns in other countries. For instance, following the Mexican peso crisis of December 1994, and the ensuing sharp rise in borrowing spreads on world capital markets, a full-blown economic crisis developed in Argentina. Similarly, the Thai baht crisis of July 1997 led to both financial and economic turmoil in Korea, Malaysia, and Indonesia, and subsequently spread to Russia and Brazil. Several countries in East Asia experienced dramatic falls in private sector credit and output, sharp increases in real interest rates and unemployment, banking sector problems, and large capital outflows that eventually forced them to abandon their pegged exchange rate systems. The collapse of Argentina's currency board in early 2002 also had adverse effects on a number of countries, including Brazil and Turkey, as a result of the sharp increase in the cost of borrowing that these countries faced on world capital markets.[1] Although the adverse effects have been short-lived in many cases, in others they have entailed large economic costs.

The mechanisms through which "contagious" external shocks are transmitted across countries has generated considerable interest in recent years. The recent literature has emphasized a variety of channels, such as trade linkages (either through bilateral trade or competition in third markets), financial linkages, and shifts in investor or market sentiment.[2] Close financial linkages imply that a crisis in one country may induce investors, or bank lenders, to rebalance their portfolios for risk management, liquidity, or other reasons.

[1] For an overview of the events leading to the Mexican peso crisis, see for instance Masson and Agénor (1996), and Sachs, Tornell and Velasco (1996). On the causes of the Asia crisis, see Alba et al. (1999) and Radelet and Sachs (1998). On the collapse of Argentina's currency board, see Perry and Servén (2003).

[2] See, for instance, Chang and Majnoni (2002), Forbes (2004), Uribe (1996), and the overviews by Prisker (2001) and Pericoli and Sbracia (2003). Paasche (2001) has argued that, in the presence of collateral-based credit constraints, contagion can also occur through changes in the terms of trade.

Caramazza et al. (2004), using panel probit regressions on 41 emerging market economies—and controlling for domestic and external fundamentals, trade spillovers, and financial weaknesses in the affected countries—found indeed that financial linkages (through common bank lenders) played a significant role in the spread of the Mexican, Asian, and Russian Crises. When countries have a common creditor, a financial crisis in, say, country A can lead to financial market pressures in country B if, owing to the need to adjust its loan portfolio, the creditor cut lending or recalls some of its loans to country B.

Shifts in market perceptions may also play an important role in the propagation of financial disturbances across countries, because economies with weaker fundamentals may be more vulnerable when others (to whom they are not necessarily closely related through either trade or financial linkages) are suffering from crises. A crisis in one country can serve as a "wake-up call" to markets, prompting a reassessment of other countries' fundamentals. Countries with (perceived) weak fundamentals may therefore be subject to a shift in market sentiment or increased risk aversion, which may translate into higher borrowing spreads.

This paper contributes to the "wake-up call" literature on contagion by studying the macroeconomic effects associated with abrupt changes in market sentiment that are unrelated to domestic fundamentals. To do so I develop an intertemporal optimizing model of a small open developing economy operating a pegged exchange rate regime and facing imperfect world capital markets. Specifically, domestic individual borrowers are assumed to face an upward-sloping supply curve of credit, with a premium that depends positively on the individual's level of foreign borrowing and some exogenous factor, which reflects subjective market perceptions. In contrast to models emphasizing "country risk" (as for instance in Aizenman (1989) and Agénor (2005a)), domestic agents are assumed to internalize the effect of their borrowing decisions on the marginal cost of funds that they face. In this setting, a change in "market sentiment" is modeled as a temporary increase in the exogenous component of the premium faced by domestic borrowers on world capital markets. The real and monetary effects of this shock are analyzed in a setting that accounts for portfolio decisions (namely, the allocation of financial wealth between bank deposits, cash balances, and foreign-currency liabilities), real wage behavior, and the link between bank credit and the supply side through firms' demand for working capital—a key feature of the financial system in many developing countries.[3] Indeed, in many of these countries, banks account for a sizable fraction of the financing needs of firms (see Agénor (2004, Chapter 4)), creating a "cost channel" through which financial disturbances may affect real output.

The remainder of the paper proceeds as follows. The model is presented in Section II, and its dynamic form is derived in Section III. Section IV characterizes the adjustment process to an adverse change in market sentiment, defined as a temporary increase in the autonomous component of the premium faced by domestic borrowers on world financial markets. Section V compares the transmission process embedded in the model two other studies that are fairly representative of the literature in that area. To illustrate the predictive ability of the model, I examine in Section VI a particular episode of contagion due to an abrupt change in market sentiment—the Tequila effect that affected Argentina in the aftermath of the Mexican peso crisis of December 1994. Section VII considers some extensions of the analysis and offers some final remarks.

[3] Studies in which the link between firms' working capital needs and bank credit is explicitly considered include Edwards and Végh (1997), Greenwald and Stiglitz (1993), Isard et al. (1996), Cheng and Ma (2005), and Neumeyer and Perri (2005). Some of these studies are discussed later.

2 The Framework

Consider a small open economy in which perfect foresight prevails and five types of agents operate: households, producers, commercial banks, the government, and the central bank. The exchange rate is depreciated at a predetermined rate by the central bank. The economy produces a single tradable good using only labor. The price of the good is fixed on world markets, and purchasing power parity holds continuously.

2.1 Producers

Firms have no direct access to world capital markets. To finance their working capital needs, which consist solely of labor costs, they borrow from commercial banks.[4] Total production costs faced by the representative firm are thus equal to the wage bill plus the interest payments made on bank loans.

Formally, the maximization problem faced by the representative firm can be written as

$$\max_{y}(y - wn - i_L l), \tag{1}$$

where y denotes output, w the real wage, n the quantity of labor employed, i_L the nominal (contractual) lending rate charged by commercial banks, and l the real amount of loans obtained from commercial banks.

The output-employment relationship takes the form

$$n = y^{\beta}, \qquad \beta > 1, \tag{2}$$

whereas the firm's financial constraint is given by

$$l \geq wn. \tag{3}$$

Constraint (3) will be assumed to be continuously binding, because the only reason for firms to demand loans is to finance labor costs.

[4]There is no domestic substitute for bank loans, so that firms cannot issue equities or bonds (claims on their capital stock) to finance their working capital needs.

Maximizing equation (1) subject to (2) and (3) yields

$$y^s \equiv [1/\beta w(1+i_L)]^{1/(\beta-1)}, \tag{4}$$

which shows that supply is inversely related to the effective cost of labor, $w(1+i_L)$. Substituting equation (4) in (2) yields labor demand as[5]

$$n^d = n^d[w(1+i_L)] = [1/\beta w(1+i_L)]^{\beta/(\beta-1)}, \qquad n^{d\prime} < 0. \tag{5}$$

Using equations (3) and (5), the firm's demand for credit is given by

$$l^d = wn^d = l^d(\overset{?}{w}, \overset{-}{i_L}). \tag{6}$$

which shows that, in general, an increase in the real wage has an ambiguous effect on the demand for credit. On the one hand, it raises directly labor costs; on the other, it lowers the demand for labor. In the present case, because the elasticity of labor demand exceeds unity, and the net effect is negative.[6]

Real wages are set according to

$$w = \mathbf{w}(\overset{+}{w_m}, \overset{-}{u}), \tag{7}$$

which shows that wages are positively related to workers' reservation wage, w_m, and negatively to the unemployment rate, u. A wage-setting equation like (7) can be derived from a variety of efficiency-wage models—as in the case, for instance, where firms face turnover costs and the quit rate increases when labor market conditions become more favorable (see Agénor

[5]Except otherwise indicated, partial derivatives are denoted by corresponding subscripts, whereas the total derivative of a function of a single argument is denoted by a prime. A sign over a variable refers to the sign of the corresponding partial derivative, and $\dot{x} \equiv dx/dt$. Time subscripts are omitted for simplicity. A '~' is used to denote steady-state values.

[6]By definition, $dl^d/dw = \tilde{n}^d + \tilde{w}(\partial n^d/\partial \omega)$. Multiplying both sides by $\tilde{w}/\tilde{l}^d = 1/\tilde{n}^d$ yields the elasticity as $\eta_{l^d/w} = 1 + \eta_{n^d/w}$, which therefore requires $\left|\eta_{n^d/w}\right| > 1$ for dl^d/dw to be negative. Here, $\eta_{n^d/w} = -\beta/(\beta-1)$, which is greater than unity in absolute value.

(2001, 2005*b*). Alternatively, (7) may be derived from a setting where a utility-maximizing trade union operates, and the relative weight attached to employment (as opposed to wages) in the union's objective function increases with the level of unemployment (see Agénor (2005*a*)). Regardless of the exact rationale, the *level* effect of unemployment on real wages (as opposed to a Phillips-curve type relationship between the *rate of change* of wages and unemployment) has been supported by much of the recent evidence on wage formation in developing countries (see Agénor (2005*b*)).

With labor supply fixed at n^s, the unemployment rate is inversely related to labor demand, so that, from (7),

$$w = w(n^d), \quad w' > 0.$$

Substituting for n^d using (5) and solving for w yields

$$w = \omega(i_L), \quad \omega' < 0, \tag{8}$$

which relates the real wage negatively to the bank lending rate.

In the above setting, an increase in the lending rate has conflicting effects on the effective cost of labor per worker, $w(1 + i_L)$. On the one hand, it increases directly effective unit labor costs, which tends to reduce labor demand. On the other, by reducing labor demand, it raises unemployment and lowers wages, which tends to reduce the effective cost of labor. In what follows I assume that the sensitivity of wages to unemployment is not too high, so that the direct effect dominates. Thus, substituting (8) in equations (4) and (6) yields

$$l^d = l^d(i_L), \quad y^s = y^s(i_L), \quad l^{d\prime}, y^{s\prime} < 0. \tag{9}$$

Firms do not invest and transfer all their profits, Π, to their owners, domestic households:

$$\Pi = y^s - wn^d - i_L l^d,$$

that is, using (6):

$$\Pi = y^s - (1 + i_L)l^d. \tag{10}$$

The financial counterpart to firms' bank credit is assumed to consist of domestic cash held outside the banking system ($z_f = l^d$).

2.2 Households

Households supply labor inelastically, consume the domestic good, and hold two categories of financial assets in their portfolios: domestic cash balances, which bear no interest, and domestic-currency deposits with the banking system. They borrow only from foreign lenders.[7]

The representative household maximizes discounted lifetime utility, given by

$$\int_0^\infty [\frac{c^{1-\eta}}{1-\eta} + \ln z_h]e^{-\rho t}dt, \quad \rho, \eta > 0, \ \eta \neq 1 \tag{11}$$

where ρ denotes the rate of time preference (assumed constant), c consumption expenditure, $\sigma = 1/\eta$ the intertemporal elasticity of substitution in consumption, and z_h real cash balances.[8]

Nominal wealth of the representative household, A, is defined as

$$A = Z_h + D - EL^*,$$

where E is the nominal exchange rate, $Z_h = Ez_h$, D is the nominal value of deposits with the banking system, and L^* is the foreign-currency value of funds borrowed abroad. Given that the world price of the good is normalized to unity, and that purchasing power parity holds continuously, the domestic

[7] The assumption that households do not borrow from domestic banks is consistent with the evidence for many developing countries, which indicates that the share of private credit allocated to households is often small and subject to quantity rationing.

[8] A more general specification would be to enter both cash and bank deposits in the instantaneous utility function, by assuming that both types of assets generate (imperfectly substitutable) liquidity services. This would, however, complicate the analysis without adding much in terms of substance.

price level and the nominal exchange rate are one and the same, and real wealth can be written as

$$a = z_h + d - L^*, \tag{12}$$

where $d = D/E$.

The flow budget constraint is given by

$$\dot{a} = wn^d + \Pi + i_d d - c - \tau - (i^* + \theta)L^* - (z_h + d)\varepsilon, \tag{13}$$

where wn^d is wage income, Π profits received from firms (as defined in (10)), τ the real value of lump-sum taxes, i_d the deposit interest rate, and ε the constant, nominal rate of devaluation.[9] The term $-(z_h + d)\varepsilon$ accounts for capital losses on domestic financial assets resulting from inflation. The cost of borrowing on world capital markets $i^* + \theta$ consists of an exogenous, risk-free interest rate i^* and a premium θ, which is defined as

$$\theta = \theta(L^*, \alpha), \tag{14}$$

where α is a shift factor. Although α may in general capture various household characteristics other than the level of borrowing (such as age distribution within the household), here it will be taken to reflect "market sentiment" or "mood" toward the country in question—in effect, a country-specific factor that reflects foreign lenders' idiosyncratic perceptions of the country's creditworthiness. The premium is positively related to both L^* and α.[10] The assumption that domestic private agents are able to borrow more on world

[9] As discussed below, banks have zero profits and therefore do not transfer any income to households.

[10] As discussed in the Appendix, it is also plausible to assume that the premium is convex in L^* (so that $\theta_{L^*L^*} > 0$), that the cross-derivative $\theta_{L^*\alpha}$ is positive, and that for L^* sufficiently high a binding borrowing constraint is eventually reached. In what follows it is assumed that the economy operates on the upward-sloping portion of the supply curve of funds, rather than at any absolute borrowing ceiling, and that θ is continuously differentiable in that range.

capital markets only at a higher rate of interest captures the existence of individual default risk and the lack of enforceability of international contracts.[11]

The representative household treats w, n^d, Π, i_d, i^*, ε and τ as given, internalizes the effect of its portfolio decisions on the marginal cost of borrowing, and maximizes (11) subject to (12), (13) and (14) by choosing a sequence $\{c, z_h, d, L^*\}_{t=0}^{\infty}$. Let $r_d = i_d - \varepsilon$ be the real domestic deposit rate. The optimality conditions are given by:

$$c^\eta / z_h = i_d \;\Rightarrow\; z_h = z_h(\overset{+}{c}, \overset{-}{r_d + \varepsilon}), \tag{15}$$

$$r_d = i^* + \theta + L^* \theta_{L^*}, \tag{16}$$

$$\dot{c}/c = \sigma(r_d - \rho), \tag{17}$$

together with the transversality condition $\lim_{t \to \infty} (e^{-\rho t} a) = 0$.

Equations (15) and (17) are standard conditions in optimizing models of this type. (15) relates the demand for cash positively to consumption and negatively to the bank deposit rate. It is derived by equating the marginal rate of substitution between consumption and real cash balances to the opportunity cost of holding cash, the nominal deposit rate. Equation (17) is the Euler equation, which shows that total consumption rises or falls depending on whether the real deposit rate (which measures the rate of return on saving) exceeds or falls below the rate of time preference.

Equation (16) is the interest parity condition that holds under the assumption of imperfect world capital markets. It equates the marginal cost of borrowing abroad and the marginal rate of return on domestic assets. In turn, the marginal cost of borrowing is given by the effective cost of borrowing,

[11] See Agénor (1997) for a more detailed discussion. The assumption that the (household-specific) premium depends positively on the agent's level of debt—rather than the economy's total debt—leads naturally to the assumption that agents internalize the effect of their borrowing decisions on θ, as discussed below.

$i^* + \theta$, plus the devaluation rate and the increase in the cost of servicing the existing stock of foreign loans induced by the marginal rise in the premium resulting from an increase in borrowing, $L^*\theta_{L^*}$.

The arbitrage condition (16) determines implicitly the demand for foreign loans. Taking a linear approximation to θ yields

$$L^* = (r_d - i^* - \theta_\alpha \alpha)/\gamma, \tag{18}$$

where $\gamma = 2\theta_{L^*} > 0$. Equation (18) shows that the optimal level of foreign borrowing is positively related to the difference between the real domestic deposit rate and the exogenous component of the cost of borrowing on world capital markets, given by the sum of the safe interest rate and the autonomous component of the premium.

Using equations (12), (15) and (18), the demand for bank deposits can be derived as

$$d = a + L^* - z_h = \Phi(\overset{-}{c}, \overset{+}{r}_d, \overset{+}{a}; \overset{-}{\alpha}), \tag{19}$$

where

$$\Phi_c = -z_{hc}, \quad \Phi_{r_d} = \gamma^{-1} - z_{hr_d}, \quad \Phi_a = 1, \quad \Phi_\alpha = -\theta_\alpha/\gamma.$$

Equation (19) indicates that the demand for bank deposits depends positively on the real deposit rate and net financial wealth, and negatively on consumption and the autonomous component of the premium.

2.3 Commercial banks

Assets of commercial banks consist of credit extended to domestic firms, l^s, and reserves held at the central bank, RR; for simplicity, banks hold no excess reserves. Bank liabilities consist of deposits held by households. The balance sheet of commercial banks can therefore be written as

$$d = l^s + RR. \tag{20}$$

Reserves held at the central bank do not pay interest and are determined by

$$RR = \mu d, \tag{21}$$

where $0 < \mu < 1$ is the reserve requirement ratio.

The actual level of deposits held by the private sector is demand determined and, from equations (20) and (21), the supply of credit is given by

$$l^s = (1 - \mu)d. \tag{22}$$

Thus, from (19) and (22), the supply of credit can be written as

$$l^s = l^s(\overset{-}{c}, \overset{+}{r_d}, \overset{+}{a}; \overset{-}{\alpha}), \tag{23}$$

where $l^s_x = (1 - \mu)\Phi_x$, with $x = c, i_d, a, \alpha$.

Banks occur no costs in intermediating between depositors and borrowers. With zero profits, $i_d d - i_L l^s = 0$. Thus, using (22), the nominal deposit rate differs from the lending rate only as a result of the distortion induced by the required reserve ratio:

$$i_L = i_d/(1 - \mu).$$

This condition implies that, in real terms, the wedge between the deposit and lending rates is given by

$$r_d = (1 - \mu)r_L - \mu\varepsilon. \tag{24}$$

2.4 Central bank and the Government

The central bank pursues a policy of unsterilized intervention to defend the peg. It therefore ensures the costless conversion of domestic currency holdings into foreign currency at the prevailing exchange rate. It does not extend credit to the economy. Its balance sheet is thus given by

$$R^* = z + RR, \tag{25}$$

where $z \equiv z_f + z_h$ denotes total cash balances held by private agents (households and firms) and R^* the central bank's net stock of foreign assets measured in foreign currency terms, which is here also equal to the supply of base money. Interest received by the central bank on its holdings of foreign assets, i^*R^*, is assumed to be transferred in its entirety to the government.

The government consumes the domestic good, in quantity g. Its resources consist of transfers from the central bank, lump-sum taxes levied on households, and the inflation tax on cash balances. The budget constraint of the government in real terms is thus

$$g - \tau = i^*R^* + (z + RR)\varepsilon. \tag{26}$$

Assuming that the government maintains a balanced budget by adjusting lump-sum taxes yields, using (25),

$$\tau = g - (i^* + \varepsilon)R^*. \tag{27}$$

2.5 Equilibrium of the credit market

To close the model requires specifying the equilibrium conditions of the currency and credit markets. By Walras' Law, these two conditions are not independent. I therefore focus on one of them, namely, the credit market.

Using (9) and (23), the equilibrium condition of the credit market is given by

$$l^s(c, r_d, a; \alpha) = l^d(r_L + \varepsilon). \tag{28}$$

Using (24) to eliminate r_d in the above equation, the equilibrium bank lending rate is given by

$$r_L = r_L(\overset{+}{c}, \overset{-}{a}; \overset{+}{\alpha}), \tag{29}$$

where $\partial r_L/\partial x = -\Omega^{-1}\Phi_x$, with $x = c, a, \alpha$, and

$$\Omega = (1-\mu)\Phi_{r_d} - \frac{l^{d\prime}}{1-\mu} > 0.$$

Equation (29) shows that the equilibrium real lending rate depends positively on consumption and the autonomous component of the premium, and negatively on the household's net financial wealth. An increase in α, for instance, lowers bank deposits and reduces the supply of credit, requiring an increase in domestic interest rates to maintain equilibrium of the credit market.

Substituting (24) in (19), the household's demand for bank deposits can be written as

$$d = d(\overset{-}{c}, \overset{+}{a}; \overset{-}{\alpha}), \tag{30}$$

where, for $x = c, a, \alpha$,

$$d_x = \Phi_x + (1 - \mu)\Phi_{r_d}(\partial r_L / \partial x).$$

Given (29), these expressions can be rewritten as

$$d_x = [1 - (1 - \mu)\Phi_{r_d}/\Omega]\Phi_x.$$

Thus, because $(1 - \mu)\Phi_{r_d}/\Omega$ is less than unity, $\text{sg}(d_x) = \text{sg}(\Phi_x)$.

3 Dynamic Structure and Steady State

To characterize the dynamic structure of the model, the first step is to note that from equation (25), $z_h = R^* - z_f - RR$. This result implies that, noting that $z_f = l$, and using (21) and (22):

$$z_h = R^* - (1 - \mu)d - \mu d = R^* - d. \tag{31}$$

Substituting this expression for z_h in equation (12) yields

$$D^* = -a = L^* - R^*, \tag{32}$$

which shows that, because the central bank does not accumulate assets and the government maintains a continuously balanced budget, the private sector's net real financial liabilities, $-a$, are equal to the economy's net stock of foreign debt measured in foreign-currency terms, D^*.

Because $\dot{D}^* = -\dot{a}$, using (13) yields

$$\dot{D}^* = c + \tau + (i^* + \varepsilon + \theta)L^* - (wn^d + \Pi) - i_d d - \varepsilon D^*.$$

Substituting the government budget constraint (27) in this expression yields

$$\dot{D}^* = c + g + i^* D^* + \theta L^* - (wn^d + \Pi) - i_d d.$$

From (10), $wn^d + \Pi = y^s - i_L l$, whereas from the banks' zero-profit condition, $i_d d - i_L l = 0$; the above expression can therefore be rewritten as

$$\dot{D}^* = c + g + i^* D^* + \theta(L^*, \alpha)L^* - y^s, \tag{33}$$

which represents the consolidated flow budget constraint of the economy.[12]

Equations (18), (24), and (29) yield

$$L^* = [(1-\mu)r_L(c, D^*; \alpha) - \mu\varepsilon - i^* - \theta_\alpha \alpha]/\gamma,$$

which can be written as

$$L^* = \lambda(\overset{+}{c}, \overset{+}{D^*}; \overset{-}{\alpha}), \tag{34}$$

where

$$\lambda_x = \gamma^{-1}[(1-\mu)(\partial r_L/\partial x)] = -(1-\mu)\Phi_x/\gamma\Omega, \text{ with } x = c, D^*,$$

$$\lambda_\alpha = \gamma^{-1}[(1-\mu)(\partial r_L/\partial \alpha) - \theta_\alpha] = \gamma^{-1}[(1-\mu)\gamma^{-1}(\frac{\theta_\alpha}{\Omega}) - \theta_\alpha],$$

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[12]Integrating equation (33) yields the economy's intertemporal budget constraint

$$D_0^* = \int_0^\infty (y^s - c - g - \theta L^*)e^{-\int_0^t i_h^* dh} dt + \lim_{t\to\infty} D^* e^{-\int_0^t i_h^* dh}.$$

The economy must eventually repay all its debt to foreign creditors, so the second term on the left-hand side in the above expression must be zero. Thus, the level of debt at $t = 0$ must be equal to the discounted stream of the excess of future production over domestic absorption plus premium-related interest payments on private foreign borrowing.

so that

$$\lambda_\alpha = \frac{\theta_\alpha}{\gamma\Omega}\left\{(1-\mu)z_{hr_d} + \frac{l^{d\prime}}{1-\mu}\right\}.$$

Equation (34) shows, in particular, that the net effect of an increase in α is a reduction in the demand for foreign loans, despite its indirect, positive effect on domestic interest rates.

Equations (17), (24), (29), (30), (33) and (34) describe the evolution of the economy along any perfect foresight equilibrium path. These equations can be summarized as follows:

$$L^* = \lambda(c, D^*; \alpha), \quad d = d(c, D^*; \alpha), \tag{35}$$

$$\dot{c}/c = \sigma[(1-\mu)r_L(c, D^*; \alpha) - \mu\varepsilon - \rho], \tag{36}$$

$$\dot{D}^* = c + g + i^* D^* + \theta[\lambda(\cdot), \alpha)]\lambda(\cdot) - y^s[r_L(c, D^*; \alpha) + \varepsilon], \tag{37}$$

with $d_{D^*} = -d_a < 0$, and equation (27) determining residually lump-sum taxes.

Equations (36) and (37) form a first-order differential equation system in consumption c, which may jump in response to new information, and net external debt D^*, which can change only gradually.[13] In the neighborhood of the steady state, this system can be written as

$$\dot{c} = G(\overset{+}{c}, \overset{+}{D^*}; \overset{+}{\alpha}), \tag{38}$$

$$\dot{D}^* = \Psi(\overset{+}{c}, \overset{+}{D^*}; \overset{?}{\alpha}) + g, \tag{39}$$

[13] Although net external debt evolves only gradually over time, both official reserves and private foreign borrowing may shift discretely in response to changes in domestic or foreign interest rates. Discrete changes in private borrowing must nevertheless be accompanied by an offsetting movement (at the official exchange rate) in the stock of foreign reserves held by the central bank, in order to leave net external debt D^* constant on impact.

where $G_x = \sigma(1-\mu)(\partial r_L/\partial x)\tilde{c}$, for $x = c, D^*, \alpha$, and

$$\Psi_c = 1 + (\tilde{\theta} + \tilde{L}^*\theta_{L^*})\lambda_c - y^{s\prime}\frac{\partial r_L}{\partial c}, \quad \Psi_{D^*} = i^* + (\tilde{\theta} + \tilde{L}^*\theta_{L^*})\lambda_{D^*} - y^{s\prime}\frac{\partial r_L}{\partial D^*},$$

$$\Psi_\alpha = \tilde{L}^*\theta_\alpha + (\tilde{\theta} + \tilde{L}^*\theta_{L^*})\lambda_\alpha - y^{s\prime}\frac{\partial r_L}{\partial \alpha}.$$

Equation (39) shows that, in general, the net effect of an increase in the autonomous component of the premium on the current account balance (as measured by Ψ_α) is ambiguous. This net effect can be decomposed into three effects. First, a portfolio effect, which results from the fact that the increase in α lowers directly (at the initial level of the premium) the demand for foreign loans by domestic households. This is measured by the term $\tilde{\theta}\lambda_\alpha$, and tends to reduce the current account deficit. Second, there is a composite income effect, which operates through two channels. An increase in α raises directly the premium, and increases interest payments on the existing stock of foreign debt. This is measured by the term $\tilde{L}^*\theta_\alpha$, which worsens the current account deficit. In addition, the direct reduction in private foreign borrowing induced by the rise in α lowers also the premium, at the initial level of debt. This is measured by the term $\tilde{L}^*\theta_{L^*}\lambda_\alpha$, which tends to reduce the current account deficit. Thus, the composite income effect has an ambiguous effect on the current account. Third, there is a supply-side effect, which is due to the fact that the increase in α raises the lending rate (by reducing the desired level of bank deposits and thus the supply of credit), thereby lowering output. This effect is captured by the term $-y^{s\prime}(\partial r_L/\partial\alpha)$, and tends to increase the current account deficit.

The fact that the composite income effect is ambiguous, and that the portfolio and supply-side effects operate in opposite directions, implies that the net effect of a change in α on the premium-related debt service payments by the private sector, θL^*, cannot be determined a priori. In what follows, it will be assumed that the sum of all three effects is such that the current account deteriorates, that is, $\Psi_\alpha > 0$. As I have shown (in an appendix available upon request), a sufficient (although not necessary) condition for this inequality to hold is that the elasticity of the external premium with respect to α , $\eta_{\theta/\alpha}$, be greater (in absolute terms) than the elasticity of the demand for foreign loans by households with respect to α, $\eta_{L^*/\alpha}$. This condition ensures that an increase in α raises premium-related debt service payments by households ($\partial(\theta L^*)/\partial\alpha > 0$), or equivalently that the sum of the portfolio and income effects is positive. This assumption is quite appropriate in the present context, given the focus is on temporary changes in α.

Linearizing equations (38) and (39) around the initial steady state gives

$$\begin{bmatrix} \dot{c} \\ \dot{D}^* \end{bmatrix} = \begin{bmatrix} G_c & G_{D^*} \\ \Psi_c & \Psi_{D^*} \end{bmatrix} \begin{bmatrix} c - \tilde{c} \\ D^* - \tilde{D}^* \end{bmatrix}. \tag{40}$$

Saddlepath stability requires one unstable (positive) root. To ensure that this condition holds, the determinant of the matrix of coefficients in (40) must be negative, that is, $G_c\Psi_{D^*} - G_{D^*}\Psi_c < 0$. This condition is interpreted graphically in Figure 1.

The steady-state solution is obtained by setting $\dot{c} = \dot{D}^* = 0$. From equation (36), the real deposit rate must be equal to the rate of time preference:

$$\tilde{r}_d = \tilde{\imath}_d - \varepsilon = \rho. \tag{41}$$

Substituting this result in (18) yields

$$\tilde{L}^* = (\rho - i^* - \theta_\alpha \alpha)/\gamma, \tag{42}$$

which indicates that the steady-state level of private foreign borrowing is positive as long as $\rho > i^* + \theta_\alpha \alpha$, that is, as long as the rate of time preference of domestic households exceeds the exogenous component of the cost of foreign borrowing.

Equations (24) and (41) yield

$$\tilde{r}_L = \frac{\rho + \mu\varepsilon}{1 - \mu}, \tag{43}$$

which implies, using (9):

$$\tilde{l}^d = l^d(\frac{\rho + \varepsilon}{1 - \mu}), \quad \tilde{y}^s = y^s(\frac{\rho + \varepsilon}{1 - \mu}). \tag{44}$$

These results indicate that in this setting—taking labor supply and other determinants of the wage-setting equation (7) as exogenous—the supply of output and firms' demand for credit are invariant in the long run to shocks other than changes in the rate of time preference, the devaluation rate, or the reserve requirement ratio.

From equation (37), the current account must be in equilibrium, so the trade surplus must equal the deficit in the services account:

$$\tilde{y}^s - \tilde{c} - g = i^*\tilde{D}^* + \tilde{\theta}\tilde{L}^*. \tag{45}$$

Finally, from (15) and (41), real cash balances held by households are given by

$$\tilde{z}_h = z_h(\tilde{c}, \rho + \varepsilon). \tag{46}$$

The steady-state equilibrium of the model is depicted in Figure 1. The locus $[\dot{D}^* = 0]$ gives the combinations of c and D^* for which net external debt (measured in foreign-currency terms) remains constant, whereas the locus $[\dot{c} = 0]$ depicts the combinations of c and D^* for which consumption does not change over time. Points above the $[\dot{D}^* = 0]$ curve are characterized by current account deficits (with the stock of debt increasing), whereas points below the curve represent surpluses (and the level of debt is falling). Points located to the left of the $[\dot{c} = 0]$ curve represent situations where the domestic real deposit rate is lower than the rate of time preference, and consumption is falling. Conversely, points located to the right of the $[\dot{c} = 0]$ curve represent situations where consumption is rising. Saddlepath stability requires that the $[\dot{c} = 0]$ curve be steeper than the $[\dot{D}^* = 0]$ curve. The saddlepath SS has a negative slope (as formally established in an appendix available on request) and defines the only convergent path to the steady-state equilibrium, which is reached at point E.

4 Change in Market Sentiment

I now consider a temporary change in α as a way to capture, as in the "wake-up call" view of contagion, a sudden shift in sentiment on world capital markets that is unrelated to the domestic economy's fundamentals. Specifically, I assume that α increases at $t = 0$ and returns to its initial value at a future date T.

To understand the dynamics associated with a temporary increase in α, consider first the long-run effects associated with a permanent shock. As can be inferred directly from equation (42), net private borrowing on world capital markets falls. The nominal deposit rate remains constant at $\rho + \varepsilon$, implying that the lending rate (given in (43)) is also constant. From (44), output therefore does not change, and neither does the demand for credit by firms. Consequently, the supply of credit (from (28)) and bank deposits (from (22)) are also unaffected.

Despite the reduction in private foreign indebtedness, the increase in the premium results in a rise in interest payments abroad and thus a deterioration of the services account. Maintaining current account equilibrium therefore requires an improvement in the trade balance. And because output does not change, consumption must fall. From (46), households' real cash balances therefore also fall. But because bank deposits and the demand for credit by domestic firms—and thus reserve requirements and firms' holdings of cash—remain constant, the fall in households' holdings of domestic currency must be accompanied by a reduction in official holdings of foreign currency. The overall effect on the economy's net external debt (the difference between private foreign borrowing and foreign assets held by the central bank) is nevertheless negative.[14] Graphically, as illustrated in Figure 1, both the

[14]As shown in an appendix (available upon request), although the reduction in net foreign indebtedness lowers debt service payments at the risk-free rate, the services account always deteriorates—thereby ensuring that in the long run the trade balance improves and consumption falls, as indicated above.

$[\dot{c} = 0]$ locus and the $[\dot{D}^* = 0]$ locus shift to the left. Point E' is the equilibrium position at which the economy would settle if the increase in α were permanent, with a lower level of consumption and lower external debt.

On impact, foreign borrowing by the private sector also falls. The discrete reduction in private foreign borrowing is accompanied by an offsetting reduction in official reserves, because the economy's total debt can change only gradually. The reduction in the central bank's net foreign assets reduces the supply of base money. But at the initial level of consumption and interest rates (that is, at the initial level of cash balances held by households), the drop in private foreign borrowing induces households to reduce their deposits in domestic banks. In turn, the reduction in deposits lowers the supply of credit, thereby requiring an increase in the domestic lending rate (which reduces firms' demand for loans) to maintain equilibrium of the credit market. The increase in real interest rates creates an incentive for the household to shift consumption toward the future, so that consumption falls on impact. Output also contracts on impact, because the increase in the lending rate translates into a rise—despite a partly offsetting reduction in wages—in the effective price of labor. The reduction in output and labor demand on impact raises unemployment.[15]

Note that here, because the household is a net debtor in the initial steady state, wealth and intertemporal effects operate in the same direction. On the one hand, the increase in the premium encourages households to save more and consume less today (the intertemporal substitution effect). On the other, the increase in the cost of foreign borrowing leads households to expect a net

[15] As also shown in the above-mentioned appendix, the fall in consumption (by reducing the demand for cash balances) tends to increase the demand for bank deposits, which in turn puts downward pressure on the domestic lending rate. If the degree of intertemporal substitution is not too high—a reasonable assumption in light of the evidence, as discussed by Agénor and Montiel (1999)—the impact effect on consumption will be limited and the demand for bank deposits will unambiguously fall. The reduction in the supply of loans will therefore require (as assumed above) an increase in the lending rate to maintain credit market equilibrium and eliminate excess demand.

increase in debt service (despite the reduction in the demand for foreign loans) in the long run, thereby reducing permanent income, lowering private expenditure and increasing saving today (the wealth effect). Consumption falls as a result of both effects.[16]

Whether the trade balance (which, in the initial equilibrium, is characterized by a surplus that matches net interest income payments on the economy's external debt) improves or not depends on how much consumption falls relative to output. At the same time, although private foreign borrowing falls, the net effect of an increase in α on the services account is a rise in interest payments by the household to foreign creditors (as assumed earlier) and therefore an increase in the deficit of the services account.[17] With a permanent shock, the net effect is a current account surplus on impact ($\dot{D}_0^* < 0$), which implies that the reduction in consumption is not only large enough to generate an improvement in the trade balance, but also that the resulting trade surplus is sufficiently large to outweigh the effect of the deterioration in the services account. Graphically, consumption jumps downward from E to G, located on the new saddlepath.

With a temporary shock, however, although consumption always falls on impact, the net effect on the current account is ambiguous and depends on the duration of the shock, T. The dynamics of a temporary shock are also illustrated in Figure 1. Consider first the case where the period of time T during which the increase in the autonomous component of the premium occurs is sufficiently large. Given that the shock is temporary, the optimal "smoothing response" is such that consumption falls initially (from E to a point such as A) by less than it would if the shock was permanent. As in the case of a permanent shock, despite the deterioration in the services account and the fall in output, the reduction in consumption is large enough to ensure

[16]See Agénor (1998) for a discussion of the case where these two effects (following an increase in the risk-free rate) operate in opposite directions.

[17]Recall that the economy's stock of foreign debt does not change on impact; thus, the increase in debt service refers only to the premium-related component.

that the economy generates trade and current account surpluses on impact ($\dot{D}_0^* < 0$). During the first phase of the transition period, consumption begins to rise (toward $S'S'$) after the initial downward jump, the current account remains in surplus, and the economy reduces its net external debt. However, as time goes by, the expected future reversal of the shock becomes gradually more important in consumption decisions, and agents begin to spend more. As a result, the current account surplus disappears gradually. At B, which corresponds to the point at which the path of the system crosses the $[\dot{D}^* = 0]$ curve corresponding to the long-run equilibrium E', the current account is in equilibrium. After that point, consumption continues to rise, and the current account moves into deficit ($\dot{D}^* > 0$). The initial saddlepath SS corresponding to the original equilibrium position is reached exactly at T (point C). After that point, consumption begins to fall, and the current account continues to deteriorate, and external debt increases, until the economy returns to its original equilibrium position at E.

During the first phase of the transition period, with consumption increasing and net external debt falling, bank deposits are increasing, credit supply is rising, and the bank lending rate is falling.[18] Foreign borrowing by the private sector is therefore falling, so that the economy is registering net capital outflows. Domestic cash balances are rising, as well as official reserves held by the central bank. In the second phase of the transition (between B and C), with consumption rising and the stock of debt increasing, the domestic lending rate is also rising, and private foreign borrowing begins to increase. At period T when the shock is reversed, consumption begins to fall and net external debt continues to increase. At the same time, the bank lending rate falls discretely, whereas private foreign borrowing jumps up. Real cash balances, official reserves, and bank deposits also jump upward, ensuring that the economy's net foreign debt remains constant. As can be inferred from

[18]The ensuing discussion assumes that the degree of intertemporal substitution, and thus the initial impact of the shock on consumption, is not too large (see Appendix B).

(30), bank deposits increase at T despite a drop in the deposit rate; the reason is that the jump in foreign borrowing (a capital inflow) is matched by an increase in both real cash balances (as a result of the reduction in the opportunity cost of money) and deposits in the banking system. Again, this portfolio reallocation occurs instantly, so as to leave the net foreign debt level of the economy constant at T.[19] The path of output mirrors the adjustment path of the lending rate. Figure 2 illustrates the adjustment path of the main variables of the economy.

Consider now the case where the length of time T during which the premium increases is relatively short. In contrast to the previous case, the current account moves into deficit following a temporary rise in α ($\dot{D}_0^* < 0$). This deficit results from a worsening of both the trade balance (as a consequence of output falling by more than consumption)) and a deterioration in the services account. It persists as long as the shock lasts, and is followed by a subsequent improvement, as the economy returns to the original steady state. This adjustment path corresponds to the sequence $EA'B'E$ in Figure 1. Essentially, a fairly short temporary shock generates little incentives for private agents to engage in intertemporal substitution; as a result, initial consumption does not adjust by much and, because output falls, there is a tendency for the trade balance to deteriorate—thereby compounding the adverse effect of the increase in the exogenous component of the premium on the services account.

The foregoing discussion assumes that policies are given. A possible way to account for an endogenous policy response is to postulate that the central bank adjusts the devaluation rate downward in response to increases in the premium, in an attempt to offset the impact of the rise in the premium on the domestic-foreign interest rate differential, thereby mitigating capital outflows. Formally, therefore, $\varepsilon = \varepsilon(\alpha)$, with $\varepsilon' < 0$. In the long run, from

[19] Note also that, from (31), the increase in R^*, which matches the increase in L^*, results from higher cash holdings not only by households, but also by firms (the supply of credit expands as a result of an increase in bank deposits).

(41) the nominal deposit rate drops in the same proportion as the devaluation rate. From (42) the real lending falls as well, thereby mitigating the adverse output effect. From the current account equilibrium condition, the steady-state value of consumption would therefore drop by less than otherwise. Thus, endogenous policy responses mitigate the adverse real effects associated with the adjustment process. Moreover, although private foreign borrowing is not affected by a change in the devaluation rate, the general equilibrium effect on the steady-state level of debt (and thus consumption) is now ambiguous and depends on the magnitude of the drop in the devaluation rate. Indeed, if ε' is large enough (in absolute terms), the increase in output may be such that it necessitates an *increase* in consumption to ensure current account equilibrium. In the short run, the reduction in the devaluation rate would also tend to offset a shift in market sentiment. The reason is that now the adverse effect of a higher α on private foreign borrowing is mitigated by the reduction in ε, as can be inferred from (18). It would therefore reduce the magnitude of the initial drop in consumption.

Another option would be to consider an endogenous reduction in the reserve requirement rate, μ, as Argentina did in early 1995, following the collapse of the Mexican peso (see below). From (44), it is clear that such changes would be highly effective in preventing the contraction in credit, and thus a recession. The problem, however, is that it is not, in general, a good idea to use reserve requirements as a stabilization instrument, given their impact on the overall process of financial intermediation. Argentina did so in the context of its currency board regime—an exchange rate arrangement that severely restricts the ability of the central bank to provide emergency liquidity and prevent costly runs on banks. The upshot of this discussion is thus that, if the exchange rate must be kept fixed (so that $\varepsilon = 0$), and reserve requirements can be used only sparingly, there are few instruments left (if one also excludes temporary capital controls) for policymakers to counter the effects of large fluctuations in world interest rates.

5 Comparison with other Studies

It is instructive to compare the transmission process of external shocks to the domestic economy, as described in this study, to the channels highlighted in some other papers focusing on the same issue, such as those of Edwards and Végh (1997) and Neumeyer and Perri (2005). The Neumeyer-Perri model adopts a specification of household preferences—first introduced in the business cycles literature by Greenwood, Hercowitz, and Huffman (1988)—that makes consumption and leisure non separable. As in the model developed here, the cost of credit affects the effective cost of labor, and the external premium is decomposed into an endogenous, domestic-related component and an exogenous component.

There are several substantive differences between the Neumeyer-Perri framework and the model developed in this paper. First, with the preferences used by Neumeyer and Perri (2005), a drop in labor demand directly affects the marginal utility of consumption (at given interest rates), thereby shifting household expenditure. This, in turn, leads to fluctuations in labor supply, which are therefore a key transmission channel of external shocks. In the present framework, where consumption and the labor-leisure decisions are separated, the effect of interest rates on consumption are completely dissociated from the effect of external shocks on production. With inelastic labor supply, the key reason for unemployment to emerge is the lack of flexibility in wages, which therefore cannot offset adverse labor demand shocks induced by the higher cost of domestic credit. A second important difference is that the Neumeyer-Perri framework is non-monetary, so that working capital needs depend on *real* interest rates. By contrast, in the present model, external shocks are transmitted through fluctuations in *nominal* interest rates.[20] In

[20] This distinction is not crucial in the present study, given the assumption of purchasing power parity. However, with the domestic good being an imperfect substitute for the foreign good à la Mundell-Fleming, the difference could be important, both analytically and empirically.

addition, the very nature of their model precludes any account of the role of the banking system in the transmission process of external shocks. Indeed, in their model, where firms borrow from domestic households and foreign investors, domestic lenders always receive back the full value of their loans (plus interest). They play therefore no role in the transmission of external shocks. A third important difference, from a modeling point of view, is that in the present framework it is the level of foreign borrowing that affects the domestic-related component of foreign interest rates, whereas it is future productivity shocks in the Neumeyer-Perri framework. The assumption adopted here is what leads to imperfect capital mobility.

Edwards and Végh (1997) developed an intertemporal optimizing model with money and a banking system which shares some similarities with the framework developed in this paper. Crucial differences, however, are that their model assumes perfect capital mobility and makes no distinction, in modeling foreign interest rates, between a risk-free component and a premium with endogenous and exogenous components, as is done here and in the Neumeyer-Perri framework. The combination of these two assumptions is what drives one of their key results: with costless banking, shocks to world interest rates have no effect on interest rate differentials, and no effect on output and employment. In the present framework, where frictions in banking activity are also absent, this result does not hold. With imperfect capital mobility (an assumption that is much in line with the evidence for developing countries, as documented for instance by Agénor and Montiel (1999) and Willett, Keil, and Ahn (2002)), domestic deposit and lending rates respond to portfolio adjustment induced by shocks to the exogenous component of the premium. The magnitude of the change in interest rate differentials depends on the pattern of substitution across assets. In turn, changes in domestic interest rates lead to changes in output and unemployment, as well as fluctuations in consumption and the current account.

6 Fitting the Facts: The Tequila Effect

How well does the model fit the facts in explaining the short-run macroeconomic effects of contagion induced by "wake-up calls," as modeled here? A rigorous empirical analysis is beyond the scope of this paper. However, an informal discussion of a specific episode of contagion may provide a useful starting point. In this section, I examine a well-known case, the so-called Tequila effect, which followed the Mexican peso crisis in late 1994. The crisis (discussed for instance by Masson and Agénor (1996)) triggered exchange market pressures and increased financial market volatility in a number of developing countries, in both Asia and Latin America. I will focus in what follows on the case of Argentina. This is a particularly well-suited choice because Argentina had been operating (as noted earlier) a currency board regime since its Convertibility Plan was introduced in April 1991. The model presented in this paper (with the added assumption $\varepsilon = 0$, given that the Argentine peso was fixed at par to the US dollar until the crisis of December 2001) describes indeed a currency board arrangement, given the absence of lending by the central bank and unsterilized intervention.

Following the collapse of the Mexican peso on December 20, 1994, external interest rate spreads faced by Argentina rose sharply, reflecting an adverse shift in sentiment on world capital markets. Gyrations in market sentiment led in early 1995 to a sharp reduction in net capital inflows, a fall in official reserves, and intense pressure on asset prices. Between December 1994 and February 1995, the cumulative decline in stock market prices (measured in terms of U.S. dollars) reached 24.8 percent. Whereas in subsequent months most countries that initially suffered from market turbulences (such as Brazil for instance) regained financial and exchange market stability, a full-fledged economic crisis developed in Argentina. As illustrated in Figure 3, The massive shift away from peso deposits, capital flight and the reduction in new borrowing led to a collapse of foreign reserves and a dramatic fall in the monetary base. The resulting liquidity crunch led to a sharp rise in interest rates.

Output contracted significantly in 1995, whereas bank deposits and domestic credit (as measured by bank claims on the private sector) fell dramatically. For 1995 as a whole, industrial output fell by 6.7 percent, real GDP by 4.6 percent, real private consumption by 6.1 percent, real domestic investment by 16 percent, and bank credit to the private sector by 5.5 percent in real terms.[21] The unemployment rate increased sharply, peaking at 18.5 percent in May 1995.[22] Both the trade balance and the current account improved, as a result of a sharp drop in imports related to the contraction in output. At a more formal level, the historical decompositions computed by Agénor, Aizenman and Hoffmaister (2003) on the basis of a Generalized VAR model showed that shocks to external spreads in the immediate aftermath of the Mexican peso crisis had indeed a sizable effect on movements in output and domestic interest rate spreads in Argentina.[23]

How does the model fare against these facts? The events are well captured by the adjustment process corresponding to a period of time T during which the increase in the autonomous component of the premium is sufficiently large, that is, path $EABE$ in Figure 1: consumption falls and output collapses, whereas interest rates and unemployment increases. Bank deposits and credit fall as well. Despite capital outflows (or a reduction in foreign borrowing), the drop in consumption is large enough to generate a trade sur-

[21]The decline in bank credit to the private sector in 1995 may have been exacerbated by the process of concentration in the banking industry, which is widely perceived to have entailed a loss of information about borrowers' net worth, thereby making banks more cautious in their lending decisions.

[22]The recession compounded the already unfavorable trends in the labor market. Unemployment rose steadily from around 6 percent in the immediate aftermath of the introduction of the Convertibility Plan to 12.5 percent in October 1994, despite an average rate of real output growth of more than 7 percent during the same period. The low output-employment elasticity may have resulted from a rise in the participation rate and increased substitution of capital for labor.

[23]In a study of several middle-income countries, Uribe and Yue (2003) found that about 60 percent of movements in country spreads are explained by their own innovations, suggesting in their view that these spreads respond very significantly to changes in domestic conditions. However, mispecification of their empirical model may explain the importance of own innovations.

plus, and the current account improves. The reduction in foreign borrowing is matched by a drop in official reserves. Thus, the model appears to predict fairly well some of the main qualitative features of the Argentine economy's response to market turbulence during 1994-95.

However, there are two important facts that the model does not predict; both of them represent potential explanations as to what may have triggered the shift in market sentiment against Argentina in the first place. Indeed, the first reason for the loss of confidence may have been the deterioration in the current account balance. In part due to high residual inflation (an average of 24.9 percent in 1992 and 10.6 percent in 1993 compared with 171.7 percent in 1991), Argentina's real effective exchange rate based on consumer prices appreciated by nearly 27 percent between April 1991 and December 1994.[24] At the same time, the current account deteriorated from near balance in 1991 to -2.8 percent in 1992, -3.1 percent in 1993, and -3.7 percent in 1994—reflecting a sharp increase in consumption and gross domestic investment, the latter rising by more than 5 percentage points of GDP between 1991 and 1994.

A second and related reason is concerns about the exchange rate regime. As noted earlier, the liquidity crunch led to a sharp increase in domestic interest rates, as predicted by the model. In addition, as shown in Figure 3, the spread between lending rates on U.S. dollar- and peso-denominated loans widened significantly between February and May 1995, reflecting an increase in the perceived risk of a collapse of the currency board regime and a subsequent large exchange rate depreciation.

Neither one of these issues is explicitly accounted for in the model. Addressing them would require extending the analysis to either a Mundell-Fleming production structure or a tradable-nontradable structure, to endogenize the real exchange rate. The second would require the explicit modeling

[24] Estimates of the real effective exchange rate based on wholesale prices and unit labor costs show a significantly lower cumulative appreciation during the same period.

of a dollarized banking system (along the lines for instance of Agénor et al. (2005)), to explain the impact of shifts in market sentiment on the credibility of pegged exchange rate regimes and spreads between domestic and foreign currency-denominated interest rates. This could be a particularly fruitful area of investigation, given the recent evidence provided by, among others, Nicoló et al. (2005), suggesting that financial instability tends to be higher in dollarized economies.

7 Summary and Conclusions

This paper used an intertemporal optimizing framework to examine the macroeconomic effects of changes in "market sentiment," that is, changes in market perceptions about the economic prospects of a country that are unrelated to the behavior of its fundamentals. A key building block of the model is the assumption that firms' must borrow from domestic banks to finance their working capital needs (essentially, labor costs), and that households borrow at a premium above the risk-free rate on imperfect world capital markets. A change in market sentiment is then analyzed as a temporary increase in the autonomous component of the premium.

The short-run dynamics associated with this shock were shown to depend in important ways on the short-run linkage between the financial sector and the supply side, the degree of intertemporal substitution in consumption, and the duration of the shock. Under the assumptions that the degree of intertemporal substitution is not too large, and that the shock is perceived to be of sufficiently long duration, the model predicts an increase in domestic interest rates, a reduction in foreign borrowing (or, equivalently, an increase in net capital outflows), a drop in official reserves and the monetary base, a reduction in bank credit, a contraction in output, an increase in unemployment, a fall in consumption, and an improvement in external accounts. These predictions of the model are consistent with the experience of many developing countries during recent periods of turbulence on world financial markets.

After comparing the transmission process of external interest rate shocks with two other studies that are fairly representative of the literature, the ability of the model to predict the facts was assessed informally by reviewing the behavior of macroeconomic aggregates in Argentina, following the collapse of the Mexican peso in December 1994. It was argued that the timing and severity of the economic downturn in Argentina resulted from a contagion effect of the type described earlier—massive capital outflows triggered by a loss of confidence by international investors in the country's economic prospects, in part because of the growing current account deficit recorded in previous years and concerns that Argentina's exchange rate regime could suffer the same fate as Mexico's.

The model, and the analysis, could be extended in several directions. Two possibilities, as noted earlier, would be to endogenize the real exchange rate and explicitly account for dollarization, on both the asset and liability sides of banks' balance sheets. A third avenue would be to endogenize domestic financial intermediation spreads (that is, the lending-deposit spread), by accounting more explicitly for credit market imperfections. The framework used in the Appendix (which dwells on Agénor and Aizenman (1998)) to explain the "external" premium could be used to determine domestic spreads as well; In such a setting, they would then depend also on a markup that compensates for the expected cost of contract enforcement and state verification, and for the expected revenue lost in adverse states of nature. A fourth direction would be to introduce net worth or balance-sheet effects on the determination of financial intermediation spreads, by explicitly accounting for firms' borrowing (both domestic and foreign) and decisions to accumulate physical capital, as for instance in Cook (2004) and Schneider and Tornell (2004). To the extent that net worth (as measured for instance by the difference between the stock of capital and the level of domestic and foreign borrowing) acts as a measure of seizable collateral in case of default, it would affect the propensity to lend. Changes in market sentiment, by altering borrowing decisions, would therefore affect the economy through another channel. These extensions would, however, increase the complexity of the present framework and numerical simulation methods may well be required to analyze its transitional dynamics.

Appendix
Default Risk and the Premium

This Appendix presents a simple model, along the lines of Agénor and Aizenman (1998), that characterizes the relationship between the premium and the world interest rate that individual domestic borrowers face on world capital markets. In this model, domestic agents face random shocks to their income or, more generally, their repayment capacity. Such shocks make future (end-of-period) repayments on the debt contracted today (at the beginning of the period) uncertain, and leads foreign lenders to charge a premium—which is such that the expected yield of the loan is greater than (and, in equilibrium, equal) to the yield that would be obtained if they were to lend at the safe interest rate.

Formally, suppose that lenders on world capital markets provide loans to domestic agents at the beginning of the period, and face the risk of default on these loans at the end of the period. They are uncertain as to whether they can obtain full legal remedies for breach of contract in the borrower's country. Lenders are perfect competitors and risk-neutral.

Let L_h^* denote (beginning-of-period) borrowing by domestic agent h. The agent's end-of-period income, in gross terms, is given by

$$(1 + \upsilon_h)g(L_h^*), \quad g' \geq 0,\ g'' \leq 0,$$

where υ_h is an idiosyncratic shock with zero mean and a density function $f(\upsilon)$, defined over the interval $(-\upsilon_m, \upsilon_m)$, with $\upsilon_m < 1$. $g(L_h^*)$ is the expected value of the agent's resources, which is assumed to depend positively on the level of debt. The function is also assumed to have a concave shape and can be thought of as a production function.

If agent h chooses to default on part or all of his or her debt (after the realization of the shock υ_h), the foreign lender is assumed to be capable of securing (through appropriate legal actions) a fraction $0 \leq \kappa < 1$ of the realized value of the agent's resources. Thus, agent h will choose to default if and only if

$$(1 + \upsilon_h)\kappa g(L_h^*) < (1 + i_h^*)L_h^*, \tag{A1}$$

where i_h^* is the contractual interest rate. The term on the left-hand side in the above expression is the agent's repayment following the decision to default, whereas the term on the right-hand side is the contractual repayment. Let $\upsilon_{\max}$ denote the highest value of the shock υ_h associated with default. This value is implicitly given by

$$(1 + \upsilon_{\max})\kappa g(L_h^*) = (1 + i_h^*)L_h^*. \tag{A2}$$

If default never occurs—as is the case if the condition $(1 + \upsilon_h)\kappa g(L_h^*) > (1 + i_h^*)L_h^*$ holds—$\upsilon_{\max}$ is set at the lower end of the support ($\upsilon_{\max} = -\upsilon_m$).

In case of default, the lender's net revenue is equal to the agent's actual repayment, minus the state verification and contract enforcement cost, C_h:[25]

$$(1 + \upsilon_h)\kappa g(L_h^*) - C_h. \tag{A3}$$

Because lenders are assumed to be risk-neutral and competitive, the contractual interest rate charged on loans to agent h is determined by the condition that expected gross repayment from h (evaluated over the range of variation of ε_h) be equal to the gross revenue that could be obtained by lending at the safe interest rate, i^*. From equations (A1) and (A3), this condition can be written as

$$(1+i^*)L^* = \int_{\upsilon_{\max}}^{\upsilon_m} [(1+i_h^*)L_h^*]f(\upsilon_h)d\upsilon_h + \int_{-\upsilon_m}^{\upsilon_{\max}} [(1+\upsilon_h)\kappa g(L_h^*) - C_h]f(\upsilon_h)d\upsilon_h \tag{A4}$$

[25]The cost C_h is a lump-sum cost, incurred by lenders in order to identify the idiosyncratic shock υ_h (after it is realized) and to enforce repayment in "bad" states of nature. The analysis would be more involved, as noted by Agénor and Aizenman (1998), if it was assumed that some costs are paid *after* obtaining information about υ_h. In that case, lenders would refraim from forcing debt repayment when the realized value of the shock υ_h is below an "enforcement threshold."

Using (A2) and (A4), the agent h-specific lending rate is given by

$$i_h^* = i^* + \frac{\int_{\upsilon_{\max}}^{\upsilon_m} [\kappa g(L^*)(\upsilon_{\max} - \upsilon_h)] f(\upsilon_h) d\upsilon_h}{L^*} + \frac{C_h \int_{-\upsilon_m}^{\upsilon_{\max}} f(\upsilon_h) d\upsilon_h}{L^*}. \quad \text{(A5)}$$

The agent-specific contractual lending rate exceeds therefore the safe world of interest rate by the sum of two terms. The first is the expected revenue lost due to default in bad states of nature. The second term measures expected state verification and contract enforcement costs.

Using (A4), agent h's net expected income can be written as

$$\kappa g(L_h^*) - (1 + \mathrm{E}i_h^*)L_h^*, \quad \text{(A6)}$$

where $\mathrm{E}i_h^*$ is the expected interest rate faced by the individual, which is given by

$$1 + \mathrm{E}i_h^* = 1 + i^* + \frac{\Pr(d/h)C_h}{L_h^*}, \quad \text{(A7)}$$

where $\Pr(d/h) = \int_{-\upsilon_m}^{\upsilon_{\max}} f(\upsilon_h) d\upsilon_h$ denotes agent h's probability of default. Hence, in the absence of default risk ($\Pr(d/h) = 0$), in equilibrium the *ex post* lending rate will be equal to the risk-free interest rate ($i_h^* = i^*$). In general, however, lenders will typically impose a premium, so that $\mathrm{E}i_h^* > i^*$.

The above equation determines implicitly the supply of credit facing the individual on world capital markets. It can be established that the supply of credit is perfectly elastic over an initial portion (with the individual facing the safe rate i^*), rises up to a certain level, and becomes completely inelastic beyond that level, when the individual reaches a borrowing constraint.[26]

A useful example is the case where the idiosyncratic shock ε_h follows a uniform distribution, so that $f(\upsilon_h) = 1/2\upsilon_m$, and $\Pr(\upsilon_h > x) = (\upsilon_m - x)/2\upsilon_m$. In that case, it can be established that

[26] In general, the supply curve of funds may be backward-bending, due to the conflicting effects of higher interest rates on expected repayment (see Agénor and Aizenman (1998), and Aizenman, Gavin, and Hausmann (2000)). In the paper, it is assumed that the economy operates on the efficient portion of the supply curve of funds. The credit ceiling is defined by the point where the supply of funds becomes inelastic. Further, it can be shown that the credit ceiling depends negatively on the verification cost, C_h, and positively on the bargaining power coefficient, κ.

$$\Pr(d/h) = (\upsilon_{\max} + \upsilon_m)/2\upsilon_m, \tag{A8}$$

and that the agent-specific lending rate is given by

$$i_h^* = i^* + \frac{\kappa g(L_h^*)}{L_h^*}\upsilon_m \Pr(d/h)^2 + \frac{\Pr(d/h)C_h}{L_h^*}, \tag{A9}$$

Combining equations (A7) and (A8), it can be inferred that, for an internal solution on the upward-sloping portion of the supply curve of credit facing agent h,

$$\mathrm{E}i_h^* = q(\overset{+}{L_h^*}; \overset{+}{C_h}, \overset{-}{\kappa}, \overset{+}{\upsilon_m}).$$

Thus, along the positive portion of the credit supply function, the *ex ante* interest rate faced by agent h rises with the individual's level of borrowing. Also, the greater the proportion of the individual's wealth that the foreign lender can confiscate in case of default, or the lower the state verification cost, the lower the interest rate.

The paper focuses on an economy composed of a multitude of agents, characterized by idiosyncratic uncertainty. Hence, for the aggregate budget constraint, the expected interest rate may be viewed as equivalent to the realized (or actual) rate.

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Figure 1

Temporary Deterioration in Market Sentiment

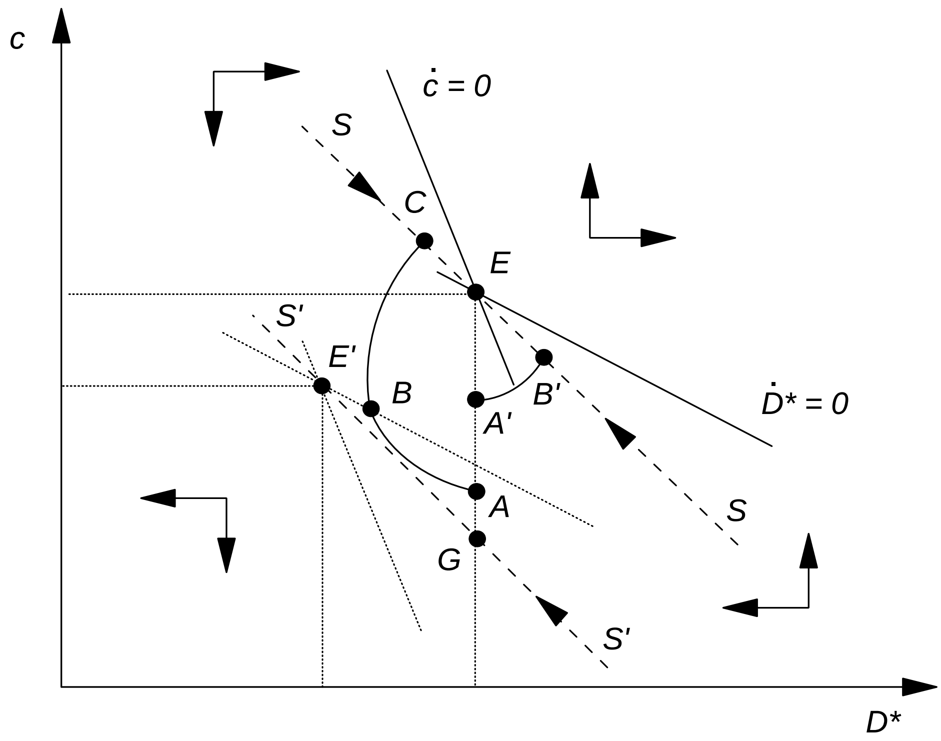


Figure 2

Adjustment Path to a Temporary Deterioration in Market Sentiment

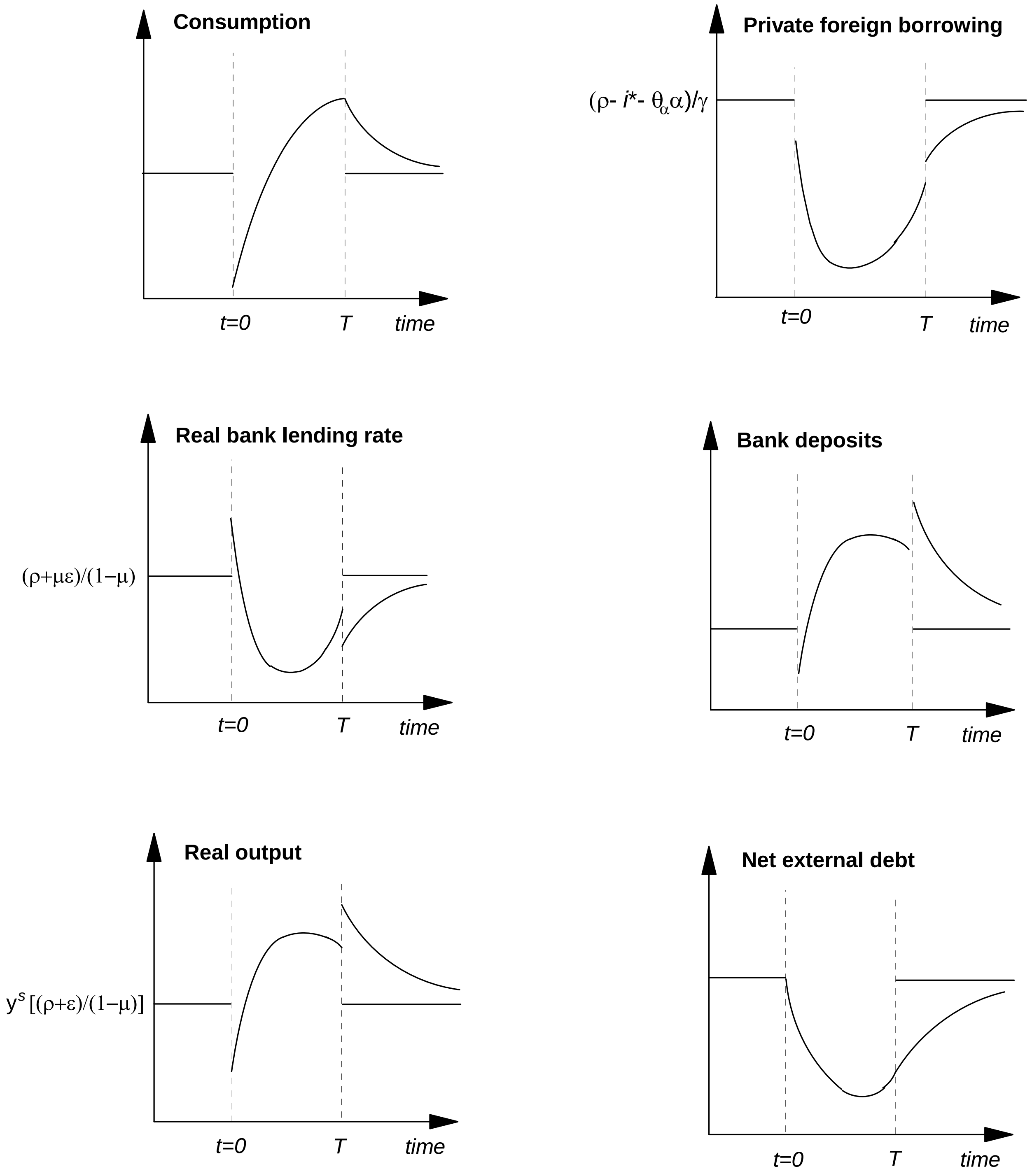
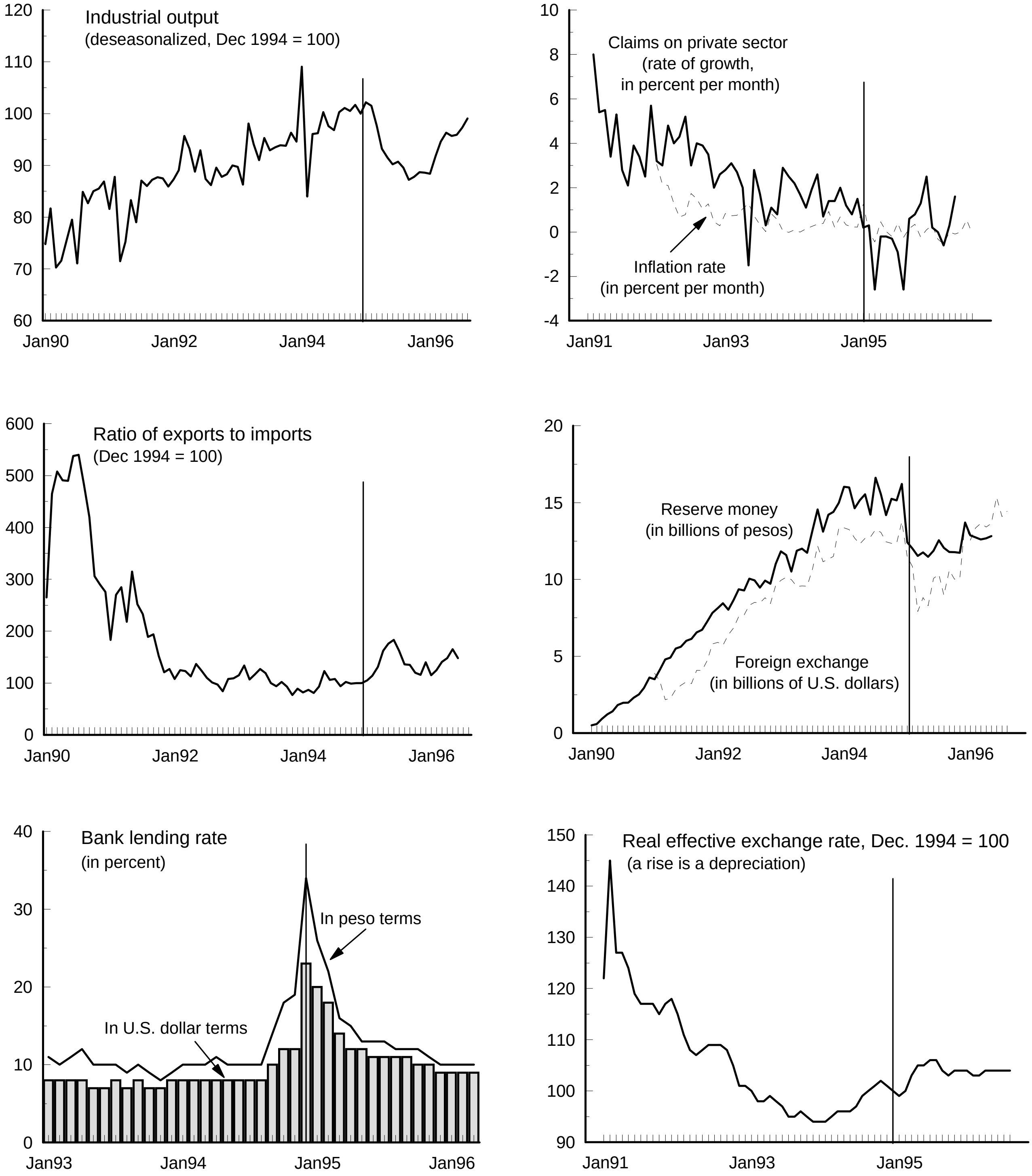


Figure 3
Argentina: Macroeconomic Indicators, 1990-96



Sources: FIEL; International Monetary Fund.
1/ The vertical line corresponds to the Mexican peso crisis (December 1994).