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FINANCIAL POLICY AND SPECULATIVE RUNS WITH A CRAWLING PEG: ARGENTINA 1979-1981

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ABSTRACT

In this paper we present a model of a balance-of-payments crisis and use it to examine the Argentine experiment with a crawling peg between December 1978 and February 1981. The approach taken allows us to examine the evolution of a crisis when the collapse is not a perfectly-foreseen event. The implementation of the model yields plausible values of the one-month ahead probabilities of a collapse of the crawling peg. The probabilities exhibit a sharp increase in the middle of 1980 and indicate a significant loss of credibility throughout the remainder of the year. The results suggest that viability of an exchange rate regime depends strongly on the domestic credit policy followed by the authorities. If this policy is not consistent with the exchange rate policy pursued by the authorities, confidence in the exchange rate policy is undermined.

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1. Introduction

This paper analyzes the viability of a regime in which the exchange rate follows a preannounced rate of crawl. An important aspect of the paper is that we are able to analyze the credibility of announced policy in a rational expectations setting by focusing on the consistency between fiscal and domestic credit policies on the one hand and the preannounced rate of crawl on the other hand. Agents, uncertain about whether the crawling peg will be adhered to, learn over time about the viability of the exchange rate regime by observing the behavior of the authorities and infering whether observed domestic credit and fiscal policies are consistent with the announced rate of crawl. At the beginning of each period agents must make their portfolio decisions based on their assessment of the probability that the crawling peg will be abandoned prior to the beginning of the following period. Their actions will, in turn, affect the probability of collapse.

Krugman (1979), building on a seminal paper by Salant and Henderson (1978) derives the timing of a speculative attack in a deterministic framework when domestic credit policy is inconsistent with the exchange rate regime.[1] The timing of a run on the central banks reserves of foreign exchange is determined by exploiting the fact that intertemporal arbitrage rules out a discrete devaluation of the exchange rate. In a deterministic setting the timing of the attack is know in advance, so that no forward discount occurs on

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[1]Discussion of the consistency conditions fiscal and credit policies must satisfy in order to be compatible with a given exchange rate regime are found in van Wijnbergen (1983), Buiter (1986b), and Obstfeld (1986b).

short maturity contracts.

Flood and Garber (1985) extend Krugman's analysis by introducing uncertainty about future domestic credit growth and going to a discrete time framework. This set-up has the desirable characteristic of a positive forward discount even on short maturity contracts and leads to uncertainty about timing of potential future speculative attack. In their model, as in Salant and Henderson (1978) and Krugman (1979), a run occurs when agents realize that postponing a run will result in a discrete jump in the exchange rate after central bank reserves are exhausted. In each period, the probability of collapse in the next period can be found by evaluating the probability that domestic credit in the next period will be sufficiently large to result in a discrete depreciation should a run occur.

In this paper we extend the analysis of Flood and Garber (1985) in two important directions. First, we introduce uncertainity about the level of foreign reserves that will trigger abandonment of the exchange rate regime. Second, we implement the model empirically using the Argentine experiment with a crawling peg during 1979 and 1980 and calculate the one-period ahead collapse probabilities implied by the model.

The first of these is clearly of great empirical relevance. In addition, it has important implications concerning the timing of a regime collapse. We argue that a speculative attack that will exhaust reserves will occur only if the central bank allows it to occur. The central bank can prevent such an attack by abandoning the exchange rate regime. Since agents do not know the central bank's decision rule, they cannot calculate the critical level of domestic credit that will result in a discrete devaluation.

The plan of the paper is as follows. In section 2 we provide a brief overview of the recent Argentine experience with a crawling peg, which provides some of the motivation for the study. In section 3 we set our the theoretical model and present a rational expectations solution. The model is then used to analyze the Argentine crawling peg in section 4. Section 5 concludes.

2. The Argentine Experience

In this section we provide a brief review of the Argentine stabilization of the late 1970's that motivates some of the questions that we address with the theoretical model in the next section.[2] In March 1976, the government of Mrs. Isabel Peron was removed by a military coup. At the time of the coup, inflation had reached levels exceeding the three hundred percent at an annual rate and the public sector deficit was approximately seventeen percent of GDP.

The new military government introduced a series of reforms aimed at removing or reducing a number of controls over the economy. Among these reforms were the gradual removal of capital controls, the freeing of interest

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[2]This section draws on the papers by Kaminsky (1981), Easterly (1982), Calvo (1983), and Connolly (1986).

rates and some reduction in trade barriers.[3] In addition, the inflation rate was reduced substantially but remained in excess of one hundred percent by the end of 1978.

In December 1978 a new stabilization program aimed at reducing the rate of inflation was put in place. Exchange rate policy was at the center of the new program. The exchange rate was to follow a preannounced rate of crawl specified by a table of daily exchange rates (the "tablita"). It was hoped that by reducing the rate of depreciation gradually to zero, Argentine inflation would converge to the inflation rates of her major trading partners. To enhance the credibility of the program, the rate of crawl was announced several months in advance and the "tablita" was extended periodically long before the existing table expired.

During the first year of the new stabilization program the declining rate of depreciation was accompanied by a declining public sector deficit and a deceleration of domestic credit. By the end of 1979, the public sector deficit amounted to only 5% of GDP.

In March 1980 a financial crisis sparked by bank failures resulted in a sharp increase in central bank lending to the financial system and a decline in confidence in the stabilization program. The increase in credit to the

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[3]Barriers to free foreign exchange transactions were virtually removed by the end of 1978. At that time the only remaining restriction was that foreign loans had a one-year minimum duration. Kaminsky (1981) observes how this requirement could be circumvented fairly easily. The minimum duration was reduced to one month in June 1980.

financial system in March 1980 was followed by increased central bank financing of the public sector in the second half of 1980, further undermining confidence in the viability of the crawling peg regime. The loss in confidence was reflected in an increase in interest rates on peso deposits relative to foreign rates adjusted for announced depreciation, and large reserve losses. By the end of 1980 the interest differential adjusted for announced depreciation was approximately three percent per month and non-gold reserves had declined to approximately forty percent of their first quarter peak. The stabilization program began to fall apart when, in early February 1981 and in April 1981, the peso was devalued by 10% and 31% respectively. Soon thereafter, dual exchange rates were adopted with the capital account rate allowed to float freely.

3. The Model

In this section we develop a monetary model of a balance-of-payment crisis. At the end of each period agents are assumed to adjust their holdings of real cash balances according to the money demand function,

$$m_t - p_t = a - bi_t + \eta_t \tag{1}$$

where m_t is log of the nominal money stock, p_t is the log of the domestic price level, i_t is the nominal interest rate, and η_t is an iid normal disturbance with mean zero and constant variance, σ_η^2.[4] Uncovered interest parity is assumed to hold so that,

$$i_t = i_t^* + {}_ts_{t+1} - s_t,$$

[4]No trading is assumed to occur between periods so that once money holdings are chosen, the choice is locked in until the following period.

where, i_t^* is the foreign nominal interest rate and ${}_ts_{t+1}$ is the exchange rate agents expect to prevail at the end of period t+1 given information available at the end of period t. The foreign interest rate is given exogenously and is assumed to evolve as a random walk,[5]

$$i_t^* = i_{t-1}^* + e_t,$$

where e_t is a $N(0,\sigma_e^2)$ innovation. Next, we assume that purchasing power parity holds so that $p_t = s_t$.[6] Combining the money demand equation (1) with the uncovered interest parity and purchasing power parity assumptions, we obtain the standard money demand function popular in the monetary approach to exchange rates,

$$m_t - s_t = a - b[i_t^* + {}_ts_{t+1} - s_t] + \eta_t. \qquad (2)$$

Finally, we abstract from the banking system so that all money is high-powered money,

$$m_t = \ln(R_t + D_t),$$

where D_t and R_t are the domestic and foreign assets of the central bank respectively. The home currency value of the central bank's foreign assets

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[5]The random walk assumption for the foreign interest rate can be tested by regressing i_t^* on i_{t-1}^*. Dickey and Fuller (1979) derive the limiting distribution of the t-ratio testing the null hypothesis that the coefficient is one. Although the distribution of the t-ratio is not normal, percentiles of the distribution for various sample sizes are found in Fuller (1976). Carrying out the Dickey-Fuller unit root test on the one-month eurodollar interest rate over a period of January 1979 to December 1980 yields a coefficient estimate of 1.019 and a t ratio of .597. The null hypothesis of a unit root in the foreign interest rate is not rejected at reasonable significance levels.

[6]Foreign prices are assumed constant and are normalized to 1.

can change due to exchange rate changes as well as foreign exchange market intervention. When the home currency depreciates, the central bank experiences a capital gain on its foreign currency denominated assets. The decision to monetize such capital gains as a means of government finance is entirely discretionary. The alternative is the creation of an accounting liability that offsets the increase in the home currency value of central bank foreign assets without directly increasing the high-powered money stock. Monetization is thus completely analogous to an increase in the domestic assets of the central bank, even though it presupposes a rise in the local currency value of the bank's foreign assets. Therefore it should be included when calculating domestic credit changes and excluded when calculating reserve changes. Throughout this paper we therefore use $R_t = S_0F_t$ as our measure of central bank foreign assets, where S_0 is the exchange rate in some base period and F_t is the foreign currency value of central bank foreign assets.

Domestic credit growth (including monetization of valuation changes) is assumed to be governed by the need to finance the fiscal deficit, and is therefore exogenously given. Domestic credit then evolves as $D_{t+1} = D_t(1+\mu_{t+1})$, where μ_{t+1} is the rate of domestic credit growth between the end of t and the end of t+1. The fiscal deficit and therefore the required rate of domestic credit expansion is assumed not to be influenced by exchange rate policy.[7]

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[7]This assumption is motivated by political constraints on fiscal policy. Obstfeld (1986a) shows that if the process governing domestic credit growth changes with the exchange rate regime, there may be multiple equilibria and rational, self-fulfilling balance of payments crises may arise.

The future path of domestic credit is unknown to agents at each point in time and is subject to both permanent and transitory stochastic disturbances,

$$\mu_{t+1} = \pi_{t+1} + \delta_{t+1},$$

where $\pi_{t+1} = \pi_t + \varepsilon_{t+1}$ is the permanent disturbance, and δ_{t+1} is the temporary disturbance. Both ε and δ are assumed to be independently and identically distributed normal random variables with zero mean and constant variance.[8]

$$\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$$

$$\delta_t \sim N(0, \sigma_\delta^2)$$

The authorities are assumed to have adopted a crawling peg under which the exchange rate will evolve as $s_{t+1} = s_t + \gamma_{t+1}$, where γ_{t+1} is the preannounced rate of crawl. However, agents do not necessarily believe that the crawling peg will be followed by the authorities in all circumstances. Instead, when forming expectations about the next period's exchange rate, agents need to asses the credibility of announced policy.

The ability and willingness of the authorities to adhere to the announced rate of crawl depends crucially on whether that exchange rate policy is consistent with the monetary and fiscal policies pursued by the authorities. The formulation of fiscal policy is frequently subject to strong political constraints that are especially severe in the case of public sector

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[8]An advantage that this distributional assumption has over the assumption that the change in domestic credit is exponentially distributed as in Flood and Garber (1984) is that it allows domestic credit to contract such as occurs in 7 of the 24 months that we analyze.

enterprises. In Argentina, these enterprises often run large deficits financed by the central bank or by transfers from the central government. If the financing needs of the public sector arising from deficits exceeds levels consistent with the announced rate of crawl, the credibility of the announced exchange rate policy will be undermined.[9]

If the crawling peg proves to be unsustainable due to the need to finance public sector deficits, we assume the authorities will abandon the crawling peg and allow the exchange rate to float.[10] The probability as of the end of period t that the crawling peg will be abandoned at the end of t+1 is denoted as ρ_t. Therefore the probability that the crawling peg will be adhered to is given by $(1 - \rho_t)$. We therefore have,

$$ {}_t s_{t+1} = \rho_t \, {}_t s^f_{t+1} + (1-\rho_t)(s_t + \gamma_{t+1}) \tag{3} $$

where ${}_t s^f_{t+1}$ is the exchange rate expected of obtain if the authorities allow the exchange rate to float at the end of period t+1. From (3) and the uncovered interest parity assumption, we see that the difference between the domestic interest rate and the foreign interest rate adjusted for the announced rate of crawl will widen when the credibility of the crawling peg is

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[9]Buiter (1986a) and Ize and Ortiz (1986) focus explicitly on the decisions of the fiscal authorities in models of exchange rate crises. Here we do not highlight these issues in interest of simplicity.

[10]Other assumptions are of course possible. Obstfeld (1984) examines the dynamics of the exchange rate and reserves when a floating rate is adopted as an interim measure and is followed by a resumption of fixed rates. Blanco and Garber (1986) analyze the movement from one fixed rate to another and compute the one-period-ahead collapse probabilities for the fixed Mexican peso exchange rate from 1973 to 1982.

reduced (ρ_t rises) and when the size of the depreciation expected given that a collapse occurs increases.[11] Combining (1) and (3) we obtain,

$$m_t - s_t = a - b[i_t^* + \gamma_{t+1}] - b\rho_t[{}_ts_{t+1}^f - (s_t + \gamma_{t+1})] + \eta_t, \tag{4}$$

which shows that desired real balances are given by real money demand that would arise if the crawling peg were fully credible ($a - b[i_t^* + \gamma_{t+1}]$) less the semi-elasticity of money demand multiplied by the expected capital loss on domestic money holdings due to a collapse of the crawling peg regime.

The criterion that the authorities are assumed to employ in deciding whether to adhere to the crawling peg has a simple form. The authorities will continue pegging the exchange rate along the announced path so long as any reserve loss resulting from that policy is not too large. If, however, reserves fall to some critical level, $\underline{R}$, the exchange rate will be allowed to float. The assumption commonly adopted in the literature (Krugman (1979) and Flood and Garber (1984) for example) is that the central bank will abandon pegging the exchange rate when reserves fall to zero.[12] This is not as natural a choice as it may appear at first sight since the central bank may decide to abandon their peg before reserves are exhausted completely or may

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[11]Krasker (1980) analyzes the implications of expected devaluations for tests of uncovered interest parity. Lizondo (1983) analyzes the behavior of currency futures prices when a discrete devaluation of known size but unknown timing is expected. Here, unlike in those models, the probability of collapse is endogenous. Lewis (1986) and Stulz (1986) present models in which uncertainty about monetary regimes can give rise to similar apparent ex-post deviations from uncovered interest parity under floating exchange rates.

[12]Buiter (1986a) and Obstfeld (1986b) are exceptions. There, as in this paper, net reserves are allowed to be negative.

borrow from abroad so that net foreign reserves may become negative. Here we assume that $\underline{R}$ may be nonzero and that agents do not know $\underline{R}$ with certainty, but instead are assumed to have some prior probability distribution each period over the possible values that $\underline{R}$ may take on. Clearly, $\underline{R}$ is no higher than the current reserve level if no collapse has taken place. We therefore assume that the upper limit is the current level of reserves.

The lower limit for the critical level of net foreign reserves is somewhat more difficult to tie down. We want to allow for the possibility that central bank net reserves may become negative, as was the case in Argentina in February 1981. If one assumes that additional foreign credit will not be available during a crisis and will only become available after a policy reform, the lower limit on the possible critical value for net reserves will be minus the central bank's current gross foreign liabilities.

Finally, the public's prior distribution for the central bank's critical value for reserves is assumed to be uniform over the interval $\underline{R}_t^{\ell}$ to $\underline{R}_t^u$, where $\underline{R}_t^{\ell}$ and $\underline{R}_t^u$ are the lower and upper limits on the range of possible values for the critical level of reserves that were described above.

The assumption that the authorities adhere to the crawling peg until some unknown reserve level, $\underline{R}$, is reached is less restrictive than it may first appear. The decision rule actually employed by the authorities may depend on other factors and may be considerably more complex than the adoption of some critical reserve level. In the monetary model employed here, what matters to agents is the exchange rate (and therefore the money supply) that is expected if the crawling peg is abandoned. Since only the money supply matters to agents and since domestic credit creation is exogenous, agents care only about the stock of reserves that will remain once the peg is abandoned and not directly about any other factors that may enter the authorities' decision rule. We therefore focus on the reserve level prevailing upon collapse rather than on other possible central bank decision rules. Uncertainty about this reserve level is a convenient means of modeling uncertainty about the decision rule.

It will prove convenient in solving for the collapse probability to focus on the rate of growth of domestic credit. As was assumed above, ρ_t, the probability as of the end of period t that a collapse will occur at the end of period t+1, is simply the probability that, if the authorities adhere to the announced path for the exchange rate, reserves will fall below $\underline{R}$. This probability depends in turn on the probability that a sufficiently large realization for domestic credit occurring. Define $\tilde{\mu}_{t+1}$ to be the smallest realization of domestic credit growth that will cause reserves to fall to $\underline{R}$ at the end of period t+1. If $\tilde{\mu}_{t+1}$ is drawn and the authorities continue the policy of a crawling peg, the central bank will observe that reserves have reached their critical level and will then close the foreign exchange market and announce that the exchange rate will be allowed to float in period t+2. Since $\rho_{t+1} = 1$, money market equilibrium requires that

$$\tilde{m}_{t+1} - s_{t+1} = a - bi^*_{t+1} - b[{}_{t+1}\tilde{s}_{t+2} - s_{t+1}] + \eta_{t+1}, \tag{5}$$

where $\tilde{m}_{t+1} = \ln(\underline{R} + D_t(1+\tilde{\mu}_{t+1}))$ is the log of the money supply at the end of period t+1 given that a collapse of the crawling peg occurred at the end of period t+1 and given that $\tilde{\mu}_{t+1}$ is drawn, ${}_{t+1}\tilde{s}_{t+2}$ is similarly defined, and $s_{t+1} = s_t + \gamma_{t+1}$.[13]

Next, we need to determine ${}_{t+1}\tilde{s}_{t+2}$ and then solve the model for $\tilde{\mu}_{t+1}$. When exchange rates are flexible and and expectations are rational, the money demand function, (2), can be solved to obtain,

$$ {}_{t+1}\tilde{s}_{t+2} = \frac{1}{1+b}\sum_{i=0}^{\infty}\left(\frac{b}{1+b}\right)^{i} {}_{t+1}\tilde{y}_{t+i+2}, $$

where $\tilde{y}_{t+i} = \tilde{m}_{t+i} - a + bi^{*}_{t+i} - \eta_{t+1}$.[14] Since the foreign interest rate is assumed to follow a random walk, ${}_{t+1}i^{*}_{t+i} = i^{*}_{t+1}$ for $i>0$. Thus we have,

$$ {}_{t+1}\tilde{s}_{t+2} = -a + bi^{*}_{t+1} - \frac{1}{1+b}\eta_{t+1} + \frac{1}{1+b}\sum_{i=0}^{\infty}\left(\frac{b}{1+b}\right)^{i} {}_{t+1}\tilde{m}_{t+i+2}. \qquad (6) $$

Given the stochastic structure of domestic credit creation described in (2), Muth (1960) shows that the optimal forecast of future domestic credit growth rates is given by,

$$ {}_{t}\mu_{t+1} = (1-\lambda)\sum_{i=0}^{\infty} \lambda^{i}\mu_{t-i}, \qquad (7) $$

where λ depends on the relative variances of the permanent and transitory components of domestic credit growth. In addition, it can be shown that ${}_{t}\mu_{t+k}$ for all $k \geq 1$ is also given by (7). We therefore denote ${}_{t}\mu_{t+k}$ as $\bar{\mu}_t$.

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[13]We will adopt the notation $\tilde{x}$ do denote the value of some variable x given that a collapse has occurred and given that the critical value for domestic credit growth is realized.

[14]In obtaining this solution we have assumed that $\lim_{T\to\infty} (b/1+b)^{T} {}_{t}s_{t+T} = 0$.

In order to solve (6) we must then deal with terms such as ${}_{t+1}\tilde{m}_{t+i+2}$ = $E_{t+1}\ln(R_{t+i+2} + D_{t+i+2})$. Since exchange rates are assumed to float freely after a collapse of the crawling peg, reserves in the future will be constant at $\underline{R}$. Thus, we need to evaluate,

$$E_{t+1}\ln[\underline{R} + D_t(1+\tilde{\mu}_{t+1})(1+\mu_{t+2})(1+\mu_{t+3})\ldots(1+\mu_{t+i+1})].$$

We will do this by taking a taylor series approximation of $\tilde{m}_{t+i+2}$ around $\mu_{t+i+2} = 0$ for $i \geq 0$. A first-order approximation yields,

$$\tilde{m}_{t+i+2} = \tilde{m}_{t+1} + \frac{D_t(1+\tilde{\mu}_{t+1})}{\underline{R} + D_t(1+\tilde{\mu}_{t+1})} \sum_{j=1}^{i} \mu_{t+j+1}$$

Taking expectations conditional on $\tilde{\mu}_{t+1}$ being drawn and noting that if $\tilde{\mu}_{t+1}$ is drawn, $\bar{\mu}_{t+1} = \lambda\,\bar{\mu}_t + (1-\lambda)\tilde{\mu}_{t+1}$, we obtain,

$${}_{t+1}\tilde{m}_{t+i+2} = \tilde{m}_{t+1} + \frac{D_t(1+\tilde{\mu}_{t+1})}{\underline{R} + D_t(1+\tilde{\mu}_{t+1})}\, i(\lambda\bar{\mu}_t + (1-\lambda)\tilde{\mu}_{t+1}).$$

Next, we use this expression to obtain,[15]

$$\frac{1}{1+b} \sum_{i=0}^{\infty} \left(\frac{b}{1+b}\right)^i {}_{t+1}\tilde{m}_{t+i+2} =$$

$$\tilde{m}_{t+1} + b\frac{D_t(1+\tilde{\mu}_{t+1})}{\underline{R} + D_t(1+\tilde{\mu}_{t+1})} (\lambda\bar{\mu}_t + (1-\lambda)\tilde{\mu}_{t+1})$$

Combining this with (6) and the money market equilibrium condition, (5), yields,

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[15]In obtaining this expression we make use of the solution, $\sum_{j=0}^{\infty} jh^j = h/(1-h)^2$.

$$\ln(\underline{R} + D_t(1+\tilde{\mu}_{t+1})) - (s_t + \gamma_{t+1}) = -a + bi^*_{t+1} - \frac{1}{1+b}\eta_{t+1} - \frac{b^2}{1+b}\,\frac{D_t(1+\tilde{\mu}_{t+1})}{\underline{R} + D_t(1+\tilde{\mu}_{t+1})}(\lambda\bar{\mu}_t + (1-\lambda)\tilde{\mu}_{t+1}). \tag{8}$$

While we cannot solve (8) directly for $\tilde{\mu}_{t+1}$, is straightforward to solve for $\tilde{\mu}_{t+1}$ numerically. Given this solution for $\tilde{\mu}_{t+1}$ we can solve for ρ_t, the probability as of the end of t of a collapse occurring at the end of period t+1. The probability of collapse is simply $\Pr(\mu_{t+1} \geq \tilde{\mu}_{t+1})$. Since μ_{t+1} is the sum of two independent normal random variables, we know that $\mu_{t+1} \sim N(\bar{\mu}_t, \sigma^2)$, where $\sigma^2 = \sigma^2_\varepsilon + \sigma^2_\delta$. If $\underline{R}$ were known, we could solve for the collapse probability by integrating (numerically) over the density for μ_{t+1}. However since $\underline{R}$ is unknown and since $\tilde{\mu}_{t+1}$ is a function of $\underline{R}$, we must first evaluate the probability of collapse conditional on $\underline{R}$ and then integrate over the possible values that $\underline{R}$ may take on. We therefore have,

$$\rho_t = (\underline{R}^\ell_t + \underline{R}^u_t)^{-1} \int_{\underline{R}^\ell_t}^{\underline{R}^u_t} (1 - \Phi([\tilde{\mu}_{t+1} - \bar{\mu}_t]/\sigma))\, d\underline{R} \tag{9}$$

where Φ is the standard normal distribution function. As can be seen from (8), $\tilde{\mu}_{t+1}$ also depends on i^*_{t+1} and the money demand disturbance, η_{t+1}, neither of which is known to agents at time t. We therefore proceed as with $\underline{R}$ by evaluating the probability of collapse conditional on particular realizations of these random variables and then integrating over the possible values they may take on. This solution for the collapse probability can be combined with (8) to obtain a full solution of the model.

4. Empirical Estimates

In this section we obtain and discuss estimates of the time series of collapse probabilities for the Argentine crawling peg experiment that lasted from December 1978 to January 1981. An advantage of the simplicity of the model set out in section 3 is that in order to compute the collapse probabilities we need only the parameters of the money demand function, a and b, the parameter in the money forecasting rule, λ, and the variance of the change in domestic credit, σ^2. Once these are obtained, the integral (9) can be evaluated numerically.[16]

Estimation of the parameters of the money demand equation is carried out using instrumental variables to account for the potential endogeneity of the domestic interest rate. Using a constant term and the foreign interest rate as instruments and estimating over January 1979 through December 1980 we obtain,

$$m_t - s_t = \underset{(7.54)}{2.74} - \underset{(-1.73)}{7.63}\, i_t$$

where the numbers in parentheses are t-ratios.[17]

We now turn to estimation of λ, the parameter in the forecasting rule for domestic credit growth. In obtaining an estimate of λ, it will prove useful to define v_{t+1} as the one-period-ahead forecast error for domestic credit growth realized at the end of period t+1. That is $\mu_{t+1} = {}_t\mu_{t+1} + v_{t+1}$. Next, we note that the forecasting rule for domestic credit growth (7) can be

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[16]We also need estimates of σ_e and σ_η. The first of these is the standard deviation of the first difference in the foreign interest rate and can be calculated directly. The second is obtained when estimating the money demand equation.

[17]The data employed in the empirical part of the paper are described in the data appendix.

rewritten as, ${}_t\mu_{t+1} = \lambda\ {}_{t-1}\mu_t + (1 - \lambda)\ \mu_t$. Combining these we obtain,

$$\mu_{t+1} - \mu_t = v_{t+1} - \lambda v_t.$$

If the information set available to agents when they forecast domestic credit growth includes past forecast error, v_t will be serially uncorrelated. In this case the variance and first autocovariance of the first difference in the growth rate of domestic credit can be written as $(1-\lambda)^2\sigma_v^2$ and $-\lambda\sigma_v^2$, respectively. These can be combined to obtain a quadratic function that can be solved for λ. Using the sample estimates of the variance and first autocovariance of the first difference in domestic credit yields a value of $\lambda = .62$.[18]

Now that we have obtained estimates of a, b, and λ, we can use these estimates to obtain estimates of the one-period-ahead probabilities of a collapse in the Argentine crawling peg. In estimating these collapse probabilities, we first solve (8) to obtain an estimate of the critical value for domestic credit growth, $\tilde{\mu}_{t+1}$, each period and then integrate (9) to obtain our estimates of ρ_t.[19] The estimates we obtain are presented in Figure 1 and are quite reasonable both in the estimated magnitude of the probabilities and in their behavior over time. The estimates of the collapse probabilities are

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[18]We choose the root of the quadratic that is less than one is absolute value in order to insure stability of (7). The sample period used for estimating the variance and first autocovariance is January 1979 to June 1980. This shorter sample is used since a complex value for λ is obtained when the full sample is used.

[19]The numerical integration is done using Simpson's rule. The normal distributions for e_{t+1} and η_{t+1} are truncated and the integration is carried out over -3 standard deviations to +3 standard deviations.

also found in Table 1, along with domestic credit growth rates. The table suggests that rapid domestic credit growth in the spring of 1980 brought about a rapid loss of confidence in the crawling peg. The results also indicate that confidence was never fully restored and that just prior to the collapse of the crawling peg the credibility of the announced exchange rates was extremely low.

The estimated probabilities are very small through the first quarter of 1980 and in most cases are below 1 percent. The largest value during this period occurs in September 1979 when the estimated probability is only 2.8%. Following the financial crisis in March 1980, central bank reserves begin to decline after more than 2 years of steady growth, domestic credit growth during April 1980 exceeds 46% (this figure is not annualized), and the collapse probability rises to 8.1% at the end of the month.[20] When domestic credit growth during May again exceeds 40%, forecasts of future domestic credit growth rise substantially, central bank reserves decline again, and the collapse probability rises to approximately 36%. In the following month domestic credit grows by only 8% and, as a result, the collapse probability falls to 25% at the end of June 1980. A 42% expansion in domestic credit growth during July again undermines the credibility of the announced crawling peg and the collapse probability rises to nearly 67% at the end of July. A sharp contraction of domestic credit during August temporarily restores

[20]The money multiplier (either for M1 or M2) shows no sign of decreasing around the time of the crisis so that the increase in domestic credit is not simply an attempt to counteract a money multiplier decrease that might be expected to accompany a crisis in the banking system.

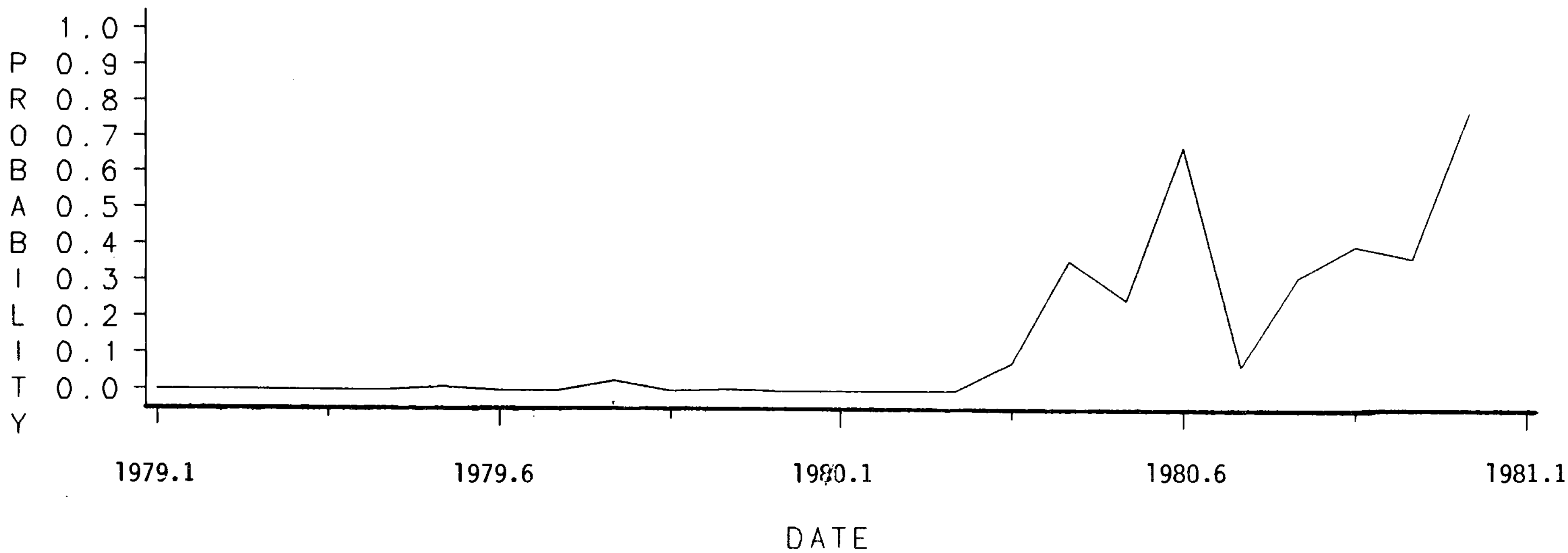
Table 1: Estimated Collapse Probabilities and Domestic Credit Growth Rates (percent)

Date		ρ_t	μ_t
1979	1	0.04	-11.27
1979	2	0.01	- 1.48
1979	3	0.07	20.89
1979	4	0.23	14.37
1979	5	0.01	- 9.35
1979	6	1.22	34.51
1979	7	0.07	-10.25
1979	8	0.12	7.32
1979	9	2.81	29.81
1979	10	0.12	-15.35
1979	11	0.43	12.71
1979	12	0.38	4.00
1980	1	0.05	- 8.68
1980	2	0.05	1.10
1980	3	0.09	3.91
1980	4	8.11	46.05
1980	5	36.00	40.09
1980	6	25.23	8.01
1980	7	67.45	42.14
1980	8	6.99	-29.72
1980	9	31.68	29.83
1980	10	40.33	15.58
1980	11	36.83	6.66
1980	12	77.30	38.84

ρ_t is the estimated probability at the end of period t that the crawling peg will be abandoned at the end of period t+1. μ_t is the rate of domestic credit growth from the end of period t-1 to the end of period t, measured in percent per month.

FIGURE 1: COLLAPSE PROBABILITY

ARGENTINA, 1979–1980



confidence in the announced exchange rate policy, bringing about a gain in central bank reserves. When domestic credit expands by nearly 30% in September, confidence is reduced once again. The credibility of the crawling peg remains low for the rest of the year, reserve losses grow, and the collapse probability rises to 77% at the end of December 1980, following a domestic credit expansion of nearly 40% during that month.

5. Conclusion

The credibility of a policy of preannounced exchange rates is undermined if the fiscal and domestic credit policies of the authorities do not prove to be consistent with the exchange rate policy. In this paper we present a model in which agents observe the domestic credit policies of the authorities and forecast future domestic credit policies on the basis observed behavior. The model can be solved each period for the probability that in the next period the authorities will abandon the exchange rate policy. Once we obtain this solution, the model is applied to the Argentine crawling peg from the beginning of 1979 to the end of 1980. The empirical results are interesting and indicate the the simple model employed produces quite plausible results. We find that in the second quarter of 1980 domestic credit growth increases and undermines confidence in the crawling peg. Eventually, the credibility of the announced exchange rates is nearly completely undermined and, immediately prior to the abandonment of the crawling peg by the authorities, the one-month-ahead collapse probability rises to 77 percent.

Data Appendix

D_t: Domestic assets of the central bank at the end of the month in millions of pesos. Calculated as $M_t - S_0F_t$, where period 0 is December 1978.

F_t: Foreign assets of the central bank at the end of the month in millions of pesos. Source: *International Financial Statistics*.

i_t: Nominal interest rate on one-month peso deposits at the end of the month. Source: *International Financial Statistics*.

i^*_t: Nominal interest rate on one-month eurodollar deposits at the end of the month. Source: *World Financial Markets*.

M_t: High powered money at the end of the month in millions of pesos. Source: *International Financial Statistics*.

R_t: Foreign assets of the central bank at the end of the month in millions of pesos. Calculated as S_0F_t.

S_t: Exchange rate at the end of the month in pesos per dollar. Source: *International Financial Statistics*.

$\underline{R}^{\ell}_t$: Gross foreign liabilities of the central bank at the end of the month in millions of pesos. Source: *International Financial Statistics*.

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