NBER WORKING PAPER SERIES

# EXPLAINING THE DURATION OF EXCHANGE-RATE PEGS

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Working Paper No. 4651

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1994

We thank Hank Farber for helpful discussions. Nancy Marion gratefully acknowledges financial support from the Lewis Haney Fund. This paper is part of NBER's research program in International Finance and Macroeconomics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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## ABSTRACT

This paper is a theoretical and empirical investigation into the duration of exchange-rate pegs. The theoretical model considers a policy-maker who must trade off the economic costs of real exchange-rate misalignment against the political cost of realignment. The optimal time to spend on a peg is derived and factors that influence peg duration are identified. The predictions of the model are tested using logit analysis with a data set of exchange-rate pegs for sixteen Latin American countries and Jamaica during the 1957-1991 period. We find that the real exchange rate is a significant determinant of the likelihood of a devaluation. Structural variables, such as the openness of the economy and its geographical trade concenhation, also significantly affect the likelihood of a devaluation. Finally. political events that change the political cost of realignment, such as regular and irregular executive transfers, are empirically important determinants of the likelihood of a devaluation.

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## 1. Introduction

An important characteristic of exchange-rate pegs is their impermanence. In the face of adverse circumstances, governments often devalue a currency or abandon attempts to peg altogether. These adverse circumstances may arise suddenly because of unusually large economic shocks or more gradually because of persistent inflation differentials between the economy that pegs its rate and the economy to which the currency is pegged. The devaluation that accompanies the end of a peg is politically costly and therefore policy-makers are often reticent about undertaking such a highly visible and unpopular measure. The choice of how long to maintain a fixed exchange rate will likely involve weighing the economic costs of a misalignment against the political costs of a devaluation.

This paper is a theoretical and empirical investigation into the determinants of the duration of fixed exchange-raw pegs. The theoretical model in Section 2 portrays policy-makers who must trade off the economic costs of a misalignment against the political costs of a devaluation. The model shows how different factors in an economy affect the optimal time spent on a given peg. These factors include the accumulated real exchange-rate misalignment, structural factors which change slowly, if at all, during the course of a peg, such as the openness of the economy or the amount of its trade going to the country with which it pegs, and the political cost accompanying the end of a peg.

The theoretical model motivates the empirical analysis in Section 3. We have constructed a data set which consists of 87 spells of dollar pegs drawn from the experience of sixteen Latin American countries and Jamaica during the period fmm the late 1950s through the early 1990s. We use logit analysis to consider tbe effect of a variety of variables on the likelihood of a devaluation over the course of these spells. The use of a logit model is an innovative strategy for estimating the monthly probability of leaving an exchange-rate peg, particularly for developing countries. In a world of perfect capital mobility and risk-neutrality, the interest differential between the home country and the rest of the world should be equal to the expected rate of change of the exchange rate which, in turn, equals the probability-weighted average of the different expected depreciation rates. For most developing countries, however, capital-account transactions are controlled, permitted financial transactions involve a risk premium, domestic interest rates do not reflect market conditions, and time-series interest-rate data is often unavailable. In those circumstances. the probability of leaving the peg cannot be extracted from the interest-rate differential Using a logit model which focuses on the roles of structure, misalignment and political costs of exchange-ratechanges can provide new insights into the factors that influence the decision to maintain the peg month by month.

The logit analysis yields several important results. For example, not only is there strong evidence that a more appreciated real exchange rate is associated with a higher likelihood of a devaluation, there is also strong evidence that structural factors matter. The more open the economy, the lower the likelihood of devaluation. The greater the degree of geographical trade concentration, the higher the likelihood of devaluation. Political events, such as regular and irregular executive transfers, also significantly increase the likelihood of a devaluation.

The model of exchange-rate choice presented in this paper as well as its empirical implementation may be considered as a complement to two other strands in the international economics literature. One strand focuses on the optimal choice of an exchange-rate regime.[1] Empirical investigation in this area. such as Heller (1978). Holden, Holden and Suss (1979). and Melvin and Edison (1990). considers how different structural factors are correlated with the choice of whether to have a fixed or floating exchange rate. As with this literature, we consider structural factors, but we focus on the likelihood of a devaluation (and thus the duration of a peg) rather than the initial choice of regime.[2] Another related strand is the speculative attack literature.[3] Our

[1] See, for example, McKinnon (1963) and Mundell (1961).

[2] The duration of exchange rate pegs is also studied by Rood, Bhandari and Home (1989). but they focus on the effects of real and monetary shocks rather than structural factors.

[3] Theoretical models in this area include Krugman (1979) and Flood and Garber (1984). Empirical research that attempts to test speculative attack models includes Blanco and Garber (1986). Cumby and van Wijnbergen (1989) and Goldberg (forthcoming).

model emphasizes the role of competitiveness and the choice of when to devalue rather than money-market factors which force the hand of authorities. This emphasis may be more appropriate when studying economies with pervasive controls on capital mobility which limit access to the reserves of central banks.

## 2. A Model of the Duration of an Exchange-Rate Peg

In this section we present a framework for analyzing the determinants of the duration of an exchange-rate peg. At the heart of this model is the trade-off between the economic cost of a misaligned real exchange rate and the political cost of a devaluation.[4] The setting for this model is a small open economy which pegs its currency to that of another country. In anticipation of the data set we study in the next section, we denote the other country as the United States and define the pegged exchange rate as the bilateral dollar exchange rate, $S_{US}$, measured in units of domestic currency per dollar.

International trade is conducted with both the United States and the rest of the world. Agents in the country devote a constant proportion (1-a) of consumption expenditures to non-traded goods. The remaining proportion a of consumption expenditures is divided between traded goods from the United States and traded goods from the rest of the world. with the proportion $\omega$ spent on the former and the proportion (1- $\omega$) spent on the latter.5

[4]In this model we assume capital controls prevent a speculative attack from occurring. Thus the policy-maker chooses when to devalue rather than having his hand forced by a sudden depletion of reserves. The reserve position of the central bank still affects the ability of the policy-maker to maintain the peg, but the level of reserves changes gradually in response m current-account imbalances. False invoicing and other measures m circumvent controls may erode the reserve posidon over time. Capital controls are prevalent in the data set wc study in the next section.

[5]This assumption is consistent with a representative consumer model in which the utility function is a weighted average of the logarithm of the goods consumed from the abroad and from home as follows

$$U(N, T_{US}, T_{ROW}) = \alpha\omega \ln T_{US} + \alpha(1-\omega)\ln T_{ROW} + (1-\alpha)\ln N$$

subject to the budget constraint

$$I = N + (T_{US}/Q_{US}) + (T_{ROW}/Q_{ROW})$$

The shares of expenditures on non-traded goods and on traded goods from each of the two trading partners provide us with two structural parameters- openness and trade concentration. We denote the weight given to traded goods in the representative basket of total expenditures. a, as the openness of the economy. A more open economy is one which has a larger value of a. Trade concentration in our model. ω, measures the extent to which trade occurs with the country to which the nominal exchange rate is pegged (here the United States) relative to trade with the rest of the world. A larger value for ω denotes greater trade concentration.

There are two "bilateral" real exchange rates. $Q_{US}$ represents the real exchange rate between the domestic country and tbe United States and $Q_{ROW}$ represents the real exchange rate between the domestic country and the rest of the world other than the United States. The multilateral real exchange rate equals the geometrically-weighted product of the bilateral rates, i.e. $Q_{US}{}^{\omega}Q_{ROW}{}^{1-\omega}$. The multilateral real exchange rate as well as the bilateral real exchange rates are defined as the price of foreign goods relative to the price of domestic goods; therefore an increase in any of these represent a real depreciation

Price indices in the domestic country, the United States and the rest of the world are weighted geometric averages of the price of traded goods, $P_T$, and the price of non-traded goods, $P_N$. The domestic price index equals $P_T{}^{\alpha}P_N{}^{1-\alpha}$, while the price indices in the United States and in the rest of the world equal $P_{T,US}{}^{\theta}P_{N,US}{}^{1-\theta}$ and $P_{T,ROW}{}^{\theta}P_{N,ROW}{}^{1-\theta}$, respectively, where θ is the weight of traded goods in these latter indices. Further simplification is obtained by assuming that the law of one price holds so $P_T = S_{US}P_{T\ US} = S_{US}\ S_{S,R}P_{T,ROW}$. With these assumptions, the multilateral real exchange rate equals

$$[1] \qquad Q = P_N^{-(1-\alpha)} S_{US}^{(1-\theta)} K^{(1-\theta)} P_T^{(\theta-\alpha)}; \qquad K = \left(P_{N,US}^{\omega}\left(S_{S,R}P_{N,ROW}\right)^{1-\omega}\right),$$

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where $Q_{US}$ and $Q_{ROW}$ represent the bilateral real exchange rates of the domestic country with the United States and the rest of the world, respectively, N is non-traded goods, and $T_{US}$ and $T_{ROW}$ represent traded goods from the United States and the rest of the world, respectively.

where $S_{S,R}$ is the cross exchange rate between the United States and the rest of the world.

The overvaluation Of the real exchange rate at time t equals $Q^* - Q(t) + e(t)$, where $Q^*$ is the non-stochastic long-run equilibrium multilateral real exchange rate, Q is the actual multilateral real exchange rate, and E(t) is a temporary shock that is distributed identically and independently through time with mean zero and variance $\sigma$.[6] The trend change in the multilateral real exchange rate is due to exogenous inflation in the price of domestic non-traded goods, $\pi$.[7] At any moment I, $P_N(t) = P_N(0) \exp(\pi t)$, where the peg begins at time 0.

The authorities face a loss arising from the amount of misalignment of the real exchange rate over the course Of a nominal peg. They also face a political cost of abandoning the peg and realigning the currency which they bear at the time of the realignment. We now analyze the authority's optimal response to the trade-off between the costs of a misalignment and the costs of a realignment.

We approach the determination of the optimal duration of a nominal peg from the perspective of the outset of a given peg. The basis of our analysis is the loss function facing the policy-maker. The loss function includes the total amount of misalignment over the course of the peg and also the political cost of realignment. We assume that the loss associated with misalignment is quadratic in the amount of misalignment.[8] The political cost of devaluing is incurred at the time of devaluation and is equal to the (possibly time-varying) amount C(r), where $\tau$

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[6] The term e(t) can represent a shock either to the price of non-traded goods 'or to the equilibrium real exchange rate. The equilibrium real exchange rate can be considered the real exchange rate that provides for external balance. For a thorough discussion *of the* concept of an equilibrium real exchange rate see Edwards (1989).

[7] The assumption of an exogenous rate of inflation is also found in the speculative attack literature. One rationale for this assumption is the exogenous seigniorage revenue requirements of the government.

[8] The quadratic form of the loss function presented below provides for symmetry between the costs of an overvalued and an undervalued real exchange rate. An overvalued currency adversely affects the export sector while an undervalued currency raises the prices of imported intermediate goods and worsens the terms of trade for domestic consumers. In the data set we study, exchange nte pegs always end with devaluations. Therefore we present the theoretical discussion in this *section* in the context of a trend appreciation of the real exchange rate and a subsequent devaluation.

is the time of devaluation. The policy-maker must choose a duration of the peg. $\tau$, that minimizes the expected cost of the accumulated misalignment and the political cost of devaluing:[9]

$$\text{[2]} \qquad \min_{\tau} L = E_0 \int_0^{\tau} \left(Q^* - Q(t) + \epsilon(t)\right)^2 e^{-\rho t} dt + \beta C(\tau) e^{-\rho\tau}$$

where $\beta$ represents the relative cost of devaluing as compared to the cost of a misalignment, p is the discount factor and $E_0$ represents expectations at time 0.

The value of $\tau$ that minimizes the loss to policy-makers is[10]

$$\text{[3]} \qquad \tau = \frac{1}{\pi}\left\{\left(\frac{(1-\theta)}{(1-\alpha)}\right)\ln(S_{US}K) + \frac{(\theta-\alpha)}{(1-\alpha)}\ln(P_T) - \ln(P_N(0)) - \ln\left(Q^* - \sqrt{\rho\beta C(\tau) - \sigma}\right)\right\}$$

This solution demonstrates how the expected time on the peg varies with the structure of the economy, the economic fundamentals that determine the equilibrium real exchange rate, the expected rate of appreciation of the actual real exchange rate, stochastic disturbances and political factors.

The expected duration of the peg is longer with a smaller rate of appreciation (i.e. a smaller value of $\pi$) since this results in less accumulated misalignment at any moment. Given $\pi$, the

[9]An alternative approach involves modeling the optimum length of a peg over a time horizon that exceeds the length of the peg; that is, to model a repeated series of episodes. We found that this approach, unlike the approach presented in the paper, did not yield a closed-form solution. The main difference conceptually between the two approaches involves the cost of devaluing. In the single episode approach the discounting of the future tends to delay devaluing. In the multiple episode approach there is the additional factor that the number of devaluations over a given time period decreases the longer the average length of the peg. The problem of not obtaining a closed-form solution in the multiple episode case is similar to the same problem that arises in (S,s) models of pricing.

[10]We also assume that $(\rho\beta C(\tau)) > \sigma$ (i.e. that the present value of the relative cost of a devaluation exceeds the variability of the misalignment around trend), that $2(1-\alpha)\pi > \rho$ (i.e. that a function of the rate of misalignment exceeds the rate at which the future is discounted) and $Q^* > \sqrt{(\rho\beta C(\tau) - \sigma)}$.

expected duration of the peg increases with a more appreciated equilibrium real exchange t-ate (a decrease in $Q^*$) or a decline in non-traded goods prices (a fall in $P_N(0)$). Given $\pi$, expected duration also increases with an increase in any of the variables in K (which include the prices of non-traded goods in the United States and the rest of the world as well as the cross exchange rate $S_{R,S}$) or a more depreciated $S_{US}$.[11] The effect of a change in the price of traded goods, $P_T$, on the expected time on the peg depends upon the openness of the domestic economy relative to the openness of other countries. If the domestic economy is more open than other countries (that is, if $a > \theta$), a lower price of traded goods will be associated with a more depreciated domestic real exchange rate since the price of the domestic consumption basket falls by more than the price of the foreign consumption basket. In this case, the lower price of traded goods is associated with a longer duration of the peg.

Expected duration Increases with openness if the price of non-traded goods in the United States and the rest of the world is greater than the price of traded goods (i.e. if $S_{US}K > P_T$ then $\partial\tau/\partial\alpha > 0$).[12] The expected duration of the peg increases with an increase in trade concentration if the price of non-traded goods in the United States is greater than the dollar price of non-traded goods in the rest of the world (i.e. since $\partial\tau/\partial K > 0$, $\partial\tau/\partial\omega > 0$ if $P_{N\ US} > P_{N,ROW}$ because this implies $\partial K/\partial\omega > 0$ ).

An increase in the variance of the misalignment, $\sigma$, by raising the expected cost of a peg of any given duration, causes the optimal peg duration to be shorter. An increase in the political cost of a realignment of the nominal peg, $C(\tau)$, leads to a longer duration. A greater weight given to

[11] We can allow more latitude to policy-makers in our model if we enable them to optimally choose the initial value of the peg given the expected value of the variables of the model. The greater generality obtained through this approach, however. comes at the cost of foregoing a closed-form solution.

[12] Related to this point is the effect of openness on the choice of a fixed or a flexible exchange-rate regime. The argument that a more open economy would prefer a fixed exchange t-ate to a flexible exchange rate is presented in McKinnon (1963). Heller (1978) finds that openness, as measured by the ratio of exports to GNP, is highly correlated with regime choice; with relatively open economies more often having fixed exchange rates.

the cost of devaluing. that is a bigger value of $\beta$, also increases the expected duration of the peg, as does a greater discounting of the future (i.e. an increase in $\rho$).

## 3. Empirical determinants of peg duration

### 3.1 The Data

In this section we use poled monthly data from 16 Latin American countries and Jamaica in order to assess whether the duration of an exchange-rate peg is related to the economic variables identified in the previous section. We define a spell as a the when there is a particular fixed value of a country's currency with respect to the United States dollar. The duration of the spell is measured in months.[13] We set the condition that the fixed exchange rate must last for at least three months to constitute a spell. We have identified spells by examining end-of-the-month exchange rate data published in the International Monetary Funds *International Financial Statistics*.[14] Our sample consists of 87 spells. Data availability dictates that the earliest spells are ones that began after 1956. The data set ends in January 1991.

Information about the duration of the pegs is provided in Table 1. The average duration of a dollar peg is 29 months while the median duration is 10 months. The standard deviation around the mean and the range of the sample are substantial. The standard deviation of the duration is over 44 months. The range of the peg durations is 3 months (by construction) to 28 1

[13]We could have used a higher-frequency measure of duration, such as weeks or days, but the explanatory variables are not available in these frequencies. A lower-frequency disaggregation, such as quarters or years, would result in the loss of valuable information.

[14]The exchange rate reported in the *International Financial Statistics* represents the "primary" exchange rate of the country. In a number of the peg episodes we study there are multiple exchange rates The exchange rate reported in the *International Financial Statistics* is probably the best choice for the one which defines the duration of a peg. Nevertheless, the existence of multiple exchange rates can lead to a somewhat ambiguous definition of the duration of a peg. A single peg episode may include changes in the value of some of the (non-primary) exchange rates or changes in the rules governing which transactions apply to which exchange rates. We supplement our use of *IFS* data with descriptive material in order to obtain precise information about the starting and ending dates of the pegs in our sample.

# TABLE 1

SUMMARY STATISTICS OF THE SPELLS

| | |
|---|---|
| Observations | a7 |
| Mean Duration in months<br>(standard deviation) | 29.01<br>(44.48) |
| Median Duration in months | 10 |
| Number of exits under Bretton Woods | 32 |
| Number of Spells with Multiple Exchange Rates | 0.71<br>(0.46) |
| Mean Value for Openness<br>(standard deviation) | 20.30<br>(11.68) |
| Mean Value for Trade Concentration<br>(standard deviation) | 32.22<br>(16.08) |
| Proportion of Spells Beginning Directly After a Previous Peg<br>(standard deviation) | 0.52<br>(0.50) |
| Proportion of Spells Ending with a Devaluation to a New Peg<br>(standard deviation) | 0.62<br>(0.49) |
| Annual Rate of Change in Bilateral Real Exch. Rate Index During Peg<br>(standard deviation) | -0.4322<br>(0.82) |

months (the longest spell represents Paraguay's peg of 126 guaranies to the dollar between 1960 and 1984). In our sample, the exit rate is high in the early months of a peg. Twelve of the eighty-seven spells in our data set end in their fourth month, one-third are over by the seventh month and more than half end within one year. About a third of the spells in the sample end during the Bretton Woods era, that is before March. 1973. In about 70% of the spells there are two or more official exchange rates.

Some information about the economic structure of countries at the start of spells is also provided in Table 1. The two structural components discussed in the theoretical model are openness and trade concentration. Openness in the theoretical model is defined as the share of traded goods in total expenditures. Operationally, however, there is no easy way of distinguishingbetween traded and nontraded goods. In lieu of this, we measure openness as the sum of exports and imports dividedby GDP. Using this definidon, average openness at the start of a spell is about 20 percent in our sample. Trade concentration is calculated as the share of total trade (exports plus imports) conducted with the United States. This corresponds closely to the definition of trade concentration in the theoretical model. On average, about one-third of total trade is conducted with the United States at the start of spells.

Table 1 also presents information on exchange-rate history before the spells and the manner in which the spells are terminated. About half the spells in our sample begin immediately after a previous peg. All the spells in our sample end with a weakening of the currency against the dollar. Sixty-two percent of the spells end with a devaluation to a new. more depreciated peg, while the remainder end with a switch to a regime of mini-devaluations, a controlled float or a float. The table also reports that the real bilateral exchange rate index with the United States appreciates an average of 43.7% per annum during a spell.

### 3.2 Estimation of the Determinants of the Duration of a Fixed Exchange Rate

The theoretical model presented in Section 2 suggests a number of important determinants for the duration of a fixed exchange-rate spell. While some of these determinants may remain constant over a spell, others will change. Therefore we cannot Simply correlate the length of each of the 87 spells in our data set with some constant measure of each explanatory variable for any one spell using ordinary least squares or duration analyis. Using the value of an explanatory variable at the beginning or at the end of a spell or using its change over the spell or its avenge value during the spell fails to Capture important information about the time path of the variable during the spell.[15]

We instead employ an empirical approach that allows us to consider time-varying determinants.[16] We construct our data set such that each observation represents the value of variables during one month of one of the 87 spells in the sample. Thus our data set contains about 2000 possible monthly observations. The dependent variable equals zero in any month when the peg is in effect and equals one in the month that the spell ends. Variables from month $t$ are used to determine the probability of exit in month $t+1$ using logit analysis.[17] In this framework, the probability of maintaining the peg up until month $t+1$, that is $D_{t+1}=0$, and the probability of a devaluation in month $t+1$, that is $D_{t+1}=1$, depend upon the vector of variables $X_t$ as follows:

$$\mathrm{Prob}(D_{t+1}=0|X_t)=\frac{1}{1+\exp(\gamma_0+\gamma_1 X_t)}$$

$$\mathrm{Prob}(D_{t+1}=1|X_t)=\frac{\exp(\gamma_0+\gamma_1 X_t)}{1+\exp(\gamma_0+\gamma_1 X_t)}$$

We can rewrite these equations in terms of the logarithm of the odds ratio as follows:

[15] For a discussion of this problem in the context of duration analysis see Heckman and Singer (1984).

[16] For a use of this technique in the context of a study of job turnover see Farber (1993).

[17] We do not use any information available after the spell, such as whether the spell ended with a devaluation to a new peg or with a change to a floating exchange rate. Because our data set includes only pegs that have survived a minimum of three months. we exclude observations on the first two months in order to avoid underestimating the monthly hazard of exit in the first months.

$$\ln\left(\frac{Prob(D_{t+1}=1)}{Prob(D_{t+1}=0)}\Big|X_t\right)=\gamma_0+\gamma_1 X_t$$

This odds ntio demonstrates that the elements of the vector $\gamma_1$ represent the partial elasticity of the likelihood of a devaluation with respect to the vector of variables Xt

Our choice of variables that may Serve as determinants of the likelihood of a devaluation is guided by the theoretical model. One time-varying element of the vector $X_t$ is an index of the bilateral real exchange rate between the country on the peg and the United States.[18] We also include the squared value of this index to capture possible non-linearides in the relationship. An appreciation of tbe real exchange rate increases the degree of misalignment, *ceteris paribus*, since in each spell there is a trend appreciation of the currency vis-a-vis the dollar. A lower value of the exchange rate index implies a more appreciated domestic real exchange rate. Therefore, we expect the coefficient on the real exchange rate index to be negative. The coefficient on the squared real exchange rate index may be positive (ii there is a diminishing effect) or negative (ii the effect is increasing).

The real exchange rate enters the theoretical model to the extent that it differs from the equilibrium real exchange rate. Therefore we would ideally like to include the equilibrium real exchange rate in the empirical analysis.[19] Unfortunately there is no consensus on how to measure the (unobservable) equilibrium teal exchange rate. As a first approximation, we assume that a number of the disntrbances affecting the equilibrium real exchange rate will be correlated with international liquidity. Disturbances that bring about a depreciation of the equilibrium real

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[18]The bilateral real exchange rata index uses the end-of-the month bilateral nominal dollar exchange rate aod the consumer price indices in the domestic country and in the United States. The index is set equal to 100 at the start of each spell.

[19] Edwards (1989) describes how the path of the equilibrium real exchange rate can be affected by anticipated future import tariffs, changes in productivity, changes in fiscal policy, changes in capital-account or current-account controls, changes in world interest rates, and changes in the terms-of-trade.

exchange rate will, *ceteris paribus*, increase misalignment and deplete the foreign assets held by the central bank and the monetary system. We therefore use movements in foreign asset holdings to capture the unobserved movements in the underlying equilibrium real exchange rate. Since we are dealing with pooled data, we measure international liquidity as a ratio, specifically the ratio of net foreign assets of the monetary sector to the quantity of money (M1).[20] We expect a negative coefficient on the net foreign assets variable since a decline in net foreign asset holdings increases the probability of leaving a peg. We also include a squared term to take account of possible non-linearities.

The two structural variables identified in the theoretical model, openness and trade concentration, are also included in the empirical analysis. Both variables are measured as percentages and are allowed to vary over the course of a single peg spell. As discussed above, the effects of these variables on the expected duration of the peg depend upon the relationship among other variables in the model. If the price of foreign non-traded goods is greater than the price of traded goods, then a more open economy is expected to have a peg of longer duration, and conversely. If the price of non-traded goods in the United States is greater than the price of foreign non-traded gods, then trade concentration is positively associated with duration, and conversely.[21]

We also include two political dummy variables as possible determinants of the likelihood of a devaluation- "regular" executive transfers and "irregular" executive transfers (i.e. coups).[22]

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[20] The international liquidity ratio is measured in percentage terms in the regression Edwards (1989) uses this ratio in his study of exchange-rate behavior. Following Edwards, we also experimented with another measure of international liquidity. namely the ratio of foreign assets of the central bank to base money.

[21] Although equation (3) suggests that the prices of traded and non-traded goods affect duration, we have made no attempt to include estimates of these prices separately in the estimation. Equation (3) also indicates that the real exchange rate between the United States and the rest of the world affects duration. A real effective exchange-rate between the US and the ROW is available for the period after 1974, but it was not a significant determinant

[22] The data were coded on the basis of information from various issues of Arthur Banks. Political Handbook of the World and cross-checked against the annual data on executive transfers in Jodice and Taylor, World Handbook of Social and Political Indicators.

These variables equal one for a particular observation if there was an executive transfer in that month and zero otherwise. We also include calendar-year and country-specific dummy variables to allow for differences across time and across countries in the cost of realigning.

The results obtained from the basic logit regression are reported in Table 2. This table includes three specifications of the regression that differ in their inclusion of dummy variables (the coefficients on the d-y variables are not presented). Specification (1) does not include any calendar-year or country-specific d-y variables, specification (2) includes calendar-year dummy variables and specification (3) includes both the year and country d-y variables. The estimates of all three specifications support the implications Of the model developed in the previous section. Real exchange-rate appreciation significantly increases the probabiiity that a peg will end. We fmd that this increase in the likelihood of a devaluation occurs at a decreasing rate. In addition, a deterioration in the net foreign asset position of the monetary sector significantly increases the monthly hazard. Structure also matters. An increase in openness significantly reduces the probability of ending a peg. Higher trade concentration increases the probability that a peg will end, although this effect is not as significant as some of the others. Executive transfers, whether regular or irregular. significantly affect the likelihood of a devaluation. 23 Interestingly, irregular executive transfers enter with a bigger coefficient in each specification than do regular executive transfers. Furthermore, when calendar-year and country-specific dummy variables are both included. irregular executive transfers are also more significant than regular transfers.[24]

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[23]Evidence of a positive association between executive transfers and the likelihood of ending a peg is consistent with the finding in Cooper's (1971) study of devaluations in developing countries. Cooper reported that in nearly 30% of the cases he examined, the government fell within a year of a devaluation, whereas only 14% of governments fell in a control group where there was no devaluation in that year. Our results suggest that those responsible for the decision to devalue believe they are in a stronger position to carry out a devaluation at the beginning of their term.

[24]In Table 2. individual calendar-year dummies since 1970 are included in specifications (2) and (3). None of the coefficients on the early years (1971.1981) is significant, suggesting that, compared to the years before 1971, there were negligible changes in the cost of realigning surrounding the collapse of the Bretton Woods agreement (1971-73) and the first two oil price shocks (1973-74.1979-80). Many of the year dummies in the 1982-90 period are positive and highly significant, however, implying a decrease in the cost of devaluation with the onset of the international debt crisis (1982) and its aftermath, including the third oil shock (1990).

## TABLE, 2: **LOGIT** ESTIMATES OVER ENTIRE SAMPLE

| Variable | Coefficient Specification | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Real Exchange Rate | -0.1355* (-2.74) | -0.1402* (-2.48) | -0.1660' (-2.60) |
| Real Exchange Rate (squared) | 0.0007' (2.04) | 0.0008* (1.97) | 0.0008 (1.94) |
| Foreign Assets | -0.0169' (-5.31) | -0.0135* (-4.55) | -0.0185* (-4.09) |
| Foreign' Assets (squared) | -0.00002 (-1.49) | -0.00001 (-1.33) | -0.00002* (-2.07) |
| Openness | -0.059* (-4.30) | -0.0680* (-3.55) | -0.0615' (-2.08) |
| Trade Concentration | 0.0272 (1.87) | 0.0107 (0.72) | 0.0170 (0.78) |
| Regular executive transfers | 1.1202 (1.78) | 1.5250* (2.22). | 1.4417 (1.95) |
| Irregular executive transfers | 1.2844 (1.76) | 1.7932* (2.43) | 2.2448* (2.77) |
| Constant | 3.3511* (1.99) | 2.9903 (1.48) | 4.5348 (1.89) |
| Log-likelihood | -226.06 | -207.62 | -201.74 |
| $\chi^2$ | 80.24 | 117.11 | 128.88 |

Specification (1) is with no calendar-year or country dummy variables.
Specification (2) is with dummy variables for selected years (see text for details).
Specification (3) is with dummy variables for selected years and for country.

Numbers in parentheses are t-statistics. *indicates significance at the 5 percent level.

The effects of different variables on the likelihood of a devaluation may change over the course of the fixed exchange-rate spell. We investigate this possibility in specifications (1) and (2) of Table 3. where we analyze separately the probability of leaving a peg in the first six months of the spell and in the subsequent period. The results indicate that the foreign asset ratio is the only significant variable for the likelihood of a devaluation at the 5 percent significance level in the early months of a peg. The two structural factors, openness and trade concentration, are significant at the 10 percent level in the first six months of a spell. In the sample restricted to the period after a peg has been in place for six months, the real exchange rate, foreign asset position, openness and irregular executive transfers are all significant at the 5 percent level and regular executive transfers are significant at the 10 percent level.

Another issue we investigate is whether the determinants of peg duration differ across historical periods. In particular, the international "rules of the game" changed after the Bretton Woods era ended. We consider possible differences in the determinants of the likelihood of a devaluation across time in specifications (3) and (4) of Table 3. The sample in specification (3) includes pegs that ended before March, 1973, while the sample in specification (4) includes pegs ending after chat date.

For spells ending in the post-Bretton Woods era, *all* of the explanatory variables (though not the quadratic terms) are highly significant. For these spells, real exchange-rate appreciation. a decrease in the proportion of net foreign assets held by the monetary sector, an increase in trade concentration, regular executive transfers and irregular executive transfers are all associated with an increased likelihood of devaluation. An increase in openness is associated with a smaller likelihood of devaluation. For pegs ending during the Bretton Woods period, the variables identified by the theoretical model have less predictive power. Only the real exchange rate and openness are significant determinants.[25]

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[25]There is no variation between executive transfers and exits during the Bretton Woods period.

TABLE 3: **LOGIT** ESTIMATES OVER SELECTED SUB-SAMPLES

| Variable | Coefficient Specification | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Real Exchange Rate | -0.1043<br>(-0.94) | -0.1309*<br>(-2.13) | -0.6485*<br>(-2.58) | -0.1231*<br>(-2.06) | -0.3269*<br>(-3.41) |
| Real Exchange Rate (squared) | 0.0004<br>(0.53) | 0.0007<br>(1.49) | 0.0039’<br>(2.57) | 0.0006<br>(1.40) | 0.0019*<br>(3.07) |
| Foreign Assets | -0.0191*<br>(-2.72) | -0.0132*<br>(-3.44) | -0.0145<br>(-1.55) | -0.0184’<br>(-5.0) | -0.0281’<br>(-5.29) |
| Foreign Assets (squared) | -0.00002<br>(-1.49) | -0.000009<br>(-0.35) | 0.0002<br>(1.49) | -0.00002<br>(-1.75) | 0.0001’<br>(2.45) |
| Openness | -0.0570<br>(-1.91) | -0.0587’<br>(-3.16) | -0.1494*<br>(-2.59) | -0.0662*<br>(-4.05) | -0.0927’<br>(-3.66) |
| Trade Concentration | 0.0559<br>(1.80) | 0.0214<br>(1.27) | 0.0020<br>(0.07) | 0.0556,<br>(3.18) | 0.0229<br>(1.17) |
| Regular executive transfer | 0.8579<br>(0.45) | 1.3037<br>(1.93) | -- | 1.7512’<br>(2.40) | -0.4501<br>(-0.33) |
| Irregular executive transfer | | 1.5545*<br>(2.08) | -- | 1.8821*<br>(2.43) | 0.4358<br>(0.41) |
| Constant | 2.3916<br>(0.59) | 3.2624<br>(1.61) | 25.4968*<br>(2.46) | 2.3282<br>(1.23) | 11.5039*<br>(3.05) |
| Log-likelihood | -54.39 | -168.87 | -56.02 | -159.32 | -151.74 |
| $\chi^2$ | 20.76 | 54.85 | 21.65 | 78.48 | 54.62 |

Regression (1) uses a sample consisting of the first six months of the spell only.
Regression (2) uses a sample in which the first six months of the spell are omitted.
Regression (3) includes spells ending in the Bretton Woods period (before March 1973).
Regression (4) includes spells ending in the post-Bretton Woods period (after March 1973).
Regression (5) includes spells that end with the government devaluing and pegging at a new exchange rate (rather than devaluing with a crawling peg or a float),

Numbers in parentheses are t-statistics. • indicates significance at the 95% level

Another interesting issue is whether the determinants of duration are different for pegs that end in a devaluation to a new peg. For this subsample. the government reveals an *ex-post* preference for pegging the currency. In specification (5) in Table 3 we consider only those spells that end with a devaluation of the currency to a new peg rather than with a switch to a crawling peg or a float. The coefficients on the real exchange rate, foreign asset holdings and openness are larger (ii absolute value) for the subsample than for the sample as a whole, suggesting that these factors may be somewhat more influential for pegs that end in a devaluation to a new peg. Executive transfers are less significant for this subsample.

Another possible determinant of the Likelihood of devaluation is the length of time already spent on the peg. To test whether time spent on the peg has an independent effect on the likelihood of devaluation. we construct a set of monthly time dummy variables. Because our sample contains so many exits in the first year. we only consider time dummies for months 4-6, months 7-9 and months 10-12. The base group consists of those spells that have lasted more than twelve months. The coefficients on the time d-y variables can be roughly interpreted as the proportional difference in the likelihood of devaluation between spells in these periods and otherwise equivalent spells that have lasted at least twelve months.

As shown in Table 4, the coefficients on the monthly time dummies are positive and highly significant. Although the confidence intervals suggest that the coefficients on these monthly dummies are not significantly different from each other, they are significantly different from the base. Thus the likelihood of a devaluation is higher for pegs in the first year than for pegs that have lasted at least twelve months, after controlling for the extent of misalignment and for structural and political factors. The presence of the monthly time dummies also reduces the significance of the time-varying real exchange rate variable.

We cannot impose too much structure on the interpretation of the coefficients on the monthly dummy variables. These dummy variables may be capturing one of several possible effects. For example, there could be a time-varying change in the political cost of realignment

TABLE 4: LOGIT ESTIMATES WITH MONTHLY TIME DUMMY VARIABLES

| Variable | Coefficient |
|---|---|
| Red Exchange Rate | -0.9892<br>(- 1.90) |
| Red Exchange Rate (squared) | 0.0004<br>(1.17) |
| Foreign Assets | -0.0129*<br>(-4.07) |
| Foreign Assets (squared) | -0.000007<br>(-0.72) |
| Openness | -0.0422*<br>(-3.09) |
| Trade Concentration | 0.0269<br>(1.92) |
| Regular executive transfers | 1.2281<br>(1.82) |
| Irregular executive transfers | 1.5522*<br>(2.15) |
| Months 4-6 | 1.0792'<br>(2.56) |
| Months 7-9 | 1.8102'<br>~(4.89) |
| Months 10- 12 | 1.1142*<br>(2.20) |
| constant | 1.3440<br>(0.743) |
| Log-likelihood | -214.22 |
| $\chi^2$ | 103.91 |

Regressions run over full sample. Numbers in parentheses are t-statistics. * indicates significance at the 5% level.

over the first year of a peg. due to. ray. changes in the credibility of the peg. Research on reputation and credibility suggests that a policy-maker may gain credibility over time while on a peg. In this case, the opportunity cost of devaluing in terms of lost credibility would increase with time spent on the peg. The expected signs of the coefficients on the time dummies in the early period of the peg would be positive.[26] The monthly time dummies could also be proxying for some missing variables that change over time, such as income. that are absent from the logit regression because of the unavailability of monthly data. An important future task will be to understand better the role played by time on the peg in determining the likelihood of devaluation.

## 4. Conclusion

Several general conclusions are worm reemphasizing. First, when a government is concerned about its country's competitive position. its decision about how long to stay on a peg will be influenced not only by the degree of real exchange-ram misalignment but also by the structure of the economy. Structure affects the cost of a given misalignment. Openness and trade concentration, which have long been thought to influence the choice of exchange-rate regime, influence its *duration* as well. We fmd that greater openness, as measured by the ratio of trade to GDP. reduces the monthly probability of leaving a peg in our sample of Latin American pegs over the 1957-1990 Period. Increased trade concentration with the trading partner to whom the country is pegged (ii our sample, the United States) increases the monthly probability of exiting a peg, though this result is not robust across all specifications and samples. Political factors are also relevant The likelihood of a devaluation increases immediately after a regular or irregular executive transfer.

[26] See Rodrik (1993) for a discussion of how growing credibility surrounding an exchange-rate-based stabilization program might reduce the probability that the peg will be abandoned. See Drazen and Masson (1993) for a model where the persistence of unemployment reduces the credibility of the peg over rime.

Our work also highlights the fact that, at lust in our sample, more attention needs to be given to what occurs in the early months of a peg in order to understand better the factors that influence its duration. The exit rate is high in the early months of the Latin American pegs we study. One-third of the pegs are over by the seventh month and more than half are over by the end of the first year. The structure of the economy. the net foreign asset position of the monetary sector and the credibility of the peg may be influential factors in the early months of a peg. Real exchange-rate misalignment becomes increasingly important as time on the peg continues. The speculative attack literature has focused on the last few months of a peg in its attempt to predict the probability of leaving a peg. Our analysis indicates that our understanding of peg duration can be enhanced by examining the early stages of a peg as well.

Finally, the logit model is a useful tool for estimating the monthly probability of leaving an exchange-rate peg, particularly for developing countries. Using a logit model which focuses on the roles of structure, misalignment and political costs of exchange-rate changes can provide new insights into the factors that influence the decision to maintain the peg month by month.

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