

Do High Interest Rates Defend Currencies During Speculative Attacks?

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Abstract: Do high interest rates defend currencies during speculative attacks? Or do they have the perverse effect of increasing the probability of a devaluation of the currency under attack? Drawing on evidence from a large sample of speculative attacks in developed and developing economies, this paper argues that the answer to both questions is "no". In particular, this paper documents a striking lack of any systematic association whatsoever between interest rates and the outcome of speculative attacks. The lack of clear empirical evidence on the effects of high interest rates during speculative attacks mirrors the theoretical ambiguities on this issue.

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1. Introduction

According to conventional wisdom, currencies that come under speculative attack can be defended with high interest rates. By raising interest rates high enough, the monetary authority can make it prohibitively costly for speculators to take short positions in the currency under attack. High interest rates may also convey a positive signal regarding the commitment of the monetary authority to maintaining a fixed exchange rate. According to the contrarian view, neither of these mechanisms is persuasive. Interest rates have to be increased to very high annualized rates in order to entice investors to hold local currency-denominated assets in the face of a small expected devaluation over a short horizon, and such extremely high interest rates are rarely observed in practice. The signaling value of high interest rates is also unclear. Although signals must be costly in order to be credible, often they impose costs that are too high for the monetary authority to take in stride. Moreover, as the costs of high interest rates mount, the monetary authority's signal can become less credible over time, raising devaluation expectations. A vicious spiral can result, as expectations of a devaluation force higher interest rates, which in turn impose greater costs on the economy.¹ In the end, high interest rates can have the perverse effect of increasing the probability that a speculative attack ends in the devaluation of the currency.

Anecdotal evidence in favour of both the conventional wisdom and the contrarian view can readily be found in speculative attacks in the 1990s. Amid the turmoil of the collapse of the European Monetary System in September of 1992, the Swedish central bank was able to temporarily stem speculative pressures against the krona by raising its marginal lending rate to 500 percent on September 17 and 18, although the peg later had to be abandoned in December of 1992. As the East Asian financial crisis spread from Thailand and Malaysia in the fall of 1997, speculative pressures against the Korean won intensified. Although the overnight call rate was raised from around 12 percent in early November to over 30 percent by the end of December, the won fell by over 50 percent during this period.

¹ Drazen and Masson (1994) develop a model in which signals become less credible over time. Bensaïd and Jeanne (1997) formalize devaluation spirals. Radelet and Sachs (1998) and Furman and Stiglitz (1998) discuss other reasons why tighter monetary policy can weaken, rather than strengthen, the currency under attack.

This paper asks whether there is any systematic empirical evidence in support of either the conventional wisdom or the contrarian view regarding the effects of high interest rates during speculative attacks. To answer this question, I study the behaviour of interest rates during a large number of successful speculative attacks (i.e. attacks that end in a sharp nominal devaluations) and failed speculative attacks (i.e. attacks that did not end in a devaluation) in a sample of 54 industrial and middle-income developing countries over the period 1975-1999.

This empirical exercise faces three difficulties: measuring the policy response to a speculative attack, accounting for possible non-linearities in the effects of the policy response, and controlling for the endogeneity of the policy response. First, it is difficult to disentangle the monetary policy response to a given speculative attack from other sources of variation in observed market interest rates during the attack. For example, increases in market interest rates during a speculative attack might reflect both a tightening of domestic credit by the monetary authority, and also an increase in the devaluation expected by market participants. In order to obtain a direct measure of the monetary policy response to speculative pressures, I consider changes in interest rates under the control of the monetary authority (i.e. central bank discount rates) as a measure of policy. A drawback of this measure is that discount rates are only one of many instruments that the monetary authorities have at their disposal to resist speculative pressures. I therefore also check the robustness of the results using a variety of other indicators of the stance of monetary policy.

Second, there may be important non-linearities in the effects of interest rates on speculative pressures, and ultimately on the outcome of the attack. For example, the credibility of the monetary authority's signal of its intent to defend the currency may depend on the economy's ability to withstand the contractionary effects of tight monetary policy, or on the quantity of reserves held by the monetary authority. In this case, simple correlations between measures of monetary policy and the outcome of speculative attacks may obscure any effects of policy present only in certain subsamples of speculative attacks. I take into account the possibility of episode-specific variation in the effects of monetary policy by splitting the sample along various dimensions, and by interacting measures of monetary policy with episode-specific characteristics.

Third and perhaps most important, the policy decisions of the monetary authority are themselves endogenous, and depend on unmeasured episode-specific characteristics that drive speculative pressures. This endogeneity bias can either exaggerate or obscure the effects of the policy response to a speculative attack. If attacks on vulnerable currencies are both more likely to succeed, and also are more likely to provoke a strong interest rate defense on the part of a “tough” monetary authority committed to maintaining the fixed exchange rate, one might expect to find large increases in interest rates during successful attacks, and conversely, small increases in interest rates during failed attacks. On the other hand, if the monetary authority is “realistic” and determines that it is futile to try to defend a vulnerable currency, there may be a positive association between high interest rates and failed attacks driven by common fundamentals. In this paper, I present and empirically implement a simple model which formalizes this endogeneity problem and motivates possible instruments for the monetary policy response.

The empirical results lend little support to either the conventional wisdom or the contrarian view of the effects of high interest rates during speculative attacks. Simple descriptive evidence provides no evidence of a significant positive or negative association between changes in interest rates and the outcome of speculative attacks, and this lack of association does not appear to reflect systematic endogeneity biases in one direction or the other. In fact, the main finding of this paper is the striking lack of any association whatsoever between changes in various measures of monetary policy and the outcome of speculative attacks.

This evidence contributes to a small but growing empirical literature on the role of monetary policy during speculative attacks.² Goldfajn and Gupta (1999) focus on the

² There is of course a large literature on the effectiveness of interventions in foreign exchange markets (see Edison (1993) for a survey). Various authors have also applied VAR methodologies to estimate the effects of monetary policy shocks on exchange rates. These papers, which focus on normal times as opposed to the periods of speculative pressures considered in this paper, find mixed results. Eichenbaum and Evans (1995) and Cushman and Zha (1997) find that positive innovations to monetary policy lead to depreciations of the domestic currency for the US and for Canada, respectively. In contrast, Sims (1992) and Grilli and Roubini (1995) find mixed evidence in the G5 and G7 economies, respectively, with positive monetary shocks leading to appreciations in some countries and depreciations in others. Finally there is a large empirical literature documenting the properties of macroeconomic variables around speculative attacks (e.g. example Eichengreen, Rose and Wyplosz (1994,1995,1996)), which to date has not focused on the policy and non-policy determinants of successful and failed attacks.

role of interest rates in the aftermath of large devaluations that result in an undershooting of the real exchange rate. They ask whether high interest rates following a devaluation increase the likelihood that real exchange rate equilibrium is restored through a nominal appreciation rather than through higher inflation. They find that high interest rates are effective in this sense only in countries with strong banking sectors. Furman and Stiglitz (1998) examine daily data on interest rates and exchange rates in a sample of nine developing countries during the 1990s to identify episodes of sustained high interest rates, and then ask whether these were followed by an appreciation of the domestic currency. They find little evidence that this is the case. Goldfajn and Baig (1998) and Gould and Kamin (2000) consider the effects of interest rates on exchange rates, using high-frequency data for five Asian countries during the East Asian financial crisis, and find either mixed or insignificant impacts of monetary policy on the exchange rate. The drawback of most of these papers is that they simply document reduced-form (partial) correlations between interest rates and exchange rates. Without controlling for the endogeneity of the monetary policy response, it is difficult to infer anything regarding the effects of high interest rates from these papers. The main contribution of this paper is to take seriously the identification problem, in a much larger sample of successful and failed speculative attacks.³

The remainder of this paper proceeds as follows. In Section 2, I describe the data and the methodology used to identify successful and failed speculative attacks. Section 3 describes measures of the monetary policy response, and presents some simple descriptive results. In Section 4, I develop a simple model to illustrate the endogeneity problem, and I use this to motivate a set of probit regressions expressing the probability that speculative attacks fail as a non-linear function of policies and fundamentals. Section 5 offers concluding remarks, and a short Appendix provides details on the data.

³ This concern with the endogeneity of monetary policy is of course not new, and is a recurring theme in the literature on the effects of monetary policy during normal times (as opposed to periods of speculative pressures). See for example the discussion in Bernanke and Mihov (1998) and Christiano, Eichenbaum and Evans (1998). In a recent careful contribution, Zettelmeyer (2000) provides evidence that apparent “perverse” effects of monetary policy announcements on exchange rates in Australia, New Zealand, and Canada can be attributed to reverse causation. In the context of speculative attacks, the most convincing other attempt at identification is Gould and Kamin (2000) who fail to find a significant impact of monetary policy after controlling for proxies for investor sentiment that may be driving both interest rates and the exchange rate.

2. Identifying Speculative Attacks

I identify successful speculative attacks as large nominal depreciations preceded by relatively fixed nominal exchange rates.⁴ I begin with an unbalanced panel of monthly observations on nominal exchange rates, in a sample of 54 industrial and middle-income developing countries over the period January 1975 to April 1999. Exchange rates are measured as the monthly average local currency price of the German mark for the European countries in the sample, and the local currency price of the U.S. dollar for all other countries. Let dx_{it} denote the monthly percentage change in the exchange rate in country i in period t , and let \overline{dx}_{it} denote its average absolute percentage change in the 12 months prior to period t . The set of large depreciation episodes is defined as $\{(i, t) \mid dx_{it} > k_i \text{ and } \overline{dx}_{it} < \bar{k}_i\}$, where k_i and \bar{k}_i are thresholds determining the minimum size of the devaluation and the maximum allowable exchange rate volatility prior to the devaluation. I set these thresholds to 5% and 1% respectively in OECD countries, and to 10% and 2.5% in the rest of the sample, which is roughly equal to twice an one-half of the standard deviation of monthly exchange rate fluctuations in the respective samples.⁵ In order to avoid double-counting prolonged crises in which the nominal exchange rate depreciates sharply for several months, I eliminate large devaluation events preceded by events in any of the prior twelve months. This results in a sample of 75 successful speculative attacks.

I identify failed speculative attacks as downward “spikes” in reserves, and upward “spikes” in nominal money market interest rate spreads over the U.S. Federal Funds rate, that occur during periods of relatively fixed nominal exchange rates and are not followed by a devaluation for at least three months. I restrict attention to the set of dates $\{(i, t) \mid \overline{dx}_{it} < \bar{k}_i \text{ and } dx_{it+s} < \bar{k}_i, s = 0, \dots, 3\}$, and define r_{it} and \bar{r}_{it-3} as the level of non-gold reserves in constant U.S. dollars in country i and period t , and the average level of reserves in the three months prior to period $t-3$, respectively. The set of

⁴ I do not require the exchange rate to be perfectly fixed prior to the attack, in order to be able to identify episodes in which narrow target zones or tightly-managed crawling pegs were abandoned.

⁵ I choose common thresholds with the subsamples of developed and developing countries, because it is difficult to specify sensible country-specific thresholds reflecting country-specific exchange rate volatility for several countries in the sample have experienced immense volatility during periods of extreme macroeconomic instability.

downward “spikes” in reserves is $\{(i, t) \mid r_{it} = \max(r_{i,t-3}, \dots, r_{i,t+3}) \text{ and } r_{it} < h_i \cdot \bar{r}_{it-3}\}$, where h_i is a threshold determining the minimum size of the downward spike as a fraction of average reserves in the three months prior to period $t-3$. Upward spikes in nominal interest rate spreads are defined analogously. I set the threshold determining the minimum size of downward (upward) spikes in reserves (spreads) at 0.75 (1.25) for OECD countries, and at 0.5 (1.5) for non-OECD countries.⁶ As above, to avoid double-counting events during sustained speculative pressures, I eliminate episodes of “spikes” preceded by episodes in any of the prior twelve months. This results in a sample of 117 failed speculative attacks.

Table 1 lists the full sample of 192 episodes, which includes many familiar episodes. The recent spate of currency crises in East Asia in 1997 are represented as successful speculative attacks, as are Brazil’s devaluation in January of 1999 and Mexico’s in December of 1994.⁷ The collapse of the EMS in the fall of 1992 yields several more successful attacks, notably in Finland, Sweden, Italy, and the United Kingdom. This methodology also identifies well-known failed attacks. Argentina’s successful resistance of speculative pressures in early 1995 in the aftermath of Mexico’s devaluation, and Brazil’s resistance of Asian contagion in the fall of 1997 both show up as failed attacks, as do speculative pressures against Belgium in the fall of 1992.⁸

Before turning to the effects of policy on the outcome of these speculative attacks, two comments on the approach to identifying attacks are in order. First, I use this somewhat more involved definition of “spikes” in reserves and spreads because in many of the countries in my sample, especially developing ones, monthly fluctuations in

⁶ A small number of spikes in spreads occur in countries and months where the average spread is near zero. To avoid counting large proportional increases in spreads relative to a very small base as events, I require that the absolute size of the jump in spreads to be at least 500 basis points if the initial average spread is less than 200 basis points.

⁷ The only exception is Malaysia where the largest monthly depreciation of the ringgit in August 1997 (6.6 percent) was not large enough to qualify as a successful attack according to my definition

⁸ Of course, this methodology for identifying attacks is not foolproof. For example, I miss the devaluation of the Malaysian ringgit in the fall of 1997 because its largest one-month devaluation of 6.6 is below my criterion for successful attacks, and I miss the 1992 devaluation of the Spanish peseta because its fluctuations against the German mark were too large in the year prior to the devaluation. I also miss the speculative pressures against the French franc in September of 1992 because France’s reserve losses between June and September are reversed by October, and so do not qualify as a downward “spike” according to my definition.

these variables feature many large changes that are reversed in the following month, many of which are not obviously associated with known episodes of speculative pressure. By focusing on sustained increases (decreases) in spreads (reserves), the definition of “spikes” avoids spuriously identifying monthly fluctuations such as these as failed attacks. This is also why using a simple weighted average of monthly fluctuations in interest rates, exchange rates and reserves as an index of exchange market pressure to identify speculative attacks (as is often done in the literature on speculative attacks in developed countries) seems less appropriate in this context.

Second, relying on reserve losses and increases in market interest rate spreads to identify failed speculative attacks is potentially problematic, because these indicators may confound speculative pressures and the policy response to these pressures. For example, published data on reserve losses does not permit me to distinguish between transactions of the monetary authorities to accommodate the increased speculative demand for their reserves, and direct sales of reserves by the monetary authority in order to support the currency. Similarly, increases in observed nominal interest rate differentials may reflect both increases in market participants’ devaluation expectations as well as policy interventions in the money market. To the extent that these considerations are important, they will introduce a bias toward finding that tightening monetary policy makes speculative attacks more likely to fail, simply because the definition of failed attacks in part reflects the presence of tight monetary policy. It is interesting to note that despite this potential bias in favour of the conventional wisdom, I find little evidence of this view in the sections that follow.

3. The Policy Reponse

The main question of interest is whether raising interest rates -- or more generally, tightening monetary policy -- prevents speculative attacks from ending in a devaluation of the currency. To address this question, I require measures of changes in the stance of monetary policy at the time of the speculative attack episodes identified above. I primarily rely on the real central bank discount rate (the nominal discount rate deflated by contemporaneous annualized monthly inflation) as a measure of the policy

instrument most directly under the control of the monetary authority.⁹ In order to take into account large swings in world interest rates over the sample period, I express these real discount rates as a spread over German and U.S. real interest rates, for the European countries and the rest of the sample, respectively. To the extent that the monetary authority uses the discount rate as an instrument during a given episode, this variable provides a good measure of the policy response to the speculative attack. However, as noted in the introduction, the monetary authorities in these many speculative attack episodes have a wide variety of instruments at their disposal. I therefore also use two other measures as crude “outcome” indicators of the stance of monetary policy to check the robustness of the results: real domestic credit growth, and the reserves of deposit money banks held in the central bank as a fraction of domestic credit. To the extent that the monetary authorities tighten monetary policy using other measures (e.g. open market operations, raising reserve requirements, etc.), this will be reflected in a reduction in real domestic credit and/or increases in bank reserves.¹⁰ Throughout the rest of the paper, I orient each measure of policy so that large values correspond to tighter policy, i.e. increases in discount rates, reductions in domestic credit growth, and increases in bank reserves.

For each speculative attack episode, it is necessary to determine whether these measures of monetary policy tightened or not, relative to a suitable benchmark. In order to do so, I require assumptions about the timing of speculative pressures and the outcome of attacks, which is complicated by the relatively coarse monthly frequency for which data is available. For both successful and failed attacks, I measure the change in monetary policy in the month in which speculative pressures peak. In the case of successful attacks, I assume that speculative pressures peak in the month prior to the large devaluation which defines an event occurring in month t , and accordingly I measure the change in monetary policy between months $t-1$ and $t-2$ as the policy

⁹ An unfortunate drawback of this measure is that central bank discount rates are reported by the IMF on an end-of-period basis only, so that intra-monthly fluctuations in this variable are ignored. Also, there is of course considerable debate over how to proxy for expected inflation when constructing real interest rates. The results presented here do not change substantially if I deflate using either past or future inflation rates, or if I simply consider changes in nominal discount rates.

¹⁰ An obvious objection to the domestic credit growth measure is that it does not distinguish between shifts in the supply and shifts in demand for domestic credit. To alleviate this concern I have also defined tight (loose) monetary policy as periods where both domestic credit growth fell (increased) and the discount rate increased (fell), with substantially similar results. A similar objection holds for the bank reserves measure.

response to the speculative attack. For failed attacks, I assume that speculative pressures peak in the month t in which the spike in reserves and/or spreads is observed, and so I measure the policy response as the change in monetary policy between months t and $t-1$.

In the remainder of this section I present some descriptive statistics on the behaviour of these policy responses during successful and failed speculative attacks. Table 2 provides the simplest possible two-way classification of the relationship between changes in policy and the outcome of speculative attacks. The three rows correspond to the three different measures of tighter monetary policy: increases in real discount rates, decreases in real domestic credit growth, and increases in bank reserves as a share of domestic credit. The next four columns of Table 2 report the number of successful and failed attacks, and the fraction of each in which the corresponding measure of monetary policy tightens. The striking feature of Table 2 is that all three measures of monetary policy on average register tightenings roughly equally often during successful and failed attacks. In fact, a simple chi-squared test of independence between changes in monetary policy and the success or failure of speculative attacks does not reject the null hypothesis that changes in the stance of monetary policy and the outcome of speculative attacks are independent (p -values reported in the last column of Table 2). It is also interesting to observe that the probability of tighter monetary policy in both successful and failed attacks is fairly close to one-half, suggesting that in many cases policy responses to speculative attacks are fairly weak.

Table 3 reports the results of a series of bivariate probit regressions, where the dependent variable is a dummy variable taking on the value one if the attack fails and zero otherwise, and the regressors consist of an intercept and the change in monetary policy. The rows of Table 3 correspond to various subsamples of events, as described below. The three panels of Table 3 correspond to the three measures of monetary policy. Within each panel, I report the estimated marginal effect of a one-standard deviation increase in the measure of policy on the probability that an attack fails, the t -statistic corresponding to the null hypothesis that the underlying coefficient on the policy measure is zero, and the number of observations.

The first row reports results for the full sample of observations.¹¹ Given the results in Table 2 for the same sample of events, it is not very surprising that the three measures of monetary policy are not significantly correlated with the outcome of the attack in these simple probit regressions. However, there are a variety of good reasons to believe that the effects of policy may be different in different subsamples of events. The rest of Table 3 explores several such hypotheses regarding the non-linear effects of monetary policy during speculative attacks. The second and third rows of Table 3 ask whether the effects of policy are different in a developed-country sample consisting of the 24 OECD economies prior to recent expansions, and in the post-1985 period which was characterized by substantially greater international capital flows than the first ten years of the sample. The next three rows restrict attention to countries with liberalized financial markets (measured as the absence of interest rate ceilings as reported in Demirguc-Kunt and Detragiache (1999)), and countries with no capital controls (alternatively using a *de jure* measure as reported in the International Monetary Fund's Yearbook of Exchange Arrangements and Exchange Controls, and a *de facto* measure which identifies episodes where the black market premium on foreign exchange was less than 5%, to identify the absence of controls). It is also possible that there are threshold effects in the relationship between monetary policy and the outcome of speculative attacks. To allow for this possibility, the next two rows of Table 3 restrict attention to the top half and the top quartile of tightening of monetary policy.

The remaining rows of Table 3 divide the sample in half at the median value of a variety of fundamentals which may influence the effectiveness of an interest rate defense. Following the suggestion of Goldfajn and Gupta (1999) that high interest rates support the currency when the banking system is strong, I restrict the sample to those episodes that were not preceded by a banking crisis in any of the previous five years in the row labelled "No Banking Crisis". Since one might expect that tightening monetary policy will only be effective if the exchange rate is not too overvalued, I construct an indicator of real exchange rate overvaluation as the trend growth rate of the real CPI-weighted exchange rate versus the US in the previous twelve months. In the row labelled "No Real Overvaluation", I restrict the sample to those episodes where this

¹¹ These summary statistics are not robust to a few extreme outliers in the measures of monetary policy observed during periods of very high inflation. I therefore discard a handful of observations where measured changes in real discount rates and real domestic credit growth are greater than 50 percent in absolute value.

growth rate is below the median for the entire sample. To capture the notion that a given defense may be more credible if the monetary authority can back up its commitment to a fixed exchange rate with a large stock of foreign currency reserves, I also divide the sample in half according to non-gold reserves relative to imports, and consider only the high-reserves subsample in the row labelled “High Reserves”. I also proxy for the overall weakness of the country’s external payments position using the average over the previous twelve months of that country’s borrowing from the International Monetary Fund, expressed as a share of its quota in the organization. In the row labelled “Low Quota Drawings”, I consider only those episodes where the country has no obligations to the IMF according to this measure. Finally, I consider the argument that it is easier to defend against a speculative attack during a booming economy than during a recession, presumably because the domestic economy is better able to withstand any of the adverse effects of high interest rates during the high point in the business cycle. I measure this as the deviation of real per capita GDP growth in a country from its average in the five preceding years, and then I divide countries in two at the median value of this deviation and consider only the booming economies in the row labelled “High Point in Cycle”.

The results in Table 3 lend little support to either the conventional wisdom or the contrarian view of the effectiveness of tight monetary policy in raising the probability that a speculative attacks fails. In all but three cases, the various measures of policy do not enter significantly at even the 10% level. The only three significant cases I find are for the effects of the third measure of policy, increases in bank reserves. In the subsamples corresponding to low black market premia, large changes in policy, and no real overvaluation, I find a marginally significant negative effect of tighter policy on the probability that the attack fails. However, this is hardly compelling evidence in favour of the contrarian view. For the table as a whole, tighter monetary policy raises the probability that the attack fails in almost exactly half of the cases (18 out of 39), and lowers it in the other half (21 out of 39). Overall, this descriptive evidence suggests a striking absence of any systematic relationship between the changes in monetary policy and the outcome of speculative attacks.

4. The Endogeneity of Policy

Although useful as data description, the evidence in the previous section can provide only limited information about the effects of policy during speculative attacks. Since policy is itself likely to respond endogenously to the same fundamentals that drive speculation, it is difficult to infer any structural relationship from the simple correlations of the previous section. In this section, I present a simple model which formalizes this issue and illustrates its ambiguous implications for the evidence of the previous section.¹² I then empirically address the endogeneity problem by estimating an instrumental variables probit model that expresses the probability that a given speculative attack ends in a devaluation as a non-linear function of fundamentals and measures of monetary policy, treating monetary policy as endogenous. After controlling for endogeneity of policy in this way, I still find no evidence that raising interest rates either lowers or raises the probability that a speculative attack ends in a devaluation of the currency.

A Simple Model

I consider a one-period model of a small open economy that fixes its exchange rate and comes under speculative attack. I assume that the economy is populated by a single speculator, and a monetary authority.¹³ The monetary authority sets the domestic interest rate, i , at the beginning of the period, and at the end of the period decides whether or not to devalue the currency by an exogenously-given and known amount, ϵ . The speculator attacks the currency by shorting it, i.e. by taking out loans in local currency at the interest rate set by the monetary authority at the beginning of the period, selling the proceeds to the monetary authority in exchange for US dollars at the beginning-of-period exchange rate, and then unwinding his position at the end-of-period exchange rate.¹⁴ The speculator's demand, S , for the reserves of the monetary authority, R , is determined by maximizing profits net of borrowing costs, which I assume for convenience to be quadratic in the volume of speculation:

¹² See Drazen (1999), Lahiri and Vegh (1997, 1999) and Lall (1997) for other models which focus specifically on the role of interest rates as a defense during speculative attacks.

¹³ The assumption of a single speculator allows me to abstract from the coordination issues emphasized by Morris and Shin (1998).

¹⁴ In practice, shorting the domestic currency during speculative attacks is generally done using forward contracts, rather than domestic currency loans. However, the substance of the analysis is not changed by this complication. See Goldstein et. al. (1993), Garber and Svensson (1995), and Lall (1997) for details.

$$(1) \quad \max_{\langle S \rangle} \pi \cdot \varepsilon \cdot S - \frac{i \cdot S^2}{2}$$

where π denotes the speculator's perception of the probability that the currency will be devalued.¹⁵ This results in a speculative demand for local currency $S(\pi, i) = \frac{\pi \cdot \varepsilon}{i}$.

The monetary authority decides whether or not to devalue the currency by weighing the costs and benefits of maintaining a fixed exchange rate. There are two costs to fixing: the monetary authority must spend a fraction $\frac{S(\pi, i)}{R}$ of its reserves to defend the exchange rate, and in order to maintain a desired level of reserves it may need to set domestic interest rates higher than it would otherwise do in the absence of speculative pressures.¹⁶ These costs are summarized in the following loss function of the monetary authority:

$$(2) \quad L(\pi, i, \theta) = \frac{S(\pi, i)}{R} + \theta \cdot i$$

where for simplicity I have assumed that the monetary authority's disutility of raising interest rates is linear in the interest rate, with θ measuring the strength of its aversion to high domestic interest rates. The level of reserves prior to the attack is not observed by the speculator, who believes that reserves are equal to R^* . Let β denote the benefits of maintaining the fixed exchange rate regime, which both the speculator and the central bank correctly perceive to be uniformly distributed on the unit interval. The timing of events is as follows: the monetary authority sets the interest rate; speculators determine

¹⁵ This convenient formulation of speculative behaviour is used by Drazen (1999). In the absence of such adjustment costs, risk-neutral speculators will take infinite short (long) positions in the currency under attack if the expected return to shorting is positive (negative). At the cost of complicating the algebra, one can also motivate a continuous speculative demand for loans by assuming that speculators are risk averse.

¹⁶ I follow the conventional (implicit) assumption that the monetary authority dislikes reserve losses and devalues when these losses are excessive. However, it is natural to ask why this should be the case. One might also imagine that the monetary authority does not value reserves per se, but rather dislikes the capital losses it suffers following a devaluation when it restores its target level of reserves by purchasing them at the depreciated exchange rate. In this case larger reserve losses make devaluations more costly. Moreover, raising interest rates may have the perverse effect of raising the rationally-expected probability of a devaluation by making devaluations less costly to the monetary authority.

their demand for reserves; the value of β is realized; and the monetary authority decides whether or not to devalue the currency to $1+\varepsilon$ depending on whether $L>\beta$ or $L<\beta$.

The speculator rationally forms his beliefs regarding the probability that the monetary authority will devalue, given his perception of the level of reserves, R^* , and given the interest rate set by the monetary authority.¹⁷ In particular, speculators understand that $\pi = \text{Pr ob}[L(\pi, i, \theta) > \beta]$, so that the rationally-perceived devaluation probability is:¹⁸

$$(3) \quad \pi = \frac{\theta \cdot R^* \cdot i^2}{R^* \cdot i - \varepsilon}$$

This probability is a U-shaped function of the interest rate. At low levels of the interest rate, the perceived devaluation probability is decreasing in i . Over this range, speculation against the currency is intense, and the marginal benefit of raising interest rates (in terms of reducing reserve losses S) outweighs the marginal cost to the domestic economy (as measured by the parameter θ). As a result, raising interest rates lowers the monetary authority's disutility of maintaining the fixed exchange rate, making a devaluation is less likely. In contrast, when interest rates are high, the marginal benefit of further increases in interest rates is smaller than the marginal cost to the domestic economy. Over this range, increases in the interest rate raise the disutility of the fixed exchange rate regime, and so raise the probability that the currency will be devalued.

The question of interest in this paper is the slope of $\pi(i)$, i.e. whether raising interest rates raises or lowers speculators' correct-in-equilibrium beliefs of the probability that a speculative attack ends in a devaluation of the currency. However, estimating $\pi(i)$ using the data on speculative attack episodes described in the previous sections is

¹⁷ To keep the model as simple as possible and to abstract from the signalling issues emphasized by Drazen (1999), I assume that the speculator does not update his beliefs about reserves after observing the interest rate set by the monetary authority.

¹⁸ To simplify this calculation, I restrict the parameters of the model to ensure that $L(\pi, i, \theta) < 1$, so that $\text{Pr ob}[L(\pi, i, \theta) > \beta] = L(\pi, i, \theta)$. It is straightforward to verify that this holds in equilibrium provided that the devaluation rate ε is small enough to ensure that the speculative demand for reserves is never too large.

complicated by two factors. First, for a given interest rate, it is clear that the slope of $\pi(i)$ will depend on episode-specific characteristics. More importantly, the monetary authority's choice of interest rates will respond endogenously to the same variables determining speculative pressures. In order to illustrate this endogeneity within the confines of a very simple model, I assume that the monetary authority sets interest rates to minimize the costs of maintaining a fixed exchange rate. In particular, I assume that the monetary authority chooses i to minimize Equation (2), taking into account the dependence of $\pi(i)$ on the interest rate it chooses as given by Equation (3). The optimal interest rate chosen by the monetary authority is:

$$(4) \quad i^* = \frac{\varepsilon}{R^*} \cdot \left(1 + \sqrt{\frac{R^*}{R}} \right)$$

and has a very natural interpretation. Other things equal, the higher is the devaluation rate ε , the greater is the volume of speculation and the higher is the interest rate set by the monetary authority to deter this speculation. When actual reserves are high, the monetary authority is better able to accommodate speculation, and the interest rate is lower. Similarly, the larger is the speculator's perception of the level of reserves, the lower is the interest rate required to deter speculation.

Since the interest rate chosen by the monetary authority in Equation (4) depends on the same fundamentals as the speculator's perceived probability of devaluation in Equation (3), simple correlations between interest rates and the outcome of speculative attacks can either obscure or accentuate the effects of tighter monetary policy. This is illustrated in Figure 1. In the top panel, I consider two episodes that are alike in every respect, except that in the latter the expected devaluation ε is lower than in the former. At the equilibrium in the first episode at A, $\pi(i)$ is decreasing in i , so that a small increase in interest rates has the conventional effect of lowering the perceived probability of a devaluation. In the latter case, the speculator's rationally-perceived devaluation probabilities are lower than before (shown as a downwards shift in $\pi(i)$), while the monetary authority reacts to these devaluation perceptions with a lower interest rate. In this episode, the equilibrium is at B with a lower interest rate and a lower devaluation probability. Simply comparing these two episodes, one might easily be led to the

mistaken conclusion that raising interest rates raises the probability of a devaluation, while precisely the converse is true (since both A and B fall on the downward-sloping portion of $\pi(i)$).

Similarly, the endogeneity problem may also lead to the conclusion that raising interest rates has the conventional effect of lowering the probability of a devaluation when in fact the opposite is true. I illustrate this possibility in the bottom panel of Figure 5. I again consider two identical episodes, which now differ in the monetary authority's distaste for interest rates, θ , and its level of reserves, R . The dashed lines correspond to an episode where both θ and R are lower than in the episode shown in solid lines. Not surprisingly, the monetary authority sets a higher interest rate, and since speculators believe that the monetary authority is "tough", the devaluation probability is lower for every interest rate i (shown as a downwards shift in $\pi(i)$). Comparing the equilibria A (with a high devaluation probability and a low interest rate) and B (with a low devaluation probability and a high interest rate), one might easily conclude that raising interest rates lowers the probability of a devaluation when the converse is true (since both A and B fall on the upward-sloping portion of $\pi(i)$).

This discussion illustrates how the endogeneity of policy can bias the estimated effects of policy in unknown directions. Moreover, as long as some of the fundamentals that drive both speculative pressures and the policy response cannot be measured and included in a regression, even partial correlations between policy and the outcome of speculative attacks will not correctly identify the effects of policy. To achieve identification, I require an exogenous source of variation in the interest rate set by the monetary authority that can be used as an instrument for policy. In this stylized model, the monetary authority's private information about the level of reserves, R , serves this purpose since changes in R shift the monetary authority's reaction function without shifting speculators' rationally-perceived devaluation probabilities. More generally, any private information of the monetary authority which influences its choice of interest rates can in principle serve to identify the effects of interest rates on speculators' beliefs that an attack will end in the devaluation of the currency.

Empirical Specification

I now turn to the empirical specification suggested by this simple model. My objective is to empirically estimate Equation (3), i.e. how speculators' correct-in-equilibrium perceptions of the probability of a devaluation depend on the interest rate set by the monetary authority, using probit regressions with a dummy variable indicating the outcome of the attack as the dependent variable. The first implication of the theory is that this probability will be a non-linear function of fundamentals observable by speculators and of the monetary policy response. Although the simple model discussed above is too stylized to take the exact functional form implied by Equation (3) literally, it does suggest that the explanatory variables in the probit equation should include not only measures of policy and fundamentals, but also interactions between the two in order to allow for such nonlinearities. Accordingly, I consider the following non-linear probit specification:

$$y_j^* = \beta_0 + \beta_1 \cdot i_j + \beta_2' f_j + \beta_3' f_j \cdot i_j + u_j$$

(5)

$$y_j = \begin{cases} 1, & \text{if } y_j^* > 0 \\ 0, & \text{if } y_j^* \leq 0 \end{cases}$$

where y_j^* is the usual latent variable in a probit specification; y_j is an indicator variable taking the value 1 if speculative attack j ends in a devaluation; i_j is a measure of the stance of monetary policy; f_j is a vector of episode-specific fundamentals observable by speculators; and u_j is a normally-distributed disturbance term. I consider the same three measures of the stance of monetary policy (i_j) as in the previous section: increases in real discount rates, decreases in domestic credit growth, and increases in the reserves of the banking system, and five of the measures of fundamentals (f_j) discussed in the previous section: a history of banking crises, the extent of real overvaluation, the adequacy of reserves, indebtedness to the IMF, and the point in the business cycle prior to the speculative attack.

The second implication of the theory is that i_j is endogenous and reacts to the same fundamentals that speculators observe. To the extent that the measured fundamentals included in f_j do not capture all of the fundamentals actually observed by both speculators and the monetary authority, the error term in Equation (5) will be correlated with policy. It is therefore necessary to instrument for both i_j and $f_j \cdot i_j$ in the

above regression. As suggested by the theory, I use the percentage change in real reserves calculated over the same interval as the change in policy as an instrument for the change in policy. In particular, I measure the change in policy, and thus also the change in reserves used as an instrument, in the month *prior* to month in which the outcome of the attack is determined.

To see why this is a reasonable strategy, observe first that lags in the publication of central bank reserves data are substantial for most countries. As long as publication lags are one month or more, the change in reserves in the month in which speculative pressures peak will be the private information of the monetary authority until the end of the following month in which the currency either is or is not devalued. It is possible to get a sense of the magnitude of these publication lags by considering information on central bank practices provided by the IMF for countries which comply with its “best practice” Special Data Dissemination Standard (SDDS) for timely provision of reserves data. As of December 2001, 48 industrial and major developing countries voluntarily comply with the SDDS.¹⁹ For the 38 of these countries that are in my sample, the average frequency of publication of “reserves template data” containing complete reserves statistics adjusted for outstanding foreign currency liabilities is just under one month, and the average publication lag is just under three weeks. Presumably, publication lags for countries outside the SDDS are substantially longer. Moreover, it is likely that publication lags even for many of the SDDS countries were also substantially longer earlier in the sample period. One suggestive piece of evidence in this regard comes from comparing the publication lag in the June 2001 print edition of the IMF’s International Financial Statistics with that of the June 1991 edition. For the countries in my sample that also comply with the SDDS, the average publication lag – i.e. the difference in months between the last available month of data and the month of publication – is nearly one month higher in June 1991 (3.2 months) than it was in June 2001 (2.4 months). This suggests that for most episodes in my sample, it is reasonable to treat the change in reserves as private information of the monetary authority over the relevant one-month horizon.

¹⁹ The information on publication schedules for reserves and other data for SDDS countries can be downloaded at <http://dsbb.imf.org/sddsindex.htm>.

For the change in reserves to be a good instrument, it also needs to be a good predictor of the policy response. Using the full sample of events, I find that the change in reserves is in fact a rather poor predictor of the policy response in many specifications, for all three measures of policy. However, if I restrict attention to the sample of OECD economies, and to a larger sample consisting of OECD economies plus developing economies with no interest rate controls, I find that in most specifications this instrument has reasonable predictive power for changes in discount rates and changes bank credit in in the first-stage regressions. I therefore report results only for these two subsamples of events and these two measures of policy. Finally, for the change in reserves to be a valid instrument, it must be uncorrelated with the error term in Equation (5), i.e. it must be uncorrelated with omitted fundamentals observed by speculators that determine the outcome of the speculative attack. Since I use the change in reserves in the month prior to the month in which the outcome of the attack is determined, it should not be be correlated with news about fundamentals that occur in the latter period.²⁰

I estimate Equation (5) using Amemiya's (1978) generalized least squares estimator for probit models with endogenous regressors. This is a two-stage procedure, in which the observed dependent variable y_j and the endogenous variables are first all regressed on the exogenous variables and the instruments. Amemiya's insight is that, provided that the model is identified, the structural parameters in Equation (5) can be retrieved from a GLS regression of the reduced form parameters of the first-stage regression involving the dependent variable on the reduced-form parameters from the remaining first-stage regressions. As shown by Newey (1987), this method is asymptotically equivalent to a minimum chi-squared estimator and is the most efficient method to extract structural from reduced-form parameter estimates.

Results

²⁰ As a robustness check, I also try lagging the instrument one period to further reduce the possibility that the instrument is correlated with fundamentals in the relevant period (which might occur if news about fundamentals is correlated over time). The drawback of this is that the predictive power of the instrument is weaker, and it is more difficult to justify the informational asymmetry between speculators and the monetary authority. With these caveats in mind, I nevertheless find similar results to those reported here.

The results of this instrumental variables probit specification are presented in Table 4. The top and bottom panels correspond to the OECD subsample, and the same sample augmented with speculative attacks occurring in developing countries with no interest rate controls, respectively. Each column corresponds to a probit regression with a dummy variable equal to one if the attack fails as the dependent variable, using the indicated measure of policy, the indicated measure of fundamentals, and the interactions between the two as explanatory variables. For each regression, I report the estimated coefficients, their standard errors, and the corresponding marginal effect of a one-standard-deviation increase in the right-hand side variable on the probability that a speculative attack fails. I also report the p-value associated with a test of the null hypothesis that the instruments are jointly significant in the first-stage regression of the policy variable on the instruments.

The results in Table 4 once again provide very little evidence of either the conventional wisdom or the contrarian view regarding the efficacy of tight monetary policy as a defense against speculative attacks. None of the specifications I consider yield statistically significant effects of policy on the outcome of the attack in one direction or the other at conventional significance levels. In this respect, the results in Table 4 mirror those of the simple probit regressions in Table 3. One interpretation of this is that, as suggested by the theory, the direction of the endogeneity bias is different across different speculative attacks, and so one should not expect the instrumented results to differ systematically from the simpler uninstrumented results presented earlier.²¹ Even the evidence on the direction of the effects of policy is not especially clear. In six of the 18 cases, the direct effect of policy is positive and consistent with the conventional view that tighter policy raises the probability that an attacks fails, while in the remaining 12 cases the opposite is true. In exactly half of the cases, the sign of the coefficient on the interaction between policy and fundamentals is positive, consistent with the idea that “good” fundamentals enhance the effectiveness of tight policy under the conventional view, while in the other half of cases the opposite is true. Overall, the results lend little support to either the conventional or the contrarian view.

²¹ An alternative explanation is of course that the instruments are too weak to successfully correct for a *systematic* endogeneity bias in one direction or the other. However, in most specifications I do not reject the null that the instruments are jointly significant in the first-stage regression, so this alternative seems less likely.

5. Conclusions

Do high interest rates help to defend exchange rates that come under speculative attack? Or do they have the perverse effect of increasing the likelihood of a devaluation? The evidence considered in this paper suggests that the answer to both questions is no. A systematic examination of interest rates around a large number of historical speculative attack episodes indicates a striking lack of evidence that the stance of monetary policy is correlated with the outcome of speculative attacks. This basic finding is robust to alternative measures of the stance of monetary policy, to interactions which control for differences in fundamentals across speculative attack episodes, and to controlling for the endogeneity of the policy response to a speculative attack.

Nevertheless, it may be premature to conclude that monetary policy is entirely ineffective in during speculative attacks. In the interests of covering a sample of speculative attacks large enough to include interesting variation in the outcome of speculative attacks, the policy response to the speculative attack, and the fundamentals that are likely to determine both the outcome of the attack and the efficacy of the policy response, I have made several compromises with regards to data and methodology. Two such compromises, and possible strategies to avoid them in future research, deserve mention.

First, I have relied on readily-available but relatively low-frequency monthly data to identify speculative attacks and the response of policy. This is unfortunate given that much of the economically interesting variation during speculative attack episodes is likely to occur at much higher daily, or even hourly, frequencies. The use of monthly data also precludes modeling the likely path-dependence in the effects of interest rates on speculative pressures, a point emphasized by Drazen (1999). Moving to high-frequency data for the more limited sample of speculative attacks for which such data is available may uncover evidence of the effects of monetary policy that are obscured by the low frequency and absence of dynamics in the present paper.

Second, in this paper I have relied on the very crude indicators of monetary policy that can readily be constructed from available monthly data. However, as noted

earlier, monetary authorities have a wide variety of instruments at their disposal, including open market operations, direct interventions in foreign exchange markets, imposition of credit ceilings, etc. Disentangling these interventions from the fluctuations in observable high-frequency data, and modeling the choice between instruments over time and across episodes, is essential to obtaining a better understanding of the role of monetary policy during speculative attacks.

Implementing these improvements for a sufficiently large set of speculative attack episodes that span the relevant range of country experiences will take time. Until then, however, it seems that the burden of proof for both the conventional wisdom that raising interest rates strengthens currencies under speculative attack, and also the contrarian view that it weakens them, lies with the proponents of these views.

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Appendix: Data Sources

The monthly data employed in this paper are drawn from the International Financial Statistics of the International Monetary Fund, as follows:

- Nominal exchange, local currency units per US dollar, period average (IFS Line rf).
- Non-gold reserves, US dollars (IFS Line 11.d)
- Money market rate, percent (IFS Line 60b)
- Discount rate, percent per year, end of period (IFS Line 60). For France, Singapore Sweden and the Netherlands after December 1993, I use repurchase rates (IFS Line 60a)
- Domestic credit, local currency units (IFS Line 32)
- Reserves of deposit money banks, local currency units (IFS Line 20)
- Consumer price index (IFS Line 64). For Australia and Ireland, I use the wholesale price index (IFS Line 63)
- Imports, c.i.f., US dollars (IFS Line 71)
- Total IMF credits and loans outstanding (IFS Line 2tl)
- IMF quota (IFS Line 2t)

Lower-frequency data corresponding to the speculative attack episodes are drawn from various sources.

- The black market premium is drawn from Easterly and Levine (1997)
- Annual real GDP growth is constant price local currency GDP figures drawn from the World Bank World Tables (NY.GDP.MKTP.KN)
- Data on banking crises are based on the IMF's May 1998 edition of the World Economic Outlook, and augmented using the original sources in Caprio and Klingebiel (1997) and Demirguc-Kunt and Detragiache (1997).
- Data on the presence of interest rate ceilings is drawn from Demirguc-Kunt and Detragiache (1999)

The sample of countries consists of all non-transition countries with per capita GNP greater than \$800 in 1995 at Atlas exchange rates and with populations greater than one

million, i.e. the World Bank's definition of middle- and upper-income countries in that year. From this sample, I drop Chile, Algeria, Panama, Romania, Saudi Arabia, El Salvador and Turkmenistan because requisite data on discount rates was not available, as well as Kuwait and Oman.

Table 1: Successful and Failed Speculative Attacks

Successful Attacks		Failed Attacks		
ARG 1975/1	KOR 1980/1	ARG 1992/12*	FIN 1996/6	NLD 1979/12*
ARG 1981/2	KOR 1997/11	ARG 1995/3*	FIN 1998/3	NLD 1981/8
AUS 1976/12	MEX 1976/9	AUS 1979/12	FRA 1979/9*	NOR 1976/4*
BEL 1982/3	MEX 1982/2	AUS 1982/1	FRA 1993/11	NOR 1979/6*
BOL 1979/12	MEX 1994/12	AUT 1978/2*	GRC 1988/3	NOR 1992/12
BOL 1982/2	MEX 1998/9	AUT 1979/5	GRC 1989/5	NZL 1979/12
BRA 1999/1	MUS 1979/11	BEL 1976/10*	GRC 1997/10	PHL 1986/2
BWA 1975/10	MUS 1981/10	BEL 1979/7*	GTM 1982/2	PNG 1993/4
BWA 1984/7	NAM 1975/10	BEL 1980/3	HKG 1991/12*	PNG 1998/3
BWA 1992/7	NAM 1984/7	BEL 1986/4*	HKG 1998/8*	PRT 1975/11
BWA 1998/7	NAM 1998/7	BEL 1992/11	IDN 1975/5	PRT 1985/1
CRI 1981/1	NOR 1986/5	BOL 1981/6	IDN 1988/5*	PRT 1990/10*
DNK 1993/8	NZL 1984/7	BOL 1987/8	IDN 1991/3*	SGP 1976/1*
DOM 1987/6	PER 1975/10	BOL 1990/6	IRL 1986/1	SWE 1976/4*
DOM 1990/4	PER 1977/11	BOL 1992/1	IRL 1989/6	SWE 1976/10
ECU 1982/5	PER 1987/11	BRA 1997/11*	ITA 1980/2*	SWE 1980/2*
ECU 1985/12	PHL 1983/10	CAN 1976/3*	ITA 1981/5	SWE 1988/5*
ECU 1992/9	PHL 1997/9	CAN 1978/2	ITA 1986/1	SWE 1990/2*
ESP 1977/7	PNG 1994/10	CAN 1981/7	ITA 1987/8	SWE 1991/11
ESP 1982/12	PRY 1984/3	CAN 1984/6	ITA 1990/12*	SWE 1998/2
ESP 1995/3	PRY 1986/12	CAN 1990/5*	JAM 1976/12	THA 1978/2*
FIN 1977/4	PRY 1989/3	COL 1995/12*	JOR 1987/4	THA 1984/1*
FIN 1982/10	SWE 1977/9	CRI 1979/8	JOR 1988/6	THA 1985/3*
FIN 1991/11	SWE 1992/12	DNK 1975/3*	KOR 1980/6*	THA 1990/9*
GBR 1992/9	THA 1984/11	DNK 1976/9	KOR 1983/1*	THA 1992/9*
GRC 1998/3	THA 1997/7	DNK 1987/2*	KOR 1989/11*	THA 1994/6*
GTM 1989/11	TTO 1985/12	DNK 1989/11*	KOR 1996/8*	TTO 1988/1
GTM 1997/1	TTO 1993/4	DNK 1993/2*	MAR 1980/8	TTO 1994/5
IDN 1978/11	TUR 1977/3	DNK 1998/8	MAR 1982/9	TUN 1986/6
IDN 1983/4	TUR 1979/6	DOM 1976/5	MEX 1994/5*	TUN 1991/4
IDN 1986/9	VEN 1984/2	DOM 1980/4	MUS 1976/8	TUR 1975/5
IDN 1997/8	VEN 1986/12	DOM 1982/9	MUS 1982/8	URY 1993/9*
IRL 1986/8	VEN 1995/12	DOM 1994/9	MUS 1994/9*	URY 1998/9*
IRL 1993/2	ZAF 1975/10	ESP 1987/5*	MUS 1999/1*	USA 1979/10
ISR 1977/11	ZAF 1984/7	FIN 1976/2	MYS 1980/9*	ZAF 1975/3*
ISR 1989/1	ZAF 1998/7	FIN 1979/11	MYS 1981/10*	ZAF 1976/8
ITA 1992/9		FIN 1980/11*	MYS 1986/8*	ZAF 1980/7*
JAM 1978/5		FIN 1990/11*	NAM 1993/6	ZAF 1981/9
JAM 1983/11		FIN 1991/5	NLD 1976/7	ZAF 1982/9*

Note: * indicates failed attacks identified by spikes in nominal interest rate differentials.

Table 2: Policy Changes and the Outcome of Speculative Attacks

	Successful Attacks		Failed Attacks		P-Value for <u>Independence</u>
	<u>Number</u>	<u>% Policy Tightens</u>	<u>Number</u>	<u>% Policy Tightens</u>	
Discount Rates	52	56%	100	57%	0.88
Domestic Credit	69	38%	100	45%	0.34
Bank Reserves	64	47%	100	39%	0.32

Table 3: Uninstrumented Probit Regressions
(Dependent Variable is Dummy=1 if Attack Fails)

	Discount Rate			Domestic Credit Growth			Bank Reserves		
	<u>Effect</u>	<u>t-stat</u>	<u>N</u>	<u>Effect</u>	<u>t-stat</u>	<u>N</u>	<u>Effect</u>	<u>t-stat</u>	<u>N</u>
Full Sample	0.02	0.51	150	0.03	0.60	114	-0.04	-1.14	164
OECD	-0.04	-0.76	73	-0.06	-1.10	51	-0.04	-0.80	66
Post-1985	0.01	0.09	75	0.05	0.77	58	-0.04	-0.73	84
No Interest Rate Controls	0.03	0.63	65	0.03	0.42	44	0.02	0.40	70
No Capital Controls	0.04	0.57	43	-0.11	-1.36	35	0.01	0.13	48
Low Black Market Premium	-0.01	-0.33	98	0.02	0.42	70	-0.12	-1.94	95
Top Half of Policy Response	0.01	0.18	75	-0.01	-0.13	57	-0.12	-1.77	82
Top Quarter of Policy Response	0.05	0.54	37	-0.01	-0.08	28	-0.11	-1.11	41
No Banking Crises	0.04	0.93	108	0.04	0.85	80	0.02	0.41	116
No Real Overvaluation	-0.07	-1.32	75	-0.02	-0.26	57	-0.09	-1.71	79
High Reserves	0.02	0.29	66	-0.02	-0.28	54	-0.06	-1.05	78
Low Quota Drawings	-0.06	-1.15	88	0.03	0.50	60	-0.02	-0.32	85
High Point in Cycle	-0.01	-0.25	75	0.02	0.31	57	-0.01	-0.30	82
Fraction < 0	0.38			0.46			0.77		

Notes: This table reports the marginal effect of policy in a probit regression expressing the probability that a speculative attack fails as a function of a constant and the indicated policy variable, in the indicated subsample of events. The columns labelled "effect" report the estimated marginal effect multiplied by the standard deviation of the measure of policy, and can be interpreted as the effect of a one-standard-deviation tightening of the indicated policy variable on the probability that the attack fails. The columns labelled "t-stat" report the t-statistic associated with the estimated coefficient in the probit regression. The columns labelled "N" report the number of observations for which the policy variables are available in the indicated subsamples of events.

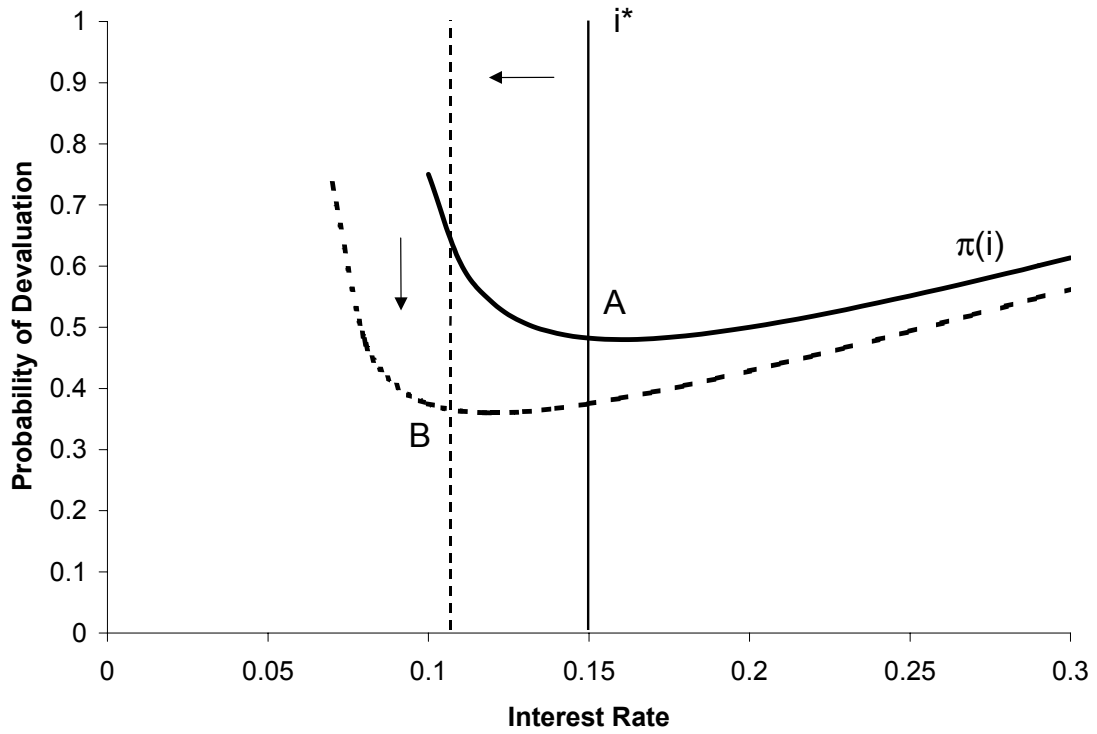
Table 4: Instrumented Probit Regressions

		Discount Rate					Bank Reserves				
		Fundamental (f):					Fundamental (f):				
		Banking	Real	Reserves/	IMF	Growth	Banking	Real	Reserves/	IMF	Growth
		<u>Crisis</u>	<u>Overvaluation</u>	<u>Imports</u>	<u>Borrowing</u>	<u>Deviation</u>	<u>Crisis</u>	<u>Overvaluation</u>	<u>Imports</u>	<u>Borrowing</u>	<u>Deviation</u>
OECD Sample											
i	β		-0.10	-0.41	-0.04	-0.07		-0.37	-6.17	0.85	0.62
	se(β)		0.12	0.57	0.07	0.06		1.29	4.13	1.41	2.74
	dP[Fail]/d β		-0.28	-0.70	-0.15	-0.21		-0.08	-0.97	0.17	0.14
ixf	β		-0.02	0.17	0.00	0.02		0.17	1.68	0.03	0.12
	se(β)		0.03	0.30	0.00	0.03		0.23	1.18	0.03	0.69
	dP[Fail]/d β		-0.29	0.71	-0.02	0.16		0.18	1.01	0.17	0.10
f	β		-0.01	-0.13	-0.02	-0.01		-0.14	-0.17	0.00	0.07
	se(β)		0.19	0.30	0.01	0.07		0.06	0.16	0.01	0.15
	dP[Fail]/d β		-0.01	-0.03	-0.16	-0.01		-0.17	-0.06	-0.04	0.07
	p-FSR		0.02	0.15	0.00	0.12		0.00	0.06	0.42	0.01
	Number of Observations		72	64	72	72		62	63	64	64
OECD Plus Developing Countries with No Interest Rate Controls Sample											
i	β	-0.15	-0.10	-0.03	-0.03	-0.09	1.41	5.18	-7.15	0.43	0.70
	se(β)	0.39	0.07	0.28	0.13	0.06	0.97	16.83	10.22	0.62	5.20
	dP[Fail]/d β	-0.11	-0.30	-0.07	-0.07	-0.28	0.32	0.25	-0.63	0.16	0.24
ixf	β	-1.06	-0.01	-0.04	0.00	-0.01	-7.37	-0.97	1.99	0.01	0.05
	se(β)	6.03	0.01	0.13	0.00	0.02	5.57	2.86	2.86	0.02	1.98
	dP[Fail]/d β	-0.31	-0.15	-0.26	-0.32	-0.06	-0.33	-0.29	0.91	0.08	0.08
f	β	0.30	-0.02	-0.26	-0.02	0.07	-1.96	-0.32	0.12	0.00	0.08
	se(β)	10.02	0.06	0.26	0.01	0.05	1.13	0.96	0.47	0.00	0.13
	dP[Fail]/d β	0.00	-0.03	-0.09	-0.14	0.08	-0.11	-0.09	0.02	-0.07	0.12
	p-FSR	0.25	0.04	0.09	0.06	0.12	0.17	0.10	0.08	0.21	0.04
	Number of Observations	92	92	84	92	92	94	89	92	94	94

Notes: This table reports the results of a probit regression which expresses the probability that a speculative attack fails as a function of the monetary policy response (i), a fundamental (f), and the interaction between the two (ixf), for the indicated measures of policies and fundamentals. All regressions also include a constant. The rows labelled β , se(β), and dP[Fail]/d β report the estimated coefficient, its standard error, and the estimated marginal effect times the standard deviation of the corresponding right-hand-side variable. The row labelled P-FSR reports the p-value associated with the null hypothesis that the instruments are jointly insignificant in the first-stage regression. Results for the interaction with banking crises are not reported for the OECD sample since this indicator variable consists almost exclusively of zeros in this sample.

Figure 1: The Endogeneity of Policy

Case 1: Endogeneity Bias Obscures Conventional View



Case 2: Endogeneity Bias Exaggerates Conventional View

