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## Does the IMF help or hurt? The effect of IMF programs on the likelihood and outcome of currency crises

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# KOF Working Papers

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on the Likelihood and Outcome of Currency Crises

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# **Does the IMF Help or Hurt? The Effect of IMF programs on the likelihood and outcome of currency crises**

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## **Abstract**

Using panel data for 68 countries over the period 1975-2002 this paper examines how IMF programs, disbursed loans, and compliance with conditionality affect the risk of currency crises and the outcome of such crises. Specifically, we investigate whether countries with previous IMF intervention are more likely to experience currency crises. In a second step, we analyze the IMF's impact on a country's decision to adjust the exchange rate, once a crisis occurred. We find that IMF involvement reduces the probability of a crisis. Once in a crisis, IMF programs significantly increase the probability that the authorities devalue the exchange rate. The amount of loans and compliance with conditionality have no impact. Our results suggest that the IMF – contrary to the Fund's critics – does indeed fulfill its functions of promoting exchange rate stability and helping its members to correct macroeconomic imbalances.

**Keywords:** IMF programs, growth, compliance, conditionality

**JEL-Codes:** F33, F34, O57

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*„The Purposes of the International Monetary Fund are:*

*(iii) To promote exchange stability, to maintain orderly exchange arrangements among its members [...]*

*(v) [... to provide] them with opportunity to correct maladjustments in their balance of payments [...]*

*(vi) [...] to shorten the duration and lessen the degree of disequilibrium in the international balances of payments of members“*

Article I, IMF Articles of Agreement

## **1. INTRODUCTION**

When the International Monetary Fund (IMF) was created in 1945 its founders envisioned a Fund that would promote exchange stability and would help its member countries to adjust to disequilibria in their balance of payments. Despite these high goals, the IMF has come under increased scrutiny and attack in recent years (e.g. Stiglitz 2002). Some of the most intense criticisms aim at the ineffectiveness of the Fund's programs and conditionality to promote good policy and economic outcomes in the recipient countries (e.g. Przeworski and Vreeland 2000, Vreeland 2003, Dreher 2006). A large literature has emerged that investigates how IMF programs and their implementation affect countries' balance of payments, the current account, inflation, and economic growth rates (for recent surveys see Joyce 2004, Bird 2007, Steinwand and Stone 2008).

In face of this abundance of studies, it is surprising that few studies have investigated the Fund's performance with regard to one of its most generic purposes: the promotion of a stable international exchange rate system. One of the rare exceptions is Mukherjee (2006), who reports that the IMF's stabilization programs failed to prevent currency crises in countries with a high degree of state intervention in the financial sector, but not in others. Hutchison (2003) reports that

28 percent of currency crises were associated with a contemporaneous short-term IMF program, while 18 percent of such programs were associated with a contemporaneous currency crisis. However, he does not provide an analysis of the causal direction of this empirical relationship. Overall, we thus know little about whether IMF programs increase or decrease a country's risk of experiencing a currency crisis or how such programs affect countries' strategies to resolve such crises. Given the paucity of evidence, it is not surprising that we know even less about the channels by which the IMF influences crisis risk and the outcome of currency crises. In theory, the Fund can influence economic policies and outcomes by its available or disbursed money, the policy conditions it attaches to its loans and, more generally, its policy advice. An equally important, but more indirect, channel is what we call the "scapegoat-channel." By allowing policymakers to shift the blame for unpopular policies onto the Fund and thus increasing their chances of political survival, the IMF can enhance the chances that economically sensible policies will in fact be implemented (Vreeland 1999). As second indirect channel, to the contrary, the "moral-hazard" associated with IMF lending might affect policies negatively (Vaubel 1983). As IMF lending may be interpreted as income insurance against adverse shocks, the insurance cover might induce the potential recipients to lower their precautions against such damages. The overall effect of the IMF depends on the net effect of those channels. In this paper we therefore examine how IMF programs, disbursed loans, and compliance with conditionality affect the risk of currency crises and the outcome of such crises. Specifically, we investigate whether countries with previous IMF intervention are more likely to experience currency crises.

In a second step, we test for the IMF's impact on a country's decision to adjust the exchange rate, once a crisis occurred. Even though the IMF aims to prevent currency crises in the first place, these crises have been a regular feature of the international exchange system. Once crises occur, the Fund's goal is thus to limit their severity, resolve them quickly and thus to prevent them from having systemic implications. Protracted crises often result from the authorities' attempt to delay a necessary adjustment of the exchange rate for too long. One of the most frequent pieces of advice the IMF gives to countries experiencing such crises therefore is an adjustment of the exchange rate. Even though IMF loans bolster countries' reserves, this advice, or even conditionality, coupled with the opportunity to blame the IMF for a devaluation, should lead to an increased propensity for exchange rate adjustment caused by IMF crisis involvement.

To anticipate our main results, we find that IMF involvement reduces the probability of a crisis. Once in a crisis, IMF programs significantly increase the probability that the exchange rate devalues.

The next section discusses the various channels by which the IMF can influence crises; section 3 describes the method and data employed. Section 4 presents the empirical analysis, while extensions are provided in section 5. The final section concludes.

## **2. CHANNELS FOR THE IMPACT OF THE IMF ON CURRENCY CRISES**

There is a multitude of channels by which the IMF can influence economic outcomes. We discuss three direct channels – money, conditionality, and policy advice – and two more indirect ones: the role of the IMF as a scapegoat for unpopular policies and its role in inducing moral hazard with the borrowing countries.

### 2.1 IMF programs and the risk of currency crises

Let us first discuss the channels through which the IMF can affect the risk that a currency crisis occurs in a country. First, IMF program approval is associated with a certain amount of money.<sup>1</sup> The effect of this money is, however, not obvious. In theory, IMF credit is meant to bolster reserves. Since low levels of foreign currency reserves increase the likelihood of speculative attacks, a boost in reserves can help prevent such crises. The knowledge that the central banks' coffers are full will not only deter speculators from attacking the currency but will also reassure domestic and foreign investors not to withdraw their funds, which could inadvertently cause a currency crisis. This in turn gives governments enough breathing space to reform and stabilize the economy. IMF credit should thus decrease the risk of currency crises. In practice, however, such credit can also increase crisis risk: Money disbursed increases borrowing governments' leeway, thus reducing incentives to politically painful adjustment measures (Boockmann and

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<sup>1</sup> In addition to the Fund's own resources, IMF programs might exert a catalytic effect on other financial flows. Empirical support for this hypothesis is, however, rather weak. For an excellent summary of this literature see Bird and Rowlands (2002).

Dreher 2003, Dreher and Rupprecht 2007). As a consequence, governments pursue inappropriate policies longer than they would otherwise do (Bandow 1994).<sup>2</sup> In fact, availability of IMF money may deteriorate economic policy even before it has been disbursed. According to the "moral-hazard hypothesis," IMF lending may be interpreted as a (subsidized) income insurance against adverse shocks (Vaubel 1983). The insurance cover induces the potential recipients to excessively lower their precautions against such damages (or even to intentionally generate a crisis). There is a considerable body of evidence that the balance of payments problems of IMF borrowers have been largely of their own making<sup>3</sup> and that macroeconomic performance during inter-program years has been deteriorating as the number of past programs increased.<sup>4</sup> As has been shown in Dreher and Vaubel (2004a), economic policy is indeed more expansive in countries with higher IMF loans available (as measured by the country's undrawn quota with the Fund). If it is true that the IMF induces moral hazard and thus "bad" economic policy, IMF involvement would make currency crises more, rather than less, likely. Finally, countries with access to IMF funding might be more attractive targets for speculators, who may infer from the IMF's involvement that rather than being punished, their risky investments might be bailed out. This perspective would also predict that IMF money actually increases the risk of crisis. Whether the positive or negative effect of IMF money prevails is thus an empirical question.

The second channel through which the IMF might affect the risk of currency crises is conditionality. The Fund attaches policy conditions to its loans. Those conditions contain measures the Fund believes to be adequate to overcome an overt or smouldering economic crisis. If these measures are adequately designed and implemented, macroeconomic conditions should improve in the wake of an IMF program and currency crises should become progressively less likely. In addition, the research on currency crises has shown that crises become more likely when investors lose confidence in a government's willingness to sacrifice domestic policy goals (such as low unemployment) in exchange for maintaining its exchange rate peg (Obstfeld 1994, 1996; for an overview over these so-called second generation models see Flood and Marion

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<sup>2</sup> According to Veiga (2005), existence of IMF arrangements in high inflation periods reduces the probability of stabilization, while the result of money disbursed is ambiguous and depends on the timing of disbursements.

<sup>3</sup> See the sources quoted in Vaubel (1991, p. 205, pp. 207) and Evrensel (2002, Table 2).

<sup>4</sup> Evrensel (2002) shows that budget deficits, inflation rates and domestic credit, among others, are higher in the second inter-program-period compared with the first. According to Conway (1994, 2007), participation in IMF programs is more likely the more frequently the country participated in the past.



1998). IMF conditionality can thus indirectly decrease the likelihood of crises by increasing investors' confidence that the government will adjust its macroeconomic policies.

With regard to the effect of IMF conditions, emphasis is on *implemented* conditions, however. Many studies have shown that non-compliance and program interruptions are quite frequent.<sup>5</sup> The IMF (2001) itself reports that countries complied with structural benchmarks in only 57 percent of all programs between 1987-99. Compliance with performance criteria was almost ten percentage points higher, while prior actions have been implemented in 80 percent of the programs analyzed. The worst implementation rates were found for conditions relating to privatization (45 percent), the social security system (56 percent) and public enterprise reforms (57 percent). These data are not without problems, however, because they do not include programs that are interrupted or permanently cancelled and classify compliance as high even if the borrower implements many minor conditions but fails to implement the important ones (Bird and Willett 2004). Killick (1995) proposes an alternative indicator of compliance. This indicator is the most widely used measure of program implementation. Specifically, IMF loans agreed but left undrawn at program expiration are used as an indicator of performance under a program. As Killick (1995: 58) points out, credit agreed but left undrawn may be a useful indicator of performance under a program. After concluding an arrangement, part of the credit associated with it will be paid out immediately. The rest is payable in tranches. Since IMF credits are highly subsidized, countries have incentives to draw all the money available immediately. However, the money is conditional on observance of several performance criteria. Unless a waiver is granted, non-compliance results in program interruptions. Therefore, if there are large unused credit lines, non-compliance and interruptions are likely to be the cause.

Bird and Willett (2004) summarize the disadvantages of this approach. Resources may not be withdrawn, because of improvements in the economy. Sometimes programs are approved on a precautionary basis only, without intentions to draw at all. On the other hand, the Fund might disburse its money even though implementation of conditions has been poor, for example because it feels that significant progress has been made, or even for political reasons.

It is not surprising that authors who concentrate on proxies that examine the percentage of IMF loans agreed but left undrawn have found even higher non-compliance rates as compared to those using the Fund's MONA data. For example, Dreher (2003) finds that in the period 1970-

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<sup>5</sup> Joyce (2003) and Vreeland (2006) summarize the recent literature on compliance with IMF conditionality.

1999 an average of 61.3 percent of programs per year suffered from non-compliance. If conditions are not implemented, of course, they cannot have any (direct) impact on economic outcomes.<sup>6</sup> Whether the IMF has an effect on the risk of currency crisis should thus also be a function of compliance. When conditions are designed to redress macroeconomic imbalances, more compliant countries should be less likely to experience crisis.

A third channel by which the IMF can affect the probability of crisis is its policy advice (Boockmann and Dreher 2003). Advice of the IMF is often discussed publicly and may influence politics in the longer run (Killick 1994: 156). Therefore, the impact of the IMF on crisis resolution might reach beyond the direct effects of conditions and finance. According to Fischer (2001: 237), one of the IMF's main contributions to reforms is that it stands consistently for a particular approach to economic policy. Chwieroth (2006) argues that the IMF provides information encouraging particular policies when there is already domestic inclination for that policy, so the information can help to reduce uncertainty and cajole domestic opponents, facilitating reform. The IMF encourages countries to pursue prudent economic policies and to avoid the emergence of major macroeconomic imbalances. IMF policy advice is thus geared toward creating an economic environment in which the emergence of a currency crisis is unlikely. In this context one can also argue that markets see IMF programs as "seal of approval" for the country's economic policies, and therefore choose not to attack the exchange rate. At the same time, critics point out that the IMF might give misguided policy advice (such as premature capital account liberalization), which might in fact increase the risk of crises.

Fourth, the IMF may induce moral hazard with its borrowers. The "moral-hazard hypothesis" was originally proposed in Vaubel (1983). According to Vaubel, IMF lending may be interpreted as a (subsidized) income insurance against adverse shocks. The insurance cover induces the potential recipients to excessively lower their precautions against such damages (or even to intentionally generate a crisis). It is easy to show that balance of payments crises "can be produced at will, virtually overnight" by an inappropriate monetary or exchange rate policy (see Niehans 1985, pp. 67). There is also a considerable body of evidence that the balance of payments problems of IMF borrowers have been largely of their own making and that

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<sup>6</sup> Marchesi and Thomas (1999) develop a model where the adoption of an IMF program signals a country's productivity. Dreher (2004b) shows that conditionality can help voters in extracting the 'type' of their government. Independent of compliance with conditions, there might thus be indirect effects on economic (and political) outcomes.

macroeconomic performance during inter-program years has been deteriorating as the number of past programs increased (Evrensel 2002). The term “moral hazard” is sometimes also used in a wider sense describing an incentive to abuse the claim to an indemnity once the accident has occurred or an incentive to abuse a loan. What we are looking at may be called “direct moral hazard” because we are analyzing the behavior of the direct recipients of insurance payments – the governments of the member states. This ought to be distinguished from indirect moral hazard effects on the lending behavior of their creditors, i.e. the “bail-out” of foreign banks etc. (Dreher and Vaubel 2004a). If the IMF really induces moral hazard with its borrowers, we would expect crises to become more likely.

Finally, currency crises can best be avoided when imbalances are redressed in due time. This requires the authorities to implement reforms that tend to be painful in the short-run. Politically, such reforms are difficult to implement. An important indirect function of the IMF in this context is its function as a scapegoat (Vreeland 1999). Policymakers can blame the IMF for “forcing” them to implement painful reforms. By easing the political pressures on these policymakers, the IMF therefore enhances their ability to implement necessary reforms despite public opposition. When these reforms are successfully implemented, they should decrease the risk of a currency crisis in the future.

To sum up, there are strong theoretical reasons to expect that IMF programs should affect currency crisis risk. Theory does not provide a definite answer as to whether this effect should be positive or negative.

## 2.2 IMF programs and the outcome of currency crises

Faced with speculative pressure, governments can either defend their exchange rate by selling foreign reserves and increasing short-term interest rates, or devalue the exchange rate to a level at which the speculative pressure subsides. The empirical evidence shows that both types of policy outcomes occur quite frequently (Eichengreen 2003, Leblang 2003, Sattler and Walter 2007). Which policy response policymakers choose depends on consideration of the political and economic costs of each option. For example, in a setting of first-generation crises, which are caused by bad macroeconomic fundamentals, the exchange rate is often significantly overvalued and the economy exhibits significant disequilibria. While devaluation can be very painful in such setting, adjusting the exchange rate is often the necessary first step in the recovery process.

Nevertheless, the political costs of devaluation can at times outweigh its benefits.<sup>7</sup> IMF programs can again affect policymakers' calculus of costs and benefits of the available policy option through five main channels: money, conditions, advice, moral hazard, and as scapegoat for unpopular policies.

IMF money directly affects the range of policy options available to the national authorities. One robust finding in the research on currency crisis outcomes in developing countries is that higher levels of foreign reserves significantly decrease the probability that the exchange rate will be adjusted (Leblang 2003, Sattler and Walter 2007). Since countries can use the funds disbursed in the wake of an IMF program to bolster their foreign reserves, a high amount of such funds should increase the likelihood that the authorities defend their exchange rate. This tendency might be enhanced by moral hazard.

In addition, conditions and advice going along with IMF programs should affect the outcome of currency crises as well. Conditions usually require countries to adjust their exchange rates in order to address their balance of payments imbalances. If such conditions accompany IMF programs – and if the authorities comply with these conditions – programs should decrease the likelihood of a currency defense and instead increase the likelihood of devaluation. Even if not formally included as condition, the IMF's advice might achieve the same.

Finally, IMF programs can have an important indirect effect on the outcome of currency crises. In this context it is important to understand that policymakers' political survival tends to be on the line during currency crises: finance ministers and prime ministers are significantly more likely to lose office if they devalue the currency (Cooper 1971; Frankel 2005, Walter 2006). No matter how necessary and beneficial devaluations can be in the long run, they often have very painful short-term consequences. By increasing the price of imports and inflation they have a direct negative effect on consumers (i.e. voters). From a political perspective, devaluations are therefore highly unpopular. In such a setting an IMF program often allows policymakers to shift the blame onto the Fund. By using the Fund as a scapegoat and claiming to be devaluing only because of IMF conditionality, policymakers can simultaneously implement economically sensible policies and ensure their political survival (see Vreeland 1999, Smith and Vreeland

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<sup>7</sup> This is particularly true at times of elections and with partisan governments. See Méon (2001, 2004), Walter (2006), and Walter and Willett (2007).

2003). This indirect effect of IMF programs should therefore decrease the likelihood that the exchange rate will be defended.

To summarize, the condition-, advice-, and the scapegoat-channel suggest that the existence of an IMF program should overall decrease the probability of an exchange rate defense and increase the likelihood that the authorities adjust the exchange rate by responding with devaluation. As the money disbursed by the Fund can be used to defend the exchange rate, however, the money and moral hazard channels suggest a decreased likelihood of devaluation.

### **3. METHOD AND DATA**

We examine how IMF programs, disbursed loans, and compliance with conditionality affect the risk of currency crises and the outcome of such crises. In a first step, we investigate whether countries with previous IMF intervention are more likely to experience currency crises. In a second step, we test for the IMF's impact on a country's decision to adjust the exchange rate, once a crisis occurred. The analysis covers the period 1975-2002 and extends to a maximum of 68 countries.<sup>8</sup> Since some of the data are not available for all countries or periods, the panel data are unbalanced and the number of observations depends on the choice of explanatory variables.

#### 3.1 Data

For the evaluation of crisis risk, our dependent variable is a dummy indicating the occurrence of a currency crisis. This variable is coded following the conventional approach of identifying currency crises as periods of extreme pressure in the foreign exchange market (Eichengreen et al. 1995). Foreign exchange market pressure (EMP) is measured on a monthly basis with a weighted index of exchange rate changes, reserve changes, and changes in the interest rate differential relative to the interest rate in a stable reference country.<sup>9</sup> The rationale for this index is that governments can respond to currency crises either by devaluing or floating their currency, by tightening monetary policy, or by spending foreign reserves. Large values of the EMP index indicate that speculative pressure is high. The data needed for calculating this index is available from the IMF's (2006) International Financial Statistics. To identify crises episodes, we follow

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<sup>8</sup> Country selection is driven by data availability. The countries and years included in this study are listed in Appendix C.

<sup>9</sup> As suggested by Kaminsky et al. (1998), we use either the US Dollar or the Deutsche Mark /the Euro as reference currency. The US dollar is the reference currency for all countries except for the Eastern European countries. For Eastern Europe the Deutsche Mark (until 1998) and the Euro (from 1999 onwards) act as reference currencies.

Eichengreen et al. (1995) and define crises as those periods where the index exceeds the country-specific mean by at least two standard deviations. The monthly data is then aggregated by year. The resulting sample of crises is listed in Appendix C. It includes many well-known crisis events such as the Mexican Peso crisis in December 1994 or the speculative attacks on the Thai baht in 1997.

The dependent variable in the second step of our analysis is the outcome of a currency crisis. We examine whether the government devalued the exchange rate within six months following upon the initial attack. If the exchange rate was not adjusted during the six-month period, it is coded as a successful defense. It then takes the value of one and is zero otherwise.

To determine whether and when countries devalued, we follow the approach suggested in Sattler and Walter (2007) and use a behavioral criterion evaluating exchange rate behavior based on the pre-attack type of the (de facto) exchange rate regime (see Appendix A). This criterion grants flexible and intermediate regimes more policy flexibility than fixed exchange rate regimes. A small depreciation of the exchange rate may be in accordance with the rules of a relatively flexible regime, such as a pre-announced crawling band, but might violate the requirements of a stricter regime, such as a hard exchange rate peg. Our devaluation-criterion therefore grants regimes with little de facto exchange rate flexibility less freedom to depreciate than countries that follow more flexible exchange rate regimes. It takes into account two different criteria: the amount of depreciation in each individual month compared with the previous month and the overall amount of depreciation since the speculative attack with the pre-attack level of the exchange rate. The first month in which either of these criteria indicates devaluation is counted as the month of devaluation. According to this operationalization, governments successfully defended their exchange rate in 45 of all 171 cases. 91 speculative attacks resulted in a devaluation within the month of the attack, while governments initially defended, but subsequently devalued during the following 6 months in response to 20.5 percent of all speculative attacks in the sample.

Since we are mainly interested in the effect of IMF programs on crisis risk and the outcome of currency crises, we use a variety of measures to capture the effects of the various channels of influence discussed above (money, conditionality, advice, and indirect channels such as moral hazard and the Fund's role as a scapegoat). Only one of those channels can be directly measured: IMF loans disbursed (as a percentage of GDP). To proxy the degree of implementation

of conditionality,<sup>10</sup> we use a dummy that is one when at most 25 percent of the amount agreed under an IMF arrangement remained undrawn at program expiration and zero otherwise.<sup>11</sup> While this is an admittedly crude measure, other available measures suffer from even greater problems. For example, the IMF provides data on the implementation of performance criteria and structural benchmarks that have been implemented under its programs in its database on Monitoring Fund Arrangements (MONA). However, as discussed above, since only those programs are included in the database which have been reviewed by the Executive Board, programs that are interrupted or permanently cancelled will not be covered. This is likely to overstate compliance. As another problem, these data do not take the importance of conditions into account. If the borrower implements many minor conditions but fails to implement the important ones, compliance might nevertheless be classified as being high. Finally, the database does not cover a sufficient number of years to allow longer-term economic analysis (Bird and Willett 2004).<sup>12</sup>

Advice, moral hazard effects<sup>13</sup> and the scapegoat-channel cannot be tested directly. Even though in principle the amount of IMF credit a country receives could also proxy the direct effect of advice on policies and the extent of moral hazard, advice, moral hazard, and credit volumes are probably not proportional. The existence of an arrangement might be a better measure for advice than the flow of money (Boockmann and Dreher 2003, Dreher and Rupperecht 2007). We thus use a dummy variable that records whether a country had any kind of IMF program during the last five years. We consider four types of programs: Stand-By-Arrangements (SBA), Extended Fund Facility (EFF), the Structural Adjustment Facility (SAF), and the Poverty Reduction and Growth Facility (PRGF).<sup>14</sup> Controlling for the amount of credit and compliance with conditionality, the

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<sup>10</sup> One would also like to control for the degree of conditionality. Dreher (2004a) and Dreher and Vaubel (2004b) used the number of conditions included in the IMF program as proxy. Stone (2006) focuses on the scope of IMF conditions. However, those data are not available for a sufficient number of years and can therefore not be used here.

<sup>11</sup> This follows Killick (1995), Dreher (2003), and Dreher (2006), among others.

<sup>12</sup> We tried to replicate the analysis using an indicator based on the Fund's MONA data as test for robustness. However, due to missing data the number of observations is reduced to 20.

<sup>13</sup> In their study of fiscal and monetary policy Dreher and Vaubel (2004a) used a country's undrawn quota with the Fund to test for moral hazard. However, as Conway (2006) points out, this variable could equally well be interpreted as a measure of the degree of implementation of IMF programs within the country. We therefore do not use this variable here.

<sup>14</sup> Prior to 1999, the PRGF was labeled Enhanced Structural Adjustment Facility.

dummy for existing IMF programs would in part capture the combined effect of advice, moral hazard, and the scapegoat-function.

In order to analyze the effect of the IMF on the occurrence of a currency crisis, we focus on the previous five years, because the economic reforms induced by an IMF program might need some time to strengthen the macroeconomic situation enough to prevent crisis. We therefore investigate whether the existence of an IMF program in the previous five years affects the probability of a crisis. Clearly, the analysis should cover only those arrangements that were in effect over much of the year in question. Only those years are thus coded as program years where an arrangement has been active over at least five months in a given calendar year.<sup>15</sup> Compliance is also measured with a dummy variable, which is coded as 1 if the country was compliant with its IMF program in the previous five years, where non-compliance is recorded if more than 25 percent of the amount agreed for an IMF program remains undrawn at program termination. The amount of IMF credit is operationalized as the sum of net financial flows in the previous 5 years for all IMF program types in percent of GDP.

Regarding the government's decision to devalue, we use the same variables but employ contemporaneous values.

We employ two sets of control variables. Regarding the probability of experiencing a crisis, we use economic and political variables that have been suggested in the literature as predictors of currency crises (e.g. Kaminsky et al. 1998, Leblang 2002). These variables include the interest rate differential, the level of foreign reserves, export share, the de jure exchange rate regime, and capital account openness. We also included the following variables in some estimations: Inflation, current account deficit, domestic credit/M2, the budget deficit, per capita GDP and an election dummy. Except for capital account openness, all these variables were lagged by one year. A detailed description of these variables can be found in Appendix A. Appendix B provides summary statistics. Turning to the government's decision to devalue, the explanatory variables include inflation, foreign currency reserves relative to money, GDP growth, export growth, and a lagged election dummy. Inflation is included to proxy for the causal mechanism underlying first-generation models, which predict that bad economic fundamentals will inevitably lead to a devaluation as outcome of currency crises (Krugman 1979). International

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<sup>15</sup> Over the period of study, 149 country-years have been at least five months under an IMF Stand-By program, 59 under an EFF arrangement, 27 under an SAF-arrangement, and 79 under a PRGF program.



reserves measure a country's technical ability to defend the exchange rate.<sup>16</sup> Second generation models focus more on the current economic situation (Obstfeld 1994). We therefore include GDP growth to control for the state of the domestic economy. The size of the export sector and the election dummy control for political factors. Since export-oriented firms tend to prefer more depreciated exchange rates (Frieden 1991), the authorities in more export-oriented countries tend to face politically powerful demands for a downward adjustment of the exchange rate, making an exchange rate defense less likely. Devaluations tend to be unpopular with voters, however, so that exchange rate adjustments tend to be less likely when elections are pending (Walter 2006).

### 3.2 Method

As our dependent variable is binary, we estimate the first stage model employing conditional fixed effects Logit.

In case of binary choice variables with panel data we observe:

$$\begin{aligned} y_{it} &= 1 \quad \text{if} \quad y_{it}^* > 0 \\ y_{it} &= 0 \quad \text{if} \quad y_{it}^* \leq 0 \end{aligned} \quad (1)$$

where:  $y_{it}^* = x'_{it} \beta + \alpha_i + v_{it}$ . This function can be interpreted as the probability to experience a crisis, which is dependent on observed variables ( $x$ ), unobserved individual (country) characteristics ( $\alpha$ ) and a random error term ( $v$ ). The probability that we observe a crisis is:

$$P(y_{it} = 1) = P(y_{it}^* > 0) = P(v_{it} > -x'_{it} \beta - \alpha_i) = F(x'_{it} \beta + \alpha_i) \quad (2)$$

In a fixed effects context, the number of parameters increases with the number of countries. This is known as the incidental parameters problem. Chamberlain (1980) shows that it is impossible to estimate the parameters of this binary choice model consistently and he therefore proposes a method to circumvent this problem, i.e. conditional Logit estimation. The idea of this approach is to condition the likelihood function on a minimal sufficient statistic for the fixed effects.

Chamberlain argues that  $\sum_{t=1}^T y_{it}$  is such a minimum sufficient statistic. The conditional likelihood function can now be written as:

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<sup>16</sup> Following Leblang(2003) we include international international reserves over money.

$$L = \prod_{i=1}^N P(y_{i1}, \dots, y_{iT} \mid \sum_{i=t}^T y_{it}) \quad (3)$$

The probability of experiencing a crisis no longer depends on the fixed effects (by construction) and hence the coefficients of the variables of interest can be estimated consistently. In essence, the conditional fixed effects Logit estimator compares all observations within a given country when there is a crisis with all the observations when there is none. We also include a dummy for each year, as these proved to be jointly significant at the one percent level.

When estimating the regressions with Logit, however, there might be a problem with the potential endogeneity of the IMF variables. Obviously, IMF programs are usually concluded in times of economic crises, and involvement becomes more likely, the more severe the crisis. The effect reported for the program variable might thus not reflect the consequences of the program itself but those of the severity of the underlying crisis. In other words, there might be a selection problem.<sup>17</sup>

An additional source of potential bias arises in the second step of our analysis. When analyzing the effect of the IMF on governments' behavior once experiencing a crisis, we thus have to account for sample selection again.

There are various methods to deal with these selection problems, and the literature on the IMF is rich on applications. Most studies pursue either some variant of Heckman's (1979) estimator or an instrumental variables approach; recently the method of matching has also been applied.<sup>18</sup> All three of those approaches have their benefits, but also imply drawbacks. Estimating the participation equation and then including the inverse Mills ratio, as suggested by Heckman (1979), depends implicitly on auxiliary restrictions such as assumptions about the distribution of error terms (Barro and Lee 2005) and the 'correct' specification of the participation equation. The challenge with the instrumental variables approach, clearly, is in finding variables that affect the

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<sup>17</sup> Vreeland (2003) provides an extensive discussion of the selection problem in the context of IMF programs. For a detailed representation of the underlying formula, see Goldstein and Montiel (1986) or Atoyán and Conway (2006).

<sup>18</sup> With respect to the IMF and economic growth, the Heckman methodology has been employed, among others, by Przeworski and Vreeland (2000). Hardoy (2003) uses 'matching' as preferred choice, while Atoyán and Conway (2006) compare results derived with the method of matching with those from employing the IV estimator. Barro and Lee (2005), Easterly (2005), and Nsouli, Mourmouras and Atoyán (2005) apply an instrumental variables approach. The latter approach seems to be the most popular in estimating the impact of the IMF on economic and political variables (a selection of recent papers is Marchesi 2003, Li 2003, Jensen 2004, and Dreher and Vaubel 2004b).

probability of program participation but do not affect crisis risk other than through their impact on participation. The problem of finding the correct variables is even more severe with respect to the matching approach, where matching of “treatment” and “control” groups would only result in unbiased estimates, when the decision to enter IMF programs could be accounted for by the matching procedure (see Przeworski and Limongi 1996).

Our first stage analysis investigates the determinants of experiencing a crisis. We use this model to calculate the inverse Mills ratio, and control for sample selection bias in the second stage. Investigating the impact of the IMF, we pursue two strategies. First, there are instruments available for participation in IMF programs. The recent empirical literature on political influences on the Fund shows that developing countries get better terms from the IMF, when they have closer ties with the Fund’s most important shareholders, as measured by their voting behavior in the UN General Assembly (Thacker 1999, Stone 2002, Barro and Lee 2005, Dreher and Jensen 2007).<sup>19</sup> Arguably, UN General Assembly voting is uncorrelated with the decision to devalue the exchange rate, providing a natural instrument. We follow Barro and Lee (2005) and employ the fraction of times a country votes the same as the country of interest (either both voting yes, both voting no, both voting abstentions, or both being absent). Of course, it could be argued that UN voting captures the moral hazard-propensity of borrowers because countries and speculators can gauge whether or not they will be bailed out in the event of a crisis, thus making them invalid as instruments. However, testing for the exogeneity of UN voting shows countries’ voting behavior to be a valid instrument for IMF loans. The overidentifying restrictions are not rejected at conventional levels of significance. When included to the outcome (second stage) regression, the voting variables are jointly completely insignificant ( $\text{Prob} > \chi^2 = 0.89$ ).

As our second approach to deal with the potential endogeneity of the explanatory variables, we employ the system GMM estimator as suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The dynamic panel GMM estimator exploits an assumption about the initial conditions to obtain moment conditions that remain informative even for persistent data. It is considered most appropriate in the presence of endogenous regressors. Results are based on the two-step estimator implemented by Roodman (2005) in Stata, including Windmeijer’s (2005) finite sample correction. We apply the Sargan-Hansen test on the validity of the instruments used (amounting to a test for the exogeneity of the

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<sup>19</sup> See Reynaud and Vauday (2007) for a recent discussion of geopolitical involvement in the Fund.

covariates) and the Arellano-Bond test of second order autocorrelation, which must be absent from the data in order for the estimator to be consistent. We treat the lagged dependent variable as endogenous and all other variables as predetermined. As before, we include time dummies in the regression. In order to minimize the number of instruments in the regressions we collapse the matrix of instruments as suggested in Roodman (2006).<sup>20</sup> As Janvry et al. (2006) and Hyslop (1999) argue, such linear probability models are more tractable and flexible in the handling of unobserved heterogeneity than linear probability models are. To anticipate the results, the Sargan-Hansen test and the Arellano-Bond test do not reject these specifications at conventional levels of significance.

When analyzing whether or not governments devalue the exchange rate, the analysis only includes countries already experiencing a crisis. We therefore can not include fixed country effects and estimate random effects Logit and Probit models instead of the conditional fixed effects Logit. In the second stage model, dummies for each year are not significant at conventional levels, so we exclude them from the Logit and Probit regressions. The GMM regressions still include them, following Roodman (2006).

The next section reports the results.

#### 4. Results

Table 1 reports the effects of IMF involvement in the previous five years on the occurrence of a currency crisis. Columns 1 and 2 include a dummy for the existence of an IMF arrangement over the previous five-year-period. Column 1 reports the results of the full model, while column 2 excludes all control variables that are not statistically significant at the ten percent level at least.<sup>21</sup> As can be seen, crises become more likely with higher money supply relative to international reserves and lower exports relative to GDP, at least at the five percent level of significance. This is in line with first-generation crisis models (Krugman 1979), which predict that worsening fundamentals will drain foreign reserves and lead to speculative attacks. Countries with more flexible de jure exchange rate regimes are more likely to experience a crisis, with coefficients

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<sup>20</sup> It is necessary to limit the number of instruments because the power of the Sargan-Hansen test is low when many instruments are used (see Bowsher 2002).

<sup>21</sup> We also tested whether past crises affect current crises and included the lagged dependent variable. The coefficient of the lagged dependent variable is completely insignificant while the impact of IMF programs is significant at the one percent level.

statistically significant at the one percent level. A possible explanation for this finding is that many countries that officially declare to follow a flexible exchange rate regime in fact intervene heavily and thus have de facto intermediate exchange rate regimes (Reinhart and Rogoff 2004). Since such intermediate regimes tend to be particularly crisis-prone (Obstfeld and Rogoff 1995, Angkinand et al. forthcoming), the positive coefficient is probably evidence for the unstable middle-hypothesis. Restricted capital accounts also make countries more crisis-prone, at the one percent level of significance. The interest rate differential is marginally insignificant according to column 1 and completely insignificant once the additional insignificant variables are excluded (column 2).

Turning to our variable of main interest, the results show that crises become significantly less likely with the existence of an IMF program in the previous five years. This effect is significant both in substantive and statistical terms. IMF programs reduce crisis risk by about 0.20 percentage points (when the marginal effect is calculated at the mean of the independent variables and assuming the fixed effects are zero), and the effect is statistically significant at the five percent level. This implies that overall, the effect of IMF programs is positive. As discussed above, however, different aspects of IMF involvement can have opposing effects. In a next step we therefore disaggregate the overall effect of IMF programs into the individual effects of the different channels through which IMF programs can affect the likelihood of crisis. To test for the effect of conditionality, we include average compliance with IMF conditions. The effect of increased funds is tested by including average IMF loans (in percent of GDP) over the previous five-year-period. When included instead of the program dummy in columns 3 and 4, both of them show a negative coefficient, but only compliance is statistically significant (at the ten percent level). Including the three IMF variables jointly and thus making the effect of conditions and money conditional on the existence of an IMF program (column 5), shows that none of the three IMF variables is statistically significant at conventional levels, probably due to the high correlation between these variables.<sup>22</sup>

Column 6, finally, addresses the potential endogeneity problems related to IMF programs. It replicates the analysis employing the system GMM estimator instead of conditional Logit. Note that the Arellano-Bond test and the Sargan-Hansen test do not reject the specification at

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<sup>22</sup> Correlation of programs with compliance is 0.64; with loans only 0.12. Correlation between loans and compliance is 0.04.

conventional levels of significance. While the results for the covariates change substantially, we obtain a negative effect of IMF programs on crisis risk, at the ten percent level of significance, while compliance and loans are not statistically significant at conventional levels. The results show that the existence of an IMF program over the previous five years reduces the probability of currency crises by about 0.1 percentage points.

Overall, our results thus point to the importance of the existence of IMF programs per se, rather than those of IMF money or compliance with conditionality. In light of our theoretical arguments above, it therefore seems that the more indirect channels such as IMF advice and its ‘seal of approval,’ as well as its function as a scapegoat is more valuable than its money and conditions. Overall, the result also suggests that these positive indirect effects outweigh the potential negative effect of IMF programs in terms of moral hazard.

Table 2 turns to the impact of IMF involvement on exchange rate devaluation. As our sample includes only those countries that actually experience a crisis, the number of observations is reduced to a maximum of 148. Column 1 reports results estimated with random effects Logit, while column 2 uses Probit instead. The results are fairly similar. Consistent with first-generation models of currency crises, which predict that bad fundamentals will lead to speculative attacks that inevitably result in a devaluation (Krugman 1979), higher rates of inflation (as a proxy for the quality of a country’s macroeconomic fundamentals) increase the probability that the exchange rate will be devalued in response to a crisis, with a coefficient significant at the ten percent level according to both estimates. Again significant at the ten percent level, the results also show that lower GDP growth increases the likelihood of an exchange rate adjustment. This is in line with predictions from second-generation models (Obstfeld 1994, 1996) that the authorities are less willing to defend the exchange rate when the economy is in recession and the trade-off between exchange rate stability and growth and employment is high. Elections in the previous year increase the likelihood of a defense, at the ten and, respectively, five percent level of significance. The positive coefficient of the post election dummy contradicts the results in Walter (2006) but is in line with Leblang (2003). Replacing the post-election dummy with a dummy for contemporaneous elections shows the expected negative coefficient, at the five percent level of significance. Exports as a share of GDP and foreign reserves relative to money do not significantly affect the probability of defense.

Most importantly, however, the coefficient of the IMF program dummy is consistently negative and is statistically significant at the ten percent level at least. Countries with an IMF

program in place in the crisis year are more likely to adjust their exchange rate in response to speculative pressure. According to the marginal effect, an IMF program reduces the likelihood of defense by between 0.11 (Logit) and 0.12 (Probit) percentage points, an effect that is significant at the ten percent level. Overall, the IMF thus seems to succeed in encouraging countries in adjusting their exchange rate when faced with speculative pressure.

Since currency crises are no random events, these results might suffer from selection bias. To correct for the potential selection problem, we include the inverse Mills ratio (calculated from the selection equation shown in column 2 of Table 1) to our specification. Column 3 shows that the results remain unchanged, while the inverse Mills ratio itself is not significant at conventional levels.

To account for the potential endogeneity of contemporaneous IMF programs, we re-estimate our results employing instrumental variables Probit (with standard errors clustered at the country level, column 4). As described above, a countries' voting behavior in the UN General Assembly is used as instrument. Column 4 shows that our results hold when we instrument for IMF programs. The existence of IMF programs increases the probability of an exchange rate adjustment at the ten percent level of significance. The corresponding marginal effect shows that the effect of IMF programs amounts to about 0.32 percentage points – and is thus substantially stronger as compared to the results reported above. This result remains when the inverse Mills ratio is included to the regression (column 5). As an alternative correction to the potential endogeneity of IMF programs, column 6 replicates the analysis employing the system GMM estimator for comparison. While the results for the covariates again differ to some extent as compared to the previous estimates, the impact of the IMF is significant at the five percent level. The negative coefficient suggests that countries with IMF programs are more likely to adjust their exchange rate in response to crisis.

To break down the overall adjustment-enhancing effect of IMF programs into the different channels discussed above, columns 7-8 replicate the analysis including the amount of IMF loans disbursed and compliance with conditionality in addition to the IMF program dummy. As in the regressions on crisis risk, IMF programs as such remain statistically significant (at the ten percent level at least) and negative, while the coefficients for loans and compliance are not significant at conventional levels. This implies that, as above, it is the overall effect of programs rather than the individual effects of money and compliance that drive the results. To some extent – holding disbursed money and compliance with conditions constant – the program dummy can

be interpreted as proxy for the IMF's advice and scapegoating function. This implies that IMF involvement can indeed facilitate exchange rate adjustments by advising policymakers to adjust and allowing them to shift the political blame for this decision onto the IMF. The results are much in line with Dreher (2005), showing IMF programs to improve fiscal and monetary policy, while money disbursed and the degree to which programs are completed have no significant impact on policies. This suggests that IMF programs have important indirect effects that go far beyond the Fund's conventional tools in terms of money and conditions.

### **5. Extensions and tests for robustness**

Table 3 tests for the robustness of our results regarding the definition of defense. Instead of the dummy employed above, we measure both whether and how long the exchange rate was defended against speculative pressure. Following Sattler and Walter (2007), we count how many months the authorities kept the exchange rate stable after it was first attacked. If the exchange rate was not adjusted during a thirteen-month period, it is coded as a successful defense. The dependent variable thus takes values between 1 to 13, where 1 represents a case in which the exchange rate was devalued in the month in which it was attacked. A value of 13 represents cases in which the exchange rate was defended for at least thirteen months after the onset of speculative pressure. The model is estimated with the random effects Negative Binomial estimator. Column 1 treats IMF programs as exogenous. Column 2 adds the inverse Mills ratio, accounting for selection into the crisis. Columns 3 and 4 replicate the analysis but instrument IMF programs with the voting variables.

Table 3 confirms the previous finding that IMF involvement facilitates exchange rate adjustment. While the impact of IMF programs is marginally insignificant according to column 1 they reduce the time the country defends its exchange rate at the ten percent level of significance when the inverse Mills ratio is included. However, the Mills ratio itself is also statistically significant at the ten percent level. We therefore replicated the analysis bootstrapping the standard errors (with 200 replications). The results are unchanged.

Instrumenting for IMF programs, columns 3 and 4 show a similar picture. At the five and, respectively, ten percent level of significance IMF programs reduce the time a country defends. Calculating the marginal effect for the final model, the results show that the existence of an IMF program reduces the time the country defends its exchange rate by almost three months.



Compliance with conditionality and the amount of IMF loans disbursed are again not significant in any model.

Table 4 tests whether excluding industrial countries from the analysis affects the results. While industrial countries turned to the Fund until the late 70s,<sup>23</sup> it might be argued that the effect of the IMF on policies is different in such countries. As can be seen, however, our results are much in line with those reported previously. IMF programs increase the probability of devaluation at the one percent level of significance (taking account of the potential endogeneity of programs).

In Table 5 we separately analyze the impact of concessional as compared to unconcessional programs on devaluations. Columns 1-4 show that the impact of unconcessional programs is marginally insignificant, while concessional programs are significant at the five and, respectively, one percent level of significance. The coefficients, however, are very similar across the different models.<sup>24</sup>

## 6. CONCLUSION

This paper has examined how IMF programs affect the risk of currency crises and the outcome of such crises. This is an important question, as the preservation of stability in the global financial system constitutes one of the Fund's prime functions. To evaluate whether the Fund fulfils this function in the context of speculative pressure in international currency markets, we used panel data for 68 countries over the period 1975-2002 and investigated whether countries with previous IMF intervention are more likely to experience currency crises and how IMF programs impact on a country's decision to adjust the exchange rate once a crisis occurred.

Our results suggest that the IMF – contrary to the Fund's critics – does indeed fulfill its functions of promoting exchange rate stability and helping its members to correct macroeconomic imbalances. The existence of an IMF program significantly decreases the risk of a currency crisis and increases the likelihood that the exchange rate will be adjusted once a crisis is underway. Most interestingly, in both cases the existence of an IMF program drives this result, rather than money in terms of disbursed loans or compliance with conditionality. This suggests

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<sup>23</sup> Italy's latest Standby-arrangement, e.g., ended in 1978; the UK had an arrangement in effect over the years 1977-79.

<sup>24</sup> We also separated IMF programs in those programs that were concluded before the onset of the crisis and those that started after the emergence of the crisis. Both coefficients are not significant at conventional levels.

that the more indirect aspects of IMF programs, such as IMF advice, its function as a “seal of approval” and its ability to reduce the political costs of implementing unpopular policies are much more relevant than the amount of money the IMF places at countries’ disposal or countries’ compliance with IMF conditions.

This has implications for the design of conditionality. Whether or not the IMF should impose conditions on sovereign countries has been highly debated from the very beginning of the IMF’s operations. The empirical results of this paper have shown that compliance with conditionality does not have a statistically significant effect on currency crisis risk or the government’s decision to devalue its currency. This finding complements other studies, which have shown that the Funds’ conditions do not (or only marginally) affect economic policies and outcomes (Dreher and Vaubel 2004b, Dreher 2005, 2006). One interpretation of these result is that conditions imposed by outside actors can be circumvented, even if the officially agreed criteria have been met. In order to lend more effectively, it would therefore be most important for the IMF to detect factors influencing ownership and thus the willingness to reform. Arguably, if the IMF would support reform-minded governments, its loans might make a difference (even if its advice might not) by helping governments to implement these reforms against political opposition (by acting as the scapegoat for unpopular policies) and by giving a “seal of approval” to these governments. The results also allow a different interpretation. According to the IMF, conditions are the outcome of a bargaining process between the government and Fund. They might therefore reflect the government’s agenda instead of being imposed by the IMF. As a consequence, compliance with conditionality does not make a difference with respect to economic policy, because the same policies would have been implemented without the Fund’s conditions. Whatever the underlying causal mechanism, conditionality would not be necessary.

In terms of policy advice, our results therefore suggest that the IMF’s surveillance and technical assistance might be more important than its lending and conditionality. Placing greater emphasis on the former might thus well be worthwhile.<sup>25</sup> To some extent this is in line with the route recently chosen.

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<sup>25</sup> See Fratzscher and Reynaud (2007) for an interesting discussion for the politics involved in IMF surveillance.

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**Table 1: IMF involvement and currency crises, 1976-2000**

	(1)	(2)	(3)	(4)	(5)	(6)
IMF program in previous 5 years	-0.81 (1.97)**	-0.81 (2.37)**			-0.836 (1.46)	-0.10 (1.73)*
Compliant with IMF program, 5 years			-0.75 (1.80)*		-0.402 (0.74)	0.002 (0.03)
IMF loans (percent of GDP), 5 years				-0.20 (1.49)	-0.055 (0.32)	-0.004 (0.31)
Interest Rate differential (t-1)	0.00 (1.61)	0.00 (0.12)	0.00 (0.12)	0.01 (1.31)	0.016 (0.89)	0.01 (2.73)***
Reserves/M2 (t-1)	-0.54 (2.57)**	-0.53 (2.71)***	-0.59 (2.95)***	-0.60 (2.69)***	-0.558 (2.36)**	0.004 (0.23)
Exports/GDP (t-1)	-5.37 (2.59)***	-6.10 (3.41)***	-8.00 (3.93)***	-5.97 (3.06)***	-7.628 (3.43)***	0.15 (1.32)
Flexible exchange Rate Regime (t-1)	0.14 (3.04)***	0.13 (3.04)***	0.13 (2.69)***	0.13 (2.85)***	0.153 (2.63)***	-0.004 (0.78)
Capital Account Openness	-0.60 (3.38)***	-0.61 (3.68)***	-0.52 (2.94)***	-0.32 (1.77)*	-0.265 (1.28)	-0.01 (0.71)
Inflation (t-1)	0.00					
	-0.35					
Current Account/GDP (t-1)	0.49					
	-0.22					
Domestic Credit/M2 (t-1)	0.10					
	-1.08					
Budget Deficit/GDP (t-1)	-3.19					
	-1.23					
(log) GDP p.c. (t-1)	0.38					
	-0.86					
Election, dummy (t-1)	0.17					
	-0.59					
Lagged dependent variable						-0.03 (0.33)
Observations	759	868	769	695	602	607
Number of countries	50	53	50	46	43	59
Method	Logit	Logit	Logit	Logit	Logit	GMM
Fixed country effects	Yes	Yes	Yes	Yes	Yes	No
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes
log likelihood	-203.08	-233.93	-195.42	-199	-159.38	
Prob > chi2	0.00	0.00	0.00	0.00	0.00	
Arellano-Bond-Test (p-level)						0.55
Sargan Test (p-level)						0.16

## Notes:

The dependent variable is one when at least one speculative attack occurred in a certain year, and zero otherwise.

Absolute value of z statistics in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%



Table 2: IMF involvement and defense, 1976-2001

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IMF program	-1.048 (2.00)**	-0.555 (1.96)*	-0.594 (1.93)*	-1.498 (1.92)*	-1.691 (2.12)**	-0.171 (2.45)**	-0.560 (1.90)*	-1.630 (2.41)**	-0.157 (2.42)**
Compliant with IMF program									
IMF loans (percent of GDP)									
Inflation (t-1)	-0.042 (1.85)*	-0.021 (1.78)*	-0.023 (1.75)*	-0.019 (1.87)*	-0.019 (1.61)	-0.000 (0.73)	-0.022 (1.82)*	-0.019 (2.00)**	-0.000 (0.73)
GDP growth (t-1)	3.563 (1.71)*	1.833 (1.65)*	2.045 (1.67)*	1.587 (1.78)*	1.634 (1.54)	0.018 (0.38)	1.925 (1.69)*	1.634 (1.91)*	0.019 (0.41)
Exports/GDP (t-1)	-0.055 (0.05)	-0.010 (0.01)	-0.816 (0.78)	-0.490 (0.77)	-1.247 (1.83)*	0.007 (0.04)	-0.052 (0.08)	-0.552 (1.04)	0.021 (0.13)
Reserves/M2 (t-1)	-0.313 (1.16)	-0.186 (1.25)	-0.172 (1.11)	-0.174 (1.39)	-0.190 (1.63)	-0.027 (1.45)	-0.183 (1.23)	-0.158 (1.26)	-0.026 (1.32)
Election, dummy (t-1)	0.882 (1.84)*	0.489 (1.71)*	0.507 (1.60)	0.397 (1.33)	0.355 (1.04)	0.049 (0.51)	0.523 (1.80)*	0.384 (1.27)	0.065 (0.85)
Inverse Mills Ratio			0.181 (0.97)		0.179 (1.28)				
Lagged dependent variable						0.032 (0.20)			0.084 (0.79)
Observations	148	148	133	147	132	148	148	147	148
Number of countries	63	63	55	63	55	63	63	63	63
Method	Logit	Probit	Probit	IV Probit	IV Probit	GMM	Probit	IV Probit	GMM
Fixed country/ time effects	No	No	No	No	No	time	No	No	time
log likelihood	-72.41	-72.85	-64.09	-160.97	-142.34		-72.53	-154.63	
Prob > chi2	0.08	0.06	0.11	0.06	0.01		0.13	0.01	
Arellano-Bond-Test (p-level)						0.49			0.42
Sargan Test (p-level)						0.45			0.49

Notes:

The dependent variable is zero if the exchange rate was devalued within the 6 months following the first months of a speculative attack, and one otherwise. Absolute value of z statistics in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 3: IMF involvement and months of defense, 1976-2001**

	(1)	(2)	(3)	(4)
IMF program	-0.280 (1.54)	-0.319 (1.67)*	-1.050 (2.03)**	-0.700 (1.84)*
Compliant with IMF program	-0.011 (0.04)	0.102 (0.34)	-0.166 (0.57)	-0.117 (0.38)
IMF loans (percent of GDP)	0.009 (0.09)	-0.002 (0.01)	0.017 (0.16)	0.016 (0.09)
Inflation (t-1)	-0.001 (0.46)	-0.001 (0.49)	-0.002 (1.35)	0.000 (0.36)
GDP growth (t-1)	0.036 (0.29)	0.044 (0.35)	0.140 (1.04)	-0.154 (0.91)
Exports/GDP (t-1)	0.229 (0.54)	-0.694 (1.01)	0.047 (0.11)	-0.957 (1.32)
Reserves/M2 (t-1)	-0.023 (0.31)	-0.006 (0.07)	0.017 (0.22)	0.070 (0.76)
Election, dummy (t-1)	0.180 (0.96)	0.215 (1.06)	0.113 (0.59)	0.089 (0.41)
Inverse Mills Ratio		0.207 (1.67)*		0.183 (1.48)
Observations	148	133	147	132
Number of countries	63	55	63	55
Method	NB	NB	IV NB	IV NB
Fixed country/ time effects	No	No	No	No
log likelihood	-365.40	-327.52	-363.01	-325.75
Prob > chi2	0.79	0.62	0.58	0.56

Notes:

The dependent variable counts how many months the authorities kept the exchange rate stable after it was first attacked. If the exchange rate was not adjusted during a thirteen-month period, it is coded as a successful defense. The dependent variable takes values between 1 to 13, where 1 represents a case in which the exchange rate was devalued in the month in which it was attacked. A value of 13 represents cases in which the exchange rate was defended for at least thirteen months after the onset of speculative pressure.

Absolute value of z statistics in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 4: IMF involvement and defense, without industrial countries, 1976-2001**

	(1)	(2)	(3)	(4)
IMF program	-0.891 (1.64)	-0.991 (1.69)*	-1.652 (2.94)***	-1.901 (3.74)***
Compliant with IMF program	-0.069 (0.08)	0.208 (0.24)	0.242 (0.55)	0.406 (0.89)
IMF loans (percent of GDP)	0.404 (0.93)	0.304 (0.61)	0.288 (0.97)	0.233 (0.70)
Inflation (t-1)	-0.044 (1.96)*	-0.046 (1.82)*	-0.020 (2.25)**	-0.017 (1.76)*
GDP growth (t-1)	3.871 (1.86)*	4.083 (1.76)*	1.713 (2.16)**	1.471 (1.68)*
Exports/GDP (t-1)	-0.225 (0.20)	-1.605 (0.87)	-0.694 (1.47)	-1.443 (2.34)**
Reserves/M2 (t-1)	-0.280 (1.10)	-0.247 (0.96)	-0.140 (1.18)	-0.156 (1.45)
Election, dummy (t-1)	0.334 (0.60)	0.155 (0.24)	0.132 (0.49)	0.010 (0.03)
Inverse Mills Ratio		0.294 (0.89)		0.173 (1.22)
Observations	137	123	136	122
Number of countries	59	51	59	51
Method	Probit	Probit	IV Probit	IV Probit
Fixed country/ time effects	No	No	No	No
log likelihood	-64.85	-56.31	-142.79	-125.98
Prob > chi2	0.41	0.53	0.00	0.00

Notes:

The dependent variable is zero if the exchange rate was devalued within the 6 months following the first months of a speculative attack, and one otherwise.

Absolute value of z statistics in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 5: IMF involvement and defense, 1976-2001, concessional vs. unconcessional**

	(1)	(2)	(3)	(4)
IMF program, unconcessional	-1.841 (1.23)	-1.998 (1.47)		
Compliant, unconcessional		-0.110 (0.22)		
IMF loans, unconcessional		-0.068 (0.41)		
IMF program, concessional			-1.830 (2.01)**	-2.010 (2.64)***
Compliant, concessional				<sup>a</sup> .
IMF loans, concessional				-0.079 (0.26)
Inflation (t-1)	-0.024 (2.29)**	-0.023 (2.31)**	-0.015 (1.41)	-0.015 (1.37)
GDP growth (t-1)	2.036 (2.23)**	1.976 (2.26)**	1.263 (1.32)	1.197 (1.29)
Exports/GDP (t-1)	-0.422 (0.63)	-0.521 (0.86)	-0.176 (0.33)	-0.231 (0.47)
Reserves/M2 (t-1)	-0.095 (0.60)	-0.088 (0.57)	-0.252 (2.44)**	-0.245 (2.48)**
Election, dummy (t-1)	0.404 (1.15)	0.383 (1.09)	0.423 (1.44)	0.350 (1.18)
Observations	147	147	147	145
Number of countries	63	63	63	63
Method	IV Probit	IV Probit	IV Probit	IV Probit
Fixed country/ time effects	No	No	No	No
log likelihood	-92.75	-88.76	-151.96	-147.84
Prob > chi2	0.11	0.12	0.00	0.00

Notes:

<sup>a</sup> Variable shows no variation and is dropped from the regression.

The dependent variable is zero if the exchange rate was devalued within the 6 months following the first months of a speculative attack, and one otherwise.

Absolute value of z statistics in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

## Appendix A: Definitions and data sources

<b>Dependent Variables:</b>																																														
Currency Crisis-Dummy (Crisis=1)	<p>Currency crisis episodes are identified based on a monthly weighted exchange market pressure index of exchange rate changes, reserve changes, and changes in the interest rate differential (Eichengreen et al. 1995). When at least one speculative attack occurred in a given year, the variable is coded as 1. The data were aggregated from a monthly to a yearly level, based on STATA code developed by Sattler and Walter (2007).</p> <p>Source: IMF (2006):</p> <ul style="list-style-type: none"> <li>- exchange rate (IFS line rf)</li> <li>- level of foreign reserves (IFS line 1ld)</li> <li>- For interest rates we use (short-term) money market rates (IFS line 60b) as first choice and discount rates (IFS line 60) as second choice if money market rates are not available.</li> </ul>																																													
Crisis Outcome-Dummy (Defense=1)	<p>Dummy variable that is coded as 1 if the exchange rate (IFS line rf) was devalued within 6 months following the month of the first speculative attack. The devaluation criterion is based on the pre-attack type of a country's de facto exchange rate regime.</p> <p>Devaluation criteria according to Sattler and Walter (2006), based on the de facto exchange rate regime type (Reinhart and Rogoff 2004):</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th colspan="2">Coded as devaluation if...</th> </tr> <tr> <th></th> <th>... monthly depreciation exceeds</th> <th>... overall depreciation exceeds</th> </tr> </thead> <tbody> <tr> <td>Preannounced Peg (RR 2)</td> <td>1%</td> <td>1%</td> </tr> <tr> <td>Preannounced Horizontal Band (RR 3)</td> <td>2%</td> <td>2%</td> </tr> <tr> <td>De Facto Peg (RR 4)</td> <td>2%</td> <td>2%</td> </tr> <tr> <td>Preannounced Crawling Peg (RR 5)</td> <td>2.5%</td> <td>5%</td> </tr> <tr> <td>Preannounced Crawling Band (RR 6)</td> <td>2.5%</td> <td>5%</td> </tr> <tr> <td>De Facto Crawling Peg (RR 7)</td> <td>4%</td> <td>8%</td> </tr> <tr> <td>De Facto Crawling Band (RR 8)</td> <td>4%</td> <td>8%</td> </tr> <tr> <td>Preannounced Crawling Band (5%) (RR 9)</td> <td>5%</td> <td>10%</td> </tr> <tr> <td>De facto crawling band (5%) (RR 10)</td> <td>5%</td> <td>10%</td> </tr> <tr> <td>noncrawling band (2%) (RR 11)</td> <td>5%</td> <td>10%</td> </tr> <tr> <td>Managed float (RR 12)</td> <td>10%</td> <td>20%</td> </tr> <tr> <td>Free Float (RR13)</td> <td>20%</td> <td>25%</td> </tr> <tr> <td>Freely Falling (RR14)</td> <td>25%</td> <td>25%</td> </tr> </tbody> </table>		Coded as devaluation if...			... monthly depreciation exceeds	... overall depreciation exceeds	Preannounced Peg (RR 2)	1%	1%	Preannounced Horizontal Band (RR 3)	2%	2%	De Facto Peg (RR 4)	2%	2%	Preannounced Crawling Peg (RR 5)	2.5%	5%	Preannounced Crawling Band (RR 6)	2.5%	5%	De Facto Crawling Peg (RR 7)	4%	8%	De Facto Crawling Band (RR 8)	4%	8%	Preannounced Crawling Band (5%) (RR 9)	5%	10%	De facto crawling band (5%) (RR 10)	5%	10%	noncrawling band (2%) (RR 11)	5%	10%	Managed float (RR 12)	10%	20%	Free Float (RR13)	20%	25%	Freely Falling (RR14)	25%	25%
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Freely Falling (RR14)	25%	25%																																												
<b>IMF Variables</b>																																														
IMF Program-Dummy	<p>Coded as 1 if the country had an IMF Program (SBA, EFF, PRGF, or SAF) for at least 5 months in a certain year.</p> <p>Source: IMF Annual Reports, various years.</p>																																													

Compliance-Dummy (1 = Compliance)	Coded as 1 if the country was compliant with its IMF program. Non-compliance is recorded if more than 25% of the amount agreed for an IMF program remains undrawn at program termination (as suggested by Killick (1995).  Source: IMF (2006)
IMF Loans	Sum of net financial flows for all IMF programs (in percent of GDP).  Source: World Bank (2006)
<b>Control Variables</b>	
Interest rate differential	Difference between domestic interest rate ((short-term) money market rates (IFS line 60b) as first choice and discount rates (IFS line 60) as second choice if money market rates are not available) and domestic interest rate in reference country.
Level of foreign reserves	Foreign reserves (IFS line 11d) divided by M2 in current US dollars (IFS line 35 divided by IFS line rf)
Export share	Exports (IFS line 78a) divided by GDP in current US dollars (IFS line 99B).
De jure exchange rate regime	De jure exchange rate classification from Ghosh et al. (2002), where 1=dollarized and 15= float with no intervention.
Inflation	% change in the consumer price index (IFS line 64).
Current account deficit	Current account balance in US dollar (IFS line 78A) divided by GDP in current US dollars (IFS line 99B).
Domestic credit/M2	Domestic credit (IFS line 32) relative to Quasi-Money (M2) (IFS line 35).
Budget deficit	Budget deficit (IFS line 80) divided by GDP (IFS line 99B).
Per capita GDP	GDP (IFS line 99B) divided by population (IFS line 99Z).
Election dummy	Dummy, variable, which takes the value of 1 if an election took place. Elections are defined as legislative elections and additional presidential elections in presidential systems.  Source: Beck et al. (2001)
GDP growth	GDP change with respect to previous year (IFS line 99B).
Export growth	Export/GDP change with respect to previous year (IFS line 78A).

**Appendix B: Descriptive Statistics**

Variable	Mean	Std. Dev.	Min	Max
Currency crisis, dummy	0.14	0.35	0.00	1.00
IMF program, dummy	0.36	0.48	0.00	1.00
Compliant with IMF program, dummy	0.15	0.36	0.00	1.00
IMF loans (percent of GDP)	0.22	1.67	-7.18	17.92
Interest Rate differential (t-1)	3093.27	162980.60	-13.63	9695412.00
Exports/GDP (t-1)	0.99	9.23	0.00	228.71
Exchange Rate Regime (t-1)	8.17	4.46	1.00	15.00
Capital Account Openness	0.04	1.54	-1.71	2.68
Inflation (t-1)	47.86	513.87	-58.92	23773.10
Current Account/GDP (t-1)	-0.04	0.10	-2.40	0.57
Domestic Credit/M2 (t-1)	3153.46	96376.79	-22.97	5068439.00
Budget Deficit/GDP (t-1)	-0.40	7.83	-250.13	15.35
(log) GDP p.c. (t-1)	7.27	1.44	4.36	13.16
Devaluation, dummy	0.02	0.14	0.00	1.00
IMF program	0.25	0.43	0.00	1.00
Compliant with IMF program	0.08	0.27	0.00	1.00
IMF loans (percent of GDP)	0.05	0.63	-3.77	12.71
Inflation (t-1)	47.86	513.87	-58.92	23773.10
GDP growth (t-1)	0.37	2.91	-1.00	136.16
Reserves/M2 (t-1)	318.66	8876.97	-1.28	437930.70
Election, dummy (t-1)	0.16	0.37	0.00	1.00
Voting in line with the US	0.21	0.12	0.00	0.80
Voting in line with France	0.42	0.17	0.00	0.91
Voting in line with Germany	0.48	0.21	0.00	1.00
Voting in line with Japan	0.53	0.17	0.00	0.94
Voting in line with the UK	0.41	0.18	0.00	0.93

### Appendix C: Countries included in the analysis

Argentina	1989	Guatemala	1990	Norway	1978
Belarus	1999	Honduras	1990	Norway	1982
Belarus	2000	Honduras	1993	Norway	1986
Bolivia	1984	Hungary	1993	Norway	1992
Bolivia	1985	Hungary	1995	Norway	1998
Botswana	1980	Indonesia	1997	Pakistan	1993
Botswana	1981	Israel	1983	Pakistan	1995
Botswana	1985	Israel	1985	Pakistan	1998
Botswana	1986	Kenya	1993	Pakistan	2000
Botswana	1991	Kenya	1995	Paraguay	1992
Botswana	1992	Kenya	1997	Peru	1990
Botswana	1998	Korea	1980	Philippines	1983
Brazil	1994	Korea	1997	Philippines	1986
Bulgaria	1996	Kuwait	1981	Philippines	1990
Burkina Faso	1980	Kuwait	1986	Philippines	1997
Burundi	1997	Kuwait	1988	Philippines	1998
Burundi	2000	Kuwait	1993	Romania	1997
Cameroon	1980	Kyrgyz Republic	1998	Saudi Arabia	1994
Cameroon	1981	Lesotho	1981	Singapore	1997
Cameroon	1994	Lesotho	1985	Slovak Republic	1998
Chad	1994	Lesotho	1988	Sri Lanka	1977
Chile	1984	Lesotho	1989	Swaziland	1980
China,P.R.	1993	Lesotho	1998	Swaziland	1981
Colombia	1985	Lesotho	2001	Swaziland	1985
Colombia	1997	Madagascar	1994	Swaziland	1998
Colombia	1999	Malaysia	1980	Swaziland	2001
Congo, Republic of	1994	Malaysia	1981	Sweden	1981
Costa Rica	1978	Malaysia	1984	Thailand	1985
Costa Rica	1981	Malaysia	1986	Thailand	1997
Costa Rica	1991	Malaysia	1997	Togo	1980
Cyprus	1982	Mali	1994	Togo	1981
Cyprus	1987	Mauritius	1979	Togo	1994
Cyprus	1992	Mauritius	1981	Tunisia	1986
Cyprus	1995	Mauritius	1997	Tunisia	1991
Czech Republic	1997	Moldova	1998	Turkey	1994
Denmark	1976	Morocco	1981	Turkey	2001
Denmark	1982	Morocco	1983	Uganda	1986
Denmark	1993	Myanmar	1980	Uganda	1988
El Salvador	1986	Myanmar	1981	Uruguay	1982
El Salvador	1990	Myanmar	1990	Uruguay	1984
El Salvador	2000	Nepal	1980	Uruguay	1989
Estonia	1997	Nepal	1981	Uruguay	1992
Finland	1991	Nepal	1984	Venezuela, Rep. Bol.	1984
Georgia	1998	Nepal	1991	Venezuela, Rep. Bol.	1986
Ghana	1981	Nigeria	1980	Venezuela, Rep. Bol.	1989
Ghana	1983	Nigeria	1986	Venezuela, Rep. Bol.	1990
Ghana	1990	Nigeria	1992	Venezuela, Rep. Bol.	1994
Guatemala	1981	Nigeria	1993	Zambia	1989
Guatemala	1986	Nigeria	1999	Zimbabwe	1991