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The Effect of Monetary Policy on Exchange Rates during Currency Crises; The Role of Debt, Institutions and Financial Openness

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ERIM REPORT SERIES *RESEARCH IN MANAGEMENT*	
ERIM Report Series reference number	ERS-2007-022-F&A
Publication	February 2007
Number of pages	34
Persistent paper URL	
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Free Keywords	Currency Crises, Institutions, Monetary Policy, Short-Term Debt, External Debt, Capital Account Openness
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The effect of monetary policy on exchange rates during currency crises; the role of debt, institutions and financial openness*

Sylvester C.W. Eijffinger and Benedikt Goderis

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Abstract

This paper examines the effect of monetary policy on the exchange rate during currency crises. Using data for a number of crisis episodes between 1986 and 2004, we find strong evidence that raising the interest rate: (i) has larger adverse balance sheet effects and is therefore less effective in countries with high domestic corporate short-term debt; (ii) is more credible and therefore more effective in countries with high-quality institutions; iii) is more credible and therefore more effective in countries with high external debt; and (iv) is less effective in countries with high capital account openness. We predict that monetary policy would have had the conventional supportive effect on the exchange rate during five of the crisis episodes in our sample, while it would have had the perverse effect during seven other episodes. For four episodes, we predict a statistically insignificant effect. Our results support the idea that the effect of monetary policy depends on its impact on fundamentals, as well as its credibility, as suggested in the recent theoretical literature. They also provide an explanation for the mixed findings in the empirical literature.

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JEL classification: E52; E58

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1 Introduction

The role of monetary policy during episodes of currency crises has gained attention over the last decade, especially in the aftermath of the Asian crisis. The large depreciations in Thailand, Korea, Indonesia, and the Philippines in 1997 and 1998 had detrimental effects on the balance sheets of banks and firms with outstanding US dollar loans. This resulted in large-scale banking sector distress and economic downturn. An important question that arose and has been subject to intense debates amongst policymakers and academics ever since, is whether higher interest rates can support the exchange rate during such crisis episodes.

The conventional view is that higher interest rates support exchange rates by discouraging capital outflows and increasing the costs of speculating against the currency of the crisis country. Higher interest rates can also signal the monetary authorities' commitment to support the exchange rate in the future (Backus and Driffill (1985) and Drazen (2000, 2003). The empirical literature, however, does not find a clear and systematic impact of monetary policy on exchange rates. Some of the studies find that tighter monetary policy appreciates the exchange rate, others find the opposite, while some fail to find any effect.[1] Most of these studies are based on particular countries and crisis episodes. Hence, the evidence seems to suggest that, if there is an effect of monetary policy on exchange rates during crises, it is likely to depend on the country-specific circumstances.

Over the last decade a small but growing theoretical literature has started to investigate these circumstances by looking at the various channels through which higher interest rates affect exchange rates. Drazen and Hubrich (2006) distinguish between two types of arguments. First, higher interest rates affect exchange rates through their impact on economic fundamentals. They might, for example, weaken the financial and banking system, increase public debt, deteriorate the housing market, and lead to a credit crunch and lower economic activity. Depending on the magnitude of these adverse effects, raising interest rates could in fact weaken the currency, rather than strengthen it.[2]

[1] See for example Basurto and Ghosh (2001), Caporale et al. (2005), Dekle et al. (2002), Furman and Stiglitz (1998), Goldfajn and Baig (2002), Goldfajn and Gupta (2003), Gould and Kamin (2001), Kraay (2003), Tanner (2001), and Zettelmeyer (2004).

[2] This argument was first made by Drazen and Masson (1994). Other contributions include: Obstfeld (1994) and Bensaid and Jeanne (1997), who show that the costs of higher interest rates can lead to self-fulfilling currency crises; Lahiri and Végh

The second type of argument is suggested by Drazen (2000, 2003) and relates to the signaling of unobserved government characteristics. If raising interest rates is believed to signal the monetary authorities' commitment to supporting its currency, then it might be successful. However, if it is believed to signal weak fundamentals or panic at the monetary authorities, then the effect will be perverse, i.e. higher interest rates will depreciate the currency.

The channels through which monetary policy affects the exchange rate have so far received little attention in the empirical literature. The only study that uses a large cross-section of currency crisis episodes and investigates the effect of monetary policy on exchange rates *during* those episodes is Goldfajn and Gupta (2003)[3]. Using a dataset of crisis episodes in 80 countries for the period 1980-1998, they find that tight monetary policy increases the probability that a real appreciation of the exchange rate occurs through a nominal appreciation rather than an increase in inflation. Hence, monetary tightening appreciates the nominal exchange rate. They test whether this effect is different for countries that also face a banking crisis and indeed find that for these countries the supportive effect of monetary tightening disappears.

This paper considers four new country-specific characteristics that could be important determinants of the effect of monetary policy *during* crises and empirically tests their importance, using a large cross-section of crisis episodes. The first characteristic we look at is a country's level of *domestic short-term corporate debt*. Furman and Stiglitz (1998) argue that higher interest rates, in addition to raising the promised return on investments, can increase the likelihood of defaults in the corporate and banking sectors by increasing debt service payments and compromising balance sheets. In addition, risk averse investors will require higher risk premia when faced with an increased likelihood of defaults. If these two effects, a higher default probability and a higher risk premium, more than offset the higher promised return on investments, then raising the interest rate has the perverse effect of causing further capital outflows and a

(2003) and Flood and Jeanne (2005), who argue that the effect of a higher interest rate depends on its fiscal implications and, consequently, its impact on expected inflation; Lahiri and Végh (2007), who show that raising interest rates can lead to a credit crunch and output contraction; and Furman and Stiglitz (1998) and Radelet and Sachs (1998), who provide an extensive discussion of why higher interest rates might depreciate the exchange rate.

[3]By contrast, three large cross-country studies look at speculative attacks *preceding* possible crises and ask whether tighter monetary policy lowers the probability of crisis. Kraay (2003) allows the effect of monetary policy to depend on several country-specific characteristics but fails to find any significant effect. Goderis and Ioannidou (2006) extend his analysis by allowing the effect to depend on a country's level of domestic corporate short-term debt. They find that for low debt, raising interest rates lowers the probability of crisis, while for higher debt this effect decreases and eventually reverses. Hubrich (2000) also builds on Kraay (2003) and finds mixed evidence: higher interest rates increase the probability of a crisis, while tighter domestic credit decreases the probability of a crisis.

weaker currency. Following Goderis and Ioannidou (2006), who look at speculative attacks, we argue that this monetary policy channel is likely to be more important for countries with higher levels of domestic short-term corporate debt. The higher the level of domestic short-term corporate debt, the larger the adverse effects of higher interest rates, and thus the larger the probability that higher interest rates have a perverse effect on exchange rates.

The second characteristic we look at is related to the credibility of higher interest rates as a signal of the monetary authorities' commitment to supporting its currency. Our hypothesis is that the credibility of government policies in general, and thus also the credibility of monetary policy, increases with *the quality of a country's institutions*. Countries with a stable government, a strong rule of law, and a high-quality bureaucracy, will be better able to credibly commit to supporting their currency. As a result, the same monetary policy decision might have different effects on the exchange rate, depending on the institutional setting within which it is taken.[4]

Thirdly, and also related to policy credibility, we consider the importance of *foreign currency denominated ('external') debt*. The recent theoretical 'third-generation' or 'balance sheet' currency crisis literature has stressed the importance of external debt, both as a determinant of crises and as a determinant of the costs of crises.[5] The effect of external debt on the interest rate-exchange rate relationship, however, has received less attention. Eijffinger and Goderis (forthcoming, 2007) argue that high external debt increases the costs of a depreciation because of its effect on corporate balance sheets. As a result, monetary authorities have stronger incentives to support its currency, even if that is costly as well. Our hypothesis is that these stronger incentives contribute to the credibility of higher interest rates, as they make continued support of the currency more likely.

Finally, we investigate the role of *capital account openness*. Currency crisis episodes are usually accompanied by large capital outflows, which will be more severe in countries with high capital mobility.

[4] The role of institutions has recently gained attention in the currency crisis literature. Li and Inclan (2001) show how institutions can affect the likelihood of currency crises by affecting macroeconomic fundamentals and driving market expectations about future fundamentals. Shimpalee and Breuer (2006) empirically assess the importance of a wide range of institutional factors in explaining the occurrence of currency crises. They find strong evidence that corruption, government instability, and a lack of law and order increase the probability of a crisis.

[5] See for example Aghion *et al.* (2000, 2001, 2004), Burnside *et al.* (2001a, 2001b, 2004), Chang and Velasco (2000), Jeanne and Wyplosz (2001), Krugman (1999), and Schneider and Tornell (2004).

In addition to raising interest rates, an alternative line of defense that is sometimes advocated is the introduction of some degree of capital controls in order to limit the outflow of capital and the depreciation that comes with it. Given that the monetary authorities' power is constrained by the size of their foreign reserves and their willingness to keep the interest rate at the required level for a long time, the presence of some degree of capital controls might make it more feasible for the authorities to support their currency. Put differently, in countries with full capital account mobility, the intensity and sheer volume of speculation make it increasingly difficult for the monetary authorities to counterbalance it. Hence, our hypothesis is that monetary policy is less effective in countries with high capital mobility.

To test the impact of these country-specific characteristics on the efficacy of monetary policy, we collected data for a large group of countries that experienced one or more periods of currency crises between 1986 and 2004. We find strong and robust evidence that domestic short-term corporate debt and institutional quality are important determinants of the impact of higher interest rates on exchange rates. In particular, higher domestic corporate short-term debt *lowers* the efficacy of monetary policy in supporting the exchange rate, while higher institutional quality *increases* the efficacy of monetary policy. We also find evidence that external debt and capital account openness affect the impact of higher interest rates. Using our regression results, we predict that monetary policy would have had the conventional supportive effect on the exchange rate during five of the crisis episodes in our sample, while it would have had the perverse effect during seven other episodes. For four episodes, we predict a statistically insignificant effect. Our results support the idea that the effect of monetary policy depends on its impact on fundamentals, as well as its credibility, as suggested in the recent theoretical literature. They also provide an explanation for the mixed findings in the empirical literature.

2 Methodology and Data

Following Kraay (2003), we define a currency crisis as the collapse of a pegged exchange rate. More specifically, we identify the onset of a crisis as a large nominal depreciation or devaluation preceded by a relatively fixed nominal exchange rate:

$$(i,t)\,|de_{i,t} > k_i \text{ and } \overline{de}_{i,t} < \overline{k}_i \tag{1}$$

where $de_{i,t}$ is the monthly percentage change in the nominal exchange rate vis-a-vis the anchor currency[6] in country i between period t and period t-1. k_i is the threshold determining the minimum size of the devaluation. $\overline{de}_{i,t}$ is the average absolute percentage change in the exchange rate in country i in the 12 months prior to period t. $\overline{k}_i$ is the threshold determining the maximum size of the "allowable" exchange rate volatility prior to the devaluation. Following Kraay (2003), k_i is set to 5% for OECD countries and 10% for non-OECD countries, while $\overline{k}_i$ is set to 1% for OECD countries and 2.5% for non-OECD countries. To prevent double-counting, we eliminate episodes that were preceded by episodes in the preceding 12 months.

This procedure is applied to all countries for which we have data and yields a list of episodes that mark the beginning of a crisis. We identify the end of crisis periods as the first month after the onset of a crisis in which speculative pressures have substantially diminished compared to their earlier crisis peaks. More formally, for crises starting in month t, we define endings as the first month $t+s$ $(s>0)$ for which the following condition is satisfied:

$$s_{i,t+s+j} \; < \bar{s}_{i,t} \; + \; 0.25 * (s_{i,t}^{MAX} - \bar{s}_{i,t}), \text{ where } j = 0,1,2 \tag{2}$$

where $s_{i,t+s+j}$ is the nominal money market interest rate[7] spread over the US Federal Funds rate in country i and month $t+s+j$ where t and s denote the starting month and the length of the crisis, respectively. $\bar{s}_{i,t}$ is the average spread[8] in the 24 months preceding month t, and $s_{i,t}^{MAX}$ is the mean of the 3 highest levels of spreads in month t and the 5 succeeding months. In order to eliminate periods in which a relatively fixed exchange rate was abandoned without substantial financial turmoil, we exclude periods for which the difference between $s_{i,t}^{MAX}$ and $\bar{s}_{i,t}$ does not exceed three percentage points, as they exhibit

[6] Historically, European countries typically pegged to the German mark whereas non-European countries often pegged to the US dollar. Hence, we use the monthly average local currency price of the German mark for European countries and the local currency price of the US dollar for all other countries (International Financial Statistics line rf).

[7] International Financial Statistics line 60b.

[8] In some cases this 24-month average might be heavily influenced by episodes of distress, related to the upcoming crisis. Since we will use the average as an indicator of the level of spreads in 'normal' times, we exclude observations that lie more than 2 standard deviations above the 24-month mean.

only a limited degree of speculative pressure. As a result, 6 episodes[9] are dropped. Table 1 shows the resulting panel of 18 currency crisis periods for which we have data.

Using this panel of crisis periods, we analyze the effect of monetary policy on the exchange rate using the following empirical specification:

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,t-1} + \beta_2 Z_{i,t-k} + \beta_3 X'_{i,t-1} Z_{i,t-k} + \epsilon_{i,t}, \tag{3}$$

where $Y_{i,t}$ is an indicator that captures the change in the exchange rate in month t for country i.[10] $X_{i,t-k}$ is an indicator that captures changes in the stance of monetary policy. $Z_{i,t-k}$ is a vector that includes episode-specific fundamentals that are expected to affect the exchange rate (e.g. international reserves, business cycle, etc.), where $k = 0, 1, ..n$. Finally, the interaction term of $X_{i,t-1}$ and $Z_{i,t-k}$ captures how the effect of monetary policy changes for different levels of fundamentals. The interaction terms of monetary policy with domestic short-term corporate debt, institutional quality, external debt, and capital account openness are used to test the central hypotheses of the paper.[11]

We use two indicators for the change in the exchange rate, $Y_{i,t}$. The first indicator, NE, captures the change in the *nominal* exchange rate and is measured as the percentage change in the monthly average local currency price of the German mark for European countries, and the percentage change in the monthly average local currency price of the US dollar for all other countries.[12] After the collapse of a fixed exchange rate, monetary authorities typically remain concerned about the nominal value of the currency. Domestic banks and companies are often exposed to nominal depreciations through foreign currency liabilities. Large depreciations also tend to lead to high levels of inflation through exchange rate pass-through. Hence, monetary authorities may want to limit nominal depreciation to avoid costly defaults and excessive inflation. Using the change in the nominal exchange rate allows us to test whether they can effectively do so.

[9] Denmark 1993, Ireland 1993, Korea 2000, Spain 1995, Sweden 1992, and United Kingdom 1992.

[10] The change in month t refers to the change between month t and month t-1.

[11] When using parametric estimation techniques, a linear interaction term is commonly used to allow for non-linear effects. It implies that the marginal effect of monetary policy, $X_{i,t-k}$, equals $\beta_1 + \beta_3 Z_{i,t-k}$ and thus depends linearly on the vector of episode-specific fundamentals $Z_{i,t-k}$.

[12] Data were taken from the International Financial Statistics database, line rf.

The second indicator, RE, captures the monthly percentage change in the *real* exchange rate. The real exchange rate is constructed by adjusting the nominal exchange rate (see above) for domestic and German/US price levels.[13] If monetary authorities are concerned about the real exchange rate, the question arises whether monetary policy can effectively support the currency in real terms. Using the change in the real exchange rate allows us to provide an answer to this question.

We turn next to our indicator of monetary policy change, $X_{i,t-k}$. Several measures have been proposed in the literature. Kraay (2003) uses the discount rate as this interest rate is to a large extent controlled by the monetary authorities and therefore provides a better measure of monetary policy than short-term money market interest rates that are also affected by market conditions. By contrast, Goldfajn and Gupta (2003) prefer money market interest rates because these interest rates better reflect short-term changes in monetary policy. Discount rates often tend to remain flat, as was for example the case during the Swedish interest rate defense in 1992 that made money market interest rates shoot up to 500%. Goderis and Ioannidou (2006) point out that the best available indicator of monetary policy is not necessarily the same across countries or time and therefore collect information on the most appropriate indicator of monetary policy for each episode in their sample.

In this paper we will use two alternative indicators of monetary policy. Our preferred indicator, MP, is based on the country-specific monetary policy interest rates collected in Goderis and Ioannidou (2006). Table 2 lists these interest rates and provides detailed information on their identification and data sources. MP is constructed as follows. We first collect daily data on the country-specific monetary policy interest rates in Table 2. We construct monthly averages of these series[14] and express them as spreads over the anchor country's monetary policy interest rates.[15] We then take the monthly percentage changes in these spreads and lag them by 1 month. Following Kraay (2003) our second indicator of monetary policy, $DISC$, is based on the discount rate and is constructed in the same way as MP.[16] Lagging the monetary policy indicator allows the transmission of monetary policy to take some time and avoids measuring the monetary

[13] Price data were taken from the International Financial Statistics database, line 64.
[14] This accounts for possible intra-monthly fluctuations, which are ignored when using end-of-month data.
[15] The Federal Funds rate for the US and the discount rate for Germany.
[16] Discount rate data were taken from the International Financial Statistics database, line 60.

policy response to changes in the exchange rate. For both measures of monetary policy, we also include the initial level of the spread as a control variable.

Next to monetary policy, we include a vector of episode-specific fundamentals, $Z_{i,t-k}$, and interactions of monetary policy with these fundamentals. Six fundamentals are taken from Kraay (2003) and/or Goderis and Ioannidou (2006). First, as an indicator of real exchange rate overvaluation, we include the average growth rate of the real exchange rate vis-a-vis the anchor country during the previous 12 months, expressed as a percentage. An average real appreciation implies a deterioration of a country's international competitiveness and increases the likelihood of a depreciation in the near future to restore competitiveness. Secondly, we include the level of non-gold reserves as a percentage of total imports in the previous month.[17] This reflects the degree to which monetary authorities can support the exchange rate in the face of speculation against the currency or a sudden reversal of capital flows. The higher the level of international reserves, the higher the probability that the exchange rate will appreciate, everything else equal. Thirdly, as an indicator of a country's external payments position, we include the average of a country's outstanding IMF loans as a percentage of a country's IMF quota in the previous twelve months.[18] A high level of IMF loans might discourage international investors to lend to a country or persuade those already present to leave the country, which depreciates the exchange rate. Fourth, we include the deviation of the real per capita GDP growth in the previous calendar year from the average of the five years before, expressed in percentage points.[19] Lower economic growth might lower international investors' expectations of future returns. Also, it might make it more difficult for a country to meet its external debt service obligations. Again, this could lead to a decrease in demand for the domestic currency, causing a depreciation of the exchange rate. Finally, we include the monthly percentage change in real exports and real imports in the previous month.[20] Higher exports increase the supply of foreign currency which, everything else equal, appreciates the exchange rate. By contrast, higher imports increase demand

[17] Data on non-gold reserves and imports were taken from the International Financial Statistics database, lines 1L.D and 71.D.

[18] Data on outstanding IMF loans and IMF quota were taken from the International Financial Statistics database, lines 2TL and 2F.S.

[19] GDP data were taken from the World Development Indicators database.

[20] Data on merchandise exports and imports in constant US dollars were taken from the International Financial Statistics database, lines 70..D and 71..D.

for foreign currency and thus depreciate the exchange rate.

In order to test the hypotheses described in the introduction of this paper, we also include measures of domestic short-term corporate debt, institutional quality, external debt, and capital account openness. Our measure of domestic short-term corporate debt is taken from Goderis and Ioannidou (2006). In particular, we collect data on short-term debt and total assets for a large number of publicly listed companies in developed and emerging markets from the Thomson Financial's Worldscope database. We construct an aggregate measure of a country's short-term debt by taking the mean of the individual short-term debt to total assets ratios in the calendar year before the year of the exchange rate change.

To capture the quality of a country's institutions we use the International Country Risk Guide (ICRG) rating, which is a weighted index of 22 variables in three subcategories of risk: political (50%), financial (25%), and economic (25%). The index includes measures of for example the quality of a country's bureaucracy, the degree of corruption, the degree of democratic accountability, the stability of the government, and the degree of law and order. The index ranges from 0 for very bad institutions to 100 for very good institutions.

As an indicator of a country's external debt position we use external debt over GDP, taken from the World Bank's World Development Indicators, in the calendar year before the year of the exchange rate change. External debt consists of all public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt, owed to nonresidents and repayable in foreign currency, goods, or services.[21]

Finally, we use the (updated) Chinn and Ito index (2005) as an indicator of capital account openness. This index was constructed using information on multiple exchange rates, current account transactions, capital account restrictions, and the requirement of the surrender of export proceeds, taken from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).[22]

Table 3 reports summary statistics for the variables used in estimation. On average, the nominal

[21] For Finland (1991) and Norway (1986), data are from the IMF's International Financial Statistics. For Korea (1997) data are from McLeod and Garnaut (1998). As part of our sensitivity analysis, we also experiment with the short-term component of external debt, as it might be most relevant for monetary authorities. Our results are robust to using short-term external debt instead of total external debt.

[22] We thank Menzie Chinn and Hiro Ito for making this index available.

and real exchange rates depreciated during the episodes in our sample, while monetary policy on average tightened.[23] The standard deviation of $DISC$ is lower than the standard deviation of MP, which is consistent with the argument above that discount rates tend to remain flatter than other monetary policy indicators.[24]

3 Estimation results

Table 4 reports pooled OLS estimation results for six alternative specifications of equation 3.[25] Column (1) shows results when using the monetary policy indicator $DISC$ and fundamentals but no interaction terms. Monetary policy enters with a positive sign, indicating that everything else equal an increase in interest rates leads to a depreciation of the nominal exchange rate. This effect is statistically significant at the 5% level and supports the revisionist view that higher interest rates weaken the home currency during currency crises.

Only four of the control variables enter with expected signs but only one of them is statistically significant so these results should be viewed with caution. In particular, external debt enters with a positive sign and is statistically significant at the 5 percent level, indicating that higher external debt depreciates the exchange rate, which is consistent with the arguments in recent balance sheet crisis literature. Capital account openness enters with a positive sign and is statistically significant at 1 percent, suggesting that higher openness depreciates the exchange rate. Exchange rate overvaluation enters with a negative sign, indicating that a lower level of this variable (higher overvaluation) leads to a depreciation of the nominal exchange rate. Finally, the growth rate of exports enters with a negative sign, suggesting that a higher level of exports appreciates the nominal exchange rate. Debt to total assets (statistically significant at the 5% level), reserves to imports, external payments position, deviations of GDP growth (statistically significant at the 5% level), growth of imports, and the initial level of the monetary policy interest rate spread, do not have the expected signs.

[23] We dropped January 1998 for Indonesia from our sample as the nominal and real exchange rate depreciation in this episode (96.8% and 84.5% respectively) represent an outlier.

[24] The correlation between the two indicators of monetary policy is 0.49.

[25] We performed Hausman tests, F-tests, and Lagrange multiplier tests to compare fixed effects, random effects, and pooled OLS estimation. The results did not reject the use of pooled OLS.

Column (2) shows the results when using our preferred monetary policy indicator MP. We again find that everything else equal an increase in interest rates depreciates the nominal exchange rate. This effect is somewhat smaller than before and statistically significant at 10 percent. The control variables enter with the same signs as before except for the level of the spread which is now positive and significant at the 1% level, indicating that higher levels of the spread correspond to nominal exchange depreciations. The coefficients of debt to total assets, external debt, capital account openness, and GDP growth are no longer statistically significant.

In columns (3) and (4) we add interaction terms of monetary policy and all fundamentals except institutional quality to test whether the effect of monetary policy depends on these fundamentals. Three of the hypotheses in this paper - increasing the interest rate to support the exchange rate is less effective in countries with high domestic corporate short-term debt, low external debt, and high capital account openness - are tested using the interaction terms of monetary policy with (domestic corporate) short-term debt to total assets, external debt, and capital account openness.

Column (3) shows results when using the monetary policy indicator $DISC$. Monetary policy again enters positive but is no longer statistically significant. The interactions of monetary policy with short-term debt to total assets, external debt and capital account openness all enter with the expected sign, confirming the hypotheses that monetary policy is less effective for higher short-term debt, lower external debt, and higher capital account openness. However, these effects are statistically insignificant, except for the interaction of external debt, which is significant at 10 percent. The interaction terms of monetary policy with the other fundamentals all enter statistically insignificant as well. This is consistent with the findings in Kraay (2003), who also fails to find any evidence of a non-linear effect of monetary policy. The fundamentals enter with the same signs as in column (1).

As argued by Goldfajn and Gupta (2003), discount rates often fail to reflect important changes in the monetary policy stance. Moreover, using a universal monetary policy interest rate fails to recognize that different countries use different key interest rates as part of their monetary policy strategy. It is therefore interesting to investigate if and how our findings change when using our preferred country-specific

monetary policy indicator MP. Column (4) shows the results. Monetary policy now enters negative and is statistically significant at 1 percent. The interaction of monetary policy and short-term debt to total assets enters with the expected sign and is also statistically significant at 1 percent. This indicates that monetary policy is more effective in countries with low levels of domestic short-term corporate debt. The interaction of monetary policy with capital account openness enters with the expected sign as well and is statistically significant at 10 percent, suggesting that monetary policy is more effective in countries with low capital account openness. Finally, the interaction of monetary policy with external debt also enters with the expected sign but is not significant in this specification. The coefficients of the control variables are very similar to the coefficients in column (2). The remaining interaction terms all enter statistically insignificant, as in column (3).

We next allow for an additional source of non-linearity by considering a country's institutional quality as a possible determinant of whether monetary policy is effective in supporting the exchange rate. Column (5) reports the results when adding the interaction of monetary policy and institutional quality to the regression equation. The interaction terms other than the ones for short-term debt, institutional quality, external debt, and capital account openness are dropped because of multicollinearity.[26] Interestingly, all four interaction terms enter with the expected signs and are all statistically significant. The interaction of monetary policy and short-term debt remains positive and enters statistically significant at the 5% level, while the interaction of monetary policy with external debt remains negative but is now statistically significant at 10 percent. The interaction of monetary policy with capital account openness again enters positive and is significant at 10 percent, although the coefficient is somewhat smaller. Finally, the interaction of monetary policy with institutional quality enters with a negative sign and is statistically significant at 5 percent. This indicates that monetary policy is more effective in countries with good institutions. While monetary policy was negative and significant in column (4), it now enters positive and statistically significant at the 10% level. The change in the coefficient of monetary policy shows that the negative and significant effect in column (4) can be attributed to the institutional quality and external indebtedness of countries. Once we control for these two variables, the coefficient of monetary policy changes sign. Insti-

[26] We tested for multicollinearity by calculating variance inflation factors (VIF) for all regressors.

tutional quality by itself enters positive but is not statistically significant. The other regressors enter with the same signs as in column (4), except for exchange rate overvaluation, and the statistical significance is unchanged.

The goodness of fit in columns (1) to (5) is quite low, given the large number of variables in the model. In column (6) we therefore drop the six control variables that are statistically insignificant. The results are very similar. Monetary policy as well as the interaction terms of monetary policy with the four fundamentals enter with the same sign, similar size, and the same level of statistical significance as in column (5). The only exception is the interaction of monetary policy with capital account openness, which has the same coefficient but is no longer statistically significant.

Summarizing, the results in Table 4 provide evidence that the efficacy of monetary policy in supporting the exchange rate during currency crises depends on a country's domestic corporate short-term debt, institutional quality, and external debt. Everything else equal, monetary policy is more effective in countries with lower corporate short-term debt, higher levels of institutional quality, or higher external debt. We also find some evidence that monetary policy is more effective in countries with low capital account openness.

4 Sensitivity Analysis

We next perform several robustness checks and address some possible econometric concerns. The first robustness check refers to the interest rate spreads that we used to construct the monetary policy indicators in Table 4. Using these spreads allows us to eliminate those changes in monetary policy that result from monetary policy changes in the anchor country, i.e. the monetary policy changes that are not expected to affect the exchange rate but instead are aimed at keeping the exchange rate stable. However, this way of constructing the monetary policy indicators implies that in principal our results could be driven by either changes in the domestic interest rate or changes in the anchor country's interest rate or by both. Since we are primarily interested in testing whether higher *domestic* interest rates support the exchange rate, it is important to investigate whether our results do indeed stem from domestic rather than foreign monetary policy changes. Hence, we separated our preferred monetary policy indicator MP

into a domestic monetary policy indicator, which is the lagged percentage change in the monthly average of the *domestic* interest rate, and a foreign monetary policy indicator, which is the lagged percentage change in the monthly average of the *anchor country's* interest rate. The domestic and foreign monetary policy indicators are denoted MP-domestic and MP-foreign, respectively. Column (1) of Table 5 reports the results of the specification in column (6) of Table 4 when replacing the monetary policy indicator MP with the domestic and foreign monetary policy indicators. The results are reassuring as they clearly show that the results in column (6) of Table 4 are driven by domestic monetary policy. In particular, MP-domestic enters positive and is statistically significant at 10 percent, which is consistent with MP in column (6) of Table 4, while MP-foreign is not statistically significant. Moreover, the interactions of MP-domestic with debt to total assets, institutional quality, external debt, and capital account openness all enter with the same signs and are all statistically significant, while the same interactions for MP-foreign are all statistically insignificant. Interestingly, while the interaction of MP-domestic with capital account openness was statistically insignificant in column (6) of Table 4, it is now significant at 5 percent.

Column (2) of Table 5 tests whether our results are robust to including a time trend. During crises the depreciation of the exchange rate will typically be highest in early months and lower in later months. The negative and highly significant coefficient of the time trend confirms this. However, the coefficients for MP and the interactions of MP with the fundamentals of interest are very similar to column (6) of Table 4, and gain in terms of statistical significance. The interactions of MP with debt to total assets and institutional quality are now significant at 1 percent, while the interaction of MP with capital account openness is significant at 5 percent.[27]

We next test the robustness of our results when adding the lagged dependent variable, i.e. the lagged exchange rate change, to the specification.[28] The results are reported in column (3) of Table 5. The lagged exchange rate change enters positive and is statistically significant at the 10 percent level. The coefficients of the other regressors are very similar to the ones in column (6) of Table 4. Both MP and the interactions of MP with debt to total assets, institutions, and capital account openness are statistically

[27] In addition to a time trend, we also considered the possibility that the impact of monetary policy is different for different crisis months. We did not find any systematic evidence to support this hypothesis.

[28] We also experimented with additional lags of the dependent variable but found that only the first lag is important.

significant, while the coefficient on the interaction of MP with external debt has a similar size but is now insignificant. Columns (4) till (7) repeat the specifications in Table 4, column (6), and Table 5, columns (1) to (3), respectively, but with the real exchange rate change instead of the nominal exchange rate change as the dependent variable. The results are very similar. In particular, the evidence of non-linear effects of monetary policy is robust to using the real exchange rate instead of the nominal exchange rate.

An econometric concern when interpreting the results in Table 4 and 5 is the possible endogeneity of monetary policy. Monetary policy could be correlated with omitted variables that also affect the exchange rate change (omitted variable bias) or could be affected by the exchange rate change (reverse causation). In both cases, our estimated coefficients will be biased as monetary policy will be correlated with the error term. To limit concerns over endogeneity, we already used lagged monetary policy instead of contemporaneous monetary policy in equation 3. However, this does not eliminate the possible bias in our coefficients if error terms are correlated over time or if monetary policy is correlated with next period's error term through the expectations of monetary authorities. Several instrumental variables have been proposed in the literature. Kraay (2003) and Goderis and Ioannidou (2006) use the percentage change in real reserves. However, this instrument is a rather poor predictor of monetary policy in our sample.[29]

In the absence of other strictly exogenous instruments, we use an alternative instrumental variables technique first suggested by Anderson and Hsiao (1981). This technique proposes to first transform the model by first-differencing to eliminate possible individual effects and then apply instrumental variables. In particular, endogenous variables in first differences are instrumented with suitable lags of their own levels and first differences. Aside from monetary policy, the lagged dependent variable in columns (3) and (7) of Table 5 could also suffer from endogeneity if the error term in equation 3 contains a country-specific unobservable fixed effect. Using the Anderson and Hsiao two-stage least squares estimator eliminates this potential endogeneity bias. Although consistent, the estimator is not efficient for panels with more than three periods, as for the later periods in the sample additional instruments are available. Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991) applied the generalized method of moments

[29] An alternative methodology to determine the exogenous component of monetary policy was suggested by Bernanke and Mihov (1998) in the context of US monetary policy. This methodology is less feasible in our cross-country analysis due to lack of data.

(GMM) approach developed by Hansen (1982) to use all available instruments. Arellano and Bover (1995) extended this difference-GMM estimator by adding the equations in levels to the system, creating what is often called the system-GMM estimator. This addition increases the number of moment conditions, thereby increasing the efficiency of the estimator. Blundell and Bond (1998) showed that exploiting these additional moment conditions provides dramatic efficiency gains.[30]

We use the system-GMM estimator to deal with the potential endogeneity of all the regressors in our model, including the lagged dependent variable.[31] In particular, in the transformed equation we instrument all regressors with lags of their own levels, while in the levels equation we instrument all regressors with lags of their own differences. For example, to explain the exchange rate change in period t we instrument monetary policy at time $t-1$[32] with levels and differences of monetary policy and the other regressors at time $t-2$. The lagged dependent variable and all the other regressors are instrumented in the same way. The number of instruments in a system GMM can potentially grow very large, which causes problems of overfitting in finite samples and weakens the Sargan test of instrument validity up to the point where it generates implausible good p values of 1.00 (Bowsher 2002). In order to minimize this problem, we take two steps to limit the instrument count.[33] First, as explained above, we only use instruments at $t-2$ and leave out all potential instruments beyond $t-2$. Second, we "collapse" the instrument set, which means that the procedure creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance.

Table 6, column (1), reports the results of the system-GMM estimation for the specification in Table 4, column (6). The results strongly confirm our earlier results. Monetary policy and its interactions with domestic short-term corporate debt, institutional quality, external debt, and capital account openness all enter with the expected signs and are now all statistically significant at the 1 percent level. The number of instruments is restricted to 20, which is not far above the number of groups. The p value of the Sargan test of instrument validity is 0.71, which indicates that the null of valid instruments cannot be rejected.

[30] For an introduction to the GMM estimators for dynamic panel data, see Bond (2002) and Roodman (2006).
[31] We use the xtabond2 procedure in Stata, written by David Roodman.
[32] Recall that our monetary policy indicators are already lagged by one period.
[33] see Roodman (2006).

Finally, at the bottom of column (1) we report the test statistics for the Arellano and Bond AR(1) and AR(2) tests of serial correlation in the error terms. If the error terms in the untransformed model are serially uncorrelated, then the differenced error terms in the differenced model should show negative first-order serial correlation and no second-order serial correlation. The Arellano and Bond AR(2) test statistic is negative but far from statistically significant, suggesting the absence of substantial serial correlation in the error terms of the untransformed model. This is important as it supports the assumption that, even if lagged levels of the regressors are endogenous, i.e. correlated with the corresponding lagged error terms, they are not correlated with the contemporaneous error terms.

Table 6, column (2), reports results when adding the lagged dependent variable to the specification. As in Table 5, column (3), the lagged exchange rate change enters positive and is statistically significant at 10 percent. The results for monetary policy and its interactions are similar to column (1), although the interaction with external debt is now only significant at 10 percent. Also, debt to total assets and institutional quality by themselves are now statistically significant but have the counterintuitive sign. External debt is significant at 10 percent and enters with the expected sign. The Sargan test again indicates that the null of valid instruments cannot be rejected. However, the p value is now quite high, which could be related to the overfitting problem, and thus results should be interpreted with caution. The Arellano and Bond test statistics indicate the absence of serial correlation in the error terms of the untransformed model. The AR(1) test statistic is now significant at the 5 percent, which is to be expected given that the error terms are first differenced.

Finally, columns (3) and (4) of Table 6 repeat the specifications in columns (1) and (2) but with the *real* exchange rate change, rather than the *nominal* exchange rate change, as the dependent variable. As before, the results are strongly robust to using this alternative exchange rate indicator.

In addition to these robustness checks, we also experiment with an alternative measure of external debt. In principal, a depreciation of the exchange rate inflates the local currency value of all foreign currency denominated debt on balance sheets, regardless of its maturity. However, this balance sheet deterioration might be more problematic for external debt with a short maturity, as this needs to be repaid or rolled

over much sooner than long-term debt. Given that crisis episodes typically do not last longer than two to three years[34], monetary authorities might be more concerned about short-term external debt than about total external debt.[35] To investigate this possibility, we re-estimate the specifications in Tables 4 to 6, using short-term external debt instead of total external debt.[36] Our results are highly robust to using this alternative measure of external debt. In the specifications with MP and the interaction of MP with short-term external debt, the latter always enters with a negative sign and is now always statistically significant at 5 percent, while significant at 1 percent for all specifications in Tables 5 and 6. Short-term external debt by itself always enters positive and is significant at 10 percent in 2 specifications. Our results for the other interaction terms go through and in some cases also gain statistical significance.[37]

Summarizing, the results of our sensitivity analysis show that the non-linear effects of monetary policy with respect to domestic corporate short-term debt, institutions, and capital account openness are robust to the separation of monetary policy in its domestic and foreign components, the inclusion of a crisis-specific time trend or lagged dependent variable, and the use of instrumental variables system-GMM estimation. The results for the interaction of monetary policy with external debt are slightly less robust but it enters with the 'right' sign and when using the system-GMM is always statistically significant. Moreover, when using short-term external debt instead of total external debt, the interaction term is always statistically significant. All in all, these results provide strong evidence in favour of the central hypotheses of this paper. The impact of higher interest rates on exchange rates during currency crises depends importantly on a country's level of domestic short-term corporate debt, institutional quality, external debt, and capital account openness.

We next investigate the economic relevance of these results, using the results in Table 6, column (1), by calculating the marginal effects of monetary policy for different levels of fundamentals. Panels (A) to (D) in Figure 1 illustrate these marginal effects for different levels of domestic short-term corporate debt to

[34] The crisis episodes in our sample last from a minimum of two months to a maximum of thirty months.

[35] We thank an anonymous referee for pointing this out.

[36] Our measure of short-term external debt was taken from the same source as total external debt (World Development Indicators) and includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. For Finland (1991), Norway (1986), and Korea (1997), short-term external debt is not available. For these episodes, we multiply total external debt by the domestic corporate short-term debt to total debt ratios.

[37] To save space, we do not report these estimation results, but they are available upon request.

assets, institutional quality, external debt, and capital account openness, when evaluating the other three fundamentals at their median levels. The ranges of levels for debt, institutions, external debt, and capital account openness correspond to the ranges in our sample. The solid lines represent the marginal effects, the dashed lines represent the 95% confidence interval. The upward sloping solid line in panel (A) shows how the marginal effect of monetary tightening increases with debt. In particular, for the lowest debt levels in our sample, the marginal effect is negative and statistically significant, indicating that raising the interest rate appreciates the exchange rate. For higher debt levels (above 0.13) the effect becomes positive, implying that raising the interest rate depreciates the exchange rate. For debt levels above 0.14, this effect is statistically significant at the 5% level. For most debt levels, this effect is also economically relevant. For example, the marginal effect of an interest rate increase in countries with a sample average debt level of 0.18, is equal to 0.09. This means that raising the interest rate change by 1 percentage point leads to an increase in the nominal depreciation by 0.09 percentage points.

Panel (B) shows the same graph for the levels of institutional quality observed in our sample. The downward sloping solid line shows how the marginal effect of higher interest rates decreases for higher levels of institutional quality. For levels of institutional quality up to 0.74, raising interest rates depreciates the exchange rate, whereas for very high levels the effect changes sign and higher interest rates appreciate the exchange rate. The latter effect is statistically significant at the 5% level for institutional quality above 0.84. Again, for most levels of institutional quality, the marginal effect is economically relevant. For a country with average institutions of 0.66, raising the interest rate change by 1 percentage point depreciates the exchange rate by an additional 0.08 percentage points.

Panel (C) shows how the marginal effect decreases for higher external debt levels. The graph differs from the others as for most of the range of external debt levels, the marginal effect of monetary policy is negative, i.e. raising interest rates appreciates the exchange rate. However, almost all observations in our sample are located within the left half of the graph. The right half of the graph contains only one observation: the maximum external debt level in our sample (1.58) which corresponds to Indonesia in 1998. Looking at the left half of panel (C) only, the marginal effect is again positive for most external

debt levels and only turns negative for external debt levels above 0.45. For the median external debt level of 0.33, raising the interest rate by 1 percentage point depreciates the exchange rate by an additional 0.05 percentage points.

The upward sloping solid line in panel (D) shows that the marginal effect of monetary policy increases with the degree of capital account openness. The marginal effect is positive for the full range of observations in our sample. For the mean openness level of 0.07, raising the interest rate by 1 percentage point depreciates the exchange rate by an additional 0.06 percentage points.

Finally, we use the results in column (1) of Table 6 to predict the marginal effects of higher interest rates in each of the crisis episodes in our sample. Panel (E) shows the results. The marginal effect is negative in six crisis episodes and positive in all the others. In five of these six crisis episodes, the marginal effect is also statistically significant at 5 percent: Slovakia (1998), South Africa (1998), Philippines (1997), Finland (1991), and Venezuela (1995). This suggests that during these episodes tighter monetary policy to support the exchange rate would have been effective. For four episodes in our sample, the predicted marginal effect of higher interest rates is not statistically significant: Russia (1998), Mexico (1998), Venezuela (2002), and Norway (1986). And for all other crisis episodes, raising the interest rate is expected to depreciate the exchange rate: Brazil (1999), Argentina (2002), Mexico (1994), South Africa (2001), Thailand (1997), Korea (1997), and Indonesia (1997). The result that monetary policy is counterproductive in the majority of episodes in our sample, is consistent with the positive and significant coefficient in column (2) of Table 4 where we did not yet control for any non-linear effects.

Finally, it should be noted that this paper abstracts from some important other channels through which higher interest rates might affect exchange rates. For example, domestic *public* debt might also be important. At the time of writing, public data availability on *short-term* public debt for the countries in our sample was still limited.[38] However, we did investigate the importance of *total* public debt, using a recent dataset by Jaimovich and Panizza (2006). We did not find any significant impact of this measure on the effect of monetary policy. This does not mean that public debt is unimportant but might simply reflect

[38] A dataset that makes a distinction between short-term and long-term government debt was recently constructed by Jeanne and Guscina (2006). At the time of writing, however, this dataset was not yet publicly available.

that it is the short-term component of public debt that matters, rather than total public debt. Other than through public and corporate debt, higher interest rates can also be harmful through the occurrence of credit contractions.

5 Conclusions

This paper has examined four new country-specific characteristics that could be important determinants of the effect of monetary policy on exchange rates during currency crises. In particular, we tested four central hypotheses: (i) raising the interest rate has larger adverse balance sheet effects and is therefore less effective in countries with high domestic corporate short-term debt; (ii) raising the interest rate is more credible and therefore more effective in countries with high-quality institutions; iii) raising the interest rate is more credible and therefore more effective in countries with high external debt; and (iv) raising the interest rate is less effective in countries with high capital account openness.

Using data for a number of currency crisis episodes between 1986 and 2004, we find strong evidence to support our hypotheses. Using our estimation results, we predict that monetary policy would have had the conventional supportive effect on the exchange rate during five of the crisis episodes in our sample, while it would have had the perverse effect during seven other episodes. For four episodes, we predict a statistically insignificant effect. Our results support the idea that the effect of monetary policy depends on its impact on fundamentals, as well as its credibility, as suggested in the recent theoretical literature. They also provide an explanation for the mixed findings in the empirical literature.

Table 1: Episodes of currency crises

Country	Start	End
Argentina	2002:1	2002:10
Brazil	1999:1	1999:5
Finland	1991:11	1993:2
Indonesia	1986:9	1989:2
Indonesia	1997:8	1999:6
Ireland	1986:8	1987:5
Korea	1997:11	1998:7
Mexico	1994:12	1996:8
Mexico	1998:9	1999:4
Norway	1986:5	1988:8
Philippines	1997:9	1997:12
Russia	1998:9	1998:11
Slovakia	1998:10	1999:12*
South Africa	1998:7	1999:3
South Africa	2001:12	2004:6**
Thailand	1997:7	1998:7
Venezuela	1995:12	1996:6*
Venezuela	2002:2	2003:7

*Due to lack of data on money market interest rates in Slovakia (1998-99) and Venezuela (1995-96), we used real non-gold reserves as an alternative indicator of speculative pressure, analogues to the methodology for interest rate spreads. The end date for Venezuela (1995-96) can be explained by Venezuela's Stand-By Arrangement with the IMF in July 1996, which caused a substantial rise in reserves.

**As this episode has not ended yet, we use the most recent month in which data were available.

Note: Slovakia 1993:7 was identified as the beginning of a crisis. This episode is excluded since it is due to the separation of Czechoslovakia into the Czech and Slovak Republic.

Table 2: Monetary Policy Interest Rates

Country	Monetary Policy Interest Rate	Identification	Source of Data
Argentina	Interbank 7 day-middle rate	Other	Datastream
Brazil	Financing overnight-middle rate	Other Studies*	Datastream
Finland	Key tender-middle rate	Central Bank-W	Datastream
Indonesia	SBI 90 day-middle rate	Central Bank-W	Datastream
Ireland	Discount rate	Central Bank-W	Datastream
Korea	Call overnight- middle rate	Central Bank-W	Datastream
Mexico, 1994:12	Cetes 28 day min. auction-middle rate	Central Bank-W	Datastream
Mexico, 1998:9	Cetes 28 day avg. auction-middle rate	Central Bank-W	Datastream
Norway	Daily interbank nominal-middle rate	Central Bank-W	Datastream
Philippines	Interbank call loan rate-middle rate	Other Studies**	Datastream
Russia	Discount (refinancing)-middle rate	Central Bank-W	Datastream
Slovakia	Basic NBS interest rate	Central Bank-W	Central Bank
South Africa	Prime overdraft-middle rate	Central Bank-W	Datastream
Thailand	Repo 14 day-middle rate	Central Bank-W	Datastream
Venezuela	Discount Rate***	Central Bank-W	IFS

Central Bank-W = Central Bank Website; Central Bank-C = Central Bank Contact (email).

* From Furman and Stiglitz (1998)

** from Caporale, Cipollini, and Demetriades (2005)

*** End-of-month monthly series.

Table 3: Summary Statistics

	Obs	Mean	St dev	Min	Max
Dependent variable:					
NE	163	0.03	0.11	-0.24	0.45
RE	163	0.01	0.10	-0.23	0.41
Monetary policy:					
MP	163	0.06	0.33	-0.87	2.04
$DISC$	123	0.03	0.17	-0.27	0.96
MP-domestic	163	0.03	0.24	-0.86	1.45
MP-foreign	163	-0.01	0.04	-0.24	0.09
Fundamentals:					
Debt to total assets	163	0.18	0.09	0.04	0.45
Institutional quality	163	0.66	0.13	0.41	0.87
External debt	163	0.37	0.30	0.01	1.58
Capital account openness	163	0.07	1.00	-1.09	2.07
Exchange rate overvaluation	163	0.02	0.03	-0.04	0.14
Reserves to imports	163	6.22	4.56	0.68	22.14
External payments position	163	1.21	1.72	0.00	6.63
Deviation GDP growth	163	-0.02	0.05	-0.20	0.10
Exports growth	163	0.01	0.14	-0.71	0.43
Imports growth	163	-0.01	0.16	-0.52	0.54
Initial level of spread (MP)	163	0.25	0.42	0.05	4.60
Initial level of spread ($DISC$)	130	0.19	0.16	0.00	0.66

This table reports summary statistics for all variables used in estimation.

Table 4: Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)
MP		0.05*		-0.23***	0.42*	0.43*
		(0.03)		(0.08)	(0.20)	(0.21)
$DISC$	0.14**		0.07			
	(0.05)		(0.15)			
Debt to total assets	-0.23**	-0.10	-0.30*	-0.14	-0.22	-0.24*
	(0.08)	(0.10)	(0.16)	(0.12)	(0.15)	(0.14)
Institutional quality					0.18	0.12
					(0.13)	(0.10)
External debt	0.10**	0.02	0.10*	0.02	0.09	0.05
	(0.04)	(0.04)	(0.05)	(0.04)	(0.07)	(0.04)
Capital account openness	0.02***	0.01	0.02**	0.01	0.01	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exchange rate overvaluation	-0.35	-0.04	-0.30	-0.34	0.06	
	(0.24)	(0.23)	(0.31)	(0.38)	(0.24)	
Reserves to imports	0.00	0.00	0.00	0.00	0.00	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
External payments position	-0.01	-0.00	-0.01	-0.00	-0.00	
	(0.02)	(0.00)	(0.02)	(0.00)	(0.00)	
Deviation GDP growth	0.45**	0.14	0.42	0.12	0.26	
	(0.17)	(0.21)	(0.24)	(0.23)	(0.24)	
Exports growth	-0.07	-0.06	-0.05	-0.06	-0.06	
	(0.04)	(0.04)	(0.06)	(0.05)	(0.04)	
Imports growth	-0.04	-0.06	-0.05	-0.05	-0.04	
	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	
Initial level of spread	-0.01	0.09***	-0.06	0.07***	0.10***	0.10***
	(0.09)	(0.01)	(0.11)	(0.01)	(0.02)	(0.01)
Monetary Policy×Debt to total assets			0.87	2.01***	1.18**	1.25**
			(1.09)	(0.63)	(0.45)	(0.43)
Monetary Policy×Institutional quality					-0.67**	-0.70**
					(0.27)	(0.28)
Monetary Policy×External debt			-0.83*	-0.34	-0.26*	-0.28*
			(0.43)	(0.26)	(0.13)	(0.13)
Monetary Policy×Capital account openness			0.04	0.08*	0.03*	0.03
			(0.06)	(0.04)	(0.01)	(0.02)
Monetary Policy×Exchange rate overvaluation			-0.72	1.16		
			(1.06)	(1.51)		
Monetary Policy×Reserves to imports			0.04	0.01*		
			(0.04)	(0.01)		
Monetary Policy×External payments position			0.05	-0.01		
			(0.23)	(0.01)		
Monetary Policy×Deviation GDP growth			-0.23	-0.12		
			(1.60)	(0.44)		
Monetary Policy×Exports growth			-0.88	-0.44		
			(0.74)	(0.79)		
Monetary Policy×Imports growth			0.74	0.81		
			(0.44)	(0.54)		
Number of observations	123	163	123	163	163	163
Adjusted R-squared	0.21	0.17	0.27	0.25	0.23	0.20

Notes: The dependent variable is NE. Robust standard errors are clustered by crisis episode and are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 5: Estimation Results - Sensitivity Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged exchange rate change			0.12*				0.10
			(0.06)				(0.09)
Time trend		-0.42**				-0.33**	
		(0.14)				(0.13)	
MP		0.42**	0.44*	0.36*		0.34*	0.37*
		(0.19)	(0.21)	(0.19)		(0.17)	(0.18)
MP-domestic	0.65*				0.55		
	(0.34)				(0.32)		
MP-foreign	0.29				-0.64		
	(1.61)				(1.19)		
Debt to total assets	-0.23	-0.19*	-0.21	-0.21	-0.22	-0.18	-0.20
	(0.16)	(0.11)	(0.14)	(0.13)	(0.17)	(0.11)	(0.14)
Institutional quality	0.13	0.17*	0.15	0.21*	0.23*	0.25**	0.22*
	(0.12)	(0.09)	(0.09)	(0.11)	(0.13)	(0.10)	(0.10)
External debt	0.05	0.06	0.05	0.07	0.07	0.08	0.07
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Capital account openness	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Initial level of spread	0.10***	0.10***	0.09***	0.09***	0.09***	0.09***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
MP×Debt to total assets		1.16***	1.12**	1.27***		1.20***	1.15**
		(0.39)	(0.50)	(0.37)		(0.33)	(0.49)
MP×Institutional quality		-0.72***	-0.72**	-0.64**		-0.65**	-0.67**
		(0.24)	(0.29)	(0.27)		(0.24)	(0.26)
MP×External debt		-0.23*	-0.24	-0.23*		-0.19	-0.20
		(0.12)	(0.15)	(0.13)		(0.12)	(0.16)
MP×Capital account openness		0.03**	0.03*	0.03*		0.03**	0.03**
		(0.01)	(0.02)	(0.02)		(0.01)	(0.02)
MP-domestic×Debt to total assets	1.75**				1.84**		
	(0.72)				(0.62)		
MP-domestic×Institutional quality	-1.01**				-0.95*		
	(0.45)				(0.45)		
MP-domestic×External debt	-0.45*				-0.38		
	(0.24)				(0.24)		
MP-domestic×Capital account openness	0.08**				0.08**		
	(0.03)				(0.03)		
MP-foreign×Debt to total assets	1.17				0.26		
	(2.41)				(2.62)		
MP-foreign×Institutional quality	0.49				1.75		
	(1.68)				(1.46)		
MP-foreign×External debt	-0.64				-0.06		
	(2.75)				(2.36)		
MP-foreign×Capital account openness	0.56				0.45		
	(0.32)				(0.27)		
Number of observations	163	163	163	163	163	163	163
Adjusted R-squared	0.26	0.26	0.23	0.18	0.24	0.22	0.20

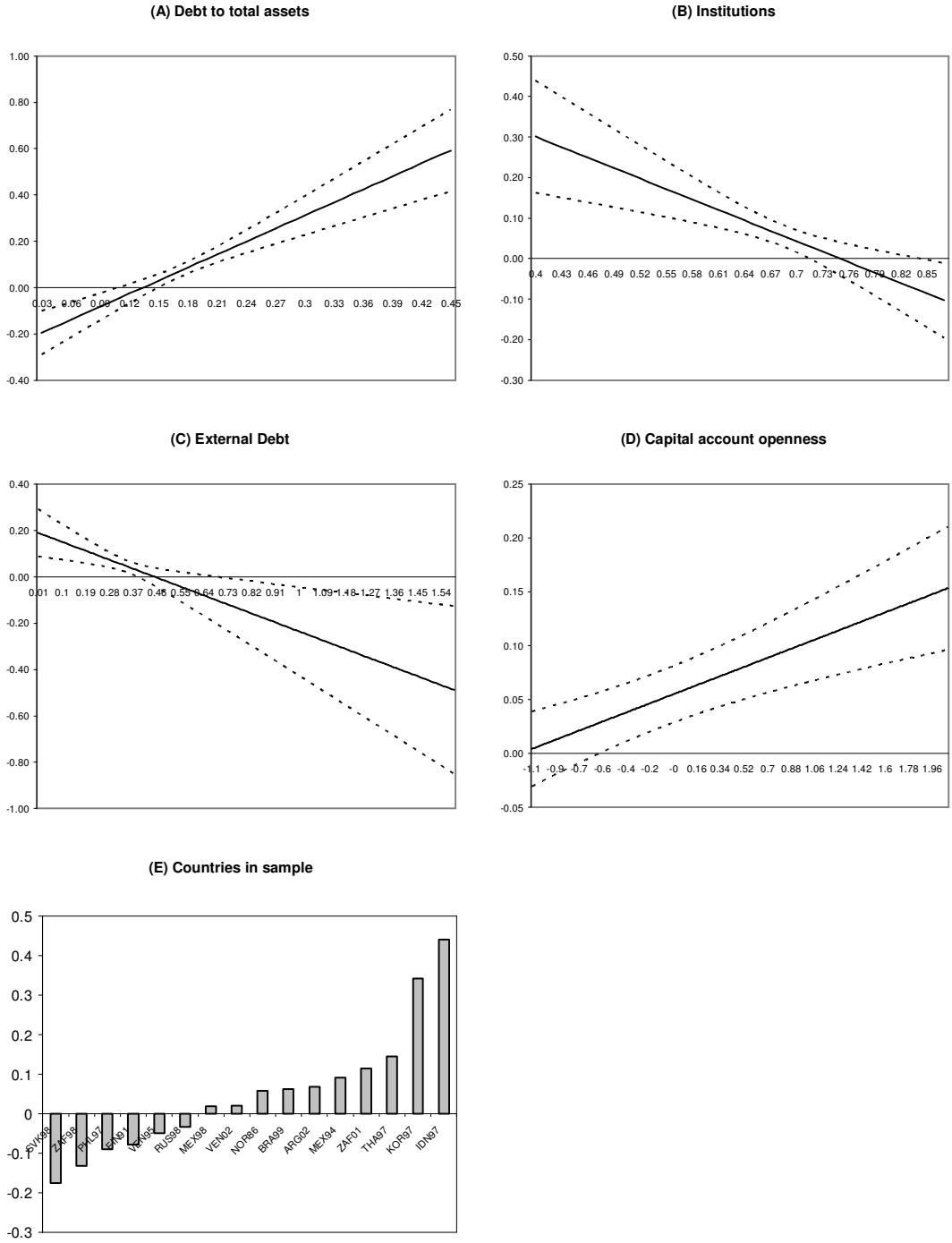
Notes: The dependent variable is NE in columns (1) to (3) and RE in columns (4) to (7). Robust standard errors are clustered by crisis episode and are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 6: Estimation Results - System GMM estimation

	(1)	(2)	(3)	(4)
Lagged exchange rate change		0.16*		0.12
		(0.08)		(0.10)
MP	0.48***	0.51**	0.42***	0.46***
	(0.18)	(0.21)	(0.16)	(0.17)
Debt to total assets	-0.35	-0.53*	-0.42	-0.55**
	(0.38)	(0.28)	(0.33)	(0.24)
Institutional quality	0.00	0.33**	0.31	0.54***
	(0.21)	(0.14)	(0.23)	(0.14)
External debt	0.02	0.11*	0.08	0.14**
	(0.09)	(0.06)	(0.08)	(0.06)
Capital account openness	-0.02	-0.03	-0.02	-0.03
	(0.02)	(0.04)	(0.02)	(0.04)
Initial level of spread	0.09***	0.08***	0.09***	0.08***
	(0.02)	(0.02)	(0.01)	(0.02)
MP×Debt to total assets	1.87***	1.78***	1.78***	1.71***
	(0.32)	(0.53)	(0.35)	(0.55)
MP×Institutional quality	-0.86***	-0.93***	-0.80***	-0.88***
	(0.24)	(0.30)	(0.22)	(0.25)
MP×External debt	-0.43***	-0.38*	-0.36***	-0.34*
	(0.15)	(0.20)	(0.13)	(0.18)
MP×Capital account openness	0.05***	0.05***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)
Number of observations	163	163	163	163
Number of crisis episodes	16	16	16	16
Number of instruments	20	22	20	22
P-value Sargan test	0.71	0.94	0.54	0.87
Arellano and Bond AR(1) test	-1.55	-2.03**	-1.60	-2.20**
Arellano and Bond AR(2) test	-0.74	0.12	-0.78	-0.05

Notes: The dependent variable is NE in columns (1) and (2) and RE in columns (3) and (4). Robust standard errors are clustered by crisis episode and are reported in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. System GMM refers to the Arrelano-Bover (1995)/Blundell-Bond (1998) one-step system GMM estimator. Forward orthogonal deviation transformation is used to eliminate fixed effects. To limit the number of instruments, the instrument sets are collapsed and only the first lags are used in the transformed and the levels equation.

Figure 1: Marginal effect of an interest rate increase for different levels of debt, institutions, external debt, and capital account openness



Notes: Figure 1 is based on Table 7, column (1). Panels (A) to (D) show the marginal effects of an increase in MP for different levels of each of the four fundamentals, when evaluating the other three at the median. Panel (E) shows the predicted marginal effect during each of the crisis episodes, using the episode-specific median levels of the four fundamentals. A value of 0.20 on the vertical axis indicates that raising MP by 1 % point leads to an increase in NE of 0.20 % point.

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