Exchange Rate Regimes and Banking Crises: The Channels of Influence Investigated*

Abstract

We investigate the effects of alternative exchange rate regimes on the probability of banking crises using a new set of classifications from the IMF that allows us to distinguish between hard and soft pegs. We find that this distinction is quite important and helps explain some of the contradictory results of previous studies. We go beyond analysis of the total effects on crises and investigate some of the major mechanisms through which exchange rate regimes can affect a country's susceptibility to banking crises. These are domestic credit growth, net foreign borrowing, and currency crises: we find stronger linkages for the last two channels than the first. We find evidence that the unstable middle hypothesis applies with respect to banking crises as well as currency crises.

JEL Classification: G21; F31; F34
Keywords: Banking Crises; Exchange Rate Regimes; Foreign Borrowing; Domestic Credit Expansion; Currency Crises

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1. Introduction

The currency and banking crises of the past decade or so have generated considerable interest in the possible relationships between exchange rate regimes and crises. While the greater part of the recent debate has focused on the role of exchange rate regimes in generating currency crises, a small literature has examined the relationships between exchange rate regimes and financial (banking) crises. This literature has not found consistent results, however. Empirical studies such as Demaç and Peria (2003) and Husain et al (2005) have found fixed rates to be more prone to banking crises than flexible rates, while Eichengreen and Rose (2000) did not find significant differences across regimes.

A major problem with these studies is that they typically did not distinguish between hard fixes and adjustable pegs, while theory suggests that the differences between these may be quite important. That this distinction may be important empirically is suggested by a later study by Eichengreen (2002) where he does distinguish between hard and soft pegs and finds the former to be substantially more prone to banking crises than the latter. This is the opposite of what we would expect for the relationships with currency crises where the two corners and unstable middle hypotheses argue that adjustable pegs are more crisis prone.

In this study we make use of a recently developed data series from the IMF that provides judgments of the Fund's staff about the exchange rate regimes that countries are following in practice. This is important since a number of studies have shown that countries' actual practice often differ substantially from their official policies.[1] While some of the distinction made in these new IMF classifications can be questioned[2], especially among different forms of managed

[1] For analysis and references, see Fisher (2001), Willett (2007) and Angkinand, Chiu and Willett (2009).
[2] See, for example, the analysis and references in Reinhart and Rogoff (2004) and Willett et al. (2005).

floating, the classification is particularly good on distinguishing hard fixes from soft adjustable pegs, and this is one of our major concerns.

A second issue on which we focus is the ways in which different exchange rate regimes influence a country's susceptibility to banking crises. Most previous studies have focused just on the overall effects of exchange rate regimes on the probabilities of banking crises and have posited quite a number of sometimes conflicting rationales for the relationships (these are reviewed in section 2). We add empirical investigation of three of the most frequently posited channels through which exchange rate regimes may influence measurable variables which in turn have been linked by earlier studies to the frequency of banking crises. These are the growth rate of domestic credit (credit booms), net foreign borrowing (generating possible liquidity and solvency problems), and currency cries which may act as triggers for bank runs (of course, banking crises also frequently generate currency crises as is emphasized in the literature on the twin crises, pioneered by Kaminsky and Reinhart, 1999).

We investigate a set of 114 industrial, emerging market, and developing countries for the period 1990-2003 (the new IMF classifications go back only to 1990). We also compare our results from this data set with the classifications provided by Reinhart and Rogoff (2004), although the later standardly used versions combine some types of hard and soft fixes into a single category. By considering the total effects, we find that as with currency crises, banking crises tend to occur more frequently under intermediate exchange rate regimes than at either corner of the exchange rate spectrum.

In the following section we provide an overview of various arguments which have been put forward about the possible ways in which alternative exchange rate regimes may influence the likelihood of banking crises. Section 3 describes the model specifications and data as well as

discusses our grouping of exchange rate regimes. Empirical results are reported in section 4, and conclusions and policy implications are discussed in the last section.

2. Channels of Relationships between Exchange Rate Regimes and Banking Crises

2.1 Overborrowing Channel

Perhaps the most frequently heard argument relating exchange rate regimes to banking crises concerns the potential for pegged exchange rates to lead the private sector to underestimate the risk of unhedged foreign currency borrowing. The resulting overborrowing due to moral hazard generated by perceptions of government guarantees against major exchange rate changes is frequently pointed to as one of the major causes of the Asian financial crises. Since much of the borrowing tends to be short term and unhedged, this creates a worsened liquidity situation both for the private sector and for the country as a whole.

Of course, such arguments assume that perverse incentives are not fully offset by wise prudential banking regulation, but for many countries this seems a safe assumption. On this view, both pegged rates and hard fixes would generate such incentives. Hard fixes should create greater incentives for unhedged foreign borrowing, but they are also less likely to be changed, so it is not clear a priori which types of regimes would tend to generate greater incentives for excessive foreign borrowing.[3]

The importance of such exchange rate-related moral hazard problems has been the subject of considerable debate. Eichengreen and Hausmann (1999) point out that excessive unhedged foreign borrowing may also be the result of "original sin" due to insufficient trust in the ability of domestic authorities to enforce contracts and avoid national defaults, and/or

[3] Conceptually, the amount of perverse incentive would be measured by the differences between the risk perceived by market actors and the "true" risk.

inflationary bursts. As a result of such considerations both governments and firms may be able to borrow only or primarily in foreign currency when borrowing abroad and sometimes even domestically. While individual actors may be able to obtain cover for such borrowing the country as a whole cannot. This analysis implies that while the moral hazard cause of unhedged borrowing can be addressed by moving to more flexible exchange rates, the original sin problem would obtain under any exchange rate regime. As with moral hazard, the importance of original sin considerations has been the subject of considerable controversy.[4] In recent years there has been substantial in the ability of governments and firms in emerging market countries to issue domestic currency denominated debt, but for most of the sample period covered by our study this was quite difficult for many countries.

Unsurprisingly, the empirical evidence on the impact of exchange rate regimes on banks' foreign borrowing is mixed. Hausmann and Panizza (2003) and Levy-Yeyati (2006) do not find a significant relationship between exchange rate regimes and their measures of the extent of banks' borrowing in foreign-denominated currency and currency mismatches.[5] Demaç and Martinez Peria (2003) find that countries with a pegged regime and high foreign liabilities relative to foreign assets are substantially more likely to have banking crises. A major limitation of these studies is that they use two-way classifications of exchange regimes (fixed versus flexible regimes). Contrary to the standard view, Arteta (2005) finds that floating exchange rate

[4] Some of this has been generated by sometimes posing these as mutually exclusive hypotheses (see for example Hausmann and Panizza, 2003 and the criticism by Willett, 2001).

[5] Recent studies have used different measures of banks' foreign borrowing as well as currency mismatches (between banks' liabilities, which are in foreign-denominated currency, and banks' assets, which are in local currency). Burnside et al (2001) use the ratio of net foreign assets to GDP. Demaç and Martinez Peria (2003) use the ratio of foreign liabilities to foreign assets. Levy-Yeyati (2006) uses the extent of banks' liability dollarization, measured by the ratio of banks' foreign currency deposits to total deposits in local currency as well as the ratio of foreign liabilities to foreign assets. Hausmann and Panizza (2003) construct an index they called Original Sin based on the amount of debt denominated in foreign currency relative to in local currency. Arteta (2005) uses the extent of currency mismatch, measured by the ratio of the difference between dollar deposits and dollar credits to total bank liabilities.

regimes are consistently associated with greater currency mismatches in a sample of developing and transition economies from the early 1990s to 2000. His results are robust to the use of both *de jure* and *de facto* regime classifications. He also uses three-way classifications (fixed, intermediate and flexible regimes) as well as disaggregating a floating regime dummy into managed and independent floats. For the latter, he finds that both managed and independent floats are associated with larger mismatches. Like the other studies reviewed his analysis does not distinguish between hard fixes and soft pegs even when a three way classification is used. The one he uses includes adjustable pegs with fixes rather than intermediate regimes.

2.2 Domestic Credit Boom Channel

The availability of "cheap" funds from abroad can lead to incentives for excessive domestic credit creation by the domestic banking sector, likely leading to an increase in the proportion of loans that turn bad. The relationship between the choice of exchange rate regimes and domestic lending booms, therefore, can be analyzed by applying the arguments from the overborrowing channel. Under pegged or other heavily managed exchange rate regimes large capital inflows are often associated with the balance of payment surpluses. With passive central bank policies the resulting increase in international reserves will increase the monetary base and lead to money and credit expansion. A positive effect of capital inflows on lending booms is not automatic, however, as domestic policies such as sterilization can be an important intervening variable to limit money and credit expansion and there is evidence of considerable sterilization by many emerging market countries (see, Sachs et al, 1996 and Ouyang, Rajan and Willett, 2008).

Empirical studies on the relationships between exchange rate regimes and domestic credit expansion are limited. A few studies have looked at domestic lending for specific groups of

countries and found that booms in bank lending have often occurred in countries with pegged exchange rate regimes (see Sachs et al, 1996 for the crisis-hit countries during the Tequila and Asian financial crises and Hilbers et al, 2005 for Central and Eastern European countries). In a related study, Jeanneau and Micu (2002) focus on the determinants of short- and long-run international bank lending. They find that fixed and intermediate exchange rate regimes in emerging market economies encourage banks in OECD countries to lend to them, while floating regimes lower such lending. They suggest that fixed and tightly managed exchange rate regimes tend to encourage lending flows due to arbitrage between domestic and international interest rates when a government is believed to implicitly guarantee the stability of the exchange rate against large changes.

2.3 Currency Crisis Channel

There has been considerable interest in the interrelationships among twin (banking and currency) crises (e.g. Kaminsky and Reinhart, 1999 and Glick and Hutchison, 2001). In countries with a pegged exchange rate where banks borrow abroad in foreign-denominated currency and lend in local currency, this currency mismatch can cause an expected depreciation of the domestic currency to lead to bank runs.[6]

We have considerable reason to believe that soft pegs make currency crises more likely, especially for countries that face substantial international capital mobility. This is the unstable middle hypothesis. Political considerations tend to induce governments to delay adjusting such pegs until after the market has begun to see them as having become substantially over- or

[6] Note, however, that while currency devaluation associated with overborrowing in foreign-denominated currency was clearly one of the major causes of the 1997 banking crises in Asia, Kaminsky and Reinhart (1999) and Glick and Hutchison (2001) find that in general banking crises increase the probability of currency crises, but not vice versa. Their findings, however, are based on a sample from 1970-1995 and from 1975-1997, respectively. In the Asian crises there was considerable causation running from currency to banking crises as well (see Willett et al, 2005).

undervalued (see Willett, 2007). In such situations while market participants will not know whether there will be an adjustment or the peg in the next period, they know in which direction the rate will go if there is a change. This creates the famous "one way speculative option" that creates incentives for both hedgers and speculators to move money out of countries with overvalued pegs. There is considerable debate, however, about how far away from the dead center of adjustably pegged exchange rate regimes one has to go to substantially reduce the probability of currency crises. The two corners or bipolar hypothesis, which holds that one needs to go all the way to one or the other of the extremes of hard fixes or floating rates, is not strongly supported by the data, but the high crisis propensity of soft pegs is confirmed (see Angkinand, Chiu and Willett, 2009).

2.4 Additional Linkages

Another important channel for possible relationships between exchange rate regimes and financial crises involves issues of bailouts and the lender of last resort function. One argument is that bank runs will be more likely under hard fixes because there will be less (and perhaps even no) scope for national lender of last resort activities. The counter argument is that for this very reason, greater market discipline and improved bank risk management practices would be imposed on the banking sector. As a result, excessive risk taking incentives and financial instability would be lessened under hard fixes. In addition, there is the debate over the possible macroeconomic discipline effects of (hard) fixed exchange rates.[7] Sounder macro policies should reduce the frequency of banking crises.

The role of national and international bailouts in both preventing and generating serious crises has likewise been the subject of much controversy. For example, Dooley (2000) suggests that the prospects of international bailouts were a major cause of the capital inflow surges to

[7] For analysis and references to the literature on this topic, see Willett (1998) and (2000).

developing countries in the 1990s and the subsequent currency and financial crises. Nonetheless, Eichengreen and Hausmann (1999), Radelet and Sachs (1998), and Willett et al. (2005) all present evidence suggesting that Dooley's argument is not persuasive as the major story line, although it quite likely has some explanatory power.

Miller (2003) makes the argument that flexible rates can make bank runs less likely than under fixed rates. She assumes away government bailouts through taxation or borrowing, leaving bank failures or inflation as the only possible policy responses to a bank run. She plausibly argues that the inflation option is more likely under flexible than fixed rates. Since being toward the head of the queue brings benefits in the case of bank failure, but not with inflation responses, she concludes that there are less incentives for bank runs to start under flexible than under fixed rates. While admiring the ingenuity of this argument, we should perhaps not put too much faith in its explanatory power. Financial crises typically are accompanied by higher inflation, but government bailouts by both taxation and borrowing are often quite substantial as well.[8]

Our review of a number of arguments concerning possible linkages between different exchange rate regimes and the frequency of financial crises indicates that there are a number of conflicting considerations. This makes it difficult, if not impossible, to draw strong prior conclusions about the likely correlations between financial crises and alternative exchange rate regimes. This is clearly an empirical issue to whose investigation we now turn.

3. Model Specification and Data

3.1 Methodology

In our empirical investigation we estimate the overall effects of different exchange rate regimes on the frequency of banking crises and then break down these total effects into those

[8] See, for example, Hoggarth et al. (2002).

which we can identify with the three potential channels that we investigate and the residual effects which if the model could be estimate precisely would reflect the effects through other channels.

To examine potential channels of exchange rate regimes on the likelihood of banking crises, we estimate a logit model using the following model specification. [9]

$$L_{i,t} = \ln\left[\frac{P_{i,t}}{1-P_{i,t}}\right] = \alpha_0 + \sum_{j=1}^{5} \alpha_j \text{regime}_{j,i,t-1} + \beta_1 \text{net foreign liabilities}_{i,t-1} + \beta_2 \text{credit growth}_{i,t-1} + \beta_3 \text{currency crisis}_{i,t-1} + \delta_k x_{k,i,t-1} + \varepsilon_{i,t} \quad (1)$$

, where $P_{i,t}$ = Prob(banking crisis$_{i,t}$ = 1 | X)=1/(1+e$^{-(X)}$)

Banking crisis$_{i,t}$ is a banking crisis dummy variable, which takes a value of one in the first year of banking crises for country *i* in year *t*, and zero if there is no crisis. Crisis observations following the onset of banking crises are excluded from the estimation to alleviate the problem of reverse causality. Banking crises dates and definitions are taken from Caprio and Klingebiel (2005). Regime$_j$ is an exchange rate regime dummy, where *j* indicates one of six categories: hard pegs, adjustable parities, crawls, tightly managed floats, other managed floats, and independent floats (discussed below). One regime must be dropped from the regression to avoid perfect-multicollinearity so that the coefficients reflect the probability of crisis under the jth regime compared with an omitted regime.

[9] The estimation uses the robust clustering of the standard error of estimates by country to reduce the problem the lack of independent observations in the analysis. Country fixed effects are not introduced in the logit regressions because by controlling for country dummies, countries not having experienced any banking crisis during the period of study (i.e. countries that have only 0s on the dependent variable) are automatically dropped from estimations. This is because they provide no information for the likelihood. As a result, the sample is automatically limited to only countries that experienced at least one crisis, which may bias the results. In addition, we use lagged channel proxies to reduce the problem of unobserved components. This problem occurs when a banking crisis and net foreign liabilities (or credit growth or currency crisis) at time *t* are jointly determined by unobserved factors, which will lead to omitted variable bias. Lagged channel proxies can also be considered as instrumental variables since they are pre-determined and uncorrelated with $\varepsilon_{i,t}$.

We investigate three potential channels through which exchange rate regimes may influence banking crises. Net foreign liabilities relative to GDP is used to proxy the extent of banks' foreign borrowings.[10] As is common in the literature, credit growth is measured as the growth rate of the ratio of domestic private credit relative to GDP and is used to capture the domestic credit boom channel. Currency crisis is a standard type of currency crisis dummy drawn from Glick and Hutchison (2001) and is based on large changes in exchange rates and/or international reserves. Using the combination rather than just changes in exchange rates allows the inclusion of large speculative attacks that proved unsuccessful. It takes a value of one in a year that a currency crisis occurs and zero otherwise. The correlation coefficient between net foreign liabilities and credit growth is 0.027, and the correlations between these two variables and the currency crisis dummy are 0.042 and 0.023, respectively. The low correlations among these three variables suggest that we can identify different changes through which exchange rate regimes affect the probability of banking crises.

Table 1 reports the basic statistics and frequency distributions among banking crises, the three proxies for possible channels and different exchange rate regimes. Since data availability varies across countries and time, the reported basic statistics are based on the consistent number of observations used in the regression analyses in the next section. The data in the Panel B suggests a positive relationship between banking crises and net foreign liabilities, credit growth and currency crises, with the extent of the relationships varies across country groups. For example, many emerging and other developing countries which on average had been creditors (i.e. holding net foreign assets) over the sample period became debtors in a year prior to the onset of a banking crisis (the last two columns of Panel B).

[10] The ratio of net foreign liabilities to GDP does not directly capture banks' overall foreign exchange exposure because some of these positions may be hedged. Data is not generally available to correct for these problems, however.

The data in Panel B also shows that all three variables show a substantial difference under hard fixes versus adjustable pegs. Countries with hard pegs are on average associated with lower net foreign liabilities relative to GDP (indeed on average, they hold positive net foreign assets), lower domestic credit growth, and a lower frequency of currency crises than those with adjustable pegs, but with no clear pattern across different country groups. Intermediate regimes (soft pegs, crawls and tightly managed floats) on average are associated with higher credit growth and frequency of currency crises than the corner regimes, and hard pegs are associated with higher net foreign assets relative to GDP than other regimes.

[Table 1 here]

The additional control variables (x) in banking crisis regressions include real GDP per capita, real GDP growth rate, inflation, real interest rates and deposit insurance coverage. This is a standard set used in the literature. The data descriptions and sources of all variables in the regressions are reported in the Data Appendix A. $\varepsilon_{i,t}$ is the error term.

Next, we investigate the extent to which exchange rate regimes may influence any or all of the three mediating variables by estimating the three model specifications. We use a country-fixed effects model to estimate the effects of exchange rate regimes on banks' foreign borrowings and credit growth[11], and use a logit model for the effect on the probability of currency crises. The general form of the model specification is defined as follows:

$$\text{Channel proxy}_{i,t} = \alpha_0 + \sum_{j=1}^{5} \gamma_j \text{regime}_{j,i,t-1} + \delta_k z_{k,i,t-1} + \mu_{i,t} \qquad (2)$$

[11] We also considered using OLS in estimating the pooled cross-section time-series data instead of country fixed effects (because when considering the total effects, we do not include country dummies in banking crisis regressions where the logit model is employed; doing so would throw countries without any banking crises out of the sample, thereby potentially biasing the results). We tested the effect of the fixed effects model using a restricted F-test with the pooled regression model as the baseline for comparison. The F-values are highly significant (p-value = 0.000), suggesting the use of fixed effects over the pooled regression. In addition, the Hausmann test suggests the use of fixed over random effects models for both the net foreign liabilities/GDP and credit growth regressions.

The channel proxy variable refers to one of the three mediating variables: foreign borrowing, credit growth or currency crises. The control variables (z) include the real GDP per capita, real GDP growth and inflation rate. The ratio of the current account to GDP and money supply to reserves are also included in the currency crisis regressions. All independent variables are lagged by one year.

The influence of different exchange rate regimes on banking crisis probabilities through any of these channels needs to be considered if the choice of exchange rate regime significantly affect an channel proxy (i.e. $\gamma_j \neq 0$), and if these proxies significantly predict the onset of banking crises after controlling for the regimes (i.e. $\beta_1 \neq 0$, $\beta_2 \neq 0$, $\beta_3 \neq 0$ in the equation 1). In other words, the total effects of exchange rate regimes on the likelihood of banking crises are the summation of the estimated channel and unidentified effects, or

$$\text{Total effect} = \alpha_j + \gamma_j \beta_M, \quad \text{where } M = 1, 2, 3 \text{ for each of the three channel proxies} \qquad (3)$$

For the sample coverage, we consider all banking crisis episodes identified in Caprio and Klingebiel (2005) during the period from 1990 to 2003.[12] The period of study is limited by the availability of the BOR's exchange rate regimes classifications. After excluding missing observations for macroeconomic and financial variables, the sample in our dataset comprises 58 banking crisis episodes in 114 countries: 20 industrial, 28 emerging market and 66 other developing countries.[13] Of these 58 episodes, 43 of them are classified as systemic banking crises.

3.2 Exchange Rate Regime Classifications

[12] There are 97 banking crisis episodes in 23 industrial, 32 emerging markets and 127 other developing countries from 1990 to 2003.
[13] See the Data Appendix B for the list of countries.

The basic data for exchange rate regimes is taken from Bubula and Otker-Robe (2003), BOR hereafter. They improve the old IMF *de jure* exchange rate regimes by classifying *de facto* exchange rate regimes based on both quantitative data and available information contained in IMF staff and country reports, along with other relevant resources such as press reports and news articles. The BOR's exchange rate regimes are classified into 13 sub-categories and available for all IMF member countries over the period 1990-2003. Following the analysis in Angkinand, Chiu, and Willett (2009) we regroup BOR's 13 categories of exchange rate regimes data into six groups (see also Data Appendix A): (1) Hard Pegs, (2) Soft Pegs (Adjustable Parities), (3) Crawls, (4) Tightly Managed Floats, (5) Other Managed Floats, (6) Independent Floats.

There is no unambiguously best way to group the regimes, but we believe that our breakdown is sensible. The rationales for our alternative breakdowns are as follows. Hard pegs include regimes of dollarization, currency unions, and currency board arrangements. A horizontal band, while offering somewhat more flexibility than a narrow band adjustable peg, would seem closer to the adjustable peg than to various types of crawling pegs and bands; therefore we include both wide and narrow bands to all adjustably fixed parities.

The various types of crawling pegs and bands form another type of natural grouping. However, close analysis of the role of exchange rate regimes in the Asian crisis revealed that *de jure* managed floats were often operated as *de facto* crawling bands and that for countries such as India, Indonesia, and Singapore, it was quite difficult to judge whether crawling bands or managed floats were better descriptions (see Willett et al. 2005).

The IMF's new *de facto* classification has three types of floats: tightly managed, other managed and independent floats in what are described as descending order of management, but the analytical basis for their distinctions is not clear and their conclusions sometimes conflict

with the classification system of Reinhart and Rogoff (2004) and other analysts. Furthermore, there is no general agreement on whether managed floats should be considered intermediate or corner regimes.[14]

We broadly refer to a group of adjustable parities (or soft pegs), crawls and tightly managed floats as intermediate regimes, with hard fixes as one corner and other managed and independent floats as the other corner. To test for the robustness of our results, we also use the regime classifications from Reinhart and Rogoff (2004) (see Data Appendix A for our groupings of regimes based on Reinhart and Rogoff's classifications).

4. Empirical Results

Tables 2-5 examine the total effects of exchange rate regimes on the probability of banking crises. Table 2 reports the estimation results from the equation 1 and Tables 3-5 from equation 2 for each of the three channel proxies. Results reported in these tables are the marginal effects. For exchange rate regime dummy variables, the marginal effect is the effect of the change in a value of the dummy variable from 0 (an omitted dummy) to 1 on the dependent variable.

Table 2 reports the effects of exchange rate regimes and the proxies for the three channels on the onset of banking crises after controlling for a number of standard variables. Column 1 shows the results based on all (systemic and borderline) banking crisis episodes, and Column 2 gives the results based only on systemic banking crises. While the relationships between regimes and banking crises may differ by country groups[15], due to the limited number of banking crisis

[14] Our intuition is that heavily managed floats should be classified as intermediate and lightly managed floats (defined as other managed floats according to BOR's classifications) should be classified at the corner, but there are no generally agreed-upon criteria for making this distinction.
[15] See Husain et al (2005).

observations in each country group under each regime type (see the Panel A, Table 1), we could not run separate regressions for each country group. As an alternative to investigate whether the channel effects vary across different group of countries, interaction terms between a channel effect proxy and dummy for emerging markets and developing countries are included in Columns 3 and 4.

The omitted exchange regime dummy in Table 2 is hard fixes. The results in Column 1 suggest that moving from hard fixes to other managed floats (independent floats) reduces the probability of the onset of banking crises by 4.8% (5.7%) a year. Since the unconditional average probability of a crisis in the sample is 5.4% (Table 1), this is quite a large reduction. Adjustable parities and crawls also have negative coefficients, but these are not significant. We also test for the significance of differences in the banking crisis probabilities for other pairs of regimes (i.e. between adjustable parities and crawls, adjustable parities and tightly managed floats, and so on; see Appendix C and more discussion below). The only significant difference found was for the flexible regimes (other managed and independent floats), which had lower probabilities of banking crises than both hard pegs and intermediate regimes. These findings on the total effect of regimes on the probability of banking crises are broadly consistent with Demaç and Peria (2003) and Husain et al (2005). While they find that fixed regimes are more prone to banking crises than flexible regimes, our results do not suggest that banking crisis probabilities would be lowered substantially by moving toward "more" flexible rates within the flexible category. A Wald chi-square test for the equality of the coefficients of other managed and independent floats cannot be rejected (Columns 1 and 2).

In Table 2, the coefficient of the ratio of net foreign liabilities to GDP is significant in all regressions with only moderate variation in the coefficients. Its positive sign indicates increased

currency risk exposure of banks through an increase in a country's net foreign liabilities, or decreased net foreign asset holdings, make a banking crisis more likely. One might question, however, whether a fall in net assets would increase the risk of a crisis as much as an increase in net liabilities. Thus we also tested for whether reductions in net foreign assets have the same effects as increases in net liabilities (see Appendix D). We find that indeed where countries have net foreign liabilities the effects of changes in these are much larger than for countries with net assets. The estimates suggest that changes in net assets do have an effect but one that is only about half as big as changes in net liabilities. Such estimates strike us as quite plausible.

The growth rate of the ratio of private domestic credit to GDP (Credit growth) has the expected positive sign, but is significant only when country group dummies and their interaction terms are included (Columns 3 and 4 in Table 2). The findings that net foreign liabilities are robustly significant, but that domestic credit growth is not, suggest that heavy foreign borrowing can increase vulnerability even when it does not generate excessive credit growth.[16]

The lag of the currency crisis dummy has the expected positive sign in all regressions but is significant only in Columns 1 and 4. In separate regressions (not shown), when we included both lagged and contemporaneous currency crisis dummies together, the coefficients of both dummies were significant at the conventional levels in all model specifications. While this helps explain the strong association between banking and currency crises, or twin crises, it does not tell us the direction of causality. We interpret our results as suggesting that exchange rate regimes

[16] The less frequent significance of credit growth is not due to high correlation with net foreign liabilities. The correlation coefficient between these two variables is 0.049.

likely have an important impact on the banking crises through their effects on the probabilities of currency crises.[17]

In Columns 3 and 4, Table 2, the signs of the interaction terms indicate that increased net foreign liabilities, credit growth, and currency crises all have larger impacts on the probability of banking crises in industrial countries than in emerging market and other developing countries. These results for industrial countries, however, are based only on seven banking crisis episodes during the collapse of the European Monetary System (EMS) and Scandinavian banking crises of the early 1990s. Thus we are hesitant to generalize from these. The indirect channel effects are not significantly different between emerging markets and other developing economies according to the Wald test for the equality of the coefficients reported in the same columns. Therefore in Tables 3-5, we report results only for the total sample and for nonindustrial countries.

With respect to the macroeconomic control variables, we find that countries experiencing economic slowdowns and high real interest rates are significantly more likely to face systemic banking crises (Columns 2 and 4, Table 2). For other control variables, real GDP per capita and inflation rates have the expected signs in all regressions and are significant in some. Deposit insurance coverage has a positive sign, but is not significant.[18]

[Table 2 here]

Next, we estimate the equation 2 by regressing the net foreign liabilities/GDP, credit growth, and currency crisis dummy on our exchange rate regime dummies and economic control variables. The results are reported in Tables 3-5. Similar to Table 2, we want to examine whether

[17] The contemporaneous regression coefficient on currency crises, however, will overstate the importance of the effect of currency crises on banking crises unless there is no causation running from banking to currency crises. This condition certainly does not hold.

[18] High deposit insurance coverage is expected to increase moral hazard and can lead to a higher likelihood of banking crises if this effect is stronger than the effects of the insurance in reducing the incentives for bank runs by depositors who are covered. Many studies also argue that moral hazard created by deposit guarantees also exists in countries with an absence or very low coverage of deposit insurance (see Angkinand and Wihlborg, 2009).

these relationships are different across country groups, such a test could be performed either by including country group dummies or by running separate regressions. Neither alternative can be employed uniformly in all three channel effect regressions, however. The net foreign liabilities/GDP and credit growth regressions are estimated using the country-fixed effects panel model; therefore, country group dummies cannot be included due to perfect multicollinearity. Regressions for each country group cannot be run separately due to the limited number of observations, particularly for the sample of industrial countries.[19] As an alternative, we report in Tables 3-5 the results based on a sample of nonindustrial countries (emerging markets plus developing countries) in addition to those from the overall sample.[20] As discussed below, since the results for this subsample are similar to those using the overall sample, but with larger coefficients, we generally analyze the total effects based on the overall sample.

The effects of the exchange rate regimes on domestic credit growth are also shown, although the effect of credit growth on banking crises is less robust (from Table 2). In each table, we report five regression results to compare the effects among the six types of regimes (control variables are not reported). Each of the six regime dummies is dropped in turn to avoid the problem of perfect multicollinearity. The reported results have two purposes. First, the predicted crisis probability under each regime can be directly compared to that of an omitted regime based on the reported marginal effects. Second, the statistical significance of the differences in the

[19] Including country group dummies or running separate regressions for each country group generally do not affect the main findings. As an example, the coefficients of exchange rate regimes dummies in the currency crisis regressions in Table 5 are similar to those reported in the Appendix E where country groups dummies are included in the sample specificiation of the currency crisis regression.

[20] We do not distinguish the results for the channel effects between emerging markets and other developing countries because the total effects of these two country groups are not significantly different from each other (see Table 2).

average probability of crises under each regime compared to an omitted regime is shown by the p-value in parentheses. [21]

Table 3 reports the results for the impact of exchange rate regimes on the ratio of net foreign liabilities to GDP. We find that net foreign liabilities relative to GDP are highest under adjustable parities and crawls. From Column 1, the significant positive coefficients of the regime dummies (with hard pegs being omitted) indicate that hard pegs are associated with the average ratio of net foreign liabilities to GDP 3.8 and 4.5 times lower than adjustable parities and crawls, respectively. For the flexible corner, the significantly negative coefficients of the tightly managed, other managed and independent floats in Columns 2 and 3 suggest that the net foreign liabilities to GDP ratio under these regimes are 1.1, 1.3 and 1.3 times lower than that under adjustable parities, and 1.8, 2.0 and 2.0 times lower than that under the crawling regimes, respectively.

Results for the nonindustrial countries are similar, but with larger magnitudes of the marginal effects. These findings contradict the view that less exchange rate variability is associated with higher incentives for foreign borrowings. It may be that the limited lender of last resort function under hard fixes generates greater market discipline and improved risk management of banks. This could explain the reduced net foreign liabilities of banks. The last two columns in this table show that there are no significant differences in crisis probabilities among the three types of floats.

[Table 3 here]

[21] An alternative for tests for inference is by performing a Wald test for the equality of coefficients (in Table 2). Both methods give similar results.

The regressions reported in Table 4 suggest that the effects through domestic credit growth are weak. In this table, other managed and independent floats are associated with the lowest domestic credit growth. There is no significant difference between these two regimes.

[Table 4 here]

In Table 5 we investigate the effects of exchange regimes on banking crises through the channel of currency crises. As in our earlier research (Angkinand, Chiu and Willett, 2009) we find that the probabilities of currency crises are substantially higher among intermediate regimes, with adjustably pegged regimes being a major contributor as suggested by the unstable middle hypothesis. When using the total sample, the results show that switching from an adjustable peg to hard pegs significantly reduces the probability of crises by 7.1% a year. The currency crisis probabilities are reduced by 5.2% a year if a country switches from an adjustable peg to a crawl, and by 8% and 9.6% per year by moving from an adjustable peg to other managed and independently floating regimes. These are all very large changes. We do not find statistically significant differences of the effects on currency crises between other managed and independent float regimes. Thus while we find support for the unstable middle hypothesis that adjustable pegs are the most crisis prone regime, we do not find support for the portion of the bipolar hypothesis that argues one must go all the way to floating rates to substantially reduce the risks of crises.

[Table 5 here]

In Table 6, we check the robustness of our results by using different classifications of exchange rate regimes. We regrouped Reinhart and Rogoff's fourteen fine exchange rate regimes into seven broad categories: hard pegs, adjustable parities, crawls, moving bands, managed floats, freely floats, and freely falling (see Data Appendix A).[22] We do not find significant differences on the banking crisis probabilities across exchange rate regimes when using Reinhart

[22] See Willett et al. (2006) for Reinhart and Rogoff's regime classifications and their limitations.

and Rogoff's classifications (not reported), but we find some differences when we estimate the channels of foreign borrowing and currency crises. Not surprisingly, when we followed Reinhart and Rogoff's strategy of putting high inflation flexible rate countries into a separate category of freely falling rates, the results show that freely falling regimes are associated with relatively high net foreign liabilities relative to GDP (the upper panel in Table 6) and the highest probability of currency crises (the lower panel). Except in comparison with the free falling regime, the results using Reinhart and Rogoff's classifications are generally consistent with the previous findings supporting the unstable middle hypothesis. However, the intermediate regimes that are associated with the highest net foreign liabilities and probabilities of currency crises are moving bands.

[Table 6 here]

5. Concluding Remarks

Using a new set of behavior classifications of exchange rate regimes developed by the IMF we have been able to show the importance of distinguishing among a wider variety of regimes than just fixed versus flexible rates in studying the relationships between exchange rate regimes and banking crises. The results support our view that it is particularly important to distinguish between hard and soft pegs.

Our main findings on the total effects of the exchange rate regimes on the probability of banking crises are summarized in Table 7. We find that the effects of exchange rate regimes operating through their influence on net foreign borrowing and the frequency of currency crises explain an important part of the total effects while effects through the credit boom channel are less important. We find that intermediate regimes are associated with a higher likelihood of

banking crises. These results suggest that the unstable middle hypothesis applies to banking crises as well as to currency crises. Our results also suggest that it is not necessary to move all the way from the middle to the flexible corner to substantially reduce the probabilities of banking crises. This is consistent with our earlier research on currency crises.

[Table 7 here]

Several lines of further research seem especially important. One is to investigate alternative measures for credit booms to test whether our finding of only a weak link between exchange rate regimes and credit growth holds up. A second area is to investigate whether some types of capital inflows increase the probability of financial crises more than others as may be suggested by recent findings that some types of capital flows are more susceptible to sudden stops and reversal than others.[23] It is also important to investigate how much strong international reserve positions can reduce the probabilities of financial as well as currency crises. Another possibility is to unbundle the currency crises dummy to see if there are different effects from successful versus unsuccessful currency attacks.

A final line of research is to investigate the roles of various political and institutional variables. For example, Chiu and Willett (2009) find that while proxies of political weakness increase the probabilities of currency crises under any type of exchange rate regime, these effects are especially strong for soft pegs. This suggests both a direct linkage with financial crises through the currency crisis channel and also the possibility of such interaction effects with other institutional variables such as capital controls, various types of domestic financial liberalization, and the quality of financial regulation and supervision.

[23] See the analysis and references in Sula and Willett (forthcoming).

Appendix A. Variable Descriptions

Banking Crisis Dummy

The dummy for the onset of a banking crisis equals 1 in the first year of each banking crisis episode, and 0 otherwise. Banking crises include systemic and nonsystemic (smaller or borderline) crisis episodes. A systemic banking crisis is defined as the situation when much or all of bank capital is exhausted, while a nonsystemic or smaller banking crisis is identified when there is evidence of significant banking problems such as a government intervention in banks and financial institutions. Source: Caprio and Klingebiel (2005)

Currency Crisis

We use the data for currency crisis episodes from Glick and Hutchison (2001). For a sample of countries and time periods, which are not covered in their studies, we construct currency crisis index following their methodology. They construct the EMP index from a weighted average of monthly real exchange rate changes and international reserve losses. A crisis is identified when the EMP index exceeds two times country-specific standard deviation plus country-specific mean. The crisis window (whether the large value of the EMP is counted as the same or new crisis) is 24 months.

Exchange Rate Regimes

This paper uses the classification of exchange rate regimes from two sources. The main source is the IMF *de facto* exchange rate regime classifications, compiled by Bubula and Otker-Robe (2003). Their data is available from 1990-2003 and is published on the IMF website at: http://www.imf.org/external/pubs/ft/wp/2003/wp03223.pdf.

The exchange rate regimes are divided into thirteen categories: (1) dollarization, (2) currency unions, (3) currency boards, (4) conventional fixed peg to a single currency, (5)

conventional fixed peg to a basket, (6) horizontal band, (7) forward looking crawling peg, (8) backward looking crawling peg, (9) forward looking crawling band, (10) backward looking crawling band, (11) tightly managed floating, (12) other managed floating with no predetermined exchange rate path, and (13) freely floating rates

Based on these thirteen categories, we use a six-way grouping in this paper: *hard pegs (1-3), adjustable parities (4-6), crawls (7-10), tightly managed floats (11), other managed floats (12), and floats (13)*.

The second source of regimes data is from Reinhart and Rogoff, R-R, (2004). The original and updated data can be downloaded from the website: http://terpconnect.umd.edu/~creinhar/Papers.html. Their fourteen categories of exchange rate regimes are: (1) No separate legal tender, (2) Pre announced peg or currency board arrangement, (3) Pre announced horizontal band that is narrower than or equal to +/- 2%, (4) De facto peg, (5) Pre announced crawling peg, (6) Pre announced crawling band that is narrower than or equal to +/- 2%, (7) De facto crawling peg, (8) De facto crawling band that is narrower than or equal to +/- 2%, (9) Pre announced crawling band that is wide than or equal to +/- 2%, (10) De facto crawling band that is narrower than or equal to +/- 5%, (11) Moving band that is narrower than or equal to +/- 2% (i.e., allows for both appreciation and depreciation over time), (12) Managed floating, (13) Freely floating, and (14) Freely falling.

Following other studies, in this paper we group R-R's fine fourteen regimes into seven regimes: *hard pegs (1-2), adjustable parities (3-4), crawls (5-10), moving bands (11), managed floats (12), freely floats (13) and freely falling (14).* A difficulty with the R-R classifications is that their second category does not distinguish between hard and soft pegs.

Economic Variables

Net foreign liabilities/GDP: Foreign liabilities less foreign assets by deposit money banks, which comprise commercial banks and other financial institutions (exclude foreign assets and liabilities by monetary authorities[24]) relative to GDP. Source: International Financial Statistics

Credit Growth: The growth rate of the ratio of domestic credit to private sector to GDP. Source: World Development Indictors (WDI)

GDP/ Cap: Real GDP per Capita (the data is constant 2000 US$). Source: WDI

GDP Growth Rate: Real GDP growth (%). Source: WDI

Inflation: the difference in the natural logarithm of Consumer Price Index (CPI). Source: CPI is from WDI.

Deposit Insurance (DI) Coverage: The natural logarithm of one plus the ratio of deposit insurance coverage per deposit per capita. Source: the coverage per deposit per capita ratio is from Demirgüç-Kunt, et al. (2005).

[24] For India and China, net foreign liabilities include those held by monetary authorities (net foreign liabilities held by deposit money banks alone are not available).

Appendix B. List of Countries

Industrial	Emerging Markets [a]		Other Developing Countries		
Australia	Argentina	Poland	Albania	Ethiopia	Mongolia
Belgium	Brazil	Russia	Algeria	Fiji	Mozambique
Canada	Bulgaria	Singapore	Angola	Gabon	Nepal
Denmark	Chile	South Africa	Armenia	Gambia	Nicaragua
Finland	China	Sri Lanka	Azerbaijan	Georgia	Panama
France	Colombia	Thailand	Bangladesh	Guatemala	Papua New Guinea
Germany	Ecuador	Turkey	Belarus	Guyana	Paraguay
Iceland	Egypt	Venezuela	Bhutan	Haiti	Saudi Arabia
Ireland	Hong Kong		Bolivia	Honduras	Sierra Leone
Italy	Hungary		Botswana	Jamaica	Slovak Republic
Japan	India		Brunei	Kenya	Slovenia
Netherlands	Indonesia		Burundi	Kuwait	Solomon Islands
New Zealand	Israel		Cameroon	Kyrgyz Republic	Swaziland
Norway	Jordan		Cape Verde	Laos	Tanzania
Portugal	Korea		Central Africa	Lithuania	Trinidad and Tobago
Spain	Malaysia		Chad	Macedonia	Uganda
Sweden	Mexico		Congo, Republic	Madagascar	Ukraine
Switzerland	Nigeria		Costa Rica	Malawi	Uruguay
United Kingdom	Peru		Cote d´Ivoire	Maldives	Vietnam
United States	Philippines		Dominican Republic	Malta	Yemen
			El Salvador	Mauritius	Zambia
			Estonia	Moldova	Zimbabwe

[a] The sample of emerging market economies is drawn largely from Fischer (2001) who places countries in this group based on J.P. Morgan's Emerging Markets Bond Index Plus (EMBI+) and the Morgan Stanley Capital International Index (MSCI). We also include Hong Kong and Singapore, which are classified as advance economies in Fischer, in our sample of emerging market countries.

Appendix C. Table 2A The effect of exchange rate regimes on banking crises

	Omitted regime				
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Tightly Managed	5) Other Managed
Hard pegs$_{t-1}$		0.028 (0.122)	0.009 (0.690)	-0.011 (0.719)	0.048 (0.006) **
Adjustable parities $_{t-1}$	-0.028 (0.122)		-0.019 (0.299)	-0.039 (0.153)	0.020 (0.121)
Crawls $_{t-1}$	-0.009 (0.690)	0.019 (0.299)		-0.020 (0.512)	0.039 (0.031)**
Tightly Managed $_{t-1}$	0.011 (0.179)	0.039 (0.153)	0.020 (0.512)		0.059 (0.036)**
Other Managed $_{t-1}$	-0.048 (0.006)**	-0.020 (0.121)	-0.039 (0.031)**	-0.059 (0.036)**	
Independent Float $_{t-1}$	-0.057 (0.001)**	-0.029 (0.010)*	-0.048 (0.005)**	-0.068 (0.011)**	-0.009 (0.321)

No. of observations = 1085; Prob > Chi-Square = 0.000

The regressions in this Table include the same set of control variables as in column 1, Table 2, but not reported. Also see note in Table 2.

Appendix D. Table 2B The effect of exchange rate regimes on banking crises

	1) all BC	2) all BC
Only net foreign liabilities $_{t-1}$	0.659 (0.003)**	
Only net foreign assets $_{t-1}$		-0.391 (0.106)[11%]
Credit growth $_{t-1}$	0.006 (0.869)	0.006 (0.859)
Currency crisis $_{t-1}$	0.169 (0.018)**	0.148 (0.025)**
Adjustable parities $_{t-1}$	-0.035 (0.047)**	-0.024 (0.184)
Crawls $_{t-1}$	-0.005 (0.847)	-0.007 (0.762)
Tightly managed $_{t-1}$	0.013 (0.693)	0.013 (0.677)
Other managed $_{t-1}$	-0.053 (0.005)**	-0.044 (0.010)**
Independent floats $_{t-1}$	-0.064 (0.000)**	-0.052 (0.002)**
No. of observations = 1085; Prob > Chi-Square = 0.000		

The variable "Only net foreign liabilities" ("Only net foreign assets") is assigned a value of zero for the observations that have net foreign assets (net foreign liabilities). Both regressions include the same set of control variables as in column 1, Table 2, but not reported. See note in Table 2.

Appendix E. Table 5A The channel through currency crises
(using the sample for all countries and including country group dummies)

	Omitted regime				
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Tightly Managed	5) Other Managed
Hard pegs$_{t-1}$		-0.067 (0.002)**	-0.011 (0.679)	-0.033 (0.296)	0.013 (0.542)
Adjustable parities $_{t-1}$	0.067 (0.002)**		0.056 (0.026)**	0.034 (0.231)	0.080 (0.000)**
Crawls $_{t-1}$	0.011 (0.679)	-0.056 (0.026)**		-0.022 (0.500)	0.025 (0.329)
Tightly Managed $_{t-1}$	0.033 (0.296)	-0.034 (0.231)	0.022 (0.500)		0.046 (0.095)*
Other Managed $_{t-1}$	-0.013 (0.542)	-0.080 (0.000)**	-0.025 (0.329)	-0.046 (0.095)*	
Independent Float $_{t-1}$	-0.029 (0.118)	-0.096 (0.000)**	-0.040 (0.071)*	-0.062 (0.021)**	-0.016 (0.346)
Emerging Markets	0.001 (0.943)	0.001 (0.943)	0.001 (0.943)	0.001 (0.943)	0.001 (0.943)
Developing	-0.022 (0.303)	-0.022 (0.303)	-0.022 (0.303)	-0.022 (0.303)	-0.022 (0.303)
No. of observations = 1169; Prob > Chi-Square = 0.000					

See note in Table 5.

References

Angkinand A, Chiu EMP, and Willett TD. 2009. Testing the Unstable Middle and Two Corners Hypotheses about Exchange Rate Regimes. *Open Economies Review* 20(1): 61-83.

Angkinand A and Wihlborg C. 2009. Deposit Insurance Coverage, Ownership, and Banks' Risk-taking in Emerging Markets. *Journal of International Money and Finance*: available online.

Arteta C. 2005. Exchange Rate Regimes and Financial Dollarization: Does Flexibility Reduce Bank Currency Mismatches in Bank Intermediation. *B.E. Journal of Macroeconomics: Topics in Macroeconomics* 5(1): 1-28.

Bubula A and Otker-Robe I. 2003. Are Pegged and Intermediate Exchange Rate Regimes More Crisis Prone? *IMF Working Paper,* WP/03/223. International Monetary Fund.

Burnside C, Eichenbaum M, and Rebelo S. 2001. Hedging and Financial Fragility in Fixed Exchange Rate Regimes. *European Economic Review* 45: 1151-1193.

Caprio G and Klingebiel D. 2005. Banking Crisis Database. In: *Systemic Financial Crises: Containment and Resolution* by Honohan P. and Laeven L. (eds.). Cambridge: University Press.

Chiu EMP and Willett TD (2009). The Interactions of Government Strength and Alternative Exchange Rate Regimes in Avoiding Currency Crises. *International Studies Quarterly*, 53(4): 1001-1025.

Demaç I and Martinez Peria MS. 2003. Banking Crises and Exchange Rate Regimes: Is There a Link? *Journal of International Economics* 61: 41-72.

Demirgüç-Kunt A, Karacaovali B, and Laeven L. 2005. Deposit Insurance around the World: A Comprehensive Database. *World Bank Policy Research Working Paper* 3628. Washington, DC.

Dooley MP. 2000. A Model of Crises in Emerging Markets. *The Economic Journal* 110(460): 256-272.

Eichengreen B. 2002. When to Dollarize. *Journal of Money, Credit, and Banking* 34(1): 1-24.

Eichengreen B and Hausmann R. 1999. Exchange Rates and Financial Fragility. *NBER Working Paper* No. 7418. National Bureau of Economic Research, Inc.

Eichengreen B and Rose A. 2000. Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises. In Guillermo C., Dornbusch R., and Obstfeld M. (eds), *Money, Capital Mobility, and Trade: Essays in Honor of Robert Mundell*. Cambridge: MIT Press.

Fischer S. (2001). Exchange Rate Regimes: Is the Bipolar View Correct? *Journal of Economic Perspectives* 15(2): 3–24.

Glick R and Hutchison M. 2001. Banking and Currency Crises: How Common are Twins? In: Glick R., Moreno R., and Spiegel M. (eds.), Financial Crises in Emerging Markets. Cambridge: United Kingdom.

Hausmann R and Panizza U. 2003. On the Determinants of Original Sin: An Empirical Investigation. *Journal of International Money and Finance* 22: 957-990.

Hilbers P, Otker-Robe I, Pazarbasioglu C, and Johnsen G. 2005. Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies. *IMF Working Paper, WP/05/151*. International Monetary Fund.

Hoggarth G, Reis R, and Saporta V. 2002. Costs of Banking System Instability: Some Empirical Evidence. *Journal of Banking & Finance* 26(5): 825-855.

Husain A, Mody A, and Rogoff KS. 2005. Exchange Rate Regime Durability and Performance in Developing versus Advanced Economies. *Journal of Monetary Economics* 52: 35-64.

Jeanneau S and Micu M. 2002. Determinants of International Bank Lending to Emerging Market Countries: Explaining the 1990s Roller Coaster. *BIS Quarterly Review* March: 52-64.

Kaminsky G. and Carmen R. 1999. The Twin Crises: Causes of Banking and Balance-of-Payments Crises. *American Economic Review* 89: 473-500.

Levy-Yeyati E. 2006. Financial Dollarization: Evaluating the Consequences. *Economic Policy* 21(45): 61-118.

Miller V. 2003. Bank Runs and Currency Peg Credibility, *Journal of International Money and Finance* 22(3): 385-392.

Ouyang A, Rajan RS & Willett TD. 2008. Managing the Monetary Consequences of Reserve Accumulation in Emerging Asia. *Global Economic Review*, 37(2): 171-199.

Radelet S and Sachs J. 1998. The Onset of the East Asian Financial Crisis. *NBER Working Paper* no. 6680, National Bureau of Economic Research, Inc.

Reinhart CM and Rogoff KS. 2004. A Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economics* 119(1): 1-48.

Sachs J, Tornell A and Velasco A. 1996. Financial Crises in Emerging Markets: The Lessons from 1995. *Brookings Papers on Economic Activity* 1: 147-215.

Sula, O and Willett TD. Measuring the Reversibility of Different Types of Capital Flows to Emerging Markets. *Emerging Markets Review,* forthcoming.

Willett TD. 1998. The Credibility and Discipline Effects of Exchange Rates as Nominal Anchors. *The World Economy* August: 303-326.

Willett TD. 2000. International Financial Markets as Sources of Crisis or Discipline: The Too Much, Too Late Hypothesis, *Princeton Essays in International Finance*.

Willett TD. 2001. Truth in Advertising and the Great Dollarization Scam. *Journal of Policy Modeling* 23: 279-289.

Willett TD. 2007. Why the Middle is Unstable: The Political Economy of Exchange Rate Regimes and Currency Crises. *World Economy* 30(5): 709-732.

Willett TD, Nitithanprapas E., Nitithanprapas I, and Rongala S. 2005. The Asian Crises Reexamined. *Asian Economic Papers,* 3(3): 32-87(56).

Willett TD, Chiu EMP, Sirathorn D, Yongbok K. (2006), Classifying and Applying Exchange Rate Regimes, presented at the Annual Meetings of the Western Economic Association.

Table 1 Frequency and summary statistics under each type of exchange rate regimes

Panel A: Frequency of banking crises

	hard pegs	adj pegs	crawls	tightly managed	other managed	indep floats	all N[b] 1990-2003
No. of BC episodes (i.e. no. of crisis onset years)							
All countries	11	17	14	7	5	4	58
Industrial	-	5	-	-	-	2	7
Emerging	3	5	9	5	1	-	23
Other developing	8	7	5	2	4	2	28
Frequency of the onset of BC (%)[a]							
All countries	7.5	5.2	8.5	9.1	3.1	1.9	5.4
Industrial	-	5.75	-	-	-	2	3.3
Emerging	11.1	9.8	11.1	16.1	2.4	-	8.7
Other developing	8.5	3.7	6.2	4.8	3.7	2.2	4.6

Panel B: The average value of the proxies for the three channels of Influence

	hard pegs	adj pegs	crawls	tightly managed	other managed	indep floats	all N[b] 1990-2003	A year prior to BC
Net foreign liabilities [c]								
All countries	-4.6	-2.0	0.3	-1.0	-1.0	1.5	-1.0	0.2
Industrial	-0.3	2.0	-0.4	5.1	6.9	6.5	4.0	0.1
Emerging	-22.4	0.1	1.1	0.6	1.5	0.4	-1.4	0.02
Other developing	-0.7	-4.2	-0.5	-2.4	-2.8	-3.1	-2.6	0.01
Credit growth [c]								
All countries	0.2	6.8	4.4	9.3	2.7	1.2	4.0	0.6
Industrial	3.3	7.7	8.6	1.0	1.5	2.6	4.6	4.1
Emerging	2.1	2.5	4.9	4.7	3.7	-5.2	2.3	5.8
Other developing	-0.9	7.8	3.9	13.2	2.3	3.0	4.6	-2.8
Currency Crises [d]								
All countries	6.7	11.4	8.6	8.0	4.4	3.4	7.5	0.2
Industrial	-	13.7	-	-	8.3	1.9	6.5	0.2
Emerging	10.3	9.0	9.7	17.5	3.8	-	8.0	0.1
Other developing	7.3	11.2	7.7	1.8	4.2	6.6	7.5	0.2

Note: [a] The annual frequency of banking crises under each type of exchange rate regime is calculated the total number of years that banking crises erupt divided by non-crisis observations in the sample under a particular regime.

[b] N = observations.

[c] The figures are the mean values; the figures in parentheses are median.

[d] Frequency of currency crises under a particular regime (%).

Table 2 The effect of exchange rate regimes on banking crises (marginal effects are reported)

	1) all BC	2) systemic BC	3) all BC	4) systemic BC
GDP/capita $_{t-1}$	-0.522 (0.107)	-0.426 (0.044)**	-0.434 (0.253)	-0.185 (0.247)
GDP growth $_{t-1}$	-0.121 (0.313)	-0.161 (0.030)**	-0.147 (0.216)	-0.115 (0.034)**
Inflation $_{t-1}$	0.019 (0.096)*	0.013 (0.068)*	0.015 (0.102)	0.009 (0.046)*
Real interest rate $_{t-1}$	0.033 (0.223)	0.044 (0.022)**	0.025 (0.311)	0.024 (0.066)*
DI coverage $_{t-1}$	0.004 (0.304)	0.002 (0.468)	0.002 (0.556)	0.001 (0.651)
Net foreign liabilities $_{t-1}$	0.248 (0.000)**	0.191 (0.000)**	0.326 (0.004)**	0.256 (0.000)**
Credit growth $_{t-1}$	0.002 (0.895)	0.013 (0.302)	0.057 (0.051)*	0.063 (0.002)**
Currency crisis $_{t-1}$	0.154 (0.024)**	0.084 (0.126)	0.394 (0.161)	0.815 (0.000)**
Adjustable parities $_{t-1}$	-0.028 (0.122)	-0.021 (0.198)	-0.028 (0.104)	-0.012 (0.198)
Crawls $_{t-1}$	-0.009 (0.690)	-0.001 (0.943)	-0.022 (0.210)	-0.008 (0.381)
Tightly managed $_{t-1}$	0.011 (0.179)	0.005 (0.839)	-0.003 (0.899)	-0.004 (0.700)
Other managed $_{t-1}$	-0.048 (0.006)**	-0.034 (0.023)**	-0.046 (0.005)**	-0.018 (0.060)*
Independent floats $_{t-1}$	-0.057 (0.001)**	-0.038 (0.010)**	-0.054 (0.001)**	-0.021 (0.048)**
Emerging markets			0.081 (0.180)	0.306 (0.178)
Developing			0.026 (0.312)	0.072 (0.084)*
Emerging × Net foreign liab $_{t-1}$			-0.155 (0.249)	-0.142 (0.039)**
Emerging × Credit growth $_{t-1}$			-0.001 (0.160)	-0.0004 (0.025)**
Emerging × Currency crisis $_{t-1}$			-0.026 (0.025)**	-0.013 (0.003)*
Developing × Net foreign liab $_{t-1}$			-0.114 (0.596)	-0.205 (0.029)**
Developing × Credit growth $_{t-1}$			-0.001 (0.025)**	-0.0004 (0.008)**
Developing × Currency crisis $_{t-1}$			-0.023 (0.140)	-0.015 (0.001)**
No. of obs.	1085	1128	1085	1128
Chi-Square	43.58	51.62	47.87	77.71
Prob > Chi-Square	0.000	0.000	0.001	0.000
Wald Chi-square [a]				
H_0: Other managed = Indep floats	1.06 (0.30)	0.59 (0.44)		
H_0: Emerging = Developing:	Net foreign liab $_{t-1}$		0.05 (0.82)	-0.59 (0.44)
	Credit growth $_{t-1}$		0.03 (0.86)	0.11 (0.74)
	Currency crisis $_{t-1}$		0.24 (0.62)	0.06 (0.80)

Note: The dependent variable is the onset of banking crises (or systemic banking crises) dummy. Estimation method is the logit model. The standard error of estimates is robust standard error and adjusted within cluster (i.e. within a country). The figures for regime dummies in the table are the effects of the change in a value of an omitted regime dummy (hard pegs in this table) to particular regimes. The number in parentheses is the p-value indicating whether the effects of particular regimes are statistically significantly different from the omitted regime. The GDP/cap and Credit growth are in the natural logarithm. The statistical significance levels of 5% and 10% are also shown by ** and *, respectively.

[a] A Wald Chi-square test that coefficients equal to each other.

Table 3 The channel through the ratio of net foreign liabilities to GDP

	Omitted regime				
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Tightly Managed	5) Other Managed
All countries					
Hard pegs$_{t-1}$		-0.038 (0.000)**	-0.045 (0.000)**	-0.027 (0.011)**	-0.026 (0.012)**
Adjustable parities $_{t-1}$	0.038 (0.000)**		-0.007 (0.222)	0.011 (0.069)*	0.013 (0.040)**
Crawls $_{t-1}$	0.045 (0.000)**	0.007 (0.222)		0.018 (0.004)**	0.020 (0.000)**
Tightly Managed $_{t-1}$	0.027 (0.011)**	-0.011 (0.069)*	-0.018 (0.004)**		0.002 (0.825)
Other Managed $_{t-1}$	0.026 (0.012)**	-0.013 (0.040)**	-0.020 (0.000)**	-0.002 (0.785)	
Independent Float $_{t-1}$	0.026 (0.010) **	-0.013 (0.063)*	-0.020 (0.000)**	-0.002 (0.825)	0.00007 (0.989)
No. of observations = 1246; R-square = 0.73; Prob > F(8,1121) = 0.000					
Nonindustrial countries					
Hard pegs$_{t-1}$		-0.067 (0.000)**	-0.068 (0.000)**	-0.054 (0.000)**	-0.049 (0.000)**
Adjustable parities $_{t-1}$	0.067 (0.000)**		-0.0009 (0.870)	0.013 (0.021)**	0.018 (0.005)**
Crawls $_{t-1}$	0.068 (0.000)**	0.0009 (0.870)		0.014 (0.018)**	0.019 (0.001)**
Tightly Managed $_{t-1}$	0.054 (0.000)**	-0.013 (0.021)**	-0.014 (0.018)**		0.005 (0.380)
Other Managed $_{t-1}$	0.049 (0.000)**	-0.018 (0.005)**	-0.019 (0.001)**	-0.005 (0.380)	
Independent Float $_{t-1}$	0.049 (0.000) **	-0.018 (0.001)*	-0.019 (0.000)**	-0.005 (0.326)	-0.0005 (0.912)
No. of observations = 1005; R-square = 0.69; Prob > F(8,900) = 0.000					

Note: The dependent variable is the ratio of net foreign liabilities to GDP. Independent variables include the exchange rate regime dummies, (log of) real GDP per capita, real GDP growth rate and inflation. All independent variables are lagged by one year. The coefficients for economic control variables are not reported. Regressions are estimated using the country fixed effect models. The figures in the table are the effects of the change in a value of an omitted regime dummy to particular regimes. The number in parentheses is the p-value indicating whether the effects of particular regimes are statistically significantly different from the omitted regime. The statistical significance levels of 5% and 10% are also shown by ** and *, respectively.

Table 4 The channel through the domestic credit growth

	Omitted regime				
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Tightly Managed	5) Other Managed
All countries					
Hard pegs$_{t-1}$		0.014 (0.794)	0.023 (0.738)	0.013 (0.831)	0.099 (0.122)
Adjustable parities $_{t-1}$	-0.014 (0.794)		0.009 (0.784)	-0.0006 (0.986)	0.085 (0.004)**
Crawls $_{t-1}$	-0.023 (0.738)	-0.009 (0.784)		-0.010 (0.813)	0.076 (0.019)**
Tightly Managed $_{t-1}$	-0.013 (0.831)	0.0006 (0.986)	0.010 (0.813)		0.086 (0.015)**
Other Managed $_{t-1}$	-0.099 (0.122)	-0.085 (0.004)**	-0.076 (0.019)**	-0.086 (0.015)**	
Independent Float $_{t-1}$s	-0.100 (0.010)	-0.086 (0.013)**	-0.077 (0.015)**	-0.086 (0.035)**	-0.0007 (0.982)
No. of observations = 1284; R-square = 0.18; Prob > F(8,1155) = 0.000					
Nonindustrial countries					
Hard pegs$_{t-1}$		0.131 (0.594)	0.139 (0.571)	0.124 (0.602)	0.216 (0.379)
Adjustable parities $_{t-1}$	-0.131 (0.594)		0.008 (0.826)	-0.007 (0.850)	0.085 (0.008)**
Crawls $_{t-1}$	-0.139 (0.571)	-0.008 (0.826)		-0.015 (0.729)	0.077 (0.023)**
Tightly Managed $_{t-1}$	-0.124 (0.602)	0.007 (0.850)	0.015 (0.729)		0.092 (0.016)**
Other Managed $_{t-1}$	-0.216 (0.379)	-0.085 (0.008)**	-0.077 (0.023)**	-0.092 (0.016)**	
Independent Float $_{t-1}$	-0.228 (0.385)	-0.097 (0.017)**	-0.089 (0.018)**	-0.104 (0.034)**	-0.012 (0.742)
No. of observations = 1042; R-square = 0.19; Prob > F(8,933) = 0.000					

Note: The dependent variable is the growth rate of the ratio of private domestic credit to GDP [calculated from the natural log of (private credit/GDP) - lag of the natural log of (private credit/GDP)]. Independent variables include the exchange rate regime dummies, (log of) real GDP per capita, real GDP growth rate and inflation. All independent variables are lagged by one year. The coefficients for economic control variables are not reported. Regressions are estimated using the country fixed effect models. The figures in the table are the effects of the change in a value of an omitted regime dummy to particular regimes. The number in parentheses is the p-value indicating whether the effects of particular regimes are statistically significantly different from the omitted regime. The statistical significance levels of 5% and 10% are also shown by ** and *, respectively.

Table 5 The channel through currency crises (marginal effects are reported)

	Omitted regime				
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Tightly Managed	5) Other Managed
All countries					
Hard pegs$_{t-1}$		-0.071 (0.000)**	-0.020 (0.451)	-0.039 (0.229)	0.009 (0.662)
Adjustable parities $_{t-1}$	0.071 (0.000)**		0.052 (0.041)**	0.033 (0.285)	0.080 (0.000)**
Crawls $_{t-1}$	0.020 (0.451)	-0.052 (0.041)**		-0.019 (0.576)	0.029 (0.265)
Tightly Managed $_{t-1}$	0.039 (0.229)	-0.033 (0.285)	0.019 (0.576)		0.048 (0.104)
Other Managed $_{t-1}$	-0.009 (0.662)	-0.080 (0.000)**	-0.029 (0.265)	-0.048 (0.104)	
Independent Float $_{t-1}$	-0.024 (0.165)	-0.096 (0.000)**	-0.044 (0.056)*	-0.063 (0.031)**	-0.015 (0.370)
No. of observations = 1169; Prob > Chi-Square = 0.000					
Nonindustrial countries					
Hard pegs$_{t-1}$		-0.051 (0.035)**	-0.013 (0.650)	-0.032 (0.339)	0.020 (0.406)
Adjustable parities $_{t-1}$	0.051 (0.035)**		0.038 (0.151)	0.018 (0.548)	0.071 (0.001)**
Crawls $_{t-1}$	0.013 (0.650)	-0.038 (0.151)		-0.020 (0.567)	0.033 (0.215)
Tightly Managed $_{t-1}$	0.032 (0.339)	-0.018 (0.548)	0.020 (0.567)		0.052 (0.076)*
Other Managed $_{t-1}$	-0.020 (0.406)	-0.071 (0.001)**	-0.033 (0.215)	-0.052 (0.076)*	
Independent Float $_{t-1}$	-0.023 (0.281)	-0.075 (0.000)**	-0.037 (0.128)	-0.056 (0.058)*	-0.004 (0.840)
No. of observations = 942; Prob > Chi-Square = 0.000					

Note: The dependent variable is the onset of a currency crisis dummy. Independent variables include of the exchange rate regime dummies, (log of) real GDP per capita, real GDP growth rate, inflation, current account to GDP and the ratio of money supply to reserves. All independent variables are lagged by one year. The coefficients for economic control variables are not reported. Estimation method is the logit model. The standard error of estimates is robust standard error and adjusted within cluster (or within a country). The figures in the table are the effects of the change in a value of an omitted regime dummy to particular regimes. The number in parentheses is the p-value indicating whether the effects of particular regimes are statistically significantly different from the omitted regime. The statistical significance levels of 5% and 10% are also shown by ** and *, respectively.

Table 6 Reinhart and Rogoff's exchange rate regimes and banking crises, 1990-2003

	Omitted regime					
	1) Hard Pegs	2) Adjustable parities	3) Crawls	4) Moving Bands	5) Managed Floats	6) Freely Floats
Dependent variable: net foreign liabilities/GDP; estimation method: country fixed effect						
Hard pegs $_{t-1}$		-0.033 (0.001)**	-0.035 (0.000)**	-0.002 (0.953)	-0.013 (0.166)	-0.016 (0.077)*
Adjustable parities $_{t-1}$	0.033 (0.001)**		-0.002 (0.887)	0.031 (0.370)	0.020 (0.110)	0.017 (0.154)
Crawls $_{t-1}$	0.035 (0.000)**	0.002 (0.887)		0.033 (0.295)	0.022 (0.001)**	0.019 (0.026)**
Moving Bands $_{t-1}$	0.002 (0.953)	-0.031 (0.370)	-0.033 (0.295)		-0.011 (0.714)	-0.014 (0.671)
Managed Floats $_{t-1}$	0.013 (0.166)	-0.020 (0.110)	-0.022 (0.001)**	0.011 (0.714)		-0.003 (0.773)
Freely Floats $_{t-1}$	0.016 (0.077)*	-0.017 (0.154)	-0.019 (0.026)**	0.014 (0.671)	0.003 (0.773)	
Freely Falling $_{t-1}$	0.030 (0.000)**	-0.033 (0.756)	-0.005 (0.241)	0.028 (0.375)	0.017 (0.007)**	0.014 (0.097)*
No. of observations = 1079; F-stat = 5.07; Prob > F-stat = 0.000						
Dependent variable: currency crisis dummy; estimation method: logit model						
Hard pegs $_{t-1}$		0.003 (0.897)	0.014 (0.512)	0.049 (0.285)	0.046 (0.021)**	-0.002 (0.952)
Adjustable parities $_{t-1}$	-0.003 (0.897)		0.011 (0.664)	-0.052 (0.299)	0.043 (0.124)	-0.006 (0.905)
Crawls $_{t-1}$	-0.014 (0.512)	-0.011 (0.664)		-0.062 (0.174)	0.032 (0.096)*	-0.016 (0.724)
Moving Bands $_{t-1}$	0.049 (0.285)	0.052 (0.299)	0.062 (0.174)		0.094 (0.032)**	0.046 (0.404)
Managed Floats $_{t-1}$	-0.046 (0.021)**	-0.043 (0.124)	-0.032 (0.096)*	-0.094 (0.032)**		-0.048 (0.280)
Freely Floats $_{t-1}$	0.002 (0.952)	0.006 (0.905)	0.016 (0.724)	-0.046 (0.404)	0.048 (0.280)	
Freely Falling $_{t-1}$	0.109 (0.087)*	0.122 (0.095)*	0.122 (0.043)**	0.060 (0.448)	0.155 (0.014)**	0.106 (0.205)
No. of observations = 929; Chi-Square = 41.61; Prob > Chi-Square = 0.000						

Note: The economic control variables are included, but not reported. The control variables for the net foreign liabilities/GDP regressions are the same as in Table 3 and those for currency crisis regressions are the same as in Table 5. The figures for regime dummies in the table are the effects of the change in a value of an omitted regime dummy to particular regimes. The number in parentheses is the p-value indicating whether the effects of particular regimes are statistically significantly different from the omitted regime. The statistical significance levels of 5% and 10% are also shown by ** and *, respectively.

Table 7 Summary findings of the total effects of exchange rate regimes on the onset of banking crises

	Summary Findings
Total Effects (equation 1)	Flexible regimes lower the probability of banking crises relative to all other regimes. There is no difference in crisis probabilities under hard pegged and intermediate regimes.
Channel Effects (equation 2)	Exchange rate regimes affect the probability of banking crises through the channels of net foreign borrowing and currency crises. The effect through credit growth is much weaker. *Net foreign borrowing channel*: Intermediate regimes (adjustable pegs and crawls) are associated with higher net foreign liabilities relative to GDP than the two corner regimes (Table 3) An increase in a country's net foreign liabilities relative to GDP makes a banking crisis more likely (Table 2). *Currency crisis channel*: Intermediate regimes (adjustable pegs) are associated with higher probabilities of currency crises than other regimes (Table 5). Banking and currency crises are found to be strongly associated suggesting evidence of twin crises (Table 2).
Total Effects with the Consideration of Channel Effects	Intermediate regimes are associated with higher probabilities of banking crises than the corner regimes supporting the unstable middle hypothesis.