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Capital Controls and Currency Crises: A More Disaggregated Political Economy Analysis

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Abstract

With the recent currency and financial crises consideration of capital controls are back in vogue as possible anti crisis measures. Empirical studies have reached mixed results on their effectiveness with some finding that controls are positively rather than negatively associated with currency crises. We argue that this relationship is likely to depend both on whether controls are primarily on capital inflows or outflows and on the quality and strength of the government. These factors may also interact. In particular, we hypothesize that controls on capital outflows are more likely increase the probability of crises, the weaker is the government in question. Using the newly constructed data set on measures of capital controls by Schindler (2009), we test these hypotheses using a panel probit analysis on a sample of 42 middle-income and 14 low-income countries over the period 1995-2005. We find strong support for the proposition that controls on outflows have a positive association with crises, especially when imposed by weak governments and find some support for the view that controls on capital inflows tend to reduce the frequency of crises.

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1. Introduction

The rash of major emerging market currency crises over the past two decades and the recent global crisis that began in the market for securities linked to subprime mortgages in the United States have struck sharp blows to beliefs that financial markets are generally sufficiently efficient to make it unwise for governments to attempt to interfere with their operation. There is still considerable disagreement over the causes of the surges and sudden stops of international financial flows to and from emerging market economies, but there can be no doubt that they have been a fact. On the face of it such variability in capital flows undermines some of the standard efficiency arguments for unfettered capital flows and supports those who advocate capital controls. The frequent unstable behavior of capital flows still leaves open the question of whether capital controls can be effective in reducing this problem. Some recent studies have found a positive rather than negative correlation between capital controls and currency crises so we need to take seriously the possibility that capital controls will be ineffective or even counterproductive.

Of course even if controls are effective in reducing the frequency of currency crises one should compare the costs of controls with the benefits. Such calculations involve immense complexities which we make no attempt to tackle in this paper. Rather we focus on the more limited, but still important, objective of investigating the effectiveness of capital controls in reducing the incidence of currency crises. Since this is primarily a policy issue for emerging market and developing countries we limit our empirical investigation to these sets of countries.

In section 2 we present arguments that we should not expect to find simple, stable relationships between capital controls and the frequency of currency crises. Many

economists have argued that there are likely to be important differences between the effectiveness of controls on capital inflows and on capital outflows. We also hypothesize that the effects of controls may vary with the political strength and stability of governments. In future work we also plan to investigate how these factors interact with the types of exchange rate regimes that are adopted.[1]

While early studies were limited to the use of zero-one dummies that are too blunt to speak to many aspects of the current debates, recently a number of much more finely gradated measures have become available. Early studies that found positive correlations between controls and crises could be supported by arguments that economic and political instability were the likely causes of both controls and crises (See Bartolini and Drazen (1997) and Wihlborg and Willett (1997)). Such an interpretation would hardly fit the Asian crisis of 1997-98, however, since this was preceded by large inflows rather than outflows of private capital.[2]

The recent experience with capital flow surges and sudden stops reinforces arguments that the effects of controls on capital inflows may be quite different from capital outflows. A recent study by Potchamanawong et al (2008) on a limited sample of 26 emerging countries during 1995-2004 finds that this is indeed the case. In this study stronger controls on capital inflows were generally found to reduce the probabilities of currency crises while stronger controls on capital outflows increased them. We make use of a new data set developed by Schindler at the IMF that has greater coverage across both countries and time and also distinguishes between controls on capital inflows and

[1] We have investigated the effects on currency crises often interactions between government strength and exchange rate regimes in Chiu and Willett (2009).
[2] See Willett et al. (2005).

outflows. Binici, Hutchison, and Schindler (2010) (hereafter BHS) use this data set to find substantial differences on capital flows of controls on inflows versus outflows.

This paper is organized as follows. Section 2 provides a brief summary of relevant literature and explains the hypotheses to be tested. We also report on some interesting patterns found in the data. For example, there appears to be missing middle phenomena with respect to controls on capital outflows, with some 80% of the observations falling into the top or bottom categories of strictness. Section 3 describes the data and methodology used to test these hypotheses. Section 4 presents our core results on the relationships among political strength, capital controls, and currency crises. A number of robustness checks are discussed in this section as well. Section 5 concludes.

2. Theoretical Framework and Review of the Literature on Capital Controls and Currency Crises

2.1 Linking Politics, Capital Controls, and Currency Crises

As noted in the introduction there are many different factors that may influence the effects of capital controls. Thus it is not surprising that the empirical results on the role of capital controls and currency crises are mixed. Contrary to what used to be conventional wisdom that capital controls help prevent crises, several recent studies have found positive rather than negative relationships between controls and crises (See Eichengreen, Rose, and Wyplosz 1996; Leblang 2003; Glick and Hutchison 2005). Glick and Hutchison, for example, find that after controlling for a number of factors the probability of a currency crisis is almost twice as high for countries with capital controls

than those without.[3] Thus they conclude that there is "a statistically significant and economically meaningful negative link between liberalization and the likelihood of a currency crisis" (p397). On the other hand a recent empirical analysis by Edwards (2006) found a negative, albeit small, effect of capital controls on the probability of currency crises while Caramazza, Ricci, and Salgado (2000) found no significant relationship. As we will discuss below, the earlier studies in this area suffered from severe limitations on the data available to construct proxies for capital controls and this may have had a substantial influence on the results of some of these studies. With the improved measures now available we have better possibilities for discriminating among some of the ways in which controls and currency crises may interact.

2.1.1 Controls on Capital Outflows

The traditional arguments that capital controls would reduce the probability of currency crises were straight forward and focused on controls on capital outflows to stop capital flight.[4] To the extent that the controls were effective they would reduce capital outflows and hence reduces the pressures on a weak currency At the time of the Bretton Woods negotiations based on the experiences of the 1930s generally viewed international financial flows as being highly unstable and there was strong support for capital controls. Indeed the adjustable peg exchange rate regime adopted at Bretton Woods was based on

[3] This finding is further supported by Glick, Guo, and Hutchison (2006), where they use a matching and propensity score methodology to address the issue of selection bias in a panel analysis of developing countries and find that, after controlling for sample selection bias, countries with liberalized capital accounts experience a lower likelihood of currency crises.

[4] For reviews of views on capital controls and how they have changed over time see Abdelal (2007), Edwards (2007), Eichengreen et al (1999), Independent Evaluation Office (2004), and Ries and Sweeney (1997).

the assumption that capital controls would deal with the problem of the one way speculative option.[5]

Over time it became increasingly recognized that comprehensive capital controls interfered with the financing of trade while selective controls were often of quite limited effectiveness. This combined with general shifts in views about the efficiency of financial markets and benefits of financial liberalization led to a general movement away from the use of capital controls. This started in the advanced economies, but in recent decades this movement had important impacts on developing countries as well.[6]

Apart from limits on the direct effectiveness of capital controls and their potential costs on the efficiency of resource allocation, for developing countries it was also noted that controls on capital outflows could also act to reduce capital inflows because of concerns about repatriation. This would reduce the positive effects of controls on outflows on the balance of payments and hence reduce their contributions to preventing currency crises. Not all scholars and governments adopted these negative views of the effectiveness of capital controls. Many commentators pointed to capital controls as an important factor in limiting the effects of the Asian crisis on China and India[7] Econometric work in Willett et al. (2005) suggests that these countries would not have been hit hard in any event, but beliefs that controls provided important protection remain

[5] At the time of a currency crisis, for example, a government faces downward pressure on the currency. In the short run, the government (or the central bank) can defend its currency against depreciation by purchasing the domestic currency, selling its international foreign reserves, and raising interest rates to prevent capital outflows. But this cannot be continued indefinitely. Speculators can typically predict the direction of any major change in exchange rates, making adjustable pegged exchange rate regimes extremely vulnerable to speculative attacks.

[6] While we have no doubt that changes in ideas or mental models had a strong impact on these policy changes, lobbying by financial interests clearly also played a role. The role of the IMF in this process has been the subject of considerable debate.

[7] Malaysia's experience with capital controls during the Asian crises remains controversial. The safest conclusion is that the effects were neither as harmful as strong critics predicted nor as beneficial as the strongest advocates have asserted. See, for example, Abdelal and Alfaro (2003) for more detailed discussions.

popular and have been reinforced by China's strong performance during the recent global financial crisis.

While we have good reasons for arguing that controls on capital outflows would be of only limited effectiveness in many cases, how can we explain actual positive correlations between such controls and the frequency of crises? The most obvious explanation is that the positive correlations between controls and crises are generated by the difficulties in fully controlling for factors that cause both crises and the adoption of controls. Poor economic policies and political instability come to mind as obvious possibilities. While studies such as Glick and Hutchison (2005) attempt to control for both of these types of influences it is doubtful that the available data allow us to fully account for such influences.

There also may be direct causal links. As suggested by Bartolini and Drazen (1997) and Whilborg and Willett (1997), capital controls may also be taken as signals about future policies and/or conditions. While the imposition of stronger capital controls could signal determination to defend a currency peg, it could also be taken as a signal that the government thinks that the situation is even worse than the market expected or that the government is unwilling or unable to make needed macroeconomic policy adjustments. For example Edwards (2006) found in a large sample of developing countries that there was a strong tendency for counties to tighten controls shortly before devaluations.

Given these conflicting considerations there is no clear theoretical presumption on the sign of the relationship between controls on capital outflows and the probability of currency crises. The relationship seems likely to depend at least in part on the quality

and strength of the government.[8] A priori it seems likely that weak governments would be both more inclined to resort to capital controls and to be less effective in enforcing them. A tightening of controls by such governments would also seem more likely to have adverse signaling effects. For this combination of reasons we hypothesize that the weakness of governments would interact negatively with the likelihood that controls would help reduce the incidence of currency crises, or stated alternatively, controls on capital outflows are more likely to have a positive impact on the probability of crises, the weaker is the government in question. Two main hypotheses can be summarized as follows:

H1: Weak governments make currency crises more likely.

H2: There is also an interactive effect with controls on capital outflows such that the weaker the government, the more likely are strong controls on capital outflows to have a positive association with currency crises.

There are of course a number of different concepts of strong and weak governments and a number of available empirical proxies. We will discuss this issue in subsection 2.2 below.

To our knowledge no previous studies have directly investigated empirically the interactive effects of political factors and capital control measures. Previous studies such as Glick and Hutchison (2005) have included measures of government strength in their regressions as a control variable and found that weak governments are indeed more likely to suffer currency crises, as we also found in our earlier study Chiu and Willett (2009). To test our hypothesis H2, however, one must look at interaction terms. Our earlier paper investigated the interactions between government strength and exchange rate regimes in

[8] In this paper we use government strength and stability interchangeably.

generating currency crises and found that while weak governments increase the likelihood of currency crises under any exchange rate regime, thus supporting H1 as does Glick and Hutchison. This effect is particularly strong under adjustable pegs, analogous to our H2 with respect to exchange rate regimes.

2.1.2 Controls on Capital Inflows

Now let us consider hypotheses about the effects of controls on capital inflows on the probabilities of currency crises. In this case negative signaling effects seem much less likely. Generally large capital inflows indicate the market thinks the country in question is following sound economic policies and has good economic prospects. An important exception, however, is where these inflows are largely to directly or indirectly help finance large budget deficits. Even when primarily a reflection of market responses to expectations of improving fundamentals large inflows of financial capital can also increase the vulnerability of a country, however, as emphasized by the frequency with which surges of capital inflows are followed by sudden stops and capital flow reversals.[9]

Capital inflows can themselves worsen a country's fundamentals by generating real exchange rate appreciation and more rapid money and credit expansion that is conducive to asset bubbles. Large inflows of financial capital can also make a country more vulnerable to shocks from abroad and to shifts in the attitudes of international investors from optimism to pessimism. Thus there are reasons to believe that controls on capital inflows could be associated with a lower probability of currency crises and that has been emphasized recently by officials in emerging market economies facing strong inflows of financial capital, some types of limitations on capital inflows should be treated

[9] On capital surges and sudden stops see Calvo (1998), Edwards (2004, 2006), Efremidze, Shier, and Sula (forthcoming) and Sula and Willett (forthcoming)

more as an aspect of macro prudential regulation than as traditional capital controls.[10] Thus our third hypothesis is

H3: Controls on capital inflows are associated with fewer currency crises.

Our prior expectations were that strong governments would be more likely to have controls on capital inflows than on outflows, but we do not have strong priors on the interaction between the strength of government and the effects of capital inflow controls on the likelihood of currency crises.

2.1.3 Some Interesting Aspects of the Data

Given the important links that have been found between different types of exchange rate regimes and the probability of currency crises, the interrelationships between exchange rate regimes and capital controls should also be investigated. We plan to do this in future work. A look at correlations among the raw data yields some interesting findings, however. A classic argument by economists such as Milton Friedman is that controls are a likely alternative to exchange rate adjustments. On this argument we would expect to see a much higher incidence of capital controls under fixed than flexible exchange rates. As table 1 shows, however, this is not borne out by the data we use in this paper. There is little difference between the average level of capital controls under floating and adjustable pegs, and the level under hard fixes is much lower than under floating. The highest levels occur under crawling regimes and managed floats. The story is the same with respect to controls on both inflows and outflows.

[Table 1 about here]

[10] For an early statement of this argument see Eichengreen (1999).

We were also surprised by the findings in tables 2 and 3 that our measure of government strength does not vary substantially across exchange rate regimes. The levels of capital controls on inflows and outflows vary more interestingly with changes in the level of government strength. In general, for individual countries the levels of controls on inflows and outflows are fairly highly correlated, giving rise to potential difficulties with the reliability of our estimates of the separate effects of each type.[11] Our results turn out to be sufficiently strong and robust, however, that we do not believe that this is a major problem. Controls on capital outflows are typically somewhat stronger than on inflows.

[Table 2 and 3 about here]

On outflow controls we find a very interesting pattern. As shown in table 4, control levels tend to cluster in the highest and lowest quadrants, with over 40% of the observations lying in each of these quadrants. The two middle quadrants account for only 10% and 6% respectively. While there has been much discussion and debate over the vanishing middle hypothesis with respect to exchange rate regimes there appears to also be a strong vanishing middle with respect to levels of controls on capital outflows.

The pattern of controls on capital inflows differs substantially as shown in table 5. Almost half (49%) of the observations fall in the lowest quadrant. While the highest quadrant has the next largest frequency, it is much lower than with capital outflows, accounting for only 21% of the observations. The second and third quadrants account for 15.5% and 14% respectively.

[Table 4 and 5 about here]

[11] See Potchamanawong (2008).

Turning to the relationships between strength of governments and levels of controls we find the curious result in table 3 that the levels of controls on both inflows and outflows are the highest at the extremes of the strength measure in our sample, 3 and 12.[12] We should not make much of this, however, since these are very thinly populated cells, accounting for only 2% of the observations (see table 6). Roughly two thirds of the observations fall within the range of 9 to 11 and over three quarters fall within 8 to 11, so these are the levels of government strength or stability that are of most relevance for our econometric analysis.[13] Over the 9 to 11 range we find what to us was a surprising result, the levels of controls on both inflows and outflows rise as government stability rises, going from .48 to .71 for outflows and from .40 to .57 for inflows.

[Table 6 about here]

2.2 Measures of Government Strength

It has been well documented that political instability as well as weak political institutions contribute significantly to the likelihood of currency crises (Edwards 1996, Bernhard and Leblang 1999, Bussière and Mulder 1999, Frieden, Ghezzi and Stein 2001, Meon and Rizzo 2002, Alesina and Wagner 2003, Shimpalee and Breuer 2006; Willett 2007). In general, a politically weak government (e.g. frequent government turnovers, riots, and strikes) tends to create uncertainty about the government's policy objectives (e.g. the authorities' commitment to implement necessary adjustment on capital controls).

[12] For example, the level of government strength in Bangladesh in 1995 was registered at 3, and the level of controls on both inflows and outflows was 0.6. Another example is Kenya in 1995, where the level of government strength was 5.50, and the level of controls on both inflows and outflows was 0.4 and 0.33, respectively.

[13] Likewise, the level of government strength in Thailand in 1998 and 1999 was quite high at 9.25 and 9.83, respectively, and the level of controls on both inflows and outflows was 0.5 and 0.92, respectively. This indicates that Thai government imposed a strict restriction on capital outflows to prevent capital flight during the crisis period, while the level of controls on inflows was relatively moderate.

Perceptions that authorities might not carry through with adjustment strategies heighten uncertainty and therefore generate turbulence in financial markets.

As noted above there are many different concepts and measures of political instability and government strength and weakness.[14] As a proxy for measuring the type of strength of governments relevant for our hypotheses, we believe that the government stability index of the *International Country Risk Guide* is particularly useful. Government stability is defined as a government's ability to carry out its declared program, and its ability to stay in office.[15] The degree of government stability is measured as the sum of three subcomponents, each running from zero to four points. A score of 4 points equates to "very high stability" and a score of 0 points to "very low stability." The three subcomponents are:

1. Government Unity (0-4)
2. Legislative Strength (0-4)
3. Popular Support (0-4)

Therefore, the ICRG index ranges from 0 (the lowest level of government stability) to 12 (the highest level).

2.3 Measures of Capital Controls

In general there are two main categories of capital control measurement: *de jure* and *de facto* measurements. *De jure* measurement, i.e., rule-base or legal restrictions, is widely practiced by well-known scholars such as Quinn (1997), Johnston and Tamirisa

[14] See Walton et al. (2008).
[15] In particular, government stability depends on the type of governance, the cohesion of the government and governing parties, the closeness of the next election, the government's command of the legislature, popular approval of government policies, and so on.

(1998), and Miniane (2004).[16] This type of measurement is based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), which has been published by IMF annually. The second measurement, *de facto* method, uses an instrumental variable or/and actual capital flow data to measure the degree of capital mobility.[17] This measure, however, often suffers from the criticism of not truly capturing the degree of capital mobility given the data can be driven by other factors that are unrelated to capital restrictions themselves.[18]

For our capital control measures in this paper, we turn to the IMF's new data set constructed by Schindler (2009), which is also derived from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions and distinguishes capital controls both by asset category and by the direction of flows. This more disaggregated type of measure allows us to differentiate between high and low levels of capital controls as well as between controls on inflows and outflows. We should stress that this type of measure captures only the extensiveness of controls, not the degree of their intensity as explored by Quinn (1997). Potchamanawong (2008) has constructed an index for a limited number of emerging market countries which combines measures of both the extensiveness and intensity of controls for a limited set of countries which is analyzed in Potchamanawong et al.(2008).

Here we rely on the larger data set of Schindler which covers 91 countries during 1995-2005. The main categories covered in this data set are as follows:

(1) Shares or other securities of a participating nature

[16] Johnston and Tamirisa's measure is the most disaggregated measure of capital controls since it combines all the classifications of the IMF's AREAER. It also distinguishes capital flows from outflows and inflows. Unfortunately this data is available only for one year of 1996.

[17] Feldstein and Horioka (1980), for example, use investment and savings to measure the level of capital controls and find a positive correlation between them.

[18] For detailed discussions on various measures of capital controls, see Potchamanawong et al (2008).

(i) purchase locally by nonresidents
(ii) sale or issue abroad by residents
(iii) purchase abroad by residents
(iv) sale or issue locally by nonresidents

(2) Bonds or other debt securities

(i) purchase locally by nonresidents
(ii) sale or issue abroad by residents
(iii) purchase abroad by residents
(iv) sale or issue locally by nonresidents

(3) Money market instruments

(i) purchase locally by nonresidents
(ii) sale or issue abroad by residents
(iii) purchase abroad by residents
(iv) sale or issue locally by nonresidents

(4) Collective investments
(i) by residents to nonresidents
(ii) by nonresidents to residents

(5) Financial credits
(i) by residents to nonresidents
(ii) by nonresidents to residents

(6) Direct investment
(i) outward investment
(ii) inward direct investment
(iii) liquidation of direct investment

In Schindler (2009), the *de jure* capital control restrictions are coded at the level of individual types of transactions. By taking unweighted averages of the appropriate subcategories, a continuous variable between 0 and 1 is created accordingly for measuring both restrictions on inflows and outflows. A higher value indicates more restrictive controls in the sense that more items are subject to restrictions. This added

degree of differentiation in capital control regime is helpful in detecting more subtle differences across countries and over time (Binici, Hutchison, and Schindler 2010).[19]

3. Data, Methodology and Design

3.1 Data and Variables

The data set for this paper comprises annual observations from 1995 to 2005 on 56 countries, including 42 middle-income economies, and 14 low-income countries.[20] This is the time period for which the new IMF data on capital controls is available. Our dependent variable used in this paper is *Currency Crises*, based on the exchange market pressure indices (EMP) proposed by Eichengreen, Rose, and Wyplosz (1996). These use the weighted averages of the depreciation of the domestic currency, the loss of international reserves, and the increase in interest rates with the weights based on the inverse of the variability of each series. Currency crises are identified if the EMP index exceeds the pooled mean by a given number of standard deviations, frequently two or three (Eichengreen, Rose, and Wyplosz (1996), Kaminsky and Reinhart (1999), and Kamin, et al. (2001)). For sensitivity tests, as suggested by Willett et al (2005), an equal weighted index is also tested. We use a threshold of two standard deviations

As a proxy for measuring the type of strength of governments relevant for our hypotheses, we follow our previous study on the effects of government strength on the relationships between exchange rate regimes and currency crises and use the government stability index of the *International Country Risk Guide*, as also mentioned in section 2.2.

[19] Another type of more continuous measure that has gained considerable popularity is provided by Chinn and Ito (2002). This is constructed based on calculations of the principal components of several control measure, but the advantage of such a principal components measure is not clear.
[20] See appendix for the sample countries.

The advantage of the ICRG index over other available indices is the fact that it is available for a long time period and for a large sample of countries.

Data on economic variables is taken from the *International Financial Statistics* (IFS) database. Drawing from the literature on determinants of currency crises, we control for a standard set of macroeconomic variables (Frankel and Rose 1996; Radelet and Sachs 1998; Corsetti, Pesanti and Roubini 1999; Bordo et al. 2001; Abiad 2003; Glick and Hutchison 2005; and Willett et al. 2005). These are: the ratio of M2 to international reserves, the rate of domestic credit growth, current account deficit/surplus as a share of GDP, real GDP growth, and real effective exchange rate appreciation.

Lastly, we also include elections as a political control variable. There already exists a large literature relating elections to economic outcomes; this literature can be divided into two distinct but related strands: one focusing on uncertainty and the second examining the incentives of policymakers surrounding elections.[21] While the electoral effect is not the primary focus of this paper, we include it in our model because it helps control for time-inconsistency and high discount rate problems.[22] We measure the electoral dates using data from *Database of Political Institution* and create an election dummy, which is coded as one if there is an election for either the legislature or executive branch in that year.

3.2 Model Specification

[21] See Lobo and Tufte (1998), Leblang and Bernhard (2000), Frieden, Ghezzi, and Stein (2001), Leblang (2002; 2003), and Walter (2006).

[22] Government officials with short-time horizons (as in the run-up to an election) in general tend to be biased toward generating expansionary macroeconomic polices for the short-run benefits (e.g. to increase domestic output and win the election) at the expense of the long-run costs (e.g. increased inflation), as suggested by the traditional political business cycle literature.

In order to assess the interactions among political variables, exchange rate regimes, and the probability of currency crises, several rounds of probit regressions are undertaken by applying an interaction dummy regression model.[23]

Our probit panel model is defined as:

$$prob[Crisis_{i,t} = 1] = \Phi[\beta_1 + \beta_2 Strength_{i,t-1} + \beta_3 KCout_{i,t-1} + \beta_4 KCin_{i,t-1}$$

$$+ \beta_5 (Strength_{i,t-1} \cdot KCout_{i,t-1}) + \beta_6 (Strength_{i,t-1} \cdot KCin_{i,t-1}) + \beta_7 X_{i,t-1} + \varepsilon_{i,t}] \quad (1)$$

$Crisis_{i,t}$ is a currency crisis dummy variable taking a value of 1 in a crisis year for any country *i* at time *t*, and 0 if there is no crisis. Φ is the standard cumulative normal distribution. *Strength* refers to our primary political variable: government stability (STAB). *KCin* and *KCout* are capital controls on both inflows and outflows, respectively. The control variables X are a set of standard economic and financial variables, and $\varepsilon_{i,t}$ is the error term. To reduce the problem of reverse causality, all of the independent variables are lagged by one year. Lagging the independent variables deals with the problem of a crisis forcing a change in capital controls. Of course, there is the potential for our approach to suffer from omitted variable bias and deeper endogeneity problems.[24] Thus we prefer to use the language of association when discussing our results.

4. Empirical Results

4.1 Descriptive Statistics and Probit Panel Analysis

[23] The reason for using a probit estimation is because we are interested in whether or not currency crises occur under certain conditions. Our outcome variable has only two possible values: a crisis or non-crisis. Because our outcome variable is binary (either the crisis occurs or does not occur), a probit model is thus the appropriate technique. While some research is beginning to use more continuous measures to capture the strength of crises, this binary approach has been standard in the literature.

[24] One way to deal with endogeneity problems with a dichotomous dependent variable and endogenous explanatory variables is to use two stage probit least squares (2SPLS) (Maddala 1983; Achen 1986). However, as pointed out by Timpone (2001), even if we obtain a consistent estimator via this two stage approach, the standard errors remain inaccurate and their correction is extremely difficult in practice.

Table 7 provides summary of descriptive statistics. Tables 4-6 show the frequencies of capital controls on outflows, capital controls on inflows, and the distribution of the government stability variable respectively. As noted in section 2.1.3 in general we find that in our sample, countries with loose controls on outflows (0-0.25) are roughly as many as countries with tight controls (0.76-1), nearly 40 percent, in each with fewer countries in the middle. For controls on inflows, approximately half of our sample countries have loose controls on capital inflows (49%). Tight controls represent only 21% of the sample while the proportions at intermediate levels are KCin2 (15.6%) and KCin3 (14.4%), As for government stability, the frequency distribution is slightly skewed toward a stable government, where more than 80% of our observations fall in between stability level 7 to level 11, as shown in table 6.

[Table 7 about here]

Regression results are presented in Table 8. There are four equations in there. Equations (1) and (3) only consider the impacts of capital inflows and outflows on the likelihood of currency crises using pooled precision weights and equal weights system, respectively. As we can see from equation (1), restrictions on capital outflows are significantly positively associated with the occurrence of currency crises. Restrictions on capital inflows have a negative association with the crisis probability but the estimated coefficient is not statistically significant. This result holds up across different crisis measures, as shown in Equation (3), and is consistent with our hypothesis H3, suggesting that controls on capital outflows tend to be less effective than on inflows in terms of crisis prevention.

[Table 8 about here]

Equations (2) and (4) are our benchmark models, which include our key political

variable – government strength and its interactions with controls on capital inflows and outflows. The estimated coefficients of *Strength* are significant and negative suggesting that a stronger government tends to be less likely to have currency crises. This offers further support for H1.

Especially interesting is that when the political strength variable is added and interacted with capital controls the coefficients for controls on both *KCin* and *KCout* become significant, and keep the positive sign for controls on outflows and negative sign for controls on inflows. This supports our presumption that the relationship between controls on capital outflows and the probability of currency crises depends at least in part on the quality and strength of the government.

Next we compute the probability of currency crises across different levels of government stability and controls on capital inflows/outflows.[25] This exercise allows us to see the influence of changes of government strength on the probability of currency crises, holding other variables constant. A significant coefficient estimate on an interaction term is "neither a necessary nor sufficient" condition for establishing the existence of an interactive relationship (Berry, DeMeritt and Esarey, 2010, p.25). The preferred method to interpret interactive effects in such models is through the graphical presentation of the relationship between changes in the variables of interest. For both analytical and graphical purposes, therefore, we break both *KCin* and *KCout* into five different subgroups with 0.25 intervals. This will give us a picture of how the crisis

[25] The reported probability is generated from the authors' own calculation via Excel. Since the distribution is the standard normal cdf Φ, we have the Probit link. That is,

$$P_r(y_i = 1 \mid x_i) = P_r(u_i \le x_i b \mid x_i) = \Phi(x_i b \mid x_i) = \int_{-\infty}^{xb} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt$$

To obtain the predicted probabilities, we go back to our link functions and fill in the values of our *X*'s and Betas from our equation. From these we plot $P_r(y_i = 1)$ against X_1 (e.g., government stability) to show the effects of changing different levels of X_1, while holding other variables constant. We use equation 2 to generate these results.

probabilities change at different degrees of government strength and various levels of controls on capital flows over time. Computed probabilities are reported in Tables 9 and 10 along with figures 1 and 2. These give the probability of crisis during a given year.

[Table 9 and Figure 1 about here]

Table 9 shows that for any level of controls on capital outflows the probability of crisis falls as the level of government strength or stability increases. The probability of crisis with no controls falls below one percent when the stability variable rises to 8 while with the highest level of restrictions this does not occur until the stability measure rises to its maximum of 12. Not surprisingly, the effects of weak government on the probability of crises are particularly strong if there is the highest level of restrictions on capital outflows (*KCout* = 1), as shown in Figure 1. The crisis propensities decrease with the loosening of capital controls on the outflows. For the bottom end of government strength in our sample these crisis probabilities are quite high, ranging from 62.5%, at the highest level of controls to 7.40% with no controls *KCout* = 0). This pattern holds, although less dramatically at all levels of government strength. For example at the strength level of 8, the probabilities drop from almost 11 % at the highest level of controls to just over 0.5% at the lowest. These estimates are consistent with the "signaling hypothesis" which basically says a tightening of controls on outflows by politically weak governments would be seen as sending an adverse signal to the markets and would therefore increase the likelihood of currency crises.

On the inflows side, we have a different story. As shown in table 10, the most crisis prone scenario occurs when a very weak government has absolutely no controls on capital inflows (*KCin* = 0). The estimated probability is 17.90%, and is gradually decreased to 8.35%, 3.28%, 1.05% and 0.28%, as the controls on the inflows are

tightened. This pattern of lower probabilities of crisis as controls on inflows are tightened continues until the stability measure rises to 9, with the differences between high and low levels of controls diminishing as government strength rises. At strength levels of 9 and above, however, the pattern reverses with the probabilities of crises rising as controls on inflows are tightened as also shown in Figure 2.

[Table 10 and Figure 2 about here]

According to the computations at low levels of controls crisis probabilities continue to fall, albeit from already low levels, as government stability increases through out the whole domain; while at high levels of controls *KCin* = 0.75 and 1.0, the probabilities start to rise again when the stability measure exceeds 5 or 6.

Comparing tables 9 and 10 we see that for given levels of government strength the crisis probabilities for a particular level of restrictions on outflows are generally higher than for the same level of restrictions on inflows as we would expect from the estimated coefficients in table 8. However at higher levels of government strength this relationship is reversed, with the reversal coming at lower levels of government stability, the lower are the levels of restrictions. We are not sure what to make of this finding.

As noted in section 2.1.3 we should not give much weight to our calculations of effects at the highest and lowest levels of government stability as there are few observations at these levels. Likewise we should not place great confidence at the exact levels at which the patterns are found to reverse.

We believe that there may be something to the qualitative finding that at lower levels of government stability greater controls on capital inflows reduce the probabilities of crises; while at higher levels of stability more controls on inflows may increase the probabilities of crises. A possible explanation is that weak governments tend to lack the

means to effectively offset the effects of large capital inflows in increasing vulnerability to crises while strong governments are able to better handle such inflows. Such a conclusion would still leave open the possibility that macro prudential type regulations on capital inflows such as Chile taxes could prove useful in reducing the danger of sudden stops and currency crises. Unfortunately our large N proxies for capital controls are not yet refined enough for us to test this hypothesis in our large sample.

4.2 Sensitivity Testing

This testing is still in progress. As shown in table 8, we found that the results were generally robust to substituting equal weights for pooled precision weights in our calculations of the crisis index. Another test we have performed is to delete the low income countries from our sample since previous studies have often found substantial differences in behavior between middle and lower income countries.[26] The results reported in table 11 are generally similar, although surprisingly the stability variable losses its significance. The general pattern of coefficients remains the same, however, and the coefficients on the capital control variables retain their significance. We also check the effects of incorporating government stability without interacting with different types of capital controls. The results, as shown in table 12, are in general consistent with our hypothesis H1. Government stability (Stab) enters into the equation with both negative and significant sign across different crisis measures. This effect is stronger when using equal weights system than pooled precision weights. The coefficients on the controls variables retain their signs but fall in magnitude and significance. We interpret these results as support for the importance of interacting government strength with

[26] See for example Rogoff et al (2003).

controls.

[Table 11 and 12 about here]

5. Concluding Remarks

Despite substantial improvements in recent years the available large n measures of capital controls are still far from perfect. Thus we put little weight on our exact estimates of the associations between capital controls and currency crises. We do believe that our results are sufficiently strong, however, to uphold our initial expectations of the importance of distinguishing between the effects of controls on capital outflows and on inflows and of taking levels of government strength or stability into account. Not only does government weakness increase the probabilities of currency crises directly, but it also interacts with the effects of controls. While increases in controls on capital outflows appear to increase rather than decrease the probabilities of crises, the increases are particularly large when governments are weak.

Our results appear somewhat at odds with the recent study by Binici, Hutchison, and Schindler (2010) who use the same set of capital control measures to look at effects on capital flows. They find that controls on capital outflows do tend to reduce these outflows while controls on inflows have no effect. A number of case studies have found some, albeit mixed, evidence that prudential type policies to discourage inflows of financial capital do have some effect, at least in shifting the composition of inflows.

Unlike the case of controls on outflows, controls on inflows are found in a number of cases to reduce the likelihood of currency crises. Our estimates suggest that this effect is particularly strong for weaker governments. With stronger governments the results suggest that increasing controls on capital inflows may increase the probabilities of crises, albeit by fairly small amounts. Why this may be should be the subject of further

investigation as should the exploration of whether different types of controls have different effects. And even though controls on outflows may be effective in reducing these flows the magnitude of these effects may not be sufficient to strongly reduce balance of payments problems.

There are a number of obvious types of extensions to the analysis presented here in addition to further work on adding control variables and doing further robustness checks. On the latter, the exploration of other measures of government strength and weakness and the inclusion of measures of the quality of institutions seem likely to be particularly worthwhile.

One extension is to switch the dependent variable from currency to financial crises. Capital surges have often been suspects as contributors to financial crises and there is much more work to do in this area including the interactions with domestic financial liberalization. Another promising area is to take the interrelations ships between capital controls and exchange rate regimes into account. (On the connections between exchange rate regimes and financial crises see the analysis and references in Angkinand and Willett (forthcoming)).

Finally, some of the conjectures about the relationships between controls and crises are formulated in terms of changes rather than levels of the controls or regulations. In this paper we followed the tradition in the literature of looking at the effects of levels of controls. This should be supplemented by investigation of the possible effects of changes in controls.

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Appendix: List of Sample Countries in the Estimation

Sample for 42 middle-income countries:

Angola	Dominican Republic	Kazakhstan	Oman	Sri Lanka
Argentina	Ecuador	Latvia	Panama	Thailand
Bolivia	Egypt	Lebanon	Paraguay	Tunisia
Brazil	El Salvador	Malaysia	Peru	Turkey
Bulgaria	Georgia	Mauritius	Philippines	Uruguay
Chile	Guatemala	Mexico	Romania	Venezuela, Bolivarian Republic of
China,P.R	Hungary	Moldova	Russia	
Costa Rica	Indonesia	Morocco	South Africa	
Czech Republic	Jamaica	Nicaragua	Swaziland	

Sample for 14 low-income countries:

Bangladesh	Ghana	Kyrgyz Republic	Togo	Yemen, Republic of
Burkina Faso	India	Pakistan	Uganda	Zambia
Côte d'Ivoire	Kenya	Tanzania	Uzbekistan	

Table 1 The mean of controls on overall flows (KC), inflows (KCin), and outflows (KCout),

	KC	KCin	KCout
Hard peg	0.43	0.33	0.53
Adjustable peg	0.45	0.42	0.49
Crawl	0.40	0.38	0.42
Managed float	0.50	0.45	0.54
Floating	0.47	0.42	0.52

Table 2 The mean of government stability (stabs) under alternative exchange rate regimes

	stabs
Hard peg	8.34
Adjustable peg	9.22
Crawl	8.51
Managed float	8.85
Floating	8.80

Table 3 The Mean of KC, KCin, and KCout under various levels of government strength

stabs	KC	KCin	KCout
3	0.60	0.60	0.60
4	0.21	0.18	0.25
5	0.37	0.31	0.42
6	0.31	0.26	0.36
7	0.34	0.32	0.37
8	0.50	0.46	0.54
9	0.44	0.40	0.48
10	0.52	0.47	0.58
11	0.64	0.57	0.71
12	0.83	0.75	0.92

Table 4 Frequency of Controls on Outflows (KCout)

	Freq.	Percent	Cum.
$KCout_1$ (0-0.25)	262	42.53	42.53
$KCout_2$ (0.26-0.5)	64	10.39	52.92
$KCout_3$ (0.51-0.75)	38	6.17	59.09
$KCout_4$ (0.76-1)	252	40.91	100
Total	616	100%	100%

Table 5 Frequency of Controls on inflows (KCin)

	Freq.	Percent	Cum.
$KCin_1$(0-0.25)	302	49.03	49.03
$KCin_2$ (0.26-0.5)	96	15.58	64.61
$KCin_3$ (051-0.75)	87	14.12	78.73
$KCin_4$ (0.76-1)	131	21.27	100
Total	616	100%	100%

Table 6 Frequency Distribution of Government Strength (stabs)

stabs	Freq.	Percent	Cum.
3	1	0.18	0.18
4	2	0.36	0.54
5	6	1.09	1.63
6	39	7.1	8.73
7	54	9.84	18.57
8	72	13.11	31.68
9	100	18.21	49.89
10	148	26.96	76.85
11	120	21.33	98.18
12	10	1.82	100
Total	549	100%	100%

Table 7 Descriptive Statistics

	Mean	*St dev.*	*Min*	*Max*
Stab	8.77	1.67	3	12
KCout	0.49	0.42	0	1
KCin	0.41	0.36	0	1
m2/reserves	3.85	3.21	0	31.13
Lending boom	35.18	32.09	0	165.72
CA/GDP	-2.85	6.78	-28.97	43.40
REER	101.94	19.32	55.85	160.20
Real GDP	4.30	4.39	-13.13	41.34
Election	0.24	0.43	0	1

Table 8 Government Strength, Controls on Capital Outflow/Inflow, and Probability of Crises

	(1) Pooled	(2) Pooled	(3) Equal	(4) Equal
Stab $_{t-1}$	-	-0.221**	-	-0.229*
		(-2.05)		(-1.78)
KCout $_{t-1}$	0.945**	2.032*	1.290*	1.608
	(2.12)	(1.65)	(1.99)	(1.04)
KCin $_{t-1}$	-0.555	-2.821**	-1.578	-4.907**
	(-0.91)	(-2.05)	(-1.58)	(-3.16)
Stab*KCout $_{t-1}$	-	-0.0893	-	-0.0428
		(-0.87)		(-0.27)
Stab*KCin $_{t-1}$	-	0.323*	-	0.410**
		(1.87)		(2.30)
m2/res $_{t-1}$	0.0115	0.0169	-0.0123	-0.0110
	(0.56)	(0.88)	(-0.51)	(-0.48)
Lending boom $_{t-1}$	-0.000571	0.00158	0.00299	0.00450
	(-0.18)	(0.59)	(0.80)	(1.27)
Ca/GDP $_{t-1}$	-0.0143	-0.0138	0.0181	0.0104
	(-0.60)	(-0.71)	(0.76)	(0.47)
REER $_{t-1}$	0.0142**	0.0198**	0.0224**	0.0234**
	(2.05)	(2.62)	(3.23)	(3.21)
Real GDP growth $_{t-1}$	0.00957	-0.115**	-0.0201	-0.0905*
	(0.34)	(-2.67)	(-0.73)	(-1.94)
Election $_{t-1}$	0.0346	0.0928	0.550*	0.510*
	(0.15)	(0.41)	(-1.92)	(-1.76)
_cons	-3.606***	-2.659**	-4.007***	-2.230*
	(-5.10)	(-2.85)	(-4.72)	(-2.07)
N	475	463	441	426

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9 Probability of Currency Crises

	KCout = 0	*KCout = 0.25*	*KCout = 0.5*	*KCout = 0.75*	*KCout = 1*
STAB = 3	7.40%	15.79%	28.71%	45.18%	62.54%
STAB = 4	4.80%	10.64%	20.40%	34.14%	50.39%
STAB = 5	2.97%	6.83%	13.73%	24.31%	38.20%
STAB = 6	1.76%	4.17%	8.73%	16.28%	27.09%
STAB = 7	1.00%	2.42%	5.23%	10.18%	17.88%
STAB = 8	0.54%	1.33%	2.95%	5.95%	10.94%
STAB = 9	0.28%	0.69%	1.56%	3.24%	6.18%
STAB = 10	0.14%	0.34%	0.78%	1.64%	3.22%
STAB = 11	0.07%	0.16%	0.36%	0.77%	1.54%
STAB = 12	0.03%	0.07%	0.16%	0.34%	0..68%

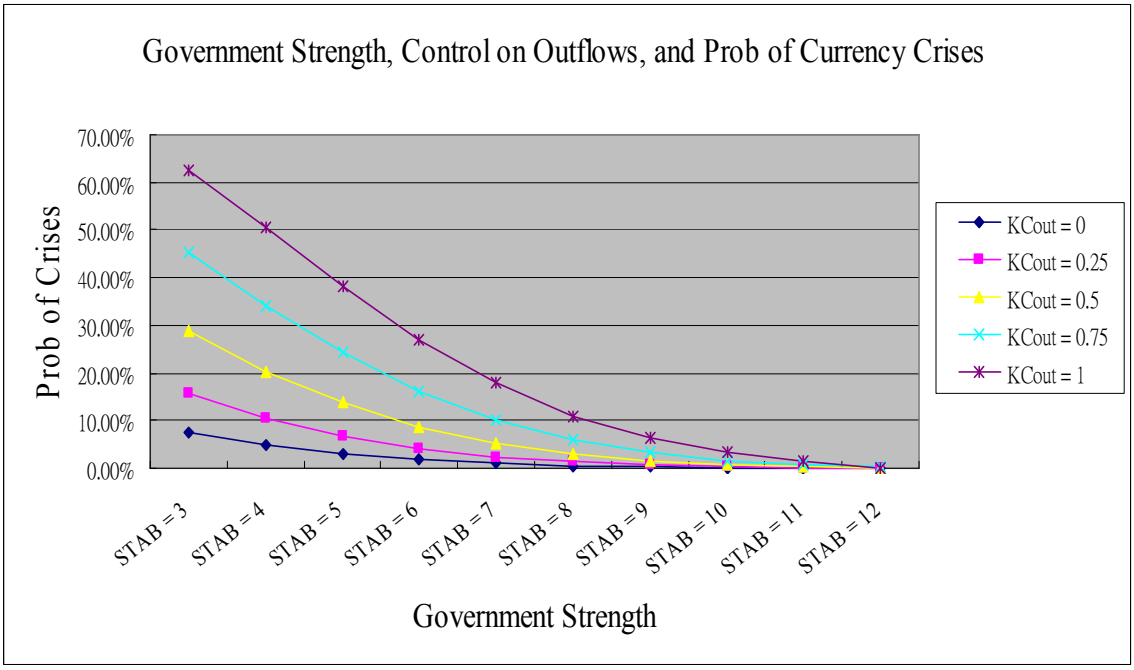

Fig 1 Prob of crises under different levels of government strength given outflow controls

Table 10 Prob of Currency Crises

	KCin = 0	*KCin = 0.25*	*KCin = 0.5*	*KCin = 0.75*	*KCin = 1*
STAB = 3	17.90%	8.35%	3.28%	1.05%	0.28%
STAB = 4	12.72%	6.40%	2.84%	1.11%	0.38%
STAB = 5	8.69%	4.83%	2.48%	1.18%	0.51%
STAB = 6	5.69%	3.58%	2.16%	1.25%	0.69%
STAB = 7	3.58%	2.61%	1.88%	1.32%	0.91%
STAB = 8	2.16%	1.87%	1.61%	1.40%	1.20%
STAB = 9	1.24%	1.31%	1.39%	1.47%	1.55%
STAB = 10	0.69%	0.91%	1.20%	1.55%	2.00%
STAB = 11	0.36%	0.62%	1.02%	1.64%	2.55%
STAB = 12	0.18%	0.41%	0.87%	1.73%	3.22%

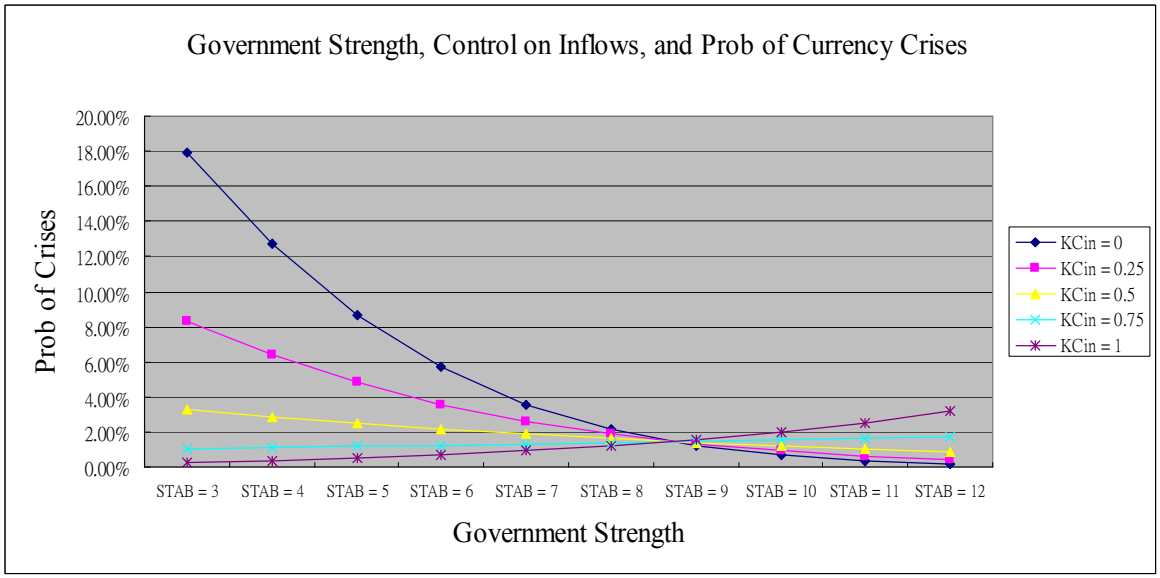

Fig 2 Prob of crises under different levels of government strength given inflow controls

Table 11 Sensitivity test: probability of crises for middle-income countries

	(1) Pooled	(2) Pooled	(3) Equal	(4) Equal
Stab $_{t-1}$	-	0.0329	-	0.0505
		(0.31)		(0.36)
KCout $_{t-1}$	0.0479	1.665**	0.673**	5.122**
	(0.16)	(1.95)	(2.11)	(2.14)
KCin $_{t-1}$	-0.305	-2.521**	-2.053***	-3.549***
	(-0.70)	(-2.34)	(-5.10)	(-3.21)
Stab*KCout $_{t-1}$	-	-0.236**	-	-0.527**
		(-2.19)		(-1.90)
Stab*KCin $_{t-1}$	-	0.341**	-	0.221
		(2.63)		(1.59)
m2/res $_{t-1}$	0.00977	0.0191**	0.000219	-0.00820
	(1.56)	(2.56)	(0.03)	(-0.72)
Lending boom $_{t-1}$	-0.0918	0.191	0.397	0.553*
	(-0.25)	(0.71)	(1.10)	(1.65)
Ca/GDP $_{t-1}$	0.000208	-0.000619**	0.000564**	0.000541**
	(0.89)	(-2.38)	(2.25)	(2.52)
REER $_{t-1}$	0.0242**	0.0279**	0.0339***	0.0327***
	(2.78)	(2.63)	(3.19)	(3.13)
Real GDP growth $_{t-1}$	0.0563*	-0.0841***	0.0454	0.0541
	(1.63)	(-3.01)	(1.19)	(1.39)
Election $_{t-1}$	-0.0538	0.121	-0.722**	-0.890**
	(-0.17)	(0.39)	(-2.00)	(-2.50)
_cons	-4.101***	-1.850**	-4.805***	-5.188**
	(-4.29)	(-2.07)	(-4.14)	(-2.56)
N	336	278	316	258

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12 Sensitivity test: Probability of crises without interaction effect

	(1) Pooled	(2) Equal
Stab $_{t-1}$	-0.187*	-0.391***
	(-1.69)	(-2.97)
KCout $_{t-1}$	0.778	2.257**
	(1.16)	(2.07)
KCin $_{t-1}$	-0.365	-3.286
	(-0.40)	(-1.41)
m2/res $_{t-1}$	0.00278	-0.142*
	(0.12)	(-1.74)
Lending boom $_{t-1}$	0.00456	0.0268**
	(1.31)	(2.64)
Ca/GDP $_{t-1}$	0.0134	0.0236
	(0.63)	(0.65)
REER $_{t-1}$	0.0229**	0.0364**
	(3.01)	(2.04)
Real GDP growth $_{t-1}$	-0.0215	-0.200**
	(-0.72)	(-2.41)
Election $_{t-1}$	0.219	0.792**
	(0.82)	(-2.50)
_cons	-2.935**	-3.237
	(-3.04)	(-1.47)
N	471	464

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$