Stopping "Hot Money" or Signaling Bad Policy?

Capital Controls and the Onset of Currency Crises

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Abstract

Restrictions on international capital transactions and other payments are usually designed to limit volatile short-term capital flows ("hot money") and stabilize the exchange rate. Their imposition, however, may have the opposite effect by inadvertently signaling the continuation of macroeconomic imbalances and inconsistent ("bad") future policy (Bartolini and Drazen, 1997a,b). This paper investigates these alternative hypotheses by testing the impact of restrictions on international capital flows and other payments controls on the likelihood of currency crises. We employ a comprehensive sample of 90 developing and emerging-market economies over the 1975-1997 period, identifying 160 currency crises. Restrictions on international capital flows, current accounts, and international payments are associated with a higher probability of the onset of a speculative attack on the currency. This finding is robust to alternative measures of liberalization on international payments and the exchange rate regime, controlling for macroeconomic determinants of currency instability, and taking into account instability emanating from the banking sector. There may be some individual exceptions but the weight of the evidence suggests that countries imposing capital restrictions are sending a "bad signal" to markets, in turn increasing the likelihood of a net capital outflow and a currency crisis.

Keywords: Currency Crises, Balance of Payments Crises, Capital Controls

JEL: F34, F15, F2, F31, G15, G18

1. Introduction

In the aftermath of the East Asian, Russian, and Brazilian currency crises of the 1990s, many economists and policymakers have focused on large and volatile capital flows as an underlying source of instability to the international financial system. Conventional wisdom holds that liberalization of international capital flows, especially when combined with fixed exchange rates, is either an underlying cause or at least a contributing factor behind the rash of currency crises experienced in recent years. A common policy prescription under these circumstances is to impose restrictions on capital flows and other international payments with the hope of insulating economies from speculative attacks and thereby creating greater currency stability.

Why might international capital flows be such a destabilizing force for developing and emerging-market economies? The presumption is that financial liberalization, and liberalization of international capital flows in particular, have encouraged a surge of short-term capital inflows ("hot money") that are very unstable. These funds may be particularly footloose, seeking the highest global return, and quite speculative in nature. Hence, funds are likely to flow out of a country just as quickly as they flow in, often without any fundamental cause, leading to currency crises with severe economic consequences (e.g. Stiglitz, 2000). Maintaining a fixed exchange rate is very difficult in these circumstances as expectations of eventual devaluation exacerbate the currency outflow, swamping the resources of governments (especially international reserves) to defend the currency without a very large contraction in monetary and fiscal policy. In this view, restricting capital flows, particularly volatile short-term capital, is necessary to

reduce excessive currency instability. We term this argument the "hot money" hypothesis of the likely effects of capital account restrictions.

An alternative view, however, holds that restrictions on the international capital account may have the opposite effect of that intended and lead to a greater likelihood of currency instability or at least lead to more dramatic collapses of the exchange rate regime once a problem arises. Two main strands of literature may be identified supporting this hypothesis. First, legal capital restrictions may prove ineffective, easily sidestepped by domestic and foreign residents and firms, and lead to economic distortions and government corruption that contribute to economic instability (Edwards, 1999c). The second argument is that the imposition (or existence) of capital controls may signal the introduction (continuance) of poorly designed economic policy and a deterioration of economic fundamentals, in turn inducing a capital outflow or cessation of inflow.[1] Bartolini and Drazen (1997a, 1997b) and Drazen (1997), building on the work of Dooley and Isard (1980), consider this channel formally. Bartolini and Drazen (1997), for example, present a model in which a government's current capital control policy signals future policies. When there is uncertainty over "government types," a policy of restricting capital flows sends a unfavorable signal that may trigger a capital outflow and currency crisis. In this view, the removal of existing controls makes investors more willing to invest in a country, as it is easier to get their capital out in the future. We term this alternative view about the likely effects of capital controls the "policy signaling" hypothesis.

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[1] Fraga (1999), for example, relates his experience at the central bank of Brazil where he found that capital controls gave policymakers a false sense of security and probably allowed Brazil to void or postpone a number of important macroeconomic policy changes and structural reforms.

Despite the renewed popularity of international capital controls, and the theoretical and practical ambiguity over their effectiveness, relatively little systematic empirical work has been undertaken in this area (Gregorio, Edwards, and Valdés, 2000). Several papers have investigated the experiences of capital controls for one or a few countries (e.g. Edison and Reinhart, 2000; Edwards, 1999a, 1999b; Gregorio, et al., 2000). Gregorio, et al. (2000), for example, investigate the Chilean experience with using unremunerated reserve requirements as a means to control international capital flows. Edison and Reinhart (2000) study the effect of capital controls on the currency crises of Malaysia and Thailand in 1997-98. However, we are aware of no studies that investigate these issues in a broader context of developing and emerging-market economies. Clearly, at a minimum, a broader investigation would be beneficial to help judge the robustness of numerous case studies. Edison and Reinhart (2000), for example, conclude from their study "…that one cannot draw general policy conclusions from the results of this paper as they are based on a scanty set of experiences" (p. 20).

This study attempts to fill this gap in the literature. The objective is to test the "hot money" and "policy signaling" hypotheses by systematically investigating the impact of capital controls and other restrictions on international payments on the likelihood of a speculative attack on the currencies of a large sample of developing and emerging-market countries. We investigate the occurrence of currency crises over time, and characterize their likelihood by the degree of international payments market restrictions and by the form of exchange rate regime (i.e. degree of exchange rate "fixity"). More formally, we employ a model of currency crises as a benchmark from which to test alternative hypotheses about the effects of capital controls. In particular, we

investigate whether capital controls effectively insulate countries—lower the probability—from a currency attack, or instead tend to exacerbate currency problems, after controlling for a host of factors typically associated with currency instability.

Section 2 reviews the literature on currency crises, focusing on the link with capital market liberalization, and formulates the key hypotheses to be tested. Section 3 describes the empirical methodology and data. Section 4 presents an overview of the data, providing descriptive statistics and the frequencies of currency crises conditional upon the form of controls on international payments. Section 5 presents the results from testing the effect of capital market restrictions on the likelihood of currency crises using a probit model. Alternative probit models are estimated, controlling for macroeconomic conditions, the form of exchange rate regime, and the occurrence of banking instability. Section 6 concludes the study.

2. Limiting Hot Money or Signaling Bad Policies? Effects of Capital Controls

2.1 Selective Literature Review

The idea of restricting capital mobility as a means of reducing macroeconomic instability has a long history. Indeed, stringent restrictions and limitations on capital flows were the norm during the Bretton Woods era and, over much of the immediate post-war period, were officially sanctioned by most governments in the large industrial countries and by the International Monetary Fund. With the turbulence in exchange markets following the introduction of generalized floating, Tobin (1978) argued that a global tax on foreign exchange transactions would reduce destabilizing speculation in international financial markets. Eichengreen and Wyplosz (1993) proposed Tobin-taxes

to discourage short-term speculators from betting against major currencies. Directing attention to developing and emerging-market economies, Krugman (1999) proposed limiting capital flows for countries that were unsuitable for either currency unions or free floating. In a similar vein, Stiglitz (1999) and others (e.g. Ito and Portes, 1998; and Eichengreen, 1999) argue that developing countries should manage and limit capital flows.

Another argument for controls is to impose them once a crisis is underway—a form of controls termed (but not advocated) "curative controls" by Edwards (1999b)—as opposed to restrictions on capital flows during normal periods. Krugman (1998) argues that countries facing a major crisis could benefit from the temporary imposition (or tightening) of controls on outflows. Once these curative controls are in place, interest rates may be lowered (from the high levels at the beginning of the crisis) and pro-growth policies put in place. Controlling capital outflows would in essence give some breathing room for crisis-managers, giving them additional time to restructure their financial sector. After the crisis has passed, the capital controls could be dismantled. This argument suggests the timing of capital controls, and their permanent versus temporary nature, is important in determining their effectiveness.

The effect of capital controls may be quite different than that intended by proponents, however. Restrictions on the international capital account may in fact lead to a net capital outflow and precipitate increased financial instability. Dooley and Isard (1980) point out that controls preventing investors from withdrawing capital from a country act like investment irreversibility. Their removal makes investors more willing to invest in a country, as it is easier to get their capital out in the future. Following this

reasoning, Bartolini and Drazen (1997a,b) show that the effect of capital controls may stem from their role as a signal of future government policies. A regime of free capital mobility may signal that the imposition of controls is less likely in the future, consistent with policies that are more favorable to investment. The ultimate purpose of capital controls in their model is to widen the tax base, and the governments with the weakest fiscal structures are likely to impose controls even though this may lead to a lower *expected* tax base (Bartolini and Drazen, 1997a). The argument is that the government's *type*—the nature of its revenue constraints—is unobserved. Future imposition of controls on outflows makes it less desirable to invest in that country currently, giving "good" governments (i.e. those not needing the broader tax base) the incentive to allow free capital mobility in order to signal good future investment prospects. Capital flows in if the signal is successful.

Bartolini and Drazen (1997a) show that a government may nonetheless impose capital controls, even though this is a "bad signal," and cause lower capital inflows on average. The reason is that, in a stochastic setting, imposing capital controls gives the government access to an additional part of the tax base and helps insure it against revenue losses from other sources following a bad state of nature. Hence, it would be willing to accept lower expected taxes to help ensure a more stable tax revenue stream. The key to their paper is explaining why some governments impose capital controls, even though it may be interpreted as a bad signal for foreign (and domestic) investors, and other governments do not (Drazen, 2000).

The second argument is of a more practical nature, questioning the ability of governments to effectively control capital flows and highlighting their distortionary and

corrupting influence. Edwards (1999c) argues that legal capital restrictions frequently prove ineffective, and are easily sidestepped by domestic and foreign residents and firms. He also documents how capital controls may lead to economic distortions and government corruption that contribute to economic instability.

2.2 Empirical Literature

Bartolini and Drazen (1997a) identify some stylized facts about capital controls. First, they find that capital controls are much more common among developing economies than industrial economies. At the beginning of 1995, for example, capital controls were used by 126 of 158 developing economies, but only in 3 of 24 OECD countries. Second, capital controls are predominantly aimed at restricting capital outflows. Third, capital controls are aimed at two main objectives—to enhance government revenues (by broadening the tax base, imposing an inflation tax, or enforcing low interest rates on government debt) or to support fixed- or managed-exchange rate policies. Finally, Bartolini and Drazen survey a number of episodes of capital account liberalization, finding that the easing of restrictions on capital outflows often represented early ingredients of a broad set of reforms (including the lifting of various elements of financial repression) and frequently led to large capital inflows.

Several papers have investigated the experiences of capital controls for one or several select countries (e.g. Edison and Reinhart, 2000; Edwards, 1999a, 1999b; Gregorio, et al., 2000). Gregorio, et al. (2000), for example, investigate the Chilean experience with using unremunerated reserve requirements as a means to control international capital flows. They examine the effects on interest rates, the real exchange

rate, and the volume and composition of capital flows. They find the effects to be elusive—no significant long-run effects on interest rate differentials and no effects on the real exchange rate were identified. Capital controls in Chile, however, did apparently tilt the composition of inflows toward a longer maturity. Using various econometric tests and a detailed case study of Chilean controls imposed in 1981, Edwards (1999a) finds that "…the relative absence of contagion effect on Chile is due to its sturdy banking regulation and not to its capital controls policy" (p. 22), and that these restrictions did not have a significant effect on interest rate behavior.

Edison and Reinhart (2000) study the effect of capital controls following the 1997 currency crises of Malaysia and Thailand. In the face of speculative attacks, the Thai authorities imposed capital controls from May 1997 to late January 1998 (the baht was floated in July 1997). The Malaysian authorities imposed a number of administrative exchange and capital control measures in September 1998 aimed at containing ringgit speculation and the outflow of capital. A key difference between the cases is that Thailand was undergoing speculative attacks and tired to use capital controls as a defense mechanism, while Malaysia was not experiencing extreme speculative pressure when controls were applied. Edison and Reinhart examine monthly data to glean the effects of controls on economic performance, foreign exchange reserves, and capital flows. They also investigated daily financial variables, testing for the effects of controls on price changes and volatility. Edison and Reinhart conclude that the controls used in Thailand did not help to achieve the desired objectives, while those in Malaysia apparently did help achieve greater exchange rate stability and more policy autonomy (although initially these measures did not prevent mutual funds from exiting the country).

Bartolini and Drazen (1997a) document that a liberalization of capital flows in many countries has led to larger capital inflows in several case studies. Grilli and Milesi-Ferretti (1995) present empirical results on a large number of possible determinants of capital controls. They use a zero-one dummy indicating whether capital controls are in place or not in a sample of 20 OECD countries, testing whether this index is linked to a variety of political and institutional determinants. They find that controls are more likely to be imposed by governments that have direct influence over monetary policy. Controls are also more prevalent when inflation and seignorage revenues are relatively large. Bartolini and Drazen (1997b) extend the approach of Grilli and Milesi-Ferretti to a sample of 73 developing countries over the 1970-94 period. They construct an index of restrictions on capital outflows as a simple average of IMF listings of restrictions on payments for capital transactions, restricting repatriation of export proceeds in a given year, and enforcing multiple exchange rates. They link a high degree of restrictions with high world real interest rates—measured as the weighted real interest rate in the G-7 industrial countries—in a yearly time-series bivariate regression. They view the causality as running from world interest rates to capital restrictions: restrictions are removed when the cost of doing so is low, i.e. only a small outflow of capital is expected when world interest are low.

Closest to our study, Grilli and Milesi-Ferretti (1995) also investigate the effects of restrictions on capital flows on macroeconomic outcomes. They find that capital controls have a significant negative effect on debt accumulation, interpreting their use as a means of enforcing financial repression of the economy. Capital controls may serve to increase tax revenues via the seignorage effect, making it easier to finance spending

without debt accumulation, but also to keep real interest rates on government debt artificially low by limiting international arbitrage in asset markets. They find support for this proposition—capital controls are associated with lower domestic interest rates after controlling for the level of domestic debt. Lewis (1997) finds that countries imposing capital controls have more highly correlated domestic consumption and output fluctuations, suggesting that they participate less in the international risk sharing opportunities associated with world capital market integration.

In sum, we are aware of no empirical studies that investigate the link between capital controls (and exchange restrictions generally) on currency stability in a broader context of developing and emerging-market economies.

2.3 Hypotheses

Given this literature review, two alternative and easily testable hypotheses about the likely effects of capital controls may be identified. The first, and most conventional, view is that the imposition of exchange controls is a useful policy instrument to limit capital flows and enhance exchange rate stability. This is the "limiting 'hot' money" hypothesis. The second view is that the imposition of capital controls may signal poorly designed future policy, leading to a loss of confidence, currency flight, and an exchange rate regime collapse. We term this the "signaling bad policy" hypothesis. Our objective is to systemically test these hypotheses in the context of a broad sample of developing and emerging-market economies.

Other questions of interest in this context include: Has the frequency of currency crises grown in tandem with the move to decontrol international capital movements?

And, are relatively wealthy and open emerging-market economies more likely to experience currency crises than the broader group of developing economies?

3. Data and Methodology

3.1 Defining Currency Crises

Currency crises are typically defined as "large" changes in some indicator of actual or potential currency value. Some studies focus on episodes of large depreciation alone (e.g. Frankel and Rose, 1996), while others include episodes of speculative pressure. The exchange rate does not always adjust during episodes of speculative pressure because the authorities successfully defended the currency by intervening in the foreign exchange market or raising domestic interest rates (e.g. Eichengreen, Rose, and Wyplosz, 1995; Moreno, 1995; Kaminsky and Reinhart, 1999). Alternative criteria have been employed in the literature for identifying "large" changes in currency value or pressure relative to what is considered "normal." Some studies employ an exogenous threshold rate of depreciation common to all countries in the analysis (e.g., Frankel and Rose, 1996; Kumar, Moorthy, and Penaudin, 1998). Other studies, by contrast, define the threshold in terms of country-specific moments (e.g., Kaminsky and Reinhart, 1999; Kaminsky, Lizondo, and Reinhart, 1998; IMF, 1998; Esquivel and Larrain, 1998; Glick and Moreno, 1998; Moreno, 1999).[2]

Our indicator of currency crises is constructed from "large" changes in an index of currency pressure, defined as a weighted-average of monthly real exchange rate

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[2] Furman and Stiglitz (1998) and Berg and Patillo (1999) evaluate the predictive power of a range of model methodologies and definitions for the 1997 Asia crisis.

changes and monthly (percent) reserve losses.[3] The weights are inversely related to the variance of changes of each component over the sample for each country. Our measure presumes that any nominal currency changes associated with exchange rate pressure should affect the purchasing power of the domestic currency, i.e. result in a change in the real exchange rate (at least in the short run). This condition excludes some large depreciations that occur during high inflation episodes, but it avoids screening out sizable depreciation events in more moderate inflation periods for countries that have occasionally experienced periods of hyperinflation and extreme devaluation.[4] Large changes in exchange rate pressure are defined as changes in our pressure index that exceed the mean plus 2 times the country-specific standard deviation, provided that it also exceeds 5 percent.[5, 6]

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[3] Our currency pressure measure of crises does not include episodes of defense involving sharp rises in interest rates. Data for market-determined interest rates are not available for much of the sample period in many of the developing countries in our dataset.

[4] This approach differs from that of Kaminsky and Reinhart (1999), for example, who deal with episodes of hyperinflation by separating the nominal exchange rate depreciation observations for each country according to whether or not inflation in the previous 6 months was greater than 150 percent, and they calculate for each subsample separate standard deviation and mean estimates with which to define exchange rate crisis episodes.

[5] Kaminsky and Reinhart (1999) use a three standard deviation cut-off. While the choice of cut-off point is somewhat arbitrary, Frankel and Rose (1996) and Kumar, Moorthy, and Perraudin (1998) suggest that the results are not very sensitive to the precise cut-off chosen in selecting crisis episodes.

3.2 Restrictions on International Payments

We consider three measures of financial control liberalization on international payments derived from the IMF classifications contained in the *Annual Report on Exchange Arrangements and Exchange Restrictions* (*EAER*). A country is classified as either "liberalized" (value of unity) or not (value of zero) in terms of the capital account (KAL), current account (CAL), and requirements to surrender export proceeds (SEL). These are quite rudimentary measures of balance of payments restrictions and, by providing only a dichotomous indication of the existence of controls, do not allow one to measure variations in the intensity of controls and enforcement. This is the only internationally comparable data available, however, and we hope to judge the robustness of the basic results on capital controls restrictions by using three alternative measures of balance of payments restrictions.

Specifically, for the 1975-84 period *EAER* coded countries (published in the reports through 1995) for the existence (or not) of balance of payments restrictions and controls on export proceeds as follows: "restrictions on payments for capital transactions", "restrictions on payments of current transactions", "surrender or repatriation requirement for export proceeds." We used these categorizations, respectively, for our KAL, CAL and SEL measures. From 1995, *EAER* began (starting

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[6] We have also constructed an alternative measure of currency crises following Esquivel and Larrain (1998) that employs a hybrid condition: the monthly depreciation in the (real) exchange rate either (i) exceeds 15 percent, provided that the depreciation rate is also substantially (e.g., two times) higher than that in the previous month, or (ii) exceeds the country-specific mean plus 2 standard deviations of the real exchange rate monthly growth rate, provided that it also exceeds 5 percent. The first condition insures that any large (real) depreciation is counted as a currency crisis, while the second condition attempts to capture changes that are sufficiently large relative to the country-specific monthly change of the (real) exchange rate. The results of our analysis are unaffected by use of this alternative measure.

with the 1996 Annual Report) to disaggregate controls on export proceeds as follows: "repatriation requirements for export proceeds" and "surrender requirements for export proceeds." We use the second, more restrictive, of these measures for our SEL category for the 1996-97 observations. From 1996, *EAER* (starting with the 1997 Annual Report) categorized balance of payments restrictions as follows: "controls on payments for invisible transactions and current transfers" and 10 separate categories for controls on capital transactions (11 categories in the 1998 Annual Report). We used the first *EAER* categorization directly for the 1996-97 CAL observations. We defined the capital account to be restricted for the 1996-97 observations (i.e. not liberalized, so that KAL= 0) if controls were in place in 5 or more of the *EAER* sub-categories of capital account restrictions *and* "financial credit" was one of the categories restricted.[7]

We also consider domestic financial liberalization (FinL), defined as the decontrol of interest rates on bank deposits, as an additional factor influencing capital flight and currency stability. This series is from Demirgüç-Kunt and Detragiache (1998) but has been augmented to cover additional countries with information from Williamson and Mahar (1998), Honohan(1995), Galbis (1993), and other IMF studies.

3.3 Determinants of Currency Crises

An important part of our work is to identify appropriate control variables in our multivariate probit models. We want to ensure that empirical links between external

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[7] The 11 classifications under capital restrictions reported in the 1998 and 1998 *EAER*s were controls on: (1) capital market securities, (2) money market instruments, (3) collective investment securities, (4) derivatives and other instruments, (5) commercial credits, (6) financial credits, (7) guarantees, sureties, and financial backup facilities, (8) direct investment,

controls, exchange rate regimes and currency crises are not spurious, attributable to variables omitted from the probit regressions. The theoretical and empirical literature has identified a vast array of variables potentially associated with currency crises (see, e.g. Kaminsky, Lizondo, and Reinhart, 1998; Frankel and Rose, 1996). The choice of explanatory variables in our benchmark model for the analysis was determined by the questions we posed earlier, the availability of data, and previous results found in the literature. We postulate a "canonical" model of currency crises in order to form a basic starting point to investigate the effects of financial liberalization. We examine simple models with few explanatory variables. The main source of the macro data is the International Monetary Fund's *International Financial Statistics* (CD-ROM) and the exchange rate regime classification data is from the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions*

Our "control variables" are lagged to avoid simultaneity problems and determine predictive ability. The lagged macroeconomic control variables, following Glick and Hutchison (2000) and others, are export growth, the log ratio of broad money to foreign reserves, credit growth, the current account to GDP ratio and whether the country recently experienced the onset of a banking crisis.[8] We also control for the form of exchange rate regime (lagged), defined as a discretely varying variable by assigning a number value on a scale of 0 to 1 according to a country's exchange rate classification in

(9) liquidation of direct investment, (10) real estate transactions, and (11) personal capital movements.

[8] The banking crisis data are from Caprio and Klingebiel (1996, 1999).

a given year, with higher values indicating greater exchange rate fixity.[9] This variable is labeled "Exchange rate fixity t-1" in the tables. Finally, we also consider whether a major banking crisis occurred around the time of the currency crisis. The banking crisis variable was constructed as a binary variable, with unity indicating the onset of a banking crisis, i.e. first year of a period of bank distress and zero otherwise.[10] These variables are frequently employed in currency crisis studies and are often found to have (some) predictive power (Berg and Patillo, 1999; Glick and Hutchison, 2000).

We expect export growth (in U.S. dollars) to be relatively slow, and the growth rate of M2/foreign reserves to be relatively high, prior to a currency crisis. A slowdown in export growth indicates a decline in foreign exchange earnings that in turn may set up the expectation—and speculative pressure—of a currency decline. A rise in the M2/foreign reserves ratio implies a decline in the foreign currency backing of the short-term domestic currency liabilities of the banking system (Calvo and Mendoza, 1996). This would make it difficult to stabilize the currency if sentiment shifts against it. Similar reasoning suggests that a larger current account surplus-to-GDP ratio would be expected to lessen the likelihood of a currency crisis, while rapid credit growth would be anticipated to precede a currency crisis.

Further, countries with greater exchange rate rigidity might be more likely to experience overvalued currencies and eventually face speculative runs and sharp

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[9] Specifically, a country-year observation categorized as an independent float is assigned a value of 0, a managed float a value of 0.1; a wide-band crawling peg, 0.2; a narrow-band crawling peg, or adjustment by indicators, 0.3; a peg with “frequent” changes, 0.4; a cooperative floating arrangement, 0.5; basket peg, 0.6; de facto peg, 0.7; SDR peg, 0.8; and a single currency peg, 0.9.

devaluation. Finally, the "twin crisis" phenomenon suggests that a domestic banking crisis could make a speculative attack on the currency more likely (Kaminsky and Reinhart, 1999; Glick and Hutchison, 2000). Several other variables were considered but not included in the reported regressions (for brevity) since they did not increase explanatory power.[11]

3.4 Data Sample and Windows

Our data sample is determined by the theoretical determinants of currency market volatility and by the availability of data. We do not confine our analysis to countries experiencing currency crises. That is, we include developing countries that did not experience a severe currency crisis/speculative attack during the 1975-97 sample period. Using such a broad control group allows us to make general statements about the conditions distinguishing countries encountering crises and others managing to avoid crises.

The minimum data requirements to be included in our study are that GDP are available for a minimum of 10 consecutive years over the period 1975-97. This requirement results in a sample of 90 developing and emerging-market countries. We have 32 emerging economies, 58 other developing and transition economies.[12] We use annual crisis observations in our analysis. While we employ monthly data for our (real)

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[10] We report results using only Caprio and Klingebiel's (1996, 1999) "major" or "systemic" bank crisis; the results are similar with their more inclusive measure of crises.

[11] We also do not consider possible contagion effects during currency crises. See Glick and Rose (1999).

exchange rate pressure index to identify currency crises and date each by the year in which it occurs, using annual data enables inclusion of a relatively large number of countries.

For each country-year in our sample, we construct binary measures of currency crises, as defined above (1 = crisis, 0 = no crisis). A currency crisis is deemed to have occurred for a given year if the change in currency pressure for any month of that year satisfies our criteria (i.e. two standard deviations above the mean as well as greater than five percent in magnitude). To reduce the chances of capturing the continuation of the same currency crisis episode, we impose windows on our data. In particular, after identifying each "large" monthly change in currency pressure, we treat any large changes in the following 24-month window as a part of the same currency episode and skip the years of that change before continuing the identification of new crises. With this methodology, we identify 160 currency crises over the 1975-99 period.

Appendices A, B, and C, respectively, provide details on the countries including in the developing country and emerging markets samples, the currency (and bank) crisis dates, and the periods of exchange payments liberalization.

4. Descriptive Statistics and Conditional Frequencies

4.1 Descriptive Statistics on Currency Crises, Liberalization, and Exchange Pegs

Table 1 shows the occurrence of currency crises in developing and emerging-market economies over the 1975-1997 period. Panel A shows the frequency of currency

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[12] Our emerging economy sample accords roughly with Furman and Stiglitz's variant (1998) of that used by Sachs, Tornell, and Velasco (1996), augmented to include Hong Kong and

crises (number of crises divided by number of observations) for the full sample and 5-year sub-sample (except for the 1995-97 sub-sample). Currency crises are a common occurrence. The 90 (32) countries in the full developing country (emerging market) sample experienced 160 (78) currency crises over the 1975-97 period. This represents a frequency of 11.7 percent on average for the developing economies. Crises were least frequent during the late 1970s (9.9 percent average frequency) and most frequent during the late 1980s (14.3 percent).

The recent spate of currency crises around the world is not an uncommon event, and does not indicate a rise in the frequency of currency crises over time. Moreover, emerging markets do not appear different than other developing economies in terms of the frequency of currency crises. They exhibit a similar frequency of currency crises to that observed in the sample overall (11.3 percent), and also a similar pattern across periods of time.

Panel B of Table 1 provides a geographic decomposition of the frequency of currency crises. Currency crises are common to all regions, and countries of every development status. Currency crises were most frequent in poor Africa (16.2 percent frequency), and least frequent in Asia (9.6 percent). (Note, however, that the figure for Africa may be overstated since the French Franc zone CFA countries are mostly excluded from the sample due to data limitations.) The same pattern holds up for both developing economies and emerging-market economies. Despite recent high profile and dramatic currency crises in Thailand, Malaysia, Indonesia, and Korea, emerging-market economies in Asia have been least frequently affected by currency instability.

Uruguay but excluding China, Israel, the Ivory Coast, and Taiwan. The full developing country

Table 2 shows the prevalence in our sample of liberalized restrictions on capital flows and other international payments. The table presents the (unconditional) frequency of our different measures of financial liberalization. For the full sample of developing economies, the highest degree of liberalization is for domestic financial liberalization (FinL; 46.5 percent), and least for the liberalization of measures controlling the surrender of export proceeds (SEL; 15 percent) and capital account liberalization (KAL; 16.2 percent). Comparing the beginning (1975-79) and end (1995-97) of our sample, we see a clear trend in the 1990s towards more liberal policies irrespective of the indicator used for comparison. Emerging markets show the same overall pattern as that identified in the full developing economy sample.

4.2 Currency Crises: Frequencies Conditional on Liberalization

Table 3 shows the frequency of currency crises conditional upon a country's having liberalized its financial controls. This table sheds light directly upon the main hypothesis of interest: whether restrictions on capital flows (or other international payments) affects the probability of a currency crisis. The setup of Table 3 is similar to that of Table 2, listing the particular measures of financial restrictions down the rows of the first column. The adjacent column pairs compare, for each particular measure, the frequency of (country-year) observations where payments were restricted or liberalized. These relative frequency measures were calculated conditional on both contemporaneous and lagged values of liberalized controls. χ^2 statistics for tests of the null hypothesis of independence between the frequency of crises and liberalized controls are also reported.

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sample excludes major oil-exporting countries.

In addition to the full developing country sample, results are also reported for the subset of emerging-market economies.

The most striking result from Table 3 is that the country-year observations associated with more liberalized capital flows (and more liberal payments systems generally) have substantially lower frequencies of currency crises than those associated with restrictions. This is strong *prima facie* evidence in support of the Bartolini and Drazen (1997) hypothesis that capital account restrictions may lead to expectations of inconsistent policies and contribute to currency instability. This is true *in every case* regardless of the liberalization measure, contemporaneous or lagged values, or whether the classification is concerned with developing or emerging-market economies.

And the differences are substantial. In the full sample of developing countries, for example, countries with restricted (not liberalized) capital flows using the KAL measure had currency problems contemporaneously for 12.7 percent of the time on average, compared to 6.8 percent for those not having restrictions. The χ^2 statistics reject the null of independence and indicate that this difference is significant (at better than 5 percent). The difference in currency crisis frequency according to whether the capital account restrictions were in place or not in the preceding year is smaller (12.3 percent versus 8.1 percent), but is still significant at the 10 percent level. The same pattern is apparent for our other measures of liberalization: the lagged relationship between currency crises and liberalization is weaker than the contemporaneous relationship. The results for the emerging country sub-sample, which are generally weaker than those for the full sample, display the same pattern.

5. Probit Results

Our use of probit models allows us to go beyond the conditional frequencies reported in the previous section and to focus on the contribution of payment restrictions to currency crises, while controlling for other macroeconomic and institutional factors that vary across time and country. We estimate the probability of currency crises using a multivariate probit model on an unbalanced panel data set for developing and emerging-market countries over the 1975-97 period (or years available). We observe that either a country at a particular time (observation t) is experiencing the onset of a crisis (i.e. the binary dependent variable, say y_t, takes on a value of unity), or it is not ($y_t = 0$). The probability that a crisis will occur, Pr($y_t = 1$), is hypothesized to be a function of a vector of characteristics associated with observation t, x_t , and the parameter vector *ß*. The likelihood function of the probit model is constructed across the n observations (the number of countries times the number of observations for each country) and the log of the function is then maximized with respect to the unknown parameters using non-linear maximum likelihood

$$\ln L = \sum_{t=1}^{n} \left[y_t \ln F(\beta' x_t) + (1 - y_t) \ln(1 - F(\beta' x_t)) \right]$$

The function $F(.)$ is the standardized normal distribution.

In these equations we employ a 24-month window following the onset of a crisis (i.e. episode of exchange rate pressure), as discussed in Section 3.4, and we eliminated from the dataset these observations. Following Eichengreen and Rose (1998), we use a weighted-probit regression where the weight is the GDP per capita. Countries with higher GDP per capita generally have more reliable data, and the observations are

correspondingly given greater weight in the analysis. In interpretation, however, should be that most importance is attached to relatively high income developing economies.

In each table we report the effect of a one-unit change in each regressor on the probability of a crisis (expressed in percentage points so that .01=1%), evaluated at the mean of the data. We include the associated z-statistics in parentheses; these test the null of no effect. Note that the sample size of the multivariate probit analysis varies depending on the set of variables considered.

We also report various diagnostic measures. The in-sample probability forecasts are also evaluated with "pseudo" R^2 statistics and analogs of a mean squared error measure, the quadratic probability score (QPS) and log probability score (LPS), that evaluate the accuracy of probability forecasts. The QPS ranges from zero to 2, and the LPS ranges from zero to infinity, with a score of zero corresponding to perfect accuracy for both.[13] For dependent binary variables, it is natural to ask what fraction of the observations are "correctly called," where, for example, a crisis episode is correctly called when the estimated probability of crisis is above a given cut-off level and a crisis occurs. Such "goodness-of-fit" statistics are shown for two probability cut-offs: 25 percent and 10 percent.

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[13] For each of the methods we can generate n probability forecasts where P_t is the probability of a crisis in the period t, $0 \le P_t \le 1$. R_t is the actual times series of observations; R_t = 1 if a crisis occurs at time t and equals zero otherwise. The analog to mean squared error for probability forecasts is the QPS:

$$QPS = \tfrac{1}{n}\sum_{t=1}^{n} 2(P_t - R_t)^2$$

Large errors are penalized more heavily under the LPS, given by:

$$LPS = \frac{1}{n}\sum_{t=1}^{n}\left[(1-R_t)\ln(1-P_t) + R_t \ln(P_t)\right]$$

5.1 Bivariate Probits

Table 4 reports the results from the probit equations explaining the likelihood of the *onset* of a currency crisis in any given year given different forms of payments liberalization in the *preceding* year. The table separates out the sample of countries into developing countries and emerging-market economies and by the four measures of liberalization analyzed in the preceding section.

The results indicate a statistically significant and economically meaningful *negative* link between liberalization and the likelihood of a future currency crisis. This result holds for capital account restrictions and for the three other measures of payments restrictions in both the developing and emerging-market economy samples. The likelihood of a currency crisis in developing economies (emerging-market economies) is reduced by 7.5 percent (9.0 percent) in the absence of restrictions on the capital account.

5.2 Multivariate Probits

Tables 5 to 7 present results linking payments restrictions to currency crises after controlling for a host of macroeconomic and institutional variables. Control variables included in Table 5 are export growth, the broad money to reserves ratio, credit growth and the current account to GDP ratio. Table 6 includes the major bank crisis variable (both current and lagged values) to the list of macroeconomic control variables. Table 7 encompasses the most inclusive set of control variables: macroeconomic, bank crisis, and also the measure of exchange rate fixity.

Table 5 reports the baseline multivariate results. All of the external (and domestic) liberalization measures are significant (at one percent) and negatively

associated with the onset of currency crises for the full developing country sample. Clearly, capital account liberalization and other forms of balance of payments and financial liberalization are associated with a lower probability of currency instability for developing countries.

The results are somewhat weaker for the emerging market sample—all of the liberalization variables have negative signs, but only KAL and FinL are significantly different from zero at conventional statistical levels of confidence. The main result still holds, however, in that (lagged) capital market liberalization is associated with greater currency stability in emerging-market economies even after controlling for macroeconomic conditions.

The results are not qualitatively affected by controlling for banking crises (Table 6) and the form of the exchange rate regime (Table 7) in addition to the macroeconomic variables. Control variables of note include export growth, the ratio of broad money to reserves, and the degree of exchange rate fixity. Low export growth and a high level of broad money to reserves (M2/reserves) are systemically linked to a higher likelihood of currency instability. Greater fixity of exchange rates also systematically predicts a higher probability of a future currency crisis in both the developing economy and emerging-market sample.

As noted, the emerging results linking liberalization of external controls to a lower probability of the onset of a currency crisis is weaker than the full sample results. Maintaining controls has not seemingly increased the likelihood of a currency problem in emerging-market economies as much as in the full developing economy sample. The

policy-signaling channel in emerging markets appears to be less evident, perhaps because of established credibility of policy and generally consistent policy design.

6. Conclusion

Our results are supportive of the signaling hypothesis that the imposition of capital controls and other restrictions on international payments lead to a fall in confidence and currency flight. The results do not support the "hot money" hypothesis that capital controls are an effective means to prevent currency crises. We find that a liberal system of exchange controls and less restriction on international payments are associated with lower probability of an exchange rate crisis. This result is clearly evident in the calculation of conditional frequencies and in the context of multivariate probit models estimating the likelihood of the onset of a currency crisis where controls are made for a host of macroeconomic and institutional factors.

A number of individual case studies and the practical experience of some central bankers are consistent with our findings. Fraga (1999), for example, relates his experience at the central bank of Brazil where he found that capital controls gave policymakers a false sense of security and probably allowed Brazil to avoid or postpone a number of important macroeconomic policy changes and structural reforms. That is, the imposition (existence) of capital controls may signal the introduction (continuance) of poorly designed economic policy and a deterioration of economic fundamentals, in turn inducing a capital outflow or cessation of inflow.

Similarly, Edwards (1999b) provides an historical overview of controls, finding that restrictions on capital outflows have seldom worked as expected and introduce major

economic distortions and lead to government corruption. Moreover, Edwards finds that although restrictions on inflows may potentially lengthen the maturity of foreign debt, they are not effective in achieving other objectives. He argues that popularity of controls on capital inflows as a device for reducing external vulnerability is due to "…a misreading of the recent history of external crises" (1999a). Valdés-Prieto and Soto (1996) also find that the existence of capital controls had a large negative impact on welfare in Chile.

Our results are consistent with early work linking liberalization to capital inflows by Dooley and Isard (1980) and to the formal signaling channel of capital controls developed by Bartolini and Drazen (1997a,b). Extensive capital controls and other restrictions on exchange payments may contribute to greater vulnerability of countries to currency crises by leading to inconsistent policies, poor policy design and, at worst, substantial corruption in the financial and international sector that eventually erodes confidence in the exchange rate system.

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Appendix A.

Countries Included in Dataset

Emerging Markets	Other Developing Countries
Argentina	Belize
Bangladesh	Bolivia
Botswana	Burundi
Brazil	Cameroon
Chile	Costa Rica
Colombia	Cyprus
Ecuador	Dominican Republic
Egypt	El Salvador
Hong Kong	Equatorial Guinea
Ghana	Ethiopia
India	Fiji
Indonesia	Grenada
Jordan	Guatemala
Kenya	Guinea-Bissau
Korea	Guyana
Malaysia	Haiti
Mauritius	Honduras
Mexico	Hungary
Morocco	Jamaica
Pakistan	Lao P.D. Rep.
Peru	Madagascar
Philippines	Malawi
Singapore	Mali
South Africa	Malta
Sri Lanka	Mozambique
Thailand	Myanmar
Trinidad and Tobago	Nepal
Tunisia	Nicaragua
Turkey	Nigeria
Uruguay	Panama
Venezuela	Paraguay
Zimbabwe	Romania
	Sierra Leone
	Swaziland
	Syrian Arab Rep.
	Uganda
	Zambia

Note: The “Developing Country” sample includes “Emerging Markets” and “Other Developing Countries”.

Appendix B.

Occurrences of Currency and Banking Crises

	Currency Crises[a]	Banking Crises[b]
Argentina	1975, 1982, 1989	1980-1982, 1989-1990, 1995
Bolivia	1981, 1983, 1988, 1991	1986-1987, 1994-1997
Brazil	1982, 1987, 1990, 1995	1990, 1994-1996
Chile	1985	1976, 1981-1983
Columbia	1985	1982-1987
Costa Rica	1981	1987
Dominican Republic	1985, 1987, 1990	
Ecuador	1982, 1985, 1988	1980-1982, 1996-1997
El Salvador	1986, 1990	1989
Guatemala	1986, 1989	
Haiti	1977, 1991	
Honduras	1990	
Mexico	1976, 1982, 1985, 1994	1981-1991, 1995-1997
Nicaragua	1993	1988-1996
Panama		1988-1989
Paraguay	1984, 1986, 1988, 1992	1995-1997
Peru	1976, 1979, 1987	1983-1990
Uruguay	1982	1981-1984
Venezuela	1984, 1986, 1989, 1994	1994-1997
Grenada	1978	
Guyana	1987, 1989	1993-1995
Belize		
Jamaica	1978, 1983, 1990	1994-1997
Trinidad & Tobago	1985, 1988, 1993	
Cyprus		
Jordan	1983, 1987, 1989, 1992	
Syrian Arab Republic	1977, 1982, 1988	
Egypt	1979, 1989	1980-1985
Bangladesh	1975	1987-1996
Myanmar	1975, 1977	