The Illusive Quest:

Do International Capital Controls Contribute to Exchange Rate Stability?

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Abstract

      We investigate the effectiveness of capital controls in insulating economies from currency crises and capital flow contractions, focusing in particular on how these relationships may have changed over time in response to global financial changes and the development of domestic and off-shore financial markets. We predict the likelihood of currency crises and capital account contractions using standard macroeconomic variables and a probit equation estimation methodology with random effects. We employ a comprehensive panel data set comprised of 69 emerging market and developing economies over 1975–2004. Both standard and duration-adjusted measures of capital control intensity (allowing controls to "depreciate" over time) suggest that capital controls have *not* effectively insulated economies from currency crises at any time during our sample period. Countries with less restrictive capital controls and more liberalized regimes appear to be less prone to currency crises and this characteristic has become more pronounced in recent years (1995-2004). We find only weak evidence that capital controls have helped to prevent capital account contractions but this effect appears to have strengthened in recent years, i.e. controls appear to facilitate a smoother flow of international capital movements but do not prevent large financial disruptions. In all cases, maintaining real GDP growth and preventing real overvaluation of the currency are critical factors preventing currency crises and capital flow contractions. The presence of capital controls greatly increases the sensitivity of currency crises to changes in real GDP growth and real exchange rate overvaluation. This is not the case for capital flow contractions.

1. Introduction

Many economists and policymakers have focused on large and volatile capital flows as an underlying source of instability to the international financial system and a causal factor to currency crises and capital flow contractions, i.e. a sharp reduction or reversal in net capital inflows. A common view is 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 these financial disruptions. 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 and limiting capital account contractions.

However, the empirical literature provides mixed results regarding the effectiveness of capital controls in insulating nations from currency crises or capital flow contractions (Eichengreen, 2001). Some studies, mainly dealing with individual country experiences, suggest that capital controls are an important instrument in insulating countries from excess exchange rate and capital flow volatility. Rodrik (2002), for example, argues that capital controls were an effective means of stemming the financial crisis in Malaysia in 1998, and was a better alternative to conditions that would have been imposed if the country had adopted an IMF program. Other studies, usually based on multi-country panel data sets, suggest that controls are not especially effective in protecting countries from exchange rate instability or capital flow contractions (e.g. Glick and Hutchison, 2005; Edwards, 2005; Eichengreen et al., 2006; and Glick, Guo and Hutchison, 2006).

Much of the empirical work investigating the effectiveness of capital controls is based on the construction of capital control indices—measuring the intensity and strength of controls—that rely on legislative and administrative rules (*de jure*) on the inflow and outflow of financial

capital and restrictions on international payments. These measures are very useful since they allow many countries to be compared over time and powerful panel-data tests to investigate the effectiveness of capital controls. However, one drawback of capital control indices based on legal and administrative measures is that they do not capture the extent to which they are enforced (that in turn depend on the quality of the bureaucracy and political considerations) or the extent to which they may be circumvented by market forces.

Changes in international and domestic financial markets in recent years may have changed the effectiveness of capital controls in insulating economies from financial disturbances. Firstly, financial and trade integration in the world economy, and the development of *global financial markets* and financial institutions with increasing global reach, has made it easier to circumvent capital controls. Hence, we would expect *de jure* capital controls to lose their effectiveness over time in response to an increasingly liberal global financial environment irrespective of the period of time that capital controls have been in place in a given country. That is, we would expect a given level of *de jure* capital controls to be less effective in maintaining exchange rate and capital flow stability since the latter part of 1990s compared with the 1970s and early 1980s. Secondly, *domestic economic forces* work to erode the effectiveness of capital account restrictions and that they become weaker over time as investors and markets adjust and find ways to circumvent them, and that this characteristic may lead to misleading inferences from empirical work that does not control for this feature of the institutional arrangements. There is a large literature on domestic financial innovation and how this process is partly driven over time by the extent of financial market restrictions. The more binding are restrictions, the larger are the economic benefits from circumventing the controls. And the longer the controls are in place, the more likely that financial innovations have developed in a way that allows agents to circumvent them. We postulate that international financial innovation also partly evolves as a

means to circumvent legal and administrative controls on international capital movements.

We address the first issue by measuring the effectiveness of capital controls over various sample periods, testing to see if their effectiveness has changed over time. We address the second issue by constructing a simple "duration adjusted" measure of capital controls (*de facto* capital controls) and using this index to investigate the effectiveness of capital controls in insulating countries from exchange rate instability and capital flow contractions. Our measure is linked to the de jure "intensity" of capital controls and the length of time that controls have been in place. Other things equal, our "duration-adjusted" measure declines with the length of the period that controls have been in place. Our premise is that economic forces work to erode the effectiveness of capital account restrictions and that they become weaker over time as investors and markets adjust and find ways to circumvent them. The "erosion" of capital controls may occur faster when the incentive to evade capital controls is large (Gros, 1987).

Our aim is to test how the likelihood of exchange rate crises and contractions in capital flows are influenced over time and by our duration-adjusted measure of capital control intensity. We are especially interested in whether the duration-adjusted measure is better able to explain currency crises and capital flow contractions than standard *de jure* measures of capital control intensity. We also investigate how the presence of capital controls has changed the sensitivity of currency crises and capital flow contractions to changes in real GDP growth and real exchange rate overvaluation. We employ probability models (probit) to measure the impact of changing capital controls on the likelihood of currency and capital flow instability.

Section 2 reviews the literature linking capital account restrictions and currency/capital flow stability. Section 3 describes the empirical methodology and data. Section 4 presents the results from testing the effect of capital market restrictions, both over different sample periods and using our duration-adjusted measure of controls, on the likelihood of currency crises and

capital account contractions. This section also investigates how the presence or absence of capital account restrictions changes the interaction between other important determinants—real GDP growth and real exchange rate overvaluation—and the likelihood of financial crises. Section 5 concludes the study.

2. Capital Controls, Sequence of Financial Liberalization and Instability

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 they 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. After the European currency crisis of 1992-93, Eichengreen and Wyplosz (1993) proposed Tobin taxes to discourage short-term speculators from betting against major currencies. In the aftermath of the Asia currency crisis of 1997-98, Krugman (1998) proposed limiting capital flows for developing countries that were unsuitable for either currency unions or free floating exchange rate regimes. In a similar vein, Stiglitz (2000) and Eichengreen (1999) have argued that developing countries should manage and limit capital flows under certain market conditions.

A large literature on the appropriate sequencing of financial liberalization also suggests that early lifting of controls on the capital account may destabilize the economy. McKinnon (1973, 1993), for example, maintains that decontrol of the capital account should come at the end of the reform sequence, following domestic financial liberalization, bank reform, and trade liberalization. In particular, McKinnon argues that a rapid inflow of (official or private) capital

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will cause real appreciation of the exchange rate, making it difficult for domestic tradeables producers "to adjust to the removal of protection" (1993, p. 117). Thus, "[a] big injection of capital at the time the liberalization occurs finances an unusual increase in imports while decreasing exports and throws out the wrong long-run price signals in private markets" (*ibid.*, see also Edwards 1984, pp. 3–4).

On the other hand, capital controls may also have a destabilizing effect. 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 a form of investment irreversibility: by making it more difficult to get capital out in the future, controls may make investors less willing to invest in a country. Following this reasoning, Bartolini and Drazen (1997a, b) show that imposing capital controls can send a signal of inconsistent and poorly designed future government policies.

Capital controls may also be ineffective and distortionary. Edwards (1999), for example, argues that legal capital restrictions frequently prove ineffective, and are easily sidestepped by domestic and foreign residents and firms. He documents how capital controls may lead to economic distortions and government corruption that in turn contribute to economic instability.

Several empirical papers have investigated the experiences with capital controls of selected developing countries. Edison and Reinhart (2001a) focus on the recent experiences of Malaysia and Thailand[1], while Edwards (1999) and Gregorio et al (2000) examine Chile. In general, these studies have found little effect of capital controls in averting currency crises, at least not without other supporting economic policies. Using various econometric tests and a detailed case study of Chilean controls imposed in the 1980s, for example, Edwards (1999) finds

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[1] Edison and Reinhart (2001b) also include Brazil and Spain in their analysis.

that "…the relative absence of contagion effect on Chile [during the currency crises of the 1990s] is due to its sturdy banking regulation and not to its capital controls policy" (p. 22). This finding is supported by Edwards' (1989) analysis of the role of capital controls in thirty-nine devaluation episodes for twenty-four developing countries over the period 1961–82. He finds that countries typically intensified their control programs in the year before devaluation, and concludes that "[a]t most one can argue that these heightened impediments to trade managed to slow down the unavoidable balance of payments crisis" (pp. 189–90).

Other studies provide a more mixed view of the effects of capital controls on the factors contributing to currency pressures in developing countries. On the one hand, Bartolini and Drazen (1997a), who survey a number of episodes of capital account liberalization, find 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. On the other hand, Grilli and Milesi-Ferretti (1995), investigating the effects of restrictions on capital flows in a panel of industrial and developing economies, find that capital controls have a significant negative effect on foreign borrowing, interpreting their use as a means of enforcing financial repression of the economy. They also find that capital controls are associated with lower domestic interest rates, consistent with the view that they limit international arbitrage in asset markets.

Glick and Hutchison (2005) systematically investigate the link between capital controls (or international payments restrictions generally) and currency stability for a broad sample of developing economies. They also investigate other empirical factors explaining both currency crises and capital account restrictions, and causal linkages between the two phenomena. Their results find a statistically significant positive link between capital controls (measured *de jure* dichotomously as to whether controls are in place or not in place). This result is robust to a

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variety of specifications and estimation methods that take into account simultaneity issues. Glick, Guo and Hutchison (2006) are concerned that earlier results may be biased by self-selection issues—countries facing exchange rate instability are more likely to impose capital controls, hence a positive link between the two phenomena. They introduce a propensity-score matching methods methodology to address the self-selection problem. This method allows a better measurement of the counterfactual (what would have occurred in the absence of capital controls) by which to estimate the impact of capital controls on exchange rate instability. Surprisingly, the earlier results hold up and support Bartolini and Drazen (1997a)—countries with capital controls are more likely to experience currency crises.

Several recent studies have investigated the link between capital controls/financial market liberalization and capital flow contractions-reversals-sudden stops using multi-country panel data sets. Eichengreen et al. (2006) find a weak negative association between capital account liberalization and sudden stops but it is generally not statistically significant. Edwards (2005) also finds some evidence of a negative association between capital account liberalization and sudden stops. Edwards (2007), on the other hand, finds evidence that capital controls lower the likelihood of capital flow contractions. He uses three alternative measures of capital controls and investigates both "capital flow contractions" (small and medium-sized contractions in net capital inflows) and sudden stops (major reversals in net capital inflows).

3. Data and Methodology

3.1 Defining Currency Crises and Capital Flow Contractions

Our primary indicator of currency crises (XRP) is constructed from "large" changes in an index

of currency pressure, defined as a weighted average of monthly real exchange rate changes[2] and

monthly (percent) reserve losses.[3] Following convention (e.g. Kaminsky and Reinhart, 1999), the

weights attached to the exchange rate and reserve components of the currency pressure index are

inversely related to the variance of changes of each component over the sample for each

country.[4] The exchange rate and reserve data are drawn from the International Monetary Fund's

International Financial Statistics CD-ROM (lines ae and 1l.d, respectively).

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

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[2] Real exchange rate changes are defined in terms of the trade-weighted sum of bilateral real exchange
rates (constructed in terms of CPI indices, line 64 of the *IFS*) against the U.S. dollar, the German mark,
and the Japanese yen, where the trade-weights are based on the average of bilateral trade with the
United States, the European Union, and Japan in 1980 and 1990 (from the IMF's *Direction of Trade*).
Most panel studies of currency crises define the currency pressure measure in terms of the bilateral
exchange rate against a single foreign country. For example, Kaminsky, Lizondo, and Reinhart (1998)
and Kaminsky and Reinhart (1999) measure the real exchange rate for all of the developing countries in
their sample against the U.S. dollar. In defining the effective rate in terms of the three major nations
likely to be the main trading partners of most developing countries, our approach provides a broader
measure than these other studies and is computationally easier to construct than a multilateral exchange
rate measure defined in terms of all of a country's trading partners. Possible alternatives, such as the
effective exchange rate measures constructed by the IMF, OECD, and others, are not available for a
broad sample of developing countries.

[3] Ideally, reserve changes should be scaled by the level of the monetary base or some other money
aggregate, but such data is not generally available on a monthly basis for most countries.

[4] 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.

experienced periods of hyperinflation and extreme devaluation.[5] 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.[6] The first condition

insures that any large (real) depreciation is counted as a currency crisis, while the second

condition attempts to screen out changes that are insufficiently large in an economic sense

relative to the country-specific monthly change of the exchange rate.

We use the measure of capital flow contraction (CFC) developed by Edwards (2007)[7]. It

is defined as an abrupt contraction in a country's capital account in a given year. Specifically, a

CFC episode is characterized by a decline in net capital flows by at least 3% of GDP

(irrespective of whether it is a net importer or net exporter of capital). This measure of capital

flow contractions differs from the literature in that the more traditional concept of sudden stop is

restricted to declines in inflows from countries that were previously receiving large inflows of

capital. (CFC captures more frequent occurrences of capital flow contractions than would a

measure of capital flow contractions).

3.2 Measuring Restrictions on International Payments

We utilize two measures of capital account restrictions in this study, both based on *de

jure* (legal and administrative controls). Our first measure, *kaclosed*, is a transformation of the

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[5] 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 sub-sample separate standard deviation and mean estimates with which to define
exchange rate crisis episodes.

[6] Other studies defining the threshold of large changes in terms of country-specific moments include
Kaminsky and Reinhart (1999); Kaminsky, Lizondo, and Reinhart (1998); and Esquivel and Larrain
(1998). 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) suggest that the results are not very sensitive
to the precise cut-off chosen in selecting crisis episodes.

Chinn-Ito (2002 and updated) measure of capital account openness. Their measure is based on underlying data reported in the International Monetary Fund's <u>Annual Report on Exchange Rate Arrangements and Exchange Restrictions</u> (AREAER). They consider the binary indices in four categories: restrictions on capital account transactions, restrictions on current account transactions, requirement to surrender export proceeds and presence of multiple exchange rates. *Kaopen* is the first principle component of these four binary indices (where each value is given a value of 0 if there are restrictions in place, and 1 otherwise; a value of 1 indicates no restrictions, i.e. an "open" capital account). This measure attempts to measure intensity of controls insofar that intensity is correlated with other restrictions on foreign exchange transactions. Our *kaclosed* transforms the Chinn-Ito openness measure to a capital account closed intensity measure, and rebases it to the [0, 100] scale where higher values indicate greater intensity of restrictions on capital account transactions.

Our duration-adjusted measure of capital controls (*kaclosed_dur*) assumes that administrative controls "depreciate" at the rate: $1/\exp(0.2 * duration)$, where duration is the number of periods since the last administrative or legal changes in capital controls. A number of depreciation rates were investigated and this rate of decay chosen since it implies a gradual decline in how the effectiveness of controls, with a half-life of about five years, and more intense circumvention of controls when they are most binding and more gradual deterioration in latter periods.

3.3 Determinants of Currency Crises and Capital account contractions

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 controls and

currency crises/capital flow contractions 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/capital flow contractions (see, e.g. Frankel

and Rose, 1996; Kaminsky et al, 1998; Kaminsky and Reinhart, 1999; Eichengreen et al., 2006;

Edwards, 2007). 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/capital flow

contractions in order to form a basic starting point to investigate the effects of capital controls.

The main source of the macro data is the IMF's *International Financial Statistics* (CD-ROM).

Our basic canonical model consists of four macroeconomic control variables that are

lagged to limit simultaneity problems. These variables are domestic credit growth (line 32)[8], the

current account to GDP ratio (line 78ald times xrrf divided by 99b) real GDP growth (line 99b.r

or 99b.p), and real exchange rate overvaluation.[9] These variables were found by Glick and

Hutchison (2006) to be significant and robust determinants in a model of currency crises.

We expect rapid domestic credit growth to be relatively high prior to a currency crisis or

capital account contraction. A rise in credit growth may signal an expansionary central bank

policy, future price increases, expansionary fiscal policy or an unsustainably overheated

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[8] As in Glick and Hutchison (2006), we also used the log ratio of broad money to foreign reserves (lines 34 plus 35 divided by 1ld times ae). However, in no instance was this variable statistically significant and was therefore omitted from the regressions.
[9] Following Kaminsky *et al* (1998) and Kaminsky and Reinhart (1999), among others, we construct the degree of real exchange rate overvaluation from deviations from a fitted trend in the real trade-weighted exchange rate index, where the exchange rate index we fit is the annual average of the monthly series used in constructing the exchange rate component of our currency pressure index (see footnote 5). As reported in Section 5.1, we also consider other measures of overvaluation as a robustness check.

economy. A larger current account surplus-to-GDP ratio would be expected to lessen the likelihood of a currency crisis or capital account contraction. We also expect relatively large exchange rate overvaluation and declining real output growth to be associated with increased likelihood of a currency crisis and/or capital account contraction. Substantially overvalued exchange rates may lead to the expectation that a large adjustment may occur, and declining real GDP growth may signal worsening economic conditions and undermine investor confidence in home-country investment opportunities.

3.4 Data Sample and Measurement Concerns

Our data sample is determined by the theoretical determinants of currency market and capital flow volatility and by the availability of data. We do not confine our analysis to countries experiencing currency crises or capital flow contractions. That is, we include developing and emerging market countries that both did and did not experience a severe currency crisis/speculative attack or capital flow contraction during the 1975–06 sample period. Using such a broad control group allows us to make inferences about the conditions and characteristics distinguishing countries encountering financial disruptions and others managing to avoid them.

We have a sample of 69 developing and emerging-market countries.[10] We use annual crisis and capital account contraction observations in our analysis. While we employ monthly data for our (real) 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 (xrp_nw) is deemed to have occurred

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[10] Our developing country sample excludes major oil-exporting countries.

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)[11]. With this methodology, we identify 308 currency crises (16 percent of the sample) over the 1975–06 period.[12] There are 311 incidences of capital flow contractions (18 percent of the sample) over the 1975-04 period.

4. Estimation Results

4.1 Descriptive Statistics on Currency Crises and Capital Controls

Table 1 shows the occurrence of currency crises and capital controls over 1975–2006, and by 5-year intervals (except for the last two years of the sample). The table reports the unconditional frequency of currency crises and presence of capital controls (number of "crisis" or "controls in place" observations, divided by the total number of observations).

The 69 developing countries in our dataset experienced 308 currency crises over 1975–2006, implying a frequency of 15.8 percent of the available country-year observations. Crises were least frequent during the early (1975–79 period: around 12 percent average frequency) and latter years (2000-2006: around 10.0 percent average frequency), and most frequent during the 1985–89 period (22.6 percent frequency). Currency crises around the world are not uncommon events, and there is no evidence of a trend increase in the frequency of currency crises over time.[13]

Table 1 also reports the intensity of restrictions on capital flows during the period. "Capital controls" ranges from 0 (no controls) to 100 (complete controls). "Capital controls— duration measure" also ranges from 0 to 100. The table reports average values for the entire

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[11] In robustness tests, we also consider a indicator that only measures the onset of a crisis (xrp_on) and a measure with windows (xrp_w). The measure with windows reduces the chances of capturing the continuation of the same currency crisis episode. 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. The results were very similar to our baseline case using xrp_nw and are omitted for brevity.

[12] We are limited to 1975-2004 in our probit regressions, however, because the capital control index stops in 2004.

[13] Currency crises were most frequent in Africa (16.2 percent frequency), and least frequent in Asia (9.6 percent). Despite recent high profile currency crises in Thailand, Malaysia, Indonesia, and Korea, the developing economies in Asia have been less frequently affected by currency instability.

sample and 5-year sub-periods. The average intensity of capital controls over the 1975-2004 period was about 68 and 44, respectively, for capital controls and capital controls-duration. The intensity of capital controls was in the 71-78 range during the 1975-94 period, and fell sharply after the mid-1970s (in the 53-59 range) reflecting a major push towards international financial liberalization and decontrol of international transactions. The capital control-duration measure indicates that capital controls were gradually eroding through most of the sample.

4.2 Probit estimation results

Our use of probit models allows us to focus on the contribution of payment restrictions to currency crises and capital flow contractions while controlling for other macroeconomic factors that vary across time and country. We estimate the probability of currency crises/capital flow contraction using a multivariate probit model for our data set of developing countries over 1975–2006. We observe that either a country at a particular time (observation t) is experiencing a currency 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 β. 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

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

is then maximized with respect to the unknown parameters using non-linear maximum likelihood. The function $F(.)$ is the standardized normal distribution. All equations are estimated with random effects.

In each table we report the effect of a one-unit change in each regressor on the probability of a crisis or capital flow contraction (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 probit analysis varies depending on the set of variables considered.

We also report various diagnostic measures. 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 in fact occurs. The chosen cut-off point should reasonably differ depending on the unconditional probability of the event and problem at hand[14]. For our "goodness-of-fit" statistics we consider two different probability cut-offs: 10 percent and 25 percent. These cut-offs bracket the unconditional frequency of currency crises and capital flow contractions.

4.3 Has Worldwide Financial Globalization Eroded the Effectiveness of Capital Controls?

The question of whether the rise in international financial market integration has eroded the effectiveness of domestic restrictions in reducing the likelihood of currency crises and capital account contractions is addressed in Tables 2 and 3, respectively. We consider three samples—the full sample (1975-2004), the early period (1975-1994) and the recent period (1995-2004). We are looking for patterns across time in the effectiveness of capital controls and other factors that may influence the vulnerability of countries to currency and capital flow instability. Our expectation is that capital controls, to the extent that they were ever effective, are likely to have been less effective in recent years.

The dependent variable denotes whether a currency crisis (Table 2) or whether a capital account contraction (Table 3) has occurred for a given observation[15]. The focus explanatory variable for our purposes is the extent of capital account restrictiveness—*kaclosed*. The control independent variables are: credit growth (lagged), current account/GDP ratio (lagged), real overvaluation (lagged) and real GDP growth (lagged). Probit models with random effects are estimated. A positive coefficient value of *kaclosed* indicates that higher restrictiveness of capital controls are associated with increasing likelihood of currency crises or capital control contractions. Higher credit growth and larger real overvaluation is expected to increase the likelihood of a currency crisis or capital account contraction. A larger current account ratio and higher GDP growth is expected to lower the likelihood of a currency crisis or capital account contraction.

Table 2 presents the estimates for currency crises, together with summary and goodness-of-fit statistics. There are 1495 observations for the full 1975-2004 sample period. (The number of observations is limited by having observations on each independent variable for a given country at a given point in time). About 81 (44) percent of the observations are predicted

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[14] See Greene (2000) for a broader discussion.

accurately, judging by the 25% (10%) cutoff value. Capital controls are highly statistically significant in all three samples, but with a sign suggesting more restrictive controls are associated with a higher probability of a currency crisis. The point estimates (reporting the marginal effects calculated at the mean for all of the independent variables) indicate that controls did not provide insulation against currency crises in either the early or the recent period, and that the point estimate on controls has climbed from 0.12 to 0.15. . This indicates that capital controls appear to be especially problematic in recent years-- in the era of financial globalization, imposing controls may signal currency weakness that in turn generates loss of confidence, capital outflows and precipitate currency crisis. In particular, a ten point rise in the restrictiveness of controls increases the probability of a currency crisis by 1.5 percent. Stated another way, our results suggest that if a country were to move from complete restrictiveness (kaclosed = 100) to complete openness (kaclosed = 0), it would reduce the likelihood of a currency crisis by 15 percent.

This is an empirical result consistent with Glick and Hutchison (2005) and Glick, Guo and Hutchison (2006), and consistent with the signaling theory of the perverse effects of capital controls put forward by Bartolini and Drazen (1997a,b). It is noteworthy that Glick, Guo and Hutchison (2006) find that this result is not due to "self-selection", i.e. countries with weak economic conditions simultaneously impose controls and experience currency instability. (They use a propensity-score matching methodology to control for selection bias and still find a statistically significant positive correlation between controls and probability of a crisis).

The control variables in the three regressions all have the expected signs, but only real overvaluation and real GDP growth are statistically significant. The regressions indicate that the likelihood of a currency crisis is more sensitive to real overvaluation (larger real overvaluation increases the probability of a crisis) and real GDP growth (a higher growth rate lowers the probability of a crisis) during the recent period compared to earlier years when financial globalization was less pervasive.

We looked further into the evolution of capital control effectiveness by considering six five-year sub-samples, starting with 1975-79 and ending with 2000-04. The objective is to identify more precisely where major shifts may have occurred in the factors contributing to currency crises. The point estimates for the explanatory variables are less statistically significant

[15] This dependent variable measure does not impose windows. We also estimated equations with windows imposed (two years before and after a currency crisis were deleted from the data set) and for the onset

in the sub-samples, reflecting fewer observations and less power in estimation, and offer no new insights beyond those reported in Table 2. We omit these results for brevity but they are available from the authors upon request.

4.4 Capital Flow Contractions

We also consider whether the rise of financial globalization has materially changed the effect of capital controls on the likelihood of capital flow contractions. Our estimates are reported in Table 3. All of the signs on *kaclosed* are negative, indicating that capital controls are negatively correlated with capital account contractions. However, only in the latter sample period, 1995-2004, is *kaclosed* close to statistically significant at conventional levels. On the other hand, a large current account surplus is an important and robust factor reducing the likelihood of a capital account contraction in all sample periods. In addition, real GDP growth is negatively associated with capital account contractions in the full and early sample periods, as is real overvaluation in the recent sample.

In finding a negative correlation between capital controls and capital flow contractions, our results are consistent with Edwards (2007). By contrast, Eichengreen et al. (2006) find a weak negative association between capital account *liberalization* and sudden stops but it is generally not statistically significant. Edwards (2005) also finds some evidence of a negative association between capital account liberalization and sudden stops.

4.5 The Erosion of Capital Controls

Tables 4 and 5 report the estimation results from using our *kaclosed_dur* measure of capital controls for currency crises. . As discussed above, this variable "depreciates" the *de jure* measure of capital controls. This is our attempt to capture the erosion of administrative measures limiting capital flows as agents

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of a currency crisis only (i.e. only the first year of a crisis).

find ways to circumvent controls and the controls also spur the development of new financial instruments that facilitate moving capital in and out of countries. This is separate from the overall picture of financial globalization in that the duration measure of controls is country-specific, and declines over time at a rate proportional to the level of initial capital controls.

The results with *kaclosed_dur* are qualitatively similar to those reported earlier using *kaclosed* but are even larger in magnitude—more restrictive controls are associated with a higher likelihood of currency crisis. The coefficients estimates for the three samples are statistically significant, and the point estimate almost doubles from the early to the recent sample (0.09 to 0.17). This again suggests that imposing capital controls in our present environment of "financial globalization" may be more problematic—signaling weakness and inducing capital flight and currency crises—than in the earlier period.

The coefficient estimates for the control variables in the regressions reported in Table 4 are almost identical to those reported in Table 2 (with *kaclosed*). Avoiding real exchange rate overvaluation and maintaining strong real GDP growth are critical factors in lowering the likelihood of a currency crisis, and this result is stronger in recent years of financial globalization than in the earlier sample period.

We also undertook the analysis with capital account contractions as the dependent variable and the results were virtually identical to those reported in Table 3. These are not reported for brevity but are available from the authors upon request.

The links between capital account restrictiveness and the probability of a currency crisis and capital flow reversal are explored further in Graphs 1 and 2. These show the nonlinear relationships between the degree of capital account restrictiveness and the probability of a crisis (Graph 1) and probability of a capital flow contraction (Graph 2), holding constant all other explanatory variables at their mean values. The graphs are based on the estimates from the recent sample period (1995-2004). The probability of a currency crisis ranges from 5 percent when the capital account is fully open to 25 percent when the capital account is completely closed. The probability of a capital account contraction is 18 percent when the capital account is fully open and 16 percent when the capital account is fully closed. It is apparent that a closed capital account appears to help somewhat in reducing the likelihood of a capital account contraction, but this effect is not large.

4.6 The Linkages between Capital Controls and the Effects of Real GDP Growth and Real Overvaluation

Graphs 3-6 consider in more detail how different levels of capital controls change the way real GDP and real overvaluation impact the likelihood of currency crises and capital account contractions. In particular, Graph 3 (Graph 4) plots the likelihood of currency crises (capital account contractions) to different rates of *real GDP growth* given completely open and completely closed capital accounts. Similarly, Graph 5 (Graph 6) plots the likelihood of currency crises (capital account contractions) to different levels of *real exchange rate overvaluation* given completely open and completely closed capital accounts.

Lower real GDP growth increases the likelihood of both currency crises and capital account contractions, a non-linear relationship that is increasingly high the lower is output growth. The effects of capital controls on this relationship differ markedly between currency crises and capital account contractions. In   particular, in Graph 3, there is a substantial

difference in the effects of real GDP growth on currency crises depending on whether capital controls are highly restrictive (upper curve) or largely absent (lower curve). This difference is negligible at high rates of GDP growth but grows substantially when output falls. In the absence of capital controls, a fall in GDP of 5 percent is associated with about a 15 percent likelihood of currency crisis (with other explanatory variables at their mean values). This probability rises to over 40 percent when capital controls are in place. In development economies, a fall in output of this order of magnitude is not unusual and with capital controls in place puts the economy at risk for a currency crisis. Declining real GDP growth also rapidly raises the probability of capital account contractions, shown in Graph 4, but this effect is only marginally higher when the capital account is completely open (upper curve—in this case liberalization increases the likelihood of capital account contractions). A real GDP growth decline of 5 percent is associated with about a 27 percent likelihood of a capital account contraction when the capital account is completely liberalized and about 25 percent when it is completely closed.

Graphs 5 and 6 undertake a similar analysis for real exchange rate overvaluations. The upper curve (lower curve) of Graph 5 shows the likelihood of currency crises to different levels of real overvaluation given that the capital account is completely closed (completely open). As overvaluation increases, the likelihood of a currency crisis increases markedly when the capital account is closed, e.g. the likelihood of a currency crisis is about 10 percent with "undervaluation" of 50 percent and rises to a likelihood of 40 percent with a 50 percent overvaluation. By contrast, when the capital account is open, real overvaluation has a much smaller effect on the likelihood of a crisis and the likelihood is less sensitive to change in real overvaluation, i.e. the likelihood ranges from 0 to 10 percent.

5. Concluding Remarks

We investigate the effectiveness of capital controls in insulating economies from currency crises and capital flow contractions, focusing in particular on how these relationships may have changed over time in response to global financial changes and the development of domestic and off-shore financial markets.

Our results suggest that the presence or absence of capital controls appear to have quite different effects on currency crises and capital flow contractions. Both standard and duration-adjusted measures of capital control intensity (allowing controls to "depreciate" over time) suggest that capital controls have *not* effectively insulated economies from currency crises at any time during our sample period. The duration-adjusted measure, however, is a more accurate predictor of the likelihood of a currency crisis. Countries with less restrictive capital controls and more liberalized regimes appear to be less prone to currency crises and this characteristic has become more pronounced in recent years (1995-2004).

We find only weak evidence that capital controls have helped to prevent capital account contractions but this effect also appears to have strengthened in recent years, i.e. controls appear to facilitate a smoother flow of international capital movements but do not prevent large financial disruptions. These results may be interpreted as follows. In "normal" times capital controls exert some insulating characteristics by facilitating less capital flow volatility, but when macroeconomic imbalances are substantial and pressures on the system are significant, capital controls appear to exacerbate financial instability.

In all cases that we investigate, maintaining real GDP growth and preventing real overvaluation of the currency appear to be critical factors preventing currency crises and capital flow contractions. The presence of capital controls greatly increases the sensitivity of currency crises to changes in real GDP growth and real exchange rate overvaluation. In this way, capital

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controls appear to make the economy much more vulnerable to macroeconomic fluctuations. By contrast, the presence of capital controls does not have much effect on the sensitivity of currency crises to changes in real GDP growth and real exchange rate overvaluation.

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Table 1. Currency Crises and Capital Controls, Unconditional Frequency (in percent)

	1975-2006	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2006
Currency crises[a]	15.76	12.17	16.90	22.59	18.58	17.52	10.74	9.68
(Number of crises)	(308)	(32)	(48)	(68)	(60)	(58)	(35)	(6)
Capital controls[b]	67.96	71.17	75.77	77.89	71.63	59.41	53.05	(N.A.)
Capital controls[c] (duration measure)	43.7	48.28	46.17	44.74	41.51	46.52	35.77	(N.A.)

[a] Number of crises divided by total country-years with available data. Number of crises in parentheses.
Currency crisis measure is "xrp_nw"
b: kaclosed, c: kaclosed_dur (average of capital controls over period)

Table 2: Determinants of Currency Crises

Explanatory Variable	1975-2004	1975-1994	1995-2004
	xrp_nw	*xrp_nw*	*xrp_nw*
Capital account controls (t) (**kaclosed**)	0.14587 (3.936)***	0.11665 (2.040)**	0.14815 (3.015)***
Credit growth (t-1)	0.01076 (0.416)	0.01451 (0.466)	0.00589 (0.113)
Current account/GDP (t-1)	-0.12531 (0.850)	-0.0693 (0.358)	-0.25967 (1.189)
Real overvaluation (t-1)	0.13194 (3.448)***	0.14454 (3.063)***	0.15333 (2.102)***
Real GDP growth (t-1)	-1.02153 (5.509)***	-0.88291 (3.558)***	-1.16942 (4.289)***
Summary Statistics			
No. of Crises	235	152	83
No. of Observations	1495	918	577
Log likelihood	-598.837	-387.711	-210.016
Goodness-of-fit (25% cutoff) [a]			
% of obs. correctly called	81	80	85
% of crises correctly called	25	22	29
% of non-crises correctly called	91	91	95
Goodness-of-fit (10% cutoff) [a]			
% of obs. correctly called	44	37	57
% of crises correctly called	84	89	77
% of non-crises correctly called	36	27	54

Note: The table reports the coefficients in the Random Effects Probit Regressions with associated z-statistic (for hypothesis of no effect) in parentheses below. Results significant at 1, 5, and 10 percent levels are indicated by ***, **, and *, respectively. Constant included, but not reported.
Coefficient reported are the marginal effects evaluated at the mean of independent variables.
Coefficients are multiplied by 100 giving marginal effects in terms of %.

[a] Goodness-of-fit statistics defined respectively as (A + D) / (A + B + C + D), A / (A + C), and D / (B + D), where A(C) denote number of crises with predictions of crises above (below) probability cutoff and B (D) denote number of corresponding non-crises with predictions of crises above (below) the cutoff.

Table 3 : Determinants of Capital Account Contractions

Explanatory Variable	1975-2004	1975-1994	1995-2004
	CAC	*CAC*	*CAC*
Capital account controls (t) (**kaclosed**)	-0.033 (0.870)	-0.03194 (0.567)	-0.07644 (1.375)
Credit growth (t-1)	-0.028 (0.829)	-0.03262 (0.853)	-0.03484 (0.427)
Current account/GDP (t-1)	-0.62769 (4.044)***	-0.74709 (3.750)***	-0.34632 (1.355)
Real overvaluation (t-1)	0.06959 (1.506)	0.05274 (0.967)	0.1719 (1.808)*
Real GDP growth (t-1)	-1.13809 (5.363)***	-1.16325 (4.430)***	-0.9674 (2.549)**
Summary Statistics			
No. of Crises	278	173	105
No. of Observations	1468	915	553
Log likelihood	-673.912	-418.71	-260.13
Goodness-of-fit (25% cutoff) [a]			
% of obs. correctly called	77	77	76
% of crises correctly called	28	32	28
% of non-crises correctly called	89	87	88
Goodness-of-fit (10% cutoff) [a]			
% of obs. correctly called	27	29	24
% of crises correctly called	88	87	90
% of non-crises correctly called	13	15	8

Note: The table reports the coefficients in the Random Effects Probit Regressions with associated z-statistic (for hypothesis of no effect) in parentheses below. Results significant at 1, 5, and 10 percent levels are indicated by ***, **, and *, respectively. Constant included, but not reported.
Coefficient reported are the marginal effects evaluated at the mean of independent variables.
Coefficients are multiplied by 100 giving marginal effects in terms of %.

[a] Goodness-of-fit statistics defined respectively as (A + D) / (A + B + C + D), A / (A + C), and D / (B + D), where A(C) denote number of crises with predictions of crises above (below) probability cutoff and B (D) denote number of corresponding non-crises with predictions of crises above (below) the cutoff.

Table 4 : Determinants of Currency Crises: Duration-Adjusted Capital Controls

| Explanatory Variable	1975-2004	1975-1994	1995-2004
	xrp_nw	*xrp_nw*	*xrp_nw*
Capital account controls (t) (kaclosed_dur)	0.13706 (3.862)***	0.09236 (1.883)*	0.16974 (3.238)***
Credit growth (t-1)	0.01552 (0.602)	0.01288 (0.411)	0.01116 (0.210)
Current account/GDP (t-1)	-0.14017 (0.959)	-0.09034 (0.470)	-0.20548 (0.939)
Real overvaluation (t-1)	0.14262 (3.677)***	0.15207 (3.197)***	0.14852 (2.048)**
Real GDP growth (t-1)	-1.01074 (5.429)***	-0.87866 (3.528)***	-1.14344 (4.188)***
Summary Statistics			
No. of Crises	235	152	83
No. of Observations	1495	918	577
Log likelihood	-599.625	-388.149	-209.211
Goodness-of-fit (25% cutoff) [a]			
% of obs. correctly called	81	80	86
% of crises correctly called	23	24	29
% of non-crises correctly called	92	91	96
Goodness-of-fit (10% cutoff) [a]			
% of obs. correctly called	44	37	59
% of crises correctly called	86	89	72
% of non-crises correctly called	36	26	57

Note: The table reports the coefficients in the Random Effects Probit Regressions with associated z-statistic (for hypothesis of no effect) in parentheses below. Results significant at 1, 5, and 10 percent levels are indicated by ***, **, and *, respectively. Constant included, but not reported.
Coefficient reported are the marginal effects evaluated at the mean of independent variables.
Coefficients are multiplied by 100 giving marginal effects in terms of %.

[a] Goodness-of-fit statistics defined respectively as (A + D) / (A + B + C + D), A / (A + C), and D / (B + D), where A(C) denote number of crises with predictions of crises above (below) probability cutoff and B (D) denote number of corresponding non-crises with predictions of crises above (below) the cutoff.

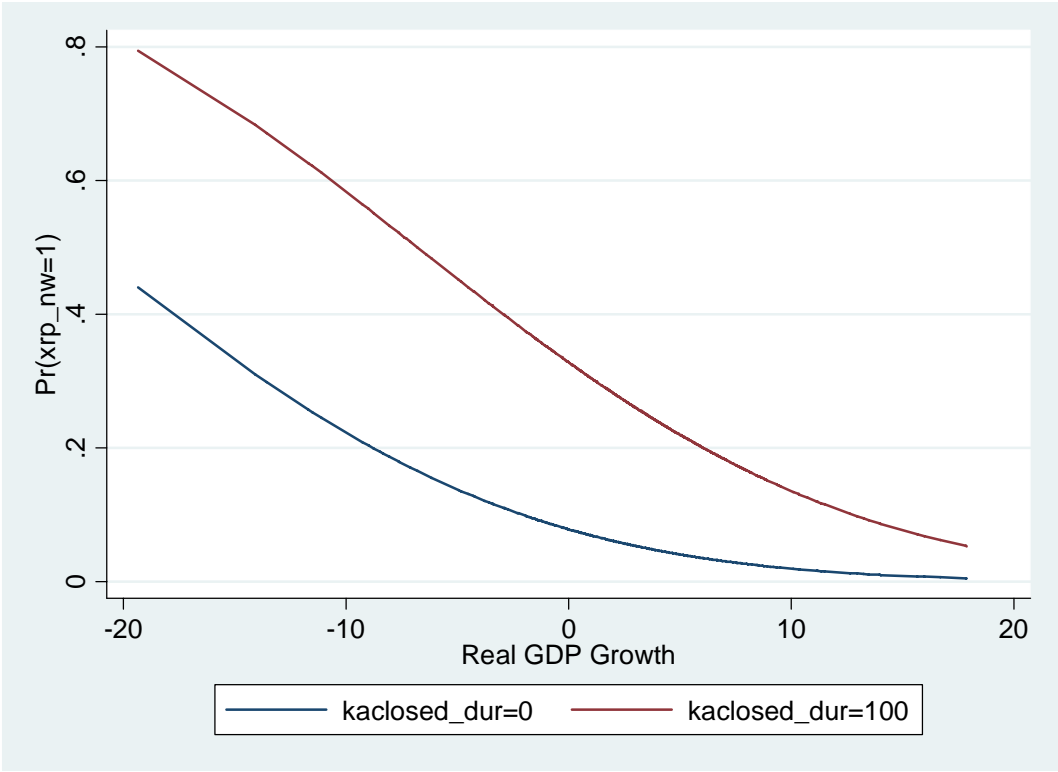Graph 1 Probability of Currency Crisis given Capital Account Restrictions
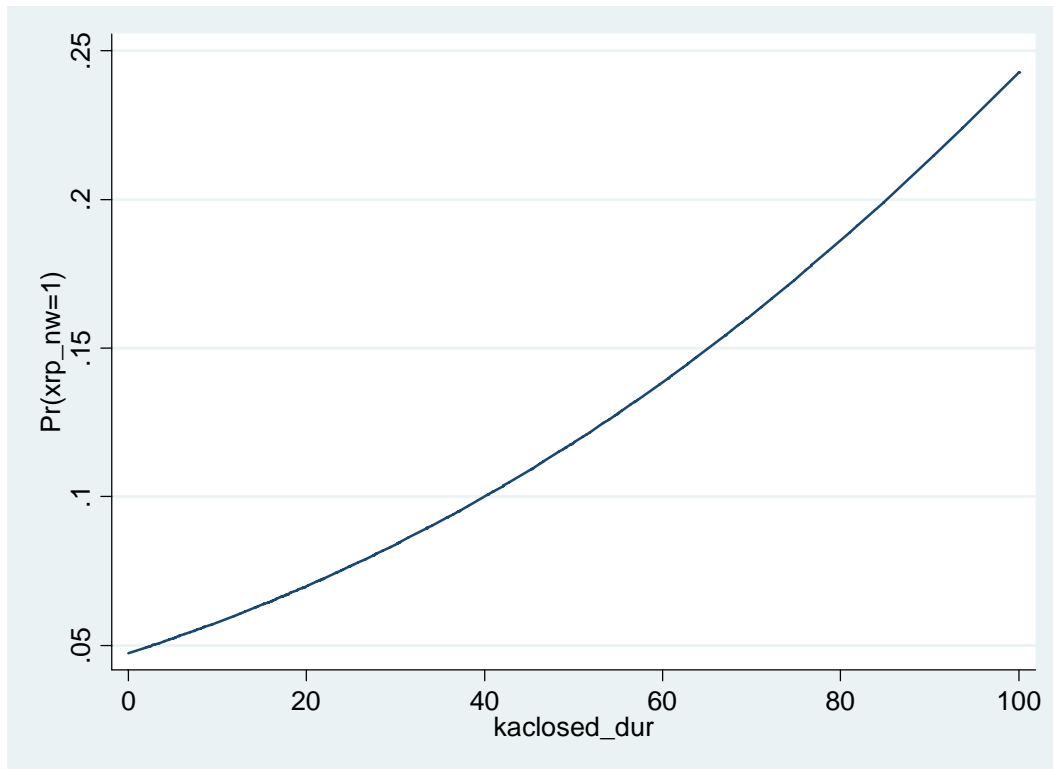
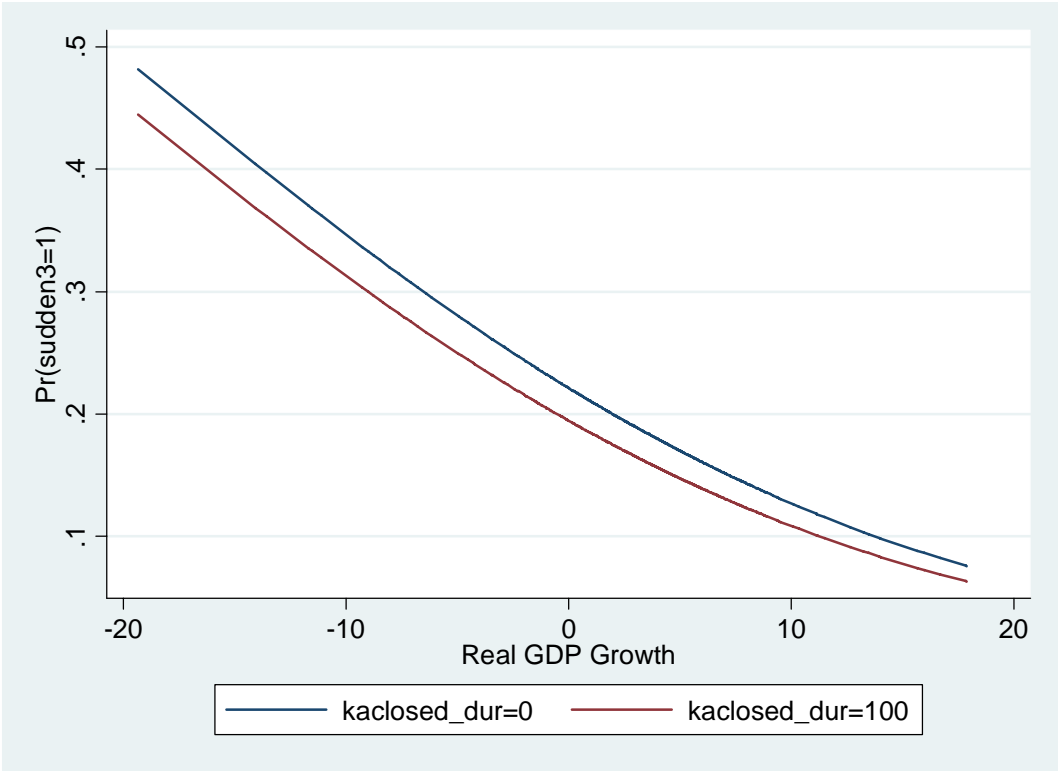Graph 2 Probability of Capital Account Contraction given Capital Account Restrictions
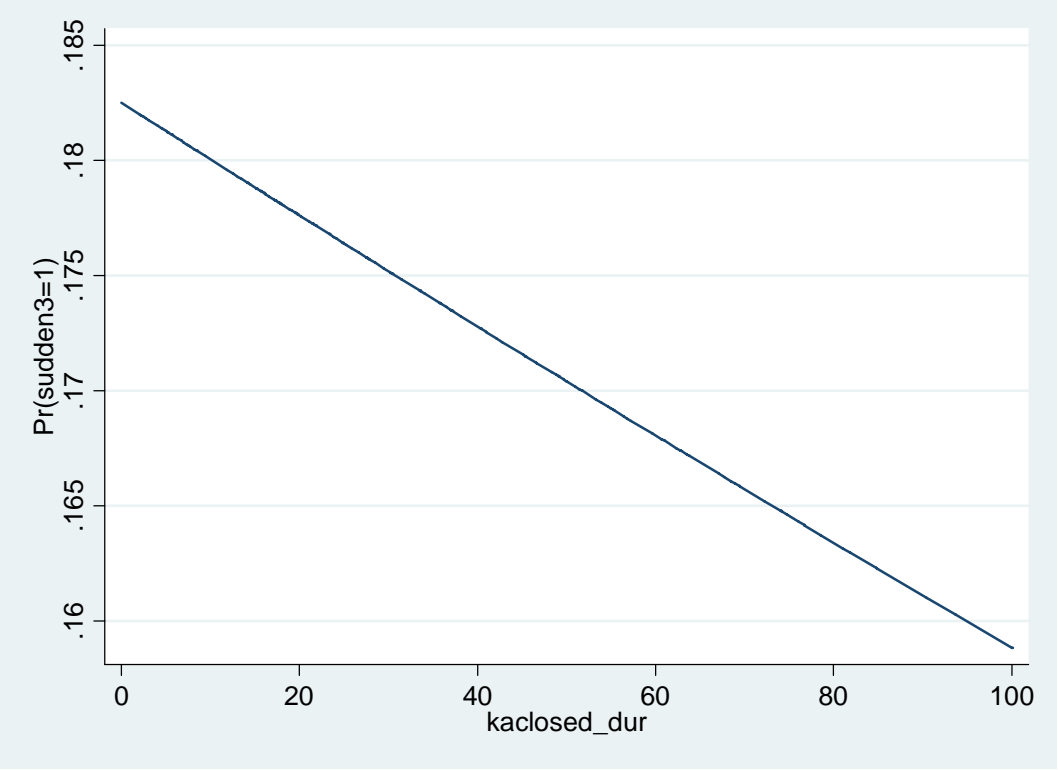
Graph 3 Probability of Currency Crisis given Real GDP Growth

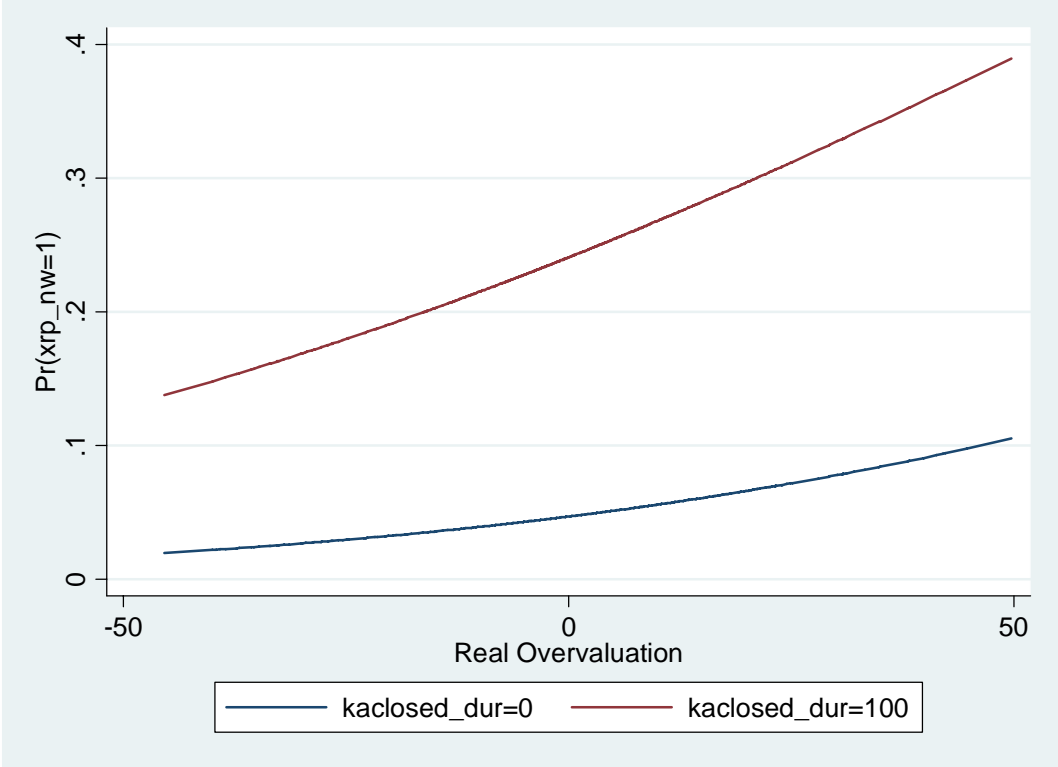Given Open (=0) and Closed (=100) Capital Account

Graph 4 Probability of Capital Account Contraction given Real GDP Growth

Given Open (=0) and Closed (=100) Capital Account

Graph 5 Probability of Currency Crisis given Real Overvaluations

Given Open (=0) and Closed (=100) Capital Account

Graph 6 Probability of Capital Account Contraction given Real Overvaluation

Given Open (=0) and Closed (=100) Capital Account