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Abstract

This paper examines whether capital account regulations are effective in reducing foreign exchange pressure and real exchange rate appreciation. Using four indices of capital inflow regulations, foreign exchange-related regulations, financial sector specific restrictions, and capital outflow regulations for 51 emerging and developing economies over the period 1995-2011, we find that all policy measures except financial sector specific restrictions are associated with lower foreign exchange pressure and reduced real exchange rate appreciation, and that the effects of capital outflow regulations are larger in magnitude than those on capital inflows. We also find that capital account regulations enhance monetary policy autonomy by reducing the effect of interest rate differentials on nominal exchange rates. Our results further indicate that increasing the restrictiveness of capital account regulations in the run-up to the crisis reduced the growth decline during the crisis, thus enhancing crisis resilience, and that countries that used capital account regulations experienced less overheating during post-crisis recovery when there was a new surge in capital inflows. The latter two results imply that capital account regulations are a powerful counter-cyclical policy instrument.

Keywords: Capital account regulations, Capital controls, Foreign exchange pressure, Global financial crisis.

JEL Classification: F21, F30, F32, F41

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1 Introduction

The May 2013 Fed announcement that it would start reducing asset purchases placed the issue of vulnerability of emerging economies to capital account volatility back in the agenda. The predictable reversal of the capital flows that was then unleashed is, of course, the counterpart of the opposite phenomenon that the Brazilian Finance Minister Guido Mantega coined the "currency wars": excessive capital inflows associated with Fed expansionary policy and, particularly, quantitative easing (QEs). Indeed, the concern with both excessive inflows and their reversibility led many countries that were receiving large capital inflows to adopt macroprudential policies, including prudential capital account regulations – CARs in short, the term we will use in this paper instead of "controls" – and domestic countercyclical macroeconomic policies (Ostry et al., 2012; Lim et al., 2011; Gallagher et al., 2012). This shift in macroeconomic policies was supported by theoretical work showing that capital inflow taxes can enhance social welfare by diminishing negative feedback effects resulting from capital flow volatility (Korinek, 2011; Jeanne and Korinek, 2010), that they can help depreciate the real exchange rate by reducing borrowing and tradable consumption (Korinek, 2013; Jeanne, 2012), and that these effects can be supported by interventions in the foreign exchange market and thus by active foreign exchange reserve management (Korinek, 2013).[1]

However, the empirical evidence used in support of CARs has largely focused on the effects on *financial* stability, leaving out the effects on *macroeconomic* stability.[2] Ostry et al. (2012) showed that capital inflow restrictions and foreign exchange-related prudential regulations improve the liability structure of borrowing countries and reduce financial fragilities during booms, which in turn improve the crisis resilience of countries during busts. If restrictions on capital inflows reduce accumulation of short-term debt and avoid excessive credit booms, do they have any systemic effect on the real exchange rate pressures and monetary autonomy? These macroeconomic effects could be particularly important to gauge the effectiveness of CARs to address pressures on the real exchange rate and the loss of monetary policy autonomy. Despite this recent theoretical and policy-related work, however, the existing empirical analyses on whether the use of CARs generates

[1] Farhi and Werning (2012) show that CARs stabilize output and inflation by offsetting the risk premium shock on domestic interest rate. For surveys of the theoretical literature, see Farhi and Werning (2012) and (Korinek, 2013).

[2] In a comprehensive literature survey, Magud and Reinhart (2007) pointed out that the studies "are not very informative regarding the effectiveness of controls in reducing the volume of capital flows and reducing real exchange rate pressures" (p. 650). Similarly, Ostry et al. (2012) refer to this study for the measures "limited effectiveness" on the volume of capital inflows and hence the exchange rate, and argue that "while capital controls may be of limited (or only temporary) use in affecting the aggregate volume of flows, inflow controls (together with FX-related and other prudential measures) can form an important part of the policy toolkit to reduce the financial-stability risks associated with inflow surges" (p. 2).

systemic macroeconomic effects have largely been inconclusive, and there has not yet been any multi-country analysis of the joint effects of CARs on real exchange rate appreciation and reserve accumulation, or the effects of CARs on monetary policy autonomy.

This absence of empirical assessment of foreign exchange market pressures – referred to below simply as "foreign exchange pressure" – resulting from capital *inflows* is surprising given the abundant studies on foreign exchange pressure resulting from capital outflows during crises. An important focus of the literature on contagion during crises has been how countries respond to large capital outflows through a mix of nominal depreciation, reserve loss, and higher interest rates. While measures of foreign exchange pressure are frequently used to capture these effects during crises and to define crisis episodes as periods when such pressure is above a certain threshold (see e.g. Frankel and Saravelos, 2010), there have not been similar attempts so far to document how country responses to large capital inflows can be captured in a similar measure of foreign exchange pressure.

This paper aims to fill this void by testing whether capital account regulations are effective in reducing foreign exchange pressure broadly and real exchange rate appreciation in particular, and thus help offset macroeconomic risks arising from large capital inflows. Using four indices of capital inflow regulations, foreign exchange-related regulations, financial sector specific restrictions, and capital outflow regulations for 51 emerging and developing economies over the period 1995-2011, we find that all policy measures except the financial sector specific restrictions are associated with lower foreign exchange pressure and reduced real exchange rate appreciation, and that the effects of capital outflow regulations are larger than that of capital inflow regulations in magnitude. Another finding is that CARs enhance monetary policy autonomy by reducing the effect of interest rate differentials on nominal exchange rates. Our results further indicate that increasing the restrictiveness of CARs in the run-up to the crisis reduced the growth decline, thus enhancing crisis resilience, and that they experienced less overheating during post-crisis recovery when there was a new surge in capital inflows. Taking the latter two results together, they imply that capital account regulations are a powerful counter-cyclical policy instrument.

Our results differ from previous empirical studies on the macroeconomic effectiveness of CARs in the following respects. First, we use a large sample of emerging and developing countries and exclude advanced countries, since the latter do not tend to use capital account policies to affect macroeconomic variables. Focusing on emerging and developing countries also allows us to capture macroeconomic effects in the context of these economies that are most vulnerable to large and

volatile capital flows. As we explain the literature review, previous findings are largely driven by sample selection. Second, we use composite indices of CARs that capture regulations over six asset categories, which allows us to capture the intensity of regulations over time, instead of only their presence at a particular asset category at any point in time.[3] Third, we use an instrumental variables-2SLS approach to control for the endogeneity bias, i.e. countries may increase the use of CARs in response to an increase in capital inflows or outflows, which has been a key factor that biased the OLS coefficients towards zero in the previous empirical analyses.[4] Our findings show that the magnitude of the IV-2SLS estimates are larger than the OLS estimates, consistent with the view that not controlling for the potential endogeneity would bias coefficients downwards.

Previous studies have shown both theoretically and empirically that the business cycles in developing countries are driven by the boom-bust pattern of capital flows.[5] During capital inflow booms, the real exchange rate appreciates due to either the nominal appreciation if the country has a flexible exchange rate regime, or the inflation rises if the country has a relatively fixed exchange rate regime (or a combination in intermediate regimes, such as managed floating or a crawling peg). Capital inflow restrictions would reduce these effects by limiting capital inflows.[6] Capital outflow restrictions may also reduce short-term portfolio inflows if investors are forward-looking –i.e. they realize that it will be too costly to move the funds out of the country due to outflow restrictions, and decide not to invest in the first place. During busts, the real exchange rate is expected to depreciate and reserves losses are likely occur. Under these conditions, regulators may react by partially liberalizing capital inflow restrictions to allow for more capital to flow in, which would help counter depreciation and reserve loss. In this sense, the restrictiveness of capital inflow and outflow regulations have to be countercyclically adjusted to manage macroeconomic-stability risks (Ocampo, 2003, 2008; Ocampo and Tovar, 2003; Ocampo and Palma, 2008).

As a countercyclical policy instrument, CARs also increase the monetary policy autonomy of developing countries that have flexible exchange rates and fairly open capital accounts. During capital account booms, restrictions on inflows open the space for contractionary monetary policy by raising interest rates without enhancing appreciation pressure and attracting further inflows

[3]See Schindler (2009) for a discussion of how the composite indices measure the intensity of regulations over time. Since the composite indices are an average of six sub-indices, an implementation of regulations over an increased number of asset categories will increase the composite indices, reflecting a rise in the intensity of policy measures.

[4]See Forbes (2012) and Werning (2012) for a discussion of the endogeneity bias in the comments for Klein (2012).

[5]See, for example, Ocampo (2008), Rodrik and Velasco (2000).

[6]Forbes et al. (2012) and Jinjarak et al. (2012) found a significant effect of signaling on the portfolio allocations of equity funds across countries.

that have domestic expansionary effects. During crises, capital outflow restrictions or relaxing inflow limitations help counter the rise in interest rates while avoiding disorderly exchange rate depreciation that may have adverse balance-sheet effects, as well as reserve losses that may lead to a currency crisis. In this way, these regulations provide more policy space to pursue countercyclical monetary policies that offsets the undesirable effects of large and volatile capital flows.

For the purpose of our analysis, we define foreign exchange pressure as the sum of real appreciation of the exchange rate and accumulation of foreign exchange reserves, weighted by the inverse of their standard deviation to compensate for different volatilities of each variable. This is analogous to the measures of foreign exchange pressure that are often used to measure the exposure of countries to sudden stops of capital inflows and its effect on nominal depreciation alongside the loss of reserves. The nominal changes in exchange rate would not capture the complete effects that we are interested in given the fact that in countries with relatively fixed exchange rates, the effects of capital inflows show up as a rise in inflation –an effect that may also be present in intermediate regimes. For this reason, we use the *real* exchange rate changes in our measure of foreign exchange pressure to capture the joint effect of capital inflows on the nominal exchange rate and the price level changes. Focusing on the real exchange rate also allows us to consider the adverse (positive) effects of overvaluation (undervaluation) of real exchange rates on the economic growth of developing countries –an effect that has been well-documented (Rodrik, 2007; Rajan and Subramanian, 2011).

The rest of the paper is organized as follows. Section 2 provides a literature review of studies that are important for the findings of this paper, highlighting our contributions. Section 3 presents a description of the four capital account regulation indices adopted in this study focusing on their evolution across regions and with respect to periods of major financial crises. Section 4 constructs a time-varying index of foreign exchange pressure, and uses it to empirically analyze the relationship between various regulations and foreign exchange pressure. Section 5 examines the relationship between CARs and the change in real exchange rate in order to test whether regulations are effective in affecting the real exchange rate, particularly to reduce appreciation during booms. Section 6 analyses the effect of CARs on the monetary policy autonomy. Section 7 focuses on testing whether the CARs improve crisis resilience and post-crisis economic performance. Section 8 concludes and derives policy implications.

2 Related Literature

There are two strands of literature to which this paper contributes. The first one is on the effectiveness of capital account restrictions on macroeconomic policy variables and crisis resilience. The second one relates to the determinants of foreign exchange pressure, which is measured generally as the sum of changes in nominal depreciation and reserve losses. In fact, our paper lies at the connection of these two bodies of literature in attempting to assess the role of capital account regulations as a determinant of foreign exchange pressure.

The great majority of studies on the effectiveness of CARs on macroeconomic variables analyse individual country cases, and only a handful of studies use multi-country samples that provide comparisons across countries. For example, as noted by Binici et al. (2010), among the 30 studies surveyed by Magud and Reinhart (2007) only five were multi-country studies. Among these, only two studies addressed the effect of CARs on reducing real exchange rate pressures. Edison and Reinhart (2001) used daily data for Spain over 1991-1993, and for Brazil, Malaysia, and Thailand over 1995-1999 with the control group of Philippines and South Korea, and did not find any effect of restrictions on capital flows on reducing real exchange rate pressures. In contrast, Miniane and Rogers (2004) studied a larger group of countries composed of 9 developing countries and 17 advanced countries [7] using monthly data for 1971:1- 1998:12, and found short-term effects on reducing real exchange rate pressures.

Using the subindices developed by Schindler (2009), Klein (2012) tested their effects on the changes in the real exchange rate for a large sample of countries composed of 23 advanced and 21 emerging market economies, and estimated that CARs have no significant effect on the changes in real exchange rate. We replicated his results to see what are the main drivers of this finding. The most important factor is the composition of the country sample. When advanced countries are excluded, and 26 additional emerging market economies are added into the OLS cross-country regressions of the real exchange rate changes, the coefficient on the capital controls on bond and money market transactions becomes significant (and negative) at the 5 % level. The second factor that influences the results is the definition of the dummy variables that capture capital controls, which take the value of 1 if there are controls on a particular segment of the capital flows. As such, they do not cover the whole range of asset categories through which flows take place, and

[7] The complete list is Australia, Austria, Belgium, Canada, Chile, Colombia, Denmark, Finland, France, Germany, Greece, India, Italy, Japan, Korea, Malaysia, Mexico, The Netherlands, Norway, The Philippines, Portugal, South Africa, Spain, Sweden, Turkey, UK.

completely exclude regulations on FDI. They also do not distinguish between inflow or outflow regulations, which makes the direction of the effect on real exchange rate difficult to assess. The third factor that drives the results is not controlling for the endogeneity bias, which has been pointed out by previous reviews of this analysis (Forbes, 2012; Werning, 2012). When we replicate the results by using an instrumental variables-2SLS approach with only emerging market economies, we find that the coefficient of the regulations on bond and money market transactions becomes even larger, pointing out that OLS estimates are downward biased relative to IV due to the endogeneity problem.

Relying on a much larger set of emerging and developing countries, excluding advanced countries, and using composites indices that cover a broader range of regulations across different asset categories, our study indicates that the regulations *do* have statistically significant and economically meaningful effects on reducing real exchange rate appreciation and foreign exchange pressures, and the estimated effects are larger under the instrumental variable-2SLS approach. This evidence is in line with the results of Rodrik (2007), showing that reducing capital account restrictions is associated with a decline in the undervaluation of the real exchange rate.

Studies on foreign exchange pressures design indices of this variable to measure the intensity of crisis across countries. For example, Frankel and Saravelos (2010) used an index of foreign exchange pressure to measure crisis intensity and tested for the determinants of crisis intensity in the global financial crisis (GFC). An interesting result was that higher pre-crisis reserves as a proportion of GDP and lower pre-crisis real exchange rate appreciation were associated with lower foreign exchange pressure during crises. An interesting result was that higher pre-crisis reserves as a proportion of GDP and lower pre-crisis real exchange rate appreciation were associated with lower exchange market pressure during the crisis. In particular, they found that a level of reserves equivalent to approximately 100% of GDP was associated with a one standard deviation fall in crisis intensity, and that a 45% appreciation in the real exchange rate over the five years prior to 2008 was associated with approximately a one standard deviation rise in crisis intensity. This confirms the view that the massive reserve accumulation by many developing countries prior to 2008 and avoiding real appreciation in pre-crisis period were effective in reducing their vulnerability to the crisis.

However, the majority of studies on determinants of foreign exchange pressure leave out the effects of CARs partly due to data limitations at high frequencies. Since most studies use monthly or quarterly data for foreign exchange pressure indices, the limited availability of data for restrictions

on capital flows at these frequencies makes it difficult to use them in the analysis. In their definition-consistent measure of foreign exchange pressure, Klaassen and Jager (2011) justify their exclusion of CARs by stating that it is difficult to measure them, and adding, with no evidence, that "insofar as capital controls are not used or are ineffective, there is no effect on excess supply on the forex market" (p.78).

There is only one study that tested for the effect of CARs on foreign exchange pressures in a cross-section of emerging market economies. Using Chinn-Ito capital account openness index, which combines both inflow and outflow regulations into a single indicator, Aizenman and Hutchison (2012) find no significant effect of capital account openness on foreign exchange pressure of emerging market economies during the GFC. They focus on a subset of emerging market economies that experienced a rise in foreign exchange pressure measured as the sum of nominal depreciation and reserve loss. The limited number of observations in their cross-country comparison and the type of capital account restrictiveness measure that does not distinguish between inflow and outflow restrictions could be partly responsible for the insignificant effect they estimated.[8]

3 Evolution of Capital Account Regulations

In this paper we use four indices of de jure capital account regulations: (i) capital inflow restrictions; (ii) foreign exchange (FX)-related regulations, (iii) financial sector regulations, and (iv) capital outflow restrictions.[9] The first and fourth indices are developed by Schindler (2009) based on the IMFs Annual Report on Exchange Arrangements and Exchange Restrictions database, and cover an average of binary regulations across six asset categories: money market instruments, bonds, equities, financial credits, collective instruments, and direct investment. They range between 0 and 1; an absence of regulations in any category coded as 0, the presence of regulations across every category coded as 1, and other values representing a mix of regulations in these categories. The second and third indices are developed by Ostry et al. (2012). The second index – FX-related regulations – covers a simple average of restrictions on lending locally in foreign exchange, restrictions on purchase of locally issued securities denominated in foreign exchange, differential treatment of deposit accounts in foreign exchange, and limits on foreign exchange positions. The

[8] If a higher value of the index indicates higher restrictions on capital inflows, we would expect a positive sign since less capital inflows would increase the pressure on the exchange rate to depreciate or the reserves to be depleted. In contrast, if higher values indicate greater restrictions on capital outflows, we would expect a negative sign, as regulations would reduce the pressure on exchange rate. These opposing effects may be responsible for the insignificant effect estimated.

[9] See Appendix Table A.2 for description and sources of variables used in the study.

third index – financial sector regulations – is composed of a simple average of differential treatment of accounts held by non-residents, limits on borrowing from abroad, and restrictions on maintenance of accounts abroad.[10]

Figure 1 shows the incidence of CARs for the countries in our sample[11] from 1995 to 2011 – i.e., the percentage of countries with a capital inflow regulation at a point in time. There are several interesting patterns that emerge from these plots. First, while a great majority of countries (85-95 percent) use FX-related regulations to reduce currency mismatch and other exchange rate risks, direct restrictions on capital inflows and outflows are used by a lesser proportion of countries, ranging around 65 to 80 percent. This is followed by restrictions specific to the financial sector including limits on financial sector borrowing from abroad that are imposed by 50 to 65 percent of countries on average.

Second, the crisis periods indicated by shaded areas of 1997-98 East Asian financial crisis and 2008-09 GFC in Figure 1 were generally preceded by fewer counties using some form of CARs, and followed by a higher proportion of countries resorting to the use of these regulations during and after the crisis periods. This indicates that countries tend to relax restrictions on capital flows once financial conditions turn to normal, and increase them during crises, which is a procyclical response with adverse effects on macroeconomic stability. Finally, in the most recent period the share of countries with inflow regulations rose from 68 percent in 2010 to 82 percent in 2011, significantly higher than the previous two peaks in the period analyzed of 78 percent in 1998 and 2001. Thus, currently more than four fifths of emerging and developing countries in our sample have adopted a measure to regulate capital inflows. Other types of CARs were also adopted by a greater share of countries following the crisis.

Figure 2 plots the country average of CARs – which can be understood as the intensity in their use – from 1995 to 2011. Two points are worth highlighting. First, the average scores for FX-related regulations are the highest, followed by capital outflow restrictions, which in turn lie above the averages for capital inflow restrictions and financial sector regulations. This is somewhat similar to the trends in share of countries adopting regulations, and taken together, it indicates that even though the shares of countries adopting capital inflow and outflow regulations are close to each other, the index scores are higher for outflow restrictions, placing its average above the inflow restrictions on average. Second, countries were on average reducing FX-related and financial

[10]Both the second and third indices correspond to the second indices that Ostry et al. (2012) used, which cover a broader range of categories of regulations than the first ones they define.

[11]See Appendix Table A.1 for a list of countries used in the study.

sector regulations in the run up to the East Asian financial crisis, and responded to the crisis by increasing these regulations for one year and reducing them thereafter. In the run up to the GFC, there was a slight increase from 2004 to 2007 across all types of regulations. During the crisis, the average scores for countries increased, and they continued to increase after the crisis – with the exception of a reduction in capital inflow restrictions in 2010. These trends reflect the fact that the global liquidity was in a contraction phase after the East Asian crisis, while it was and still is in an expansion phase after the GFC, requiring many countries to respond with measures to reduce net capital inflows to offset for this excessive global liquidity.

Figure 3 plots the index for CARs from 1995 to 2011 across different regions of developing countries. Three interesting regularities emerge from this disaggregation. First, South and East Asia has the highest average scores for all indicators of capital account restrictiveness, thus reaffirming the view that countries in this region have the most closed capital accounts. The second region with relatively high scores is the Middle East and North Africa, and this is followed by Eastern Europe and Latin America. While Latin America has higher restrictions for FX-related transactions than Eastern Europe, the latter has had higher scores for capital inflow and outflow restrictions as well as the financial sector regulations for most of the period, but Latin America has more or less caught up with Eastern Europe in the recent period.

Second, in the run up to the GFC the regional responses to capital inflows varied considerably. All regions except Eastern Europe responded with higher FX-related and financial sector regulations from 2003 to 2007. While Latin America increased its capital inflow restrictions in the same period, South and East Asia reduced them, and Middle East and North Africa and Eastern Europe kept them more or less unchanged. In turn, capital outflow restrictions were significantly increased in Latin America, slightly increased in Eastern Europe and Middle East and North Africa, and kept constant in South and East Asia.

Finally, there were considerable differences in regions responses to the GFC. Latin America responded by raising CARs for all categories. Middle East and North Africa increased capital outflow restrictions keeping others the same. Eastern Europe reduced capital outflow restrictions and financial sector regulations during the crisis and increased them after the crisis, and increased capital inflow and FX-related regulations during and after the crisis. South and East Asia kept its CARs unchanged, except by relaxing restrictions in FX-related transactions both during and after the crisis.

Table 1 presents the correlation coefficients for the measures of CARs from 1995 to 2011. The

index of capital inflow restrictions is highly positively correlated with capital outflow restrictions, with a correlation coefficient of 0.83, and moderately positively correlated with FX-related regulations and financial sector regulations (0.65 and 0.57, respectively). In addition, the latter two measures are moderately positively correlated with each other and also with the capital outflow restrictions. The fact that these measures are highly to moderately correlated with each other may give rise to multicollinearity in regressions which use them simultaneously as explanatory variables.

4 Capital Account Regulations and Foreign Exchange Pressure

4.1 A Foreign Exchange Pressure Index

We define foreign exchange pressure index as a weighted average of changes in reserve accumulation and the real exchange rate that uses the inverse of standard deviations of each variable as weights. This measure is comparable across countries and over time. We use data on consumer price index-based real effective exchange rates (RER) from Darvas (2012) – which covers 178 countries in total, including our sample, deriving the indices from 172 trading partners – and international reserves minus gold (RES) in US dollars from *the International Financial Statistics* of the IMF to calculate our index of foreign exchange pressure:

$$FXP_{it} = \frac{1}{\sigma_i^{RES}} \frac{\Delta RES_{it}}{RES_{it}} + \frac{1}{\sigma_i^{RER}} \frac{\Delta RER_{it}}{RER_{it}} \tag{1}$$

where i is an index for countries, t is an index for yearly time periods, Δ is the difference operator showing the difference between time t and $t-1$ for country i, and σ is the standard deviation of each component. An increase in RER indicates a real appreciation of the exchange rate, and an increase in RES indicates an accumulation of international reserves.

Defined in this way, a rise in FXP indicates that there is foreign exchange pressure on the economy through two alternative channels, which may be mixed in practice. The first one is a percentage increase in international reserves adjusted for its volatility; such reserve accumulation also generates an expansion in the monetary base unless it is sterilized. The second channel is a percentage increase in real exchange rate adjusted for its volatility, which measures the effect of net capital inflows on both the nominal exchange rate (as the increase in the supply of foreign currency generates nominal appreciation pressures) and the domestic price level (as the capital inflows create inflationary pressures). Conversely, a fall in FXP indicates a loss of international reserves and/or a real depreciation of the exchange rate, both of which reflect a capital outflow from the economy.

Our method is fairly close to that followed in recent studies using various foreign exchange pressure indices (Aizenman and Hutchison, 2012; Frankel and Saravelos, 2010). The main difference is that while most of these studies use the nominal exchange rate and calculate the index as the (weighted) sum of a nominal depreciation plus a loss of international reserves, we use the real exchange rate to calculate an index of real appreciation and reserve accumulation. Our method seems preferable for studying the cross-country effects of a surge in net capital inflows to emerging market economies, while theirs seem useful for studying speculative attacks on the currency and large capital outflows during crises. Another difference is occasionally the weighting scheme, where some studies use equal weights. For instance, Aizenman and Hutchison (2012) initially use first equal weights and later conduct a robustness check by using a standardized index, concluding that their results are robust to this alternative weighting scheme.[12]

4.2 The Baseline Panel Evidence

The data set consists of a maximum of 51 emerging and developing countries covering the period 1995 to 2011. Our baseline specification for estimating the relationship between foreign exchange pressure and capital account regulations takes the form:

$$FXP_{it} = \alpha + \beta CAR_{it-1} + \delta X_{it} + f_t + r_i + u_{it} \tag{2}$$

where FXP is the foreign exchange pressure index for country i at time t as defined in Eq.(1); CAR_{it-1} is the capital account regulations in place at country i at time $t-1$; X_{it} is a set of control variables including the real GDP growth rate, the log of real per-capita GDP, overall institutional quality, and the rate of inflation; f_t is the set of time dummies; r_i is the region-specific fixed effects; and u_{it} is the error term. Our primary interest lies in $\hat{\beta}$.

An important concern when estimating the effect of CARs on the foreign exchange pressure relates to the possibility of reverse causality that may arise if countries respond to a rise in capital inflows by strengthening capital account restrictions. To the extent that it exists, such endogeneity

[12]The origins of the concept of exchange market pressure rests on the work of Girton and Roper (1977), who focused on quantifying the pressure in any exchange rate regime. This was further formalized by Weymark (1995) and Weymark (1997), who defined exchange market pressure on a currency as its positive (or negative) excess supply on the foreign exchange market if policy makers do not take actions to remove that excess supply, that is, if they take a passive position, such that this excess supply is expressed in the relative depreciation (or appreciation) required to clear the market. As a result, in a pure float the exchange market pressure is the observed depreciation, whereas in fixed or managed float regimes the exchange market pressure is the depreciation-equivalent of excess supply based on the counterfactual of no intervention in the market. Other studies include Eichengreen et al. (1995), Eichengreen et al. (1996), Sachs et al. (1996a), Corsetti et al. (1998), Fratzscher (1998), Kaminsky et al. (1998), Berg and Pattillo (1999), Tornell (1999), Bussiere and Mulder (2000), Pentecost et al. (2001), Collins (2003), Frankel and Wei (2005), Frankel and Xie (2010), Frankel and Saravelos (2010), IMF (2007), IMF (2009).

bias would tend to reduce the estimated effects of CARs by biasing the results towards finding no effect. In order to control for the potential endogeneity problem, we use lagged values of CARs in all regressions to lessen the bias, and complement the OLS estimations with an instrumental variable two-stage least squares (IV-2SLS) technique to explicitly address reverse causality. In the latter case, and following Ostry et al. (2012), we use two instruments: a binary variable showing the presence of a bilateral investment treaty between each country and the United States over time, and a binary variable showing whether the country is a European Union member. Given that both of these agreements prohibit the use of CARs, we would expect them to be highly negatively correlated with CARs.[13] However, there is no particular reason to expect that they would be a determinant of foreign exchange pressure, or of real exchange rate appreciation.

Table 2 presents the results from the IV-2SLS estimation on the left panel, and OLS estimation on the right panel. The Hansen test of over-identifying restrictions cannot be rejected in IV-2SLS regressions, supporting the validity of the instruments. The results for the coefficient estimates in columns (1), (2) and (4) show that capital inflow regulations, FX regulations, and capital outflow regulations are significantly (1 to 5% level) and negatively related to the foreign exchange pressure. The financial sector restrictions are also negatively associated to the foreign exchange pressure, but significant only at the 10% level. The fact that the magnitudes of the IV estimates on the left panel are all larger than those in the OLS estimates on the right panel indicates that not controlling for endogeneity has biased the OLS estimates toward zero. However, our IV estimates of the effects of CARs on foreign exchange pressure are likely to be conservative in the sense of underestimating these cross-country effects by roughly 10 percent (implying that the true coefficient is 1.01 rather than 0.92 for column (1)). The underlying reason for this downward bias is that the instrumental variables fail to completely correct for endogeneity in small samples in the presence of weak instruments or many instruments, making the IV estimates biased in the direction of OLS.[14] On the conservative side, column (1) estimates show that moving from the 25^{th} to the 75^{th} percentile

[13]The bilateral investment treaties with the U.S. and the EU membership restrict the imposition of capital controls only and not of prudential measures, and therefore, they are more appropriate as instruments for capital inflow and outflow regulations, and financial sector specific regulations, and not FX-related prudential regulations. However, often times FX-related prudential regulations act indirectly as capital controls. For example, limits on banks' open FX positions, which is an FX-related regulation, tend to restrict overborrowing from abroad in foreign currency.

[14]For a useful discussion of this issue, see Stock et al. (2002). Comparing the Kleibergen-Paap Wald rk F statistic with Stock-Yogo weak ID test critical values, the IV relative bias falls between 10 to 15% at the maximum. Because the OLS estimates in our case are close to zero, this weak instrument bias pulls down the estimated coefficients by 10 to 15% depending on the regression. Therefore, the true coefficients are in fact 10 to 15% higher than those reported on the left panel of Table 2. This point applies also to the estimates reported in Tables 3, 4, 5, and 6 for the regressions with instrumental variables.

of capital inflow regulations is related to a 0.62 percentage point reduction in the foreign exchange pressure, controlling for real GDP growth, the level of real GDP per capita, overall institutional quality, inflation as well as region-specific and time fixed effects. This is a sizable effect considering that the foreign exchange pressure has a mean of 0.77 and a standard deviation of 1.50 percentage points. Having capital inflow restrictions in place reduces the foreign exchange pressure by 41% of one standard deviation.

Column (2) estimates indicate that moving from the 25^{th} to the 75^{th} percentile of FX-related regulations is associated with a 0.74 percentage point reduction in the foreign exchange pressure, which corresponds to 49% of one standard deviation of foreign exchange pressure. Finally, column (4) estimates show that moving from the 25^{th} to the 75^{th} percentile of capital outflow regulations is related with a 0.79 percentage point decline in the foreign exchange pressure, with an economically significant impact of 53% of one standard deviation.[15] Overall, CARs have a statistically significant and economically meaningful impact on foreign exchange pressure. However, columns (5) to (7) do not provide any evidence for their complementarity, which could possibly result from multicollinearity.

It is important to reflect about the sources of endogeneity bias. Many of the potential sources of bias that we can imagine would induce a positive relationship between CARs and foreign exchange pressure, not the negative relationship we have documented. Therefore, to the extent that endogenous mechanisms are at play, it is not clear that they tend to generate a bias that works against our findings. A rise in foreign exchange pressure due to a surge in capital inflows is expected to increase restrictions on capital inflows as the authorities try to limit appreciation pressures. Similarly, a fall in foreign exchange pressure is expected to decrease restrictions on capital inflows. Overall, it is unlikely that our negative coefficient results from the reverse effect of foreign exchange pressure on CARs.

4.3 Robustness Analysis with Additional Covariates

In order to take into account any variables that may be correlated with policy measures and may cause omitted variable bias, in this subsection we augment the baseline specification and undertake

[15] This finding indicates that raising capital outflow restrictiveness is associated with a decline in foreign exchange pressure. This could result from investors' perception that the cost of moving funds out of the country has risen, which might in turn induce them not to make inward investments in the first place. Since this would reduce capital inflows, we would expect a decline in foreign exchange pressure. In recent years, however, some countries (e.g. South Africa and Thailand) have responded to surges in inflows by liberalizing outflows. In this case, we would expect reducing capital outflow restrictiveness would reduce foreign exchange pressure. However, we do not find support for this mechanism.

a series of robustness tests using additional covariates. We include measures of the terms of trade, gross domestic saving, government consumption, FDI inflows, and exchange rate regime. In the first two columns, we add covariates gradually in combinations of two variables since some of them tend to lose significance in regressions including all covariates (although they still have the correct sign).

The results reported in Table 3 show that including these additional regressors does not make much difference to the coefficients on CARs. The estimated value of the coefficients move slightly (e.g. from a high of -0.99 to a low of -0.84 in case of capital inflow regulations), but remain strongly significant throughout different specifications.[16] Despite the wide range of controls incorporated, the central finding on CARs remains robust. It is important to note that the effect of these regulations continue to be strong even when major drivers of the real exchange rate are added as control variables.

The results for the additional covariates in Table 3 are quite interesting and are in line with theoretical expectations. The positive terms-of-trade movements are associated with rising foreign exchange pressure as expected, with combined effects of real exchange rate appreciation and reserve accumulation, although the estimated effect is only significant in column (1) at the 5% level. Increases in saving rates tend to reduce the foreign exchange pressure by reducing the appreciation of the real exchange rate, as do the fiscal policies that reduce government consumption; however, despite correct signs the effects of these variables are not statistically significant. FDI inflows, which are highly significant in all specifications, are positively related to foreign exchange pressure as they tend to appreciate the real exchange rate. The inflation rate is highly significantly (at the 1% level) and negatively related to foreign exchange pressure, indicating that lower inflation rates tend to be associated with an appreciated exchange rate – perhaps indicating that inflation-targeting central banks tend to tolerate the appreciation of the real exchange rate because of its positive effects on inflation. Finally, the exchange rate regime – a binary variable that takes a value equal to 1 for a de facto fixed exchange rate regime, and 0 otherwise – is negatively (and in some cases significantly) associated with the foreign exchange pressure, which suggests that de facto fixed exchange rate regimes tend to have lower foreign exchange pressure. Since countries with a de facto fixed exchange rate regime tend to accumulate more international reserves, the estimated negative effect is likely to operate through the real exchange rate channel, implying that countries with de facto

[16]The estimates for financial sector restrictions remain insignificant in these regressions, although they continue to have the expected negative sign as seen in columns (6) and (7) of Table 3.

fixed exchange rate regimes are better at avoiding real exchange rate appreciation.

5 Capital Account Regulations and the Real Exchange Rate

One of the major motivations of many developing countries in implementing capital account regulations during periods of massive capital inflows is to diminish the real appreciation pressures and avoid being trapped in a "currency war". To examine whether CARs are effective in reducing real exchange rate appreciation, we estimate the effect of these regulations on the annual percentage changes in real exchange rate for the period 1995 to 2011. Our baseline specification includes a lagged dependent variable, real income growth, real income per capita, reserves as a share of GDP, institutional quality, coupled with a full set of year dummy variables and region-specific fixed effects. We augment this specification with additional covariates in the next subsection.

Two panels of Table 4 present the results from the IV-2SLS estimation on the left and OLS estimation on the right, respectively. The Hansen test of over-identifying restrictions cannot be rejected for the case of IV-2SLS regressions, supporting the validity of the instruments (the same instruments, bilateral investment treaties with the U.S. and E.U. membership, are used as in the previous section). The results for the coefficient estimates in columns (1) to (4) show that capital inflow regulations, FX-related regulations, and capital outflow restrictions are significantly (at 5% level) and negatively related to the appreciation of the real exchange rate, while the effect of the financial sector restrictions is also negative but insignificant. The IV estimates on the left panel are all larger than the OLS estimates on the right panel, implying that not controlling for endogeneity has biased the OLS estimates toward zero, as in the previous section. Column (1) estimates show that moving from the 25^{th} to the 75^{th} percentile of capital inflow regulations is related to a 3.54 percentage point reduction in the real exchange rate appreciation, controlling for real GDP growth, the level of real GDP per capita, reserves as a share of GDP, and overall institutional quality. This is a substantial effect given that the annual percentage change in real exchange rate has a mean of 1.72 and a standard deviation of 10.70 percentage points. Having capital inflow restrictions in place reduces the real exchange rate appreciation by 33% of one standard deviation.

Column (2) of Table 4 indicates that moving from the 25^{th} to the 75^{th} percentile of FX-related regulations is associated with a 4.08 percentage point reduction in the real exchange rate appreciation, which corresponds to 38% of one standard deviation of changes in the real exchange rate. Column (4) estimates show that moving from the 25^{th} to the 75^{th} percentile of capital outflow

regulations is related with a 4.06 percentage point decline in the real exchange rate appreciation, corresponding to 38% of one standard deviation. Columns (5) to (7) do not provide any evidence for their complementarity, which could be again due to the presence of multicollinearity. Finally, the results also show that reserves as a share of GDP is positively associated to real exchange rate appreciation. To conclude, when the results in Table 2 and 4 are taken together, the key implication is that capital outflow regulations are at least as effective, if not more, as the capital inflow regulations and FX-related prudential regulations as a macroeconomic policy tool in offsetting the adverse effects of large capital inflows in foreign exchange pressure broadly, and particularly the pressure on the real exchange rate to appreciate.

To control for the omitted variable bias, we conduct a series of robustness tests using the same additional covariates as in the previous section because most of them are key drivers of the changes in real exchange rates. The results reported in Table 5 show that including these additional covariates slightly increases the estimated coefficients for CARs without changing their significance. If we take the results from the regressions with full set of covariates including the inflation rates, the effects reported in the previous section are slightly revised upward: Moving from the 25^{th} to the 75^{th} percentile of capital inflow regulations (FX-related regulations or capital outflow regulations) is related with a 3.61 (4.29 or 4.83) percentage point decline in the real exchange rate appreciation, thus yielding a 0.07 (0.21 or 0.77) percentage point difference in comparison to baseline estimates. These small differences, despite large reductions in sample size and range of controls used, points out that the key findings on the effects of these measures on the real exchange rate remain strong.

Table 5 further shows that the additional covariates have the correct signs in line with theoretical expectations. Two variables that are highly significant (at 1% level) in all specifications are gross domestic saving rate, and the inflation rate, both of which are negatively related to the real exchange rate appreciation, as expected. On the other hand, the terms of trade, government consumption, and FDI inflows are all positively related to the real exchange rate appreciation, but the effects are significant only in some regressions. While the terms of trade is exogenous for most countries, the level of government consumption and openness to FDI flows are largely policy determined, which indicates that countries with tighter fiscal policies and selective openness to FDI are expected to have less real exchange rate appreciation. Finally, the exchange rate regime is negatively and in some cases significantly related to the real exchange rate appreciation, which indicates that countries with de facto fixed exchange rate regimes tend to have lower rates of real exchange rate appreciation, which is in line with the results from Table 3.

6 Capital Account Regulations and Monetary Policy Autonomy

Another key reason for the monetary authorities in developing countries to use capital account regulations during capital inflow surges is "the fear of loss of monetary autonomy" (Magud et al., 2011). The loss of monetary autonomy is especially severe if the authorities implement tight monetary policies by raising domestic interest rates, which in turn attracts more capital inflows that offset the contractionary effects of monetary tightening. In such cases, the use of capital flow restrictions can help regain monetary policy autonomy by breaking the link between domestic and international interest rates. To examine whether CARs are effective in providing monetary policy autonomy, we estimate the effect of the interaction term between the regulations and interest rate differentials on the annual percentage changes in nominal exchange rate. CARs are effective in improving monetary autonomy if the change in the interest rate differentials has a smaller effect on the nominal exchange rate. This requires the coefficient of the interaction term to have the opposite sign of the coefficient of the interest rate differential: reducing the appreciation during booms and the depreciation during busts.

Our specification follows the empirical work on monetary policy autonomy and CARs in individual country cases (Clements and Kamil, 2009; Baumann and Gallagher, 2012; Coelho and Gallagher, 2010), and takes the following form:

$$\Delta ln(s_{it}) = \alpha + \beta_0 \Delta ln(s_{it-1}) + \beta_1 (i - i^f)_{it} + \beta_2 CAR_{it} + \beta_3 CAR_{it}(i - i^f)_{it} + \beta_4 X_{it} + f_t + r_i + v_{it} \quad (3)$$

where s_{it} is the nominal exchange rate for country i at time t with reference to the U.S. dollar; $(i - i^f)_{it}$ is the difference between domestic money market rate, i, and the foreign money market rate, i^f, for country i at time t, i.e. the interest rate differential [17]; CAR_{it} is the capital account regulation for country i at time t; X_{it} is a set of control variables; f_t is the set of time dummies; r_i is the set of region-specific fixed effects; and v_{it} is the error term. Our primary interest lies in $\hat{\beta}_3$, the coefficient of the interaction term between CARs and interest rate differentials. This term measures the degree to which these regulations improve monetary autonomy: regulations provide more autonomy if changes in the interest rate differential have smaller effects on the nominal exchange rate, which is satisfied when the interaction term has the sign that is opposite of the sign of interest rate differential.

[17] We use annualized data for the money market rates for individual countries as reported in the IMFs *International Financial Statistics*, and the Federal funds rate of the U.S. as the foreign money market rate. We refer to the interest rate differential in Table 6 where we report our estimates as IRD.

The above specification is related to the broader empirical literature on the uncovered interest parity (UIP) puzzle (Clements and Kamil, 2009; Baumann and Gallagher, 2012; Coelho and Gallagher, 2010). It may be viewed as an augmented form of the Fama regression that ties realized changes in the nominal exchange rate to interest rate differentials. In the simple form of this regression, where the only explanatory variable is the interest rate differential, the uncovered interest parity would hold if the coefficient estimate is one and the constant term is zero. However, empirical studies show that the coefficient estimates significantly differ from one. Chinn and Ito (2007) estimate that from 1984 to 2006, for industrial countries the coefficient is 2.379, and for the Euro area currencies before the monetary union it is 3.634, and that the null of unity is rejected in both cases. They argue that these high coefficients result from high depreciation of the currencies that experienced the EMS crisis in the early 1990s. For the non-industrialized countries, they estimate a coefficient of 0.797, with the coefficient for Asian emerging market countries (0.823) being slightly higher than that for Latin America (0.707), and they find large differences across individual countries. These positive panel data estimates point out the tendency for most of the developing country currencies to depreciate, resulting in the highest deviations from the UIP during the tequila crisis of 1994 and the Asian crisis of 1997-98 (Chinn and Ito, 2007). Based on our sample from 1995 to 2011, we estimate a coefficient of 0.757 for this simple version of the UIP regression (the results are not reported here). Despite the differences in sample period and countries included, our estimate is strikingly similar to that of Chinn and Ito (2007).

We use the specification in Eq.(3) to test for the monetary policy autonomy hypothesis. Controlling for the real GDP growth, level of real GDP per capita, overall institutional quality, reserves as a share of GDP, and exchange rate regime, we estimate the effects of interest rate differential (IRD), the CARs, and the interaction term between IRD and CARs on the realized nominal exchange rate depreciation. Table 6 presents the results from instrumental variables 2SLS estimation on the left panel, and those from OLS estimation on the right one. CARs are instrumented with the bilateral investment treaties with the U.S. and the E.U. membership as before.

The results in Table 6 show that the coefficients of interest rate differentials positive and mostly significant (ranging between 1.28 and 1.68 in the IV estimates). Only for two types of CARs the interaction variables are significant and negative: those for capital inflow regulations and financial sector restrictions. This indicates that these two types of regulations reduce the effect of interest rate differentials on the nominal exchange rate depreciation, thereby enhancing monetary policy autonomy. For example, in the case of capital inflow restrictions reported in column (1), the

interaction term reduces the effect of interest rate differential from 1.28 to 0.23, thereby reducing the rate of depreciation during economic downturns. Intuitively, higher restrictiveness of capital inflow regulations is likely reduce the entry of short-term capital inflows during boom periods, which tend to leave the country vulnerable to large depreciations during busts. Therefore, capital inflow regulations reduce the depreciation pressures during downturn phases by reducing the entry of short-term capital during booms that tend to exit in massive amounts during the downturn.

7 Capital Account Regulations, Crisis Resilience, and Post-Crisis Performance

If capital account regulations are related to lower foreign exchange pressure and real exchange rate appreciation as Tables 2-5 suggest, this would smooth out macroeconomic fluctuations and enhance *real* macroeconomic stability – i.e., the stability of GDP growth – by reducing excessive spending and current account deficits during booms and thereby the vulnerability of the economy during crises. Further, one would expect a quicker recovery from the crisis if the country has sound macroeconomic fundamentals that are not distorted by surges of capital inflows or outflows. In this section, we test whether: (i) CARs provide more resilience during crisis episodes, and (ii) whether they enhance post-crisis macroeconomic performance by avoiding overheating due to the post-crisis surge in capital flows to emerging economies.

To investigate the first hypothesis, we estimate the effect of CARs on the change in real GDP growth in 2009 relative to the average growth over 2003-08. This differs from the dependent variable used by Ostry et al. (2012), which is the change in average real GDP growth in 2008-09 relative to the average growth over 2003-07. The shift in cut-off point in growth decline variable has important effects. Since the growth rates did not turn negative in most emerging and developing countries in 2008 (in fact, several countries had significantly positive growth rates in 2008), treating 2008 as a crisis year reduces the growth decline experienced by the large majority of countries. This is also evident from the mean of the growth decline variable, which is -7.5 percentage points in our case vs. -5.2 in case of Ostry et al. (2012).

Table 7 presents the OLS regression results. Controlling for changes in the terms of trade, growth rate of trading partners, and overall institutional quality (the same variables as in Ostry et al. (2012)), we find much stronger effects of CARs averaged over 2007-09 and 2005-07 on crisis resilience. First, the estimated coefficients for FX-related regulations and financial sector restrictions

are significantly (at 1% and 5% level respectively) and positively associated to the crisis resilience these two variables were estimated as insignificant in Ostry et al. (2012).[18]

Second, the magnitudes of the positive effects are larger. While the difference is small for capital inflow regulations, it is larger for FX-related regulations and financial sector restrictions. We find that moving from the 25th to the 75th percentile of FX-related regulations (financial sector restrictions) reduces the growth decline during the crisis by 5 (4.8) percentage points, which is about 1-2 percentage point larger than the effect estimated by Ostry et al. (2012). However, we find the same range of reduction in growth decline (3-4 percentage points, or 3.7 percentage points) in case of capital inflow regulations while our estimate is slightly higher.

Third, we also examine the effects of capital outflow restrictions on crisis resilience. Our results in columns (7) and (8) show that moving from the 25th to the 75th percentile of capital outflow restrictions decreases the growth decline during the crisis by 5.5 6.2 percentage points. Given the average decline of growth in our sample is 7.5 percentage points, this is an economically significant impact, and it is about 1 percentage point larger than the effect of FX-related regulations and financial sector restrictions, and about 2 percentage point larger than that of capital inflow restrictions. Overall, we can conclude that capital outflow regulations may play an even more important role than other CARs in the event of a crisis, and the effect presumably works by the capacity to limit the large flows of capital when the crisis is about to hit and by reducing the speculative capital inflows through making it harder to move the funds abroad in the subsequent period.

As we have shown in Section 3, a growing number of countries began using various forms of CARs during the global financial crisis period, which showed up as a rising trend in the associated indices. This raises the question of whether the use of CARs during the crisis period has helped in slowing down overheating economies in the post-crisis recovery. This is what we would expect if CARs are effective in reducing the surge in capital inflows during the recovery period, starting in late 2009. To examine this relationship between between CARs and post-crisis performance, we estimate the effect of these measures averaged over 2007-09 and 2005-07 on the change in average post-crisis real income growth in 2010-11 relative to the countrys average growth in 2008-09, controlling for change in terms of trade, growth in trading partners income, and overall institutional quality. Columns

[18]To be clear, Ostry et al. (2012) find a significant effect for FX-related regulations if it is narrowly defined to cover only lending locally in foreign exchange, and differential treatment of deposit accounts in foreign exchange, excluding restrictions on purchase of locally issued securities denominated in foreign currency and limits on open foreign exchange positions. Our results show that the composite index covering all of these restrictions is highly significantly and positively related to crisis resilience. They also consider an earlier period of regulations over 2000-02, however, tests with latter periods we use here do not make any difference to their results.

(1) and (2) in Table 8 indicate that countries that used capital inflow regulations experienced less overheating during the post-crisis recovery period when there was a surge in capital inflows. The estimates suggest that moving from the 25^{th} to the 75^{th} percentile of capital inflow regulations has slowed down the post-crisis overheating by 3.4 percentage points. This is an economically significant effect given that the average post-crisis growth in our sample is 6.0 percentage points with respect to the decline during crisis. Columns (3), (4), and (5) in Table 8 show that countries that used FX-related regulations and financial sector specific restrictions also experienced less overheating after the crisis. Moving from the 25^{th} to the 75^{th} percentile of FX-related regulations and financial sector specific restrictions is associated with 3.1 to 3.4 percentage point less growth in the post-crisis period.

Overall, taken together with the finding of improved crisis resilience as shown in Table 7, there is significant evidence that CARs smooth out macroeconomic fluctuations associated with large and volatile capital flows by reducing the growth collapse during busts and by reducing the excessive growth during booms.

8 Conclusion

This paper analyzes the effects of capital account regulations on macroeconomic-stability risks related to large and volatile capital inflows focusing on their effectiveness on reducing foreign exchange pressure, diminishing real exchange rate appreciation, and enhancing crisis recovery as well as post-crisis economic performance. Our findings indicate that capital inflow and outflow regulations, as well as foreign-exchange related regulation and financial sector specific restrictions, help reduce the foreign exchange pressures and the real exchange rate appreciation resulting from capital inflow surges. Capital outflow regulations may reduce the entry of speculative foreign capital by making it more costly to exit, and our estimates show that they tend to have a larger effect than capital inflow regulations and other prudential policy measures. Foreign-exchange related regulations that do not discriminate based on residence can also help diminish the buildup of foreign exchange pressure during booms. CARs also help provide monetary policy autonomy by reducing the effect of interest rate differentials on nominal exchange rates. By smoothing out macroeconomic fluctuations associated with foreign exchange markets and reducing excessive spending and current account deficits related to real exchange rate appreciation during booms, these regulations can reduce the vulnerability of the economy during crises when external financing dries out rapidly. Our empirical results

indicate that increasing the restrictiveness of CARs in the run-up to the crisis reduced the growth decline, thus enhancing crisis resilience, and that the effects of capital outflow regulations appear larger than other measures. Finally, this result, together with our findings that countries that use capital inflow regulations over 2008-11 experienced less overheating, indicate that these regulations are particularly useful to smooth the intensity of business cycles associated with the boom-bust pattern of external financing to emerging and developing countries.

This paper has not examined various issues related to the design of CARs, which include whether they should target temporary versus permanent, whether they need to be price or quantity-based, or whether their scope should be narrow or broadly defined. Each of these questions has been subject to an extensive debate which is beyond the specific focus of this paper. However, what is clear is that a countercyclical use of CARs that are strengthened during booms and relaxed during busts would serve as an effective macroeconomic policy tool for many financially open countries that are vulnerable to large swings in capital flows. While the IMF has recognized that these policy measures can enhance financial stability and help reduce financial fragilities in the pre-crisis period and enhance resilience to crises (IMF, 2011a,b,c, 2012), it has not sufficiently underscored their importance and effectiveness as a macroeconomic policy tool with crucial effects on key macroeconomic variables including the real exchange rate. Despite the new "institutional view" that it has endorsed giving some policy space for countries to use CARs to manage financial-stability risks, the IMF endorses its previous view that these measures should be used as a policy of last resort, even after resorting to fiscal tightening to manage large capital inflows, and that their use should be mostly temporary. In addition, they support the imposition of such measures in the steady-state for financial-stability reasons. Our findings point out, on the contrary, that every developing country that is subject to large swings in procyclical capital flows must have the policy space to use CARs as countercyclical tools that would serve as a first best policy response, as they directly target the source of disturbance, excessive capital inflows during booms; they should in turn be relaxed during busts when external financing becomes scarcer. They should, of course, be used as part of a countercyclical macroeconomic policy package, and not as a substitute for a broader package of this sort. In this sense, our results suggest that CARs should be viewed as a permanent macroeconomic policy tool whose restrictiveness is adjusted countercyclically to dampen macroeconomic fluctuations and reduce vulnerability to crises.

References

Aizenman, J., Hutchison, M. M., 2012. Exchange market pressure and absorption by international reserves: Emerging markets and fear of reserve loss during the 2008-2009 crisis. Journal of International Money and Finance 31, 1076–1091.

Baumann, B. A., Gallagher, K. P., 2012. Navigating capital flows in brazil and chile. IPD working paper series, Initiative for Policy Dialogue (IPD), Columbia University.

Berg, A., Pattillo, C., 1999. Are currency crises predictable? A test. IMF Staff Papers 46(2).

Binici, M., Hutchison, M., Schindler, M., 2010. Controlling capital? Legal restrictions and the asset composition of international financial flows. Journal of International Money and Finance 29, 666–684.

Bussiere, M., Mulder, C., 2000. Political instability and economic vulnerability. International Journal of Finance and Economics 5(4), 309–30.

Chinn, M. D., Ito, H., 2007. Price-based measurement of financial globalization: A cross-country study of interest rate parity. Pacific Economic Review 12(4), 419–444.

Clements, B. J., Kamil, H., 2009. Are capital controls effective in the 21st century? The recent experience of colombia. IMF Working Paper (09/30).

Coelho, B., Gallagher, K. P., 2010. Capital controls and 21st century financial crises: Evidence from Colombia and Thailand. Political Economy Research Institute Working Paper 213, Amherst, Massachusetts: Political Economy Research Institute.

Collins, S., 2003. Probabilities, probits and the timing of currency crises. Georgetown university, The Brookings Institution and NBER.

Corsetti, G., Pesenti, P., Roubini, N., 1998. Paper tigers? A model of the asian crisis. Research Paper 9822, Federal Reserve Bank of New York.

Darvas, Z., 2012. Real effective exchange rates for 178 countries: A new database. Working Paper 2012/06, Bruegel.

Edison, H., Reinhart, C., 2001. Stopping hot money: On the use of capital controls during financial crises. Journal of Development Economics 66(2), 533–553.

Eichengreen, B., Rose, A., Wyplosz, C., 1995. Exchange market mayhem: The antecedents and aftermath of speculative attacks. Economic Policy 21, 249–312.

Eichengreen, B., Rose, A., Wyplosz, C., 1996. Contagious currency crises. Scandinavian Journal of Economics 98, 463–484.

Farhi, E., Werning, I., 2012. Dealing with the trilemma: Optimal capital controls with fixed exchange rates. manuscript.

Forbes, K., 2012. Discussion of michael kleins capital controls: Gates and walls. Technical report, Brookings Papers on Economic Activity.

Forbes, K., Fratzscher, M., Kostka, T., Straub, R., 2012. Bubble thy neighbor: direct and spillover effects of capital controls. NBER Working Paper 18052, National Bureau of Economic Research.

Frankel, J. A., Saravelos, G., 2010. Are leading indicators of financial crises useful for assessing country vulnerability? Evidence from the 2008-09 global crisis. NBER Working Paper 16047, National Bureau of Economic Research.

Frankel, J. A., Wei, S.-J., 2005. Managing macroeconomic crises. NBER Working Paper 10907, National Bureau of Economic Research.

Frankel, J. A., Xie, D., 2010. Estimation of de facto flexibility parameter and basket weights in evolving exchange rate regimes. American Economic Review 100, 568–572.

Fratzscher, M., 1998. Why are currency crises contagious? A comparison of the Latin American Crisis of 1994-1995 and the Asian Crisis of 1997-1998. Weltwirtschaftliches Archiv 134(4), 664–91.

Gallagher, K., Griffith-Jones, S., Ocampo, J. A., 2012. Regulating global capital flows for long-run development. Technical report, Pardee Center, Boston.

Girton, L., Roper, D., 1977. A monetary model of exchange market pressure applied to the postwar Canadian experience. American Economic Review 76, 537–548.

IMF, 2007. World economic outlook. Technical report, Washington: International Monetary Fund.

IMF, 2009. World economic outlook. Technical report, Washington: International Monetary Fund.

IMF, 2011a. Recent experiences in managing capital inflows: Cross-cutting themes and possible policy framework. IMF policy paper, Washington: International Monetary Fund.

IMF, 2011b. Strengthening the international monetary system: Taking stock and looking ahead. Technical report, Washington: International Monetary Fund.

IMF, 2011c. World economic outlook. Technical report, Washington: International Monetary Fund.

IMF, 2012. The liberalization and management of capital flows: An institutional view. Technical report, Washington: International Monetary Fund.

Jeanne, O., 2012. Capital account policies and the real exchange rate. Working Paper .

Jeanne, O., Korinek, A., 2010. Managing credit booms and busts: A Pigouvian taxation approach. NBER Working Papers 16377, National Bureau of Economic Research.

Jinjarak, Y., Noy, I., Zheng, H., 2012. Capital controls in Brazil: Stemming a tide with a signal? Working paper, School of Economics and Finance, Victoria, University of Wellington.

Kaminsky, G., Lizondo, S., Reinhart, C. M., 1998. Leading indicators of currency crises. International Monetary Fund Staff Papers 45, 148.

Klaassen, F., Jager, H., 2011. Definition-consistent measurement of exchange market pressure. Journal of International Money and Finance 30(1), 74–95.

Klein, M. W., 2012. Capital controls: Gates and walls. Conference draft presented at the Fall 2012 Brookings panel on economic activity.

Korinek, A., 2011. The new economics of prudential capital controls: A research agenda. IMF Economic Review 59, 523–561.

Korinek, A., 2013. Capital controls and currency wars. Working Paper .

Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., , Wu, X., 2011. Macroprudential policy: What instruments and how to use them? Lessons from country experiences. IMF Working Paper (238).

Magud, N. E., Reinhart, C. M., 2007. Capital controls: An evaluation. In: Edwards, S. (Ed.), Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences, chapter 14, Chicago: The University of Chicago Press.

Magud, N. E., Reinhart, C. M., Rogoff, K. S., 2011. Capital controls: Myth and realitya portfolio balance approach. NBER Working Paper 16805, National Bureau of Economic Research.

Miniane, J., Rogers, J., 2004. Capital controls and the international transmission of U.S. money shocks. Mimeograph, Washington, DC: Board of Governors of the Federal Reserve.

Ocampo, J. A., 2003. Capital account and counter-cyclical prudential regulation in developing countries. In: Ffrench-Davis, R., Griffith-Jones, S. (Eds.), From Capital Surges to Drought: Seeking Stability for Emerging Markets, London: Palgrave Macmillan.

Ocampo, J. A., 2008. A broad view of macroeconomic stability. In: Serra, N., Stiglitz, J. E. (Eds.), The Washington Consensus Reconsidered: Towards a New Global Governance, chapter 6, New York: Oxford University Press.

Ocampo, J. A., Palma, G., 2008. The role of preventive capital account regulations. In: Ocampo, J. A., Stiglitz, J. E. (Eds.), Capital Market Liberalization and Development, chapter 7, New York: Oxford University Press.

Ocampo, J. A., Tovar, C., 2003. Columbia's experience with reserve requirements on capital inflows. CEPAL Review 81, 7–31.

Ostry, J. D., Ghosh, A. R., Chamon, M., Qureshi, M. S., 2012. Tools for managing financial-stability risks from capital inflows. Journal of International Economics 88(2), 407–421.

Pentecost, E. J., Hooydonk, C. V., Poeck, A. V., 2001. Measuring and estimating exchange market pressure in the EU. Journal of International Money and Finance 20, 401–418.

Rajan, R. G., Subramanian, A., 2011. Aid, dutch disease, and manufacturing growth. Journal of Development Economics 94(1), 106–118.

Rodrik, D., 2007. The real exchange rate and economic growth: Theory and evidence. Working Paper 2008-0141, Weatherhead Center for International Affairs, Harvard University.

Rodrik, D., Velasco, A., 2000. Short-term capital flows. In: Proceedings of the Annual World Bank Conference on Development Economics, pp. 59–90, Washington, DC: World Bank.

Sachs, J., Tornell, A., Velasco, A., 1996a. Financial crises in emerging markets: The lessons from 1995. Technical report, Brookings Papers on Economic Activity.

Schindler, M., 2009. Measuring financial integration: A new data set. IMF Staff Papers 56(1), 222–238.

Stock, J. H., Wright, J. H., Yogo, M., 2002. A survey of weak instruments and weak identification in generalized method of moments. Journal of Business and Economic Statistics 20(4), 518–529.

Tornell, A., 1999. Common fundamentals in the Tequila and Asian crises. Harvard Institute of Economic Research Working Papers 1868, Harvard, Institute of Economic Research.

Werning, I., 2012. Discussion of michael kleins capital controls: Gates and walls. Technical report, Brookings Papers on Economic Activity.

Weymark, D. N., 1995. Estimating exchange market pressure and the degree of exchange market intervention for Canada. Journal of International Economics 39, 273–295.

Weymark, D. N., 1997. Measuring the degree of exchange market intervention in a small open economy. Journal of International Money and Finance 16, 55–79.

Table 1. Correlation between capital account regulations

	Capital inflow restrictions	FX-related regulations	Financial sector regulations	Capital outflow restrictions
Capital inflow restrictions	1.00			
FX-related regulations	0.65	1.00		
Financial sector regulations	0.57	0.54	1.00	
Capital outflow restrictions	0.83	0.65	0.56	1.00

Note: The figures reported are the contemporaneous Pearson correlation coefficients for the period 1995-2011. The coefficients are significant at 1% level for all indices.

Table 2. Panel estimation of the effects of capital account regulations on foreign exchange pressure (*FXP*), 1995-2011

	Instrumental variables – 2SLS							OLS							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Capital inflow regulations	-0.92*** (0.32)				-3.05 (7.08)	-1.97 (1.48)	9.69 (40.48)	-0.35** (0.17)	-0.30* (0.18)				-0.30 (0.24)	-0.22 (0.20)	-0.37 (0.35)
FX regulations		-1.48** (0.58)			2.90 (9.76)					-0.03 (0.21)			0.18 (0.28)		
Financial sector restrictions			-1.82* (0.94)			1.68 (2.43)					-0.10 (0.18)			0.03 (0.21)	
Capital outflow regulations				-0.82** (0.38)			-9.64 (36.95)					-0.12 (0.14)			0.14 (0.27)
Real GDP growth	0.06*** (0.02)	0.07*** (0.02)	0.06*** (0.02)	0.07*** (0.02)	0.07*** (0.03)	0.07*** (0.02)	0.04 (0.14)	0.07*** (0.02)	0.06*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.06*** (0.02)	0.07*** (0.02)
Real GDP per capita (log)	-0.16** (0.06)	-0.11 (0.08)	-0.22 (0.15)	-0.13 (0.10)	-0.30 (0.51)	-0.05 (0.17)	0.16 (1.21)	-0.07 (0.07)	-0.09 (0.06)	-0.07 (0.07)	-0.03 (0.08)	-0.06 (0.08)	-0.08 (0.07)	-0.03 (0.08)	-0.08 (0.08)
Institutional quality	-0.09 (0.59)	-0.71 (0.96)	-0.16 (0.82)	0.45 (0.76)	1.49 (5.28)	-0.22 (1.00)	2.03 (7.18)	-0.53 (0.53)	-0.12 (0.59)	-0.09 (0.68)	-0.36 (0.66)	0.31 (0.73)	-0.01 (0.69)	-0.36 (0.68)	0.27 (0.71)
ln (1+ inflation)	-0.34*** (0.09)	-0.39*** (0.11)	-0.34*** (0.10)	-0.44*** (0.10)	-0.29 (0.23)	-0.33*** (0.11)	-0.65 (0.89)		-0.33*** (0.10)	-0.35*** (0.12)	-0.33*** (0.12)	-0.42*** (0.10)	-0.33*** (0.11)	-0.31*** (0.11)	-0.41*** (0.10)
Observations	672	625	614	602	608	595	602	732	672	625	614	602	608	595	602
Hansen test of overid.restrictions p-value	0.38	0.35	0.13	0.38	n.a.	n.a.	n.a.								
R-squared								0.14	0.15	0.15	0.14	0.18	0.15	0.14	0.18
25^{th} to 75^{th} percentile diff.in policy measures	0.67	0.50	0.67	0.96	0.67, 0.50	0.67, 0.67	0.67, 0.96	0.67	0.67	0.50	0.67	0.96	0.67, 0.50	0.67, 0.67	0.67, 0.96

Notes: Dependent variable is the index of foreign exchange pressure (Mean = 0.77, Std dev = 1.50). In columns (1) to (7) all capital account regulations are instrumented with binary variables that take the value of 1 if the country has a bilateral investment treaty with the U.S. in year t (and zero otherwise); and if the country is in the European Union (and zero otherwise). Capital inflow regulations, FX regulations, financial sector specific restrictions, and capital outflow regulations are lagged one year. Constant, region-specific, and time fixed effects are included in each regression. Clustered standard errors on country level are reported in parentheses; *, **, *** indicate significance at 10%, 5%, and 1% levels respectively. Capital inflow regulations is Schindler's (2009) capital controls on inflow index.FX regulations is Ostry et al.'s (2012) index for the average of binary variables reflecting restrictions on financial sector's lending locally in foreign exchange, and differential treatment of deposit accounts in foreign exchange. Financial sector restrictions is Ostry et al.'s (2012) index for the average of binary variables reflecting restrictions on financial sector's borrowing abroad, maintenance of accounts abroad, and differential treatment of accounts held by nonresidents. Capital outflow regulations is Schindler's (2009) capital controls on outflow index.

Table 3. Additional covariates in IV– 2SLS panel estimation of the effects of capital account regulations on foreign exchange pressure, 1995-2011

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Capital inflow regulations	-0.84**	-0.88**	-0.99***						
	(0.35)	(0.36)	(0.36)						
FX regulations				-1.16**	-1.51**				
				(0.55)	(0.60)				
Financial sector restrictions						-1.52	-1.83		
						(1.08)	(1.33)		
Capital outflow regulations								-0.86**	-1.06***
								(0.35)	(0.32)
Real GDP growth	0.08***	0.08***	0.08***	0.09***	0.09***	0.08***	0.08***	0.08***	0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Real GDP per capita (log)	-0.14	-0.14	-0.17	-0.06	-0.12	-0.16	-0.22	-0.08	-0.14
	(0.10)	(0.10)	(0.11)	(0.11)	(0.12)	(0.14)	(0.18)	(0.11)	(0.12)
Institutional quality	-0.07	-0.12	0.01		-0.36	-0.14	0.06	0.01	0.30
	(0.76)	(0.75)	(0.76)	-0.56 1.10	(1.11)	(0.89)	(0.97)	(0.83)	(0.84)
ln (1+ inflation)	-0.37***	-0.37***	-0.37***	-0.40***	-0.41***	-0.38***	-0.38***	-0.39***	-0.40***
	(0.09)	(0.09)	(0.09)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Terms of trade (log)	1.61**	1.56*	1.55*	1.35	1.26	0.99	0.92	1.78*	1.75*
	(0.78)	(0.80)	(0.81)	(0.86)	(0.88)	(0.76)	(0.81)	(0.91)	(0.93)
Gross domestic saving	-0.05	-0.03	-0.04	-0.04	-0.04	-0.02	-0.03	-0.04	-0.05
(share of GDP)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Government consumption		0.06	0.06	0.09	0.08	0.11*	0.12*	0.06	0.06
(% of GDP)		(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.07)	(0.06)	(0.06)
FDI inflows (share of GDP)		0.04***	0.04***	0.04***	0.04***	0.04***	0.04***	0.03***	0.03***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exchange rate regime			-0.15		-0.36*		-0.18		-0.33**
			(0.14)		(0.21)		(0.20)		(0.15)
Observations	597	596	596	550	550	542	542	546	546
Hansen test of overid. restrictions (p-value)	0.44	0.43	0.46	0.37	0.47	0.25	0.31	0.54	0.66
25^{th} to 75^{th} percentile diff. in policy measures	0.67	0.67	0.67	0.50	0.50	0.67	0.67	0.96	0.96

Notes: Dependent variable is the index of FX pressure (Mean = 0.77, Std dev = 1.50). All capital account regulations are instrumented with binary variables that take the value of 1 if the country has a bilateral investment treaty with the U.S. in year t (and zero otherwise); and if the country is in the European Union (and zero otherwise). Capital inflow regulations, FX regulations, financial sector specific restrictions, and capital outflow regulations are lagged one year. Constant, region-specific and time fixed effects are included in each regression. Terms of trade (log), gross domestic saving (share of GDP), government consumption (share of GDP), FDI inflows (share of GDP), and ln (1+ inflation) are in differenced form. Exchange rate regime (binary variable equal to 1 for a de facto fixed exchange rate regime, and 0 otherwise) is lagged one period. Clustered standard errors on country level are reported in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Table 4. Panel estimation of the effects of capital account regulations on the percentage change in real exchange rate, 1995-2011

	Instrumental variables – 2SLS							OLS						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Capital inflow regulations	-5.28**				3.73	-3.06	-1.16	-1.76**				-1.26	-0.93	-2.28
	(2.19)				(0.38)	(-0.26)	(-0.14)	(0.84)				(0.91)	(0.87)	(1.72)
FX regulations		-8.16**			-15.82*	-11.32			-0.94			-0.30		
		(3.39)			(-1.70)	(-0.84)			(1.12)			(1.29)		
Financial sector restrictions			-8.15							-0.38			-0.01	
			(5.96)							(0.72)			(0.79)	
Capital outflow regulations				-4.23**			-7.89				-1.09			0.54
				(2.11)			(-1.12)				(0.84)			(1.60)
Real GDP growth	0.47***	0.55***	0.52***	0.51***	0.86**	0.72*	0.86***	0.46***	0.54***	0.53***	0.51***	0.53***	0.52***	0.52***
	(0.13)	(0.13)	(0.13)	(0.13)	(2.10)	(1.94)	(2.71)	(0.12)	(0.12)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)
Real GDP per capita (log)	-1.01**	-0.57	-1.37	-0.76	0.26	-1.28	-0.57	-0.69	-0.39	-0.50	-0.50	-0.50	-0.52	-0.56
	(0.48)	(0.52)	(0.84)	(0.46)	(0.17)	(-1.21)	(-0.56)	(0.43)	(0.40)	(0.43)	(0.42)	(0.40)	(0.44)	(0.45)
Institutional quality	-2.35	-5.93	-1.11	-1.28	-17.38	-6.92	-5.42	-2.27	-3.68	-3.18	-1.79	-3.24	-3.38	-2.35
	(3.80)	(4.58)	(3.82)	(3.29)	(-1.33)	(-0.99)	(-0.97)	(3.30)	(2.95)	(2.86)	(3.22)	(2.83)	(2.99)	(3.41)
Reserves (as a share of GDP)	0.06***	0.04***	0.04***	0.06***	0.05	0.06	0.12**	0.06***	0.04**	0.04**	0.06***	0.04**	0.04**	0.06***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.61)	(0.97)	(2.55)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Observations	732	684	671	656	561	535	570	732	684	671	656	667	652	656
Hansen test of overid. rest. (p-value)	0.78	0.43	0.25	0.50	0.87	0.43	0.41							
R-squared								0.23	0.19	0.19	0.23	0.19	0.18	0.23
25th to 75th percentile diff. in measures	0.67	0.50	0.67	0.96	0.67, 0.50	0.67, 0.67	0.67, 0.96	0.67	0.50	0.67	0.96	0.67, 0.50	0.67, 0.67	0.67, 0.96

Notes: Dependent variable is the percentage change in real exchange rate (Mean = 1.72, Std dev = 10.70). In columns (1) to (7) all capital account regulations are instrumented with binary variables that take the value of 1 if the country has a bilateral investment treaty with the U.S. in year t (and zero otherwise); and if the country is in the European Union (and zero otherwise). Capital inflow regulations, FX regulations, financial sector specific regulations, and capital outflow regulations are lagged one year. Constant, lagged dependent variable, region-specific and time fixed effects are included in each regression. Reserves (as a share of GDP) in percentage change and lagged one period. Clustered standard errors on country level are reported in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Table 5. Additional covariates in IV – 2SLS panel estimation of the effects of capital account regulations on the percentage change in real exchange rate, 1995-2011.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital inflow regulations	-6.05**	-5.39**						
	(2.83)	(2.41)						
FX regulations			-9.60***	-8.58***				
			(3.70)	(2.86)				
Financial sector restrictions					-10.37	-15.11		
					(8.51)	(10.58)		
Capital outflow regulations							-5.09**	-5.03**
							(2.30)	(2.22)
Real GDP growth	0.71***	0.63***	0.75***		0.73***	0.66***	0.69***	0.63***
	(0.13)	(0.14)	(0.15)	0.67*** (0.16)	(0.14)	(0.16)	(0.14)	(0.15)
Real GDP per capita (log)	-0.87		-0.54	-0.80	-1.47	-2.17	-0.70	-1.06*
	(0.54)	-1.22** (0.51)	(0.60)	(0.55)	(1.01)	(1.38)	(0.50)	(0.54)
Institutional quality	-3.74	-1.42	-7.04	-6.33	-0.38	0.26	-2.75	-0.68
	(3.93)	(3.50)	(5.22)	(4.85)	(4.56)	(6.31)	(3.13)	(3.62)
Reserves (as a share of GDP)	0.04***	.028**	0.04***	0.03**	0.04**	0.03**	0.03**	0.03**
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Terms of trade (log)	10.48**	5.18	11.32*	3.94	7.37	1.29	12.48**	6.04
	(4.79)	(4.70)	(5.71)	(5.81)	(5.19)	(4.99)	(5.06)	(5.04)
Gross domestic saving	-0.87***	-0.59***	-0.91***	-0.60***	-0.84***	-0.61***	-0.97***	-0.66***
(share of GDP)	(0.24)	(0.19)	(0.24)	(0.19)	(0.24)	(0.22)	(0.28)	(0.21)
Government consumption	0.73**	0.47	0.95**	0.60	1.02**	0.89*	0.42	0.44
(% of GDP)	(0.36)	(0.37)	(0.39)	(0.39)	(0.42)	(0.53)	(0.49)	(0.38)
FDI inflows (share of GDP)	0.11	0.11	0.12	0.12	0.13	0.15**	0.08	0.10
	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.07)	(0.09)	(0.08)
Exchange rate regime	-1.17*	-1.15*	-2.51**	-2.29**	-1.34	-1.51	-1.54*	-1.56**
	(0.65)	(0.60)	(1.06)	(0.95)	(1.04)	(1.22)	(0.79)	(0.77)
ln (1+ inflation)		-2.92***		-3.14***		-2.88***		-3.08***
		(0.77)		(0.78)		(0.77)		(0.80)
Observations	649	597	603	551	594	543	595	547
Hansen test of overid. restrictions (p-value)	0.91	0.74	0.59	0.82	0.23	0.62	0.80	0.61
25^{th} to 75^{th} percentile diff. in policy measures	0.67	0.67	0.50	0.50	0.67	0.67	0.96	0.96

Notes: Dependent variable is the percentage change in real exchange rate (Mean = 1.72, Std dev = 10.70). All capital account regulations are instrumented with binary variables that take the value of 1 if the country has a bilateral investment treaty with the U.S. in year t (and zero otherwise); and if the country is in the European Union (and zero otherwise). Capital inflow regulations, FX regulations, financial sector specific regulations, and capital outflow regulations are lagged one year. Reserves (as a share of GDP) in percentage change and lagged one period. Terms of trade (log), gross domestic saving (share of GDP), government consumption (share of GDP), FDI inflows (share of GDP), and ln (1+ inflation) are in differenced form. Exchange rate regime (binary variable equal to 1 for a de facto fixed exchange rate regime, and 0 otherwise) is lagged one period. Constant, lagged dependent variable, region-specific and time fixed effects are included in each regression. Clustered standard errors on country level are reported in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Table 6: Panel estimation of the effects of capital account regulations on monetary policy autonomy, 1995-2011

	Instrumental variables – 2SLS				OLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest rate differential (IRD)	1.28***	-0.70	1.67***	1.48***	1.06***	0.15	1.27***	0.80***
	(0.30)	(0.86)	(0.44)	(0.45)	(0.13)	(0.39)	(0.31)	(0.15)
Capital inflow regulations	7.86				8.69***			
	(4.95)				(2.70)			
Capital inflow regulations * IRD	-1.05**				-0.62***			
	(0.48)				(0.17)			
FX regulations		1.06				-1.97		
		(15.38)				(3.28)		
FX regulations * IRD		2.61*				1.34*		
		(1.37)				(0.69)		
Financial sector restrictions			19.01**				7.79***	
			(8.21)				(2.50)	
Financial sector restrictions * IRD			-1.58***				-0.92**	
			(0.56)				(0.39)	
Capital outflow regulations				7.10				1.69
				(8.31)				(2.06)
Capital outflow regulations * IRD				-0.82				0.38
				(0.61)				(0.47)
Real GDP growth	-0.97***	-0.94***	-0.65***	-0.91***	-0.97***	-0.92***	-0.74***	-0.99***
	(0.31)	(0.27)	(0.19)	(0.30)	(0.32)	(0.27)	(0.24)	(0.30)
Real GDP per capita (log)	0.51	0.97	2.58**	0.85	1.13	0.95	1.79	1.72
	(0.83)	(1.23)	(1.26)	(0.98)	(0.82)	(1.16)	(1.09)	(1.13)
Institutional quality	-8.30	6.01	-8.43	-9.17	-9.99	-2.23	-8.91	-14.05
	(10.01)	(16.38)	(11.36)	(10.51)	(9.65)	(11.51)	(9.95)	(11.79)
Reserves (as a share of GDP)	-0.09**	-0.01	-0.09*	-0.08	-0.09*	-0.03	-0.07*	-0.06
	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)
Exchange rate regime	1.33	0.61	2.38	2.28	1.07	0.44	1.23	1.28
	(1.06)	(2.39)	(1.56)	(1.92)	(1.03)	(1.44)	(1.06)	(1.13)
Observations	652	625	612	600	652	625	612	600
Hansen test of overid. restrictions (p-value)	0.75	0.98	0.18	0.73				
R-squared					0.40	0.42	0.41	0.42
25^{th} to 75^{th} percentile diff. in policy measures	0.67	0.50	0.67	0.96	0.67	0.50	0.67	0.96

Notes: Dependent variable is the percentage change in nominal exchange rate (Mean = 6.54, Std dev = 26.50). In columns (1) to (7) all capital account regulations are instrumented with binary variables that take the value of 1 if the country has a bilateral investment treaty with the U.S. in year t (and zero otherwise); and if the country is in the European Union (and zero otherwise). Kazakhstan and Bulgaria are omitted from sample due to their extreme values for nominal depreciation. Exchange rate regime is a binary variable equal to 1 for a de facto fixed exchange rate regime, and 0 otherwise. Constant, lagged dependent variable, region-specific and time fixed effects are included in each regression. Clustered standard errors on the country level are reported in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Table 7. OLS cross-section estimation of the effects of capital account regulations on crisis resilience: global financial crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital inflow regulations	5.56**	5.61**						
	(2.25)	(2.52)						
FX regulations			9.91***	9.82***				
			(3.62)	(3.75)				
Financial sector restrictions					6.69**	7.20**		
					(3.04)	(3.17)		
Capital outflow regulations							6.50***	5.73**
							(2.31)	(2.36)
Terms of trade change	0.28*	0.25*	0.26*	0.26**	0.23*	0.23*	0.22*	0.23
	(0.14)	(0.14)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.14)
Growth in trading partners	1.30	1.45*	0.10	0.22	2.24*	2.43**	1.54**	1.52*
	(0.82)	(0.86)	(0.76)	(0.76)	(1.21)	(1.18)	(0.75)	(0.80)
Institutional quality	-7.28	-7.14	-14.27	-12.43	-8.85	-9.18	-6.50	-7.41
	(11.37)	(11.12)	(12.08)	(12.97)	(10.22)	(9.90)	(10.70)	(10.69)
Observations	40	40	38	37	36	35	40	40
R-squared	0.29	0.29	0.39	0.40	0.36	0.36	0.34	0.32
25th to 75th percentile diff. in policy measures	0.67	0.67	0.50	0.50	0.67	0.67	0.96	0.96

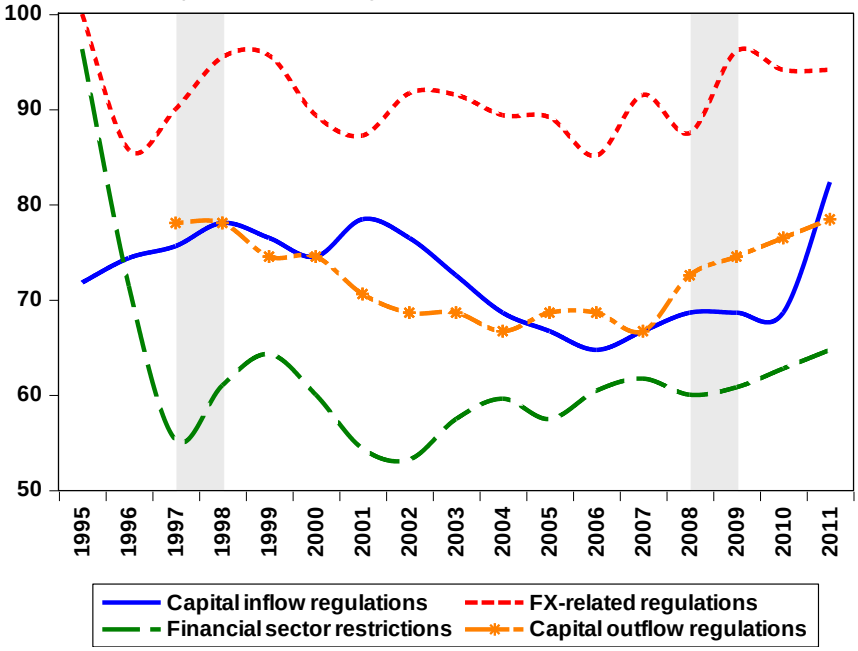
Notes: Dependent variable is the difference between real GDP growth rates in 2009, and averaged over 2003-08 (in percentage points; Mean=-7.5; Std dev=6.5). Capital inflow regulations, FX regulations, financial sector specific restrictions, and capital outflow regulations are averaged over 2007-09 for columns (1), (3), (5) and (7), and over 2005-07 for columns (2), (4), (6), and (8). Institutional quality index is for 2007. Constant included in each regression. Robust standard errors in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Table 8. OLS cross-section estimation of the effects of capital account regulations used in crisis on the post-crisis performance: global financial crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital inflow regulations	-5.14**	-5.11**						
	(2.20)	(2.25)						
FX regulations			-6.16**	-5.70**				
			(2.63)	(2.64)				
Financial sector restrictions					-5.11**	-4.68*		
					(2.50)	(2.74)		
Capital outflow regulations							-3.76*	-3.42*
							(1.98)	(1.94)
Terms of trade change	0.01	-0.00	0.11	0.10	0.10	0.09	0.07	0.07
	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.07)
Growth in trading partners	-2.35	-3.09	-4.37	-4.69	-4.41	-4.36	-4.34	-4.62
	(3.26)	(3.25)	(3.09)	(3.17)	(3.16)	(3.27)	(3.03)	(3.04)
Institutional quality	12.73	12.92	8.10	7.01	11.36	12.25	14.20	13.57
	(8.73)	(8.75)	(9.31)	(9.69)	(9.00)	(9.28)	(8.47)	(8.59)
Observations	42	42	44	43	43	42	47	47
R-squared	0.21	0.21	0.21	0.19	0.21	0.19	0.19	0.18
25th to 75th percentile diff. in policy measures	0.67	0.67	0.50	0.50	0.67	0.67	0.96	0.96

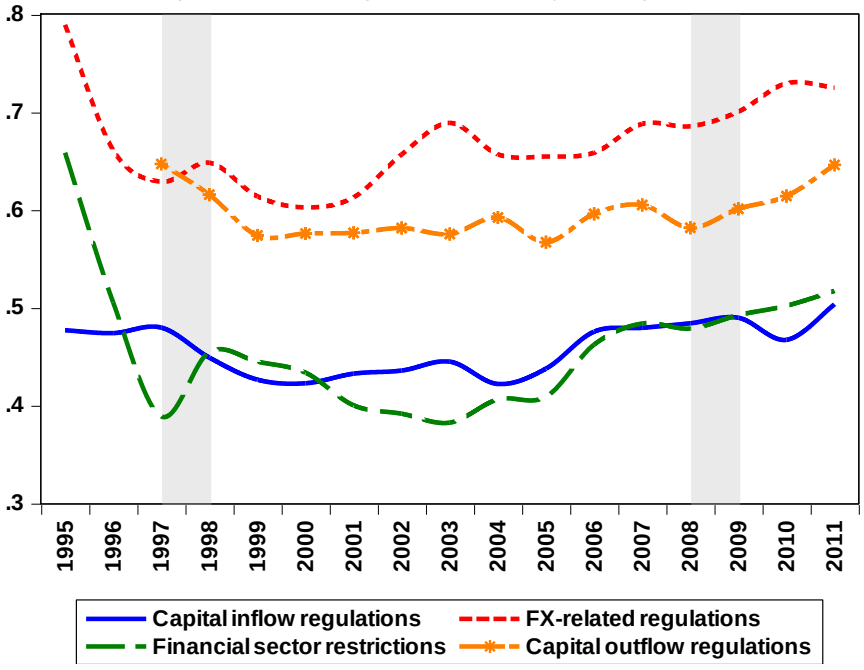
Notes: Dependent variable is the difference between real GDP growth rates averaged over 2010-11, and 2008-09 (in percentage points; Mean=6.02; Std dev=5.59). Capital inflow regulations, FX regulations, financial sector specific restrictions, and capital outflow regulations are averaged over 2007-09 for columns (1), (3), (5) and (7), and over 2005-07 for columns (2), (4), (6), and (8). Institutional quality index is for 2008. Constant included in each regression. Robust standard errors in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% respectively. See Table 2 for definitions of capital inflow/outflow regulations, FX regulations, and financial sector restrictions.

Figure 1:
Incidence of Capital Account Regulations



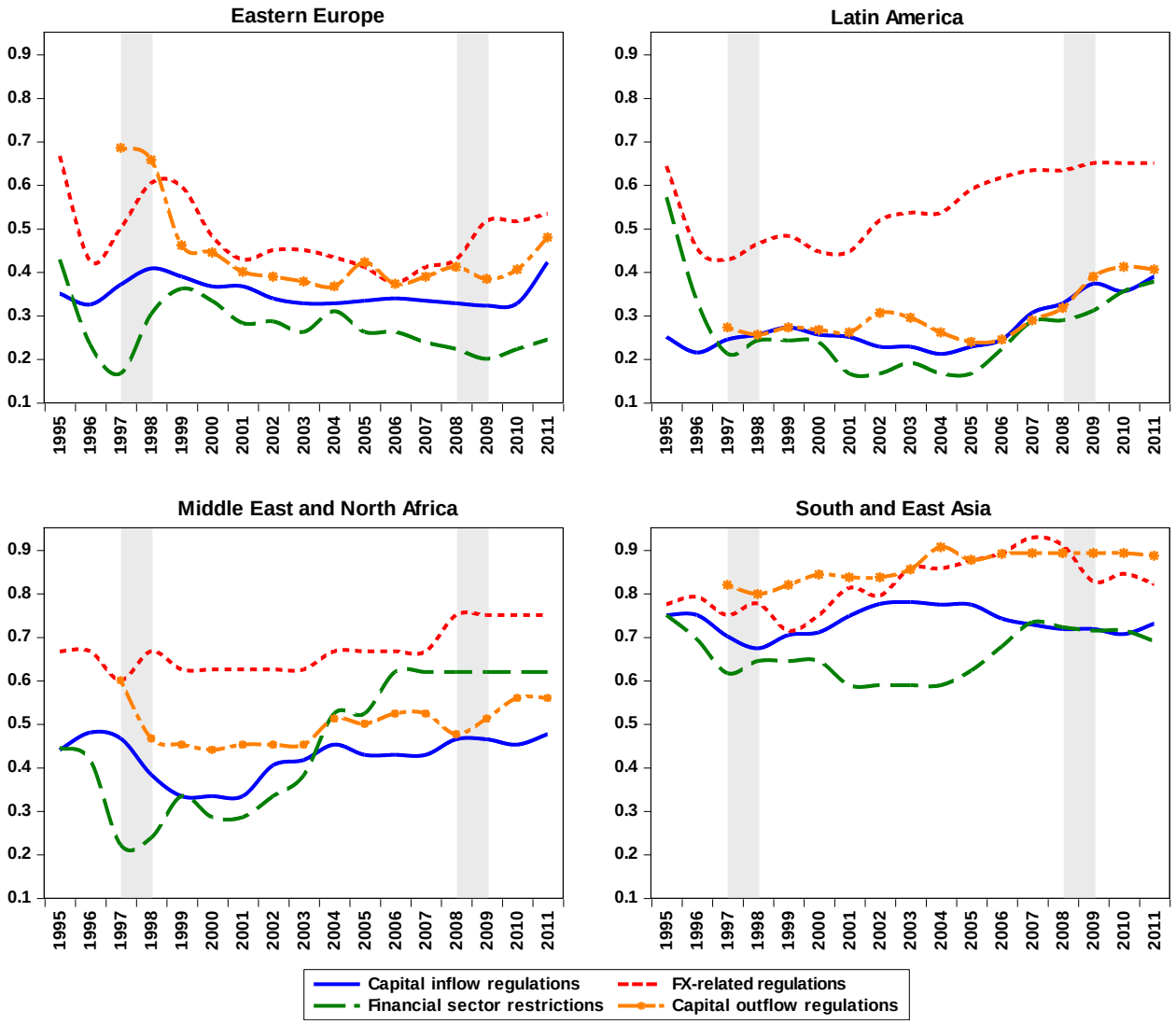
Source: Schindler (2009), Ostry et al. (2012) and authors' estimates from IMF's AREAER.
Note: Numbers show the percentage of countries with a capital account regulation over time.

Figure 2
Evolution of Capital Account Regulations, Country Average



Source: Schindler (2009), Ostry et al. (2012) and authors' estimates from IMF's AREAER.
Note: Numbers show the average of capital account regulations across countries over time.

Figure 3
Evolution of Capital Account Regulations, Regional Averages



Source: Schindler (2009), Ostry et al. (2012) and authors' estimates from IMF's AREAER.
Note: Numbers show the average of capital account regulations across countries for each region over time.

Appendix

Table A1. List of Countries

Algeria	Costa Rica	Guatemala	Korea	Peru	Tunisia
Argentina	Croatia	Hungary	Latvia	Philippines	Turkey
Armenia	Czech Republic	Iceland	Lebanon	Poland	Ukraine
Bosnia & Herzegovina	Dominican Republic	India	Lithuania	Romania	Uruguay
Brazil	Ecuador	Indonesia	Malaysia	Russian Federation	Venezuela, Rep. Bol.
Bulgaria	Egypt	Israel	Mexico	Serbia, Republic of	Vietnam
Chile	El Salvador	Jamaica	Morocco	South Africa	
China,P.R.: Mainland	Estonia	Jordan	Pakistan	Sri Lanka	
Colombia	Georgia	Kazakhstan	Panama	Thailand	

Table A2. Description and Sources of Variables

Variable	Description	Obs.	Mean	Std. Dev.	Source
Capital inflow regulations	Index between 0 (no restrictions) to 1 (restrictions)	823	0.4	0.4	Schindler (2009) and authors' update over 2006-2011 based on IMF's AREAER
FX-related regulations	Index between 0 (no restrictions) to 1 (restrictions)	767	0.6	0.3	Ostry et al. (2012), broad index (fxreg2), and authors' update over 2009-2011 based on IMF's AREAER
Financial sector restrictions	Index between 0 (no restrictions) to 1 (restrictions)	760	0.4	0.3	Ostry et al. (2012), broad index (fincont2), and authors' update over 2009-2011 based on IMF's AREAER
Capital outflow regulations	Index between 0 (no restrictions) to 1 (restrictions)	745	0.5	0.4	Schindler (2009) and authors' update over 2006-2011 based on IMF's AREAER
International reserves minus gold, percent change	in percent	856	19.4	39.0	IMF's IFS database
Real exchange rate	CPI-based real effective	864	102.0	21.7	Darvas (2012)
Real GDP growth	in percent	858	4.2	4.2	IMF's WEO database
Real GDP per capita (log)	log, constant 2005 USD	857	7.9	0.9	World Bank's World Development Indicators
Exchange rate regime	Binary variable equal to 1 if a de facto pegged exchange rate regime, and 0 otherwise	867	0.3	0.5	Ghosh et al. 2010 and authors' update over 2009-2011 based on IMF's AREAER
Institutional quality (ICRG) index	Index between 0 (high) to 1 (low)	833	0.7	0.1	International Risk Country Guide, updated from 2009-2011
Bilateral investment treaty	Binary variable equal to 1 if a bilateral investment treaty with the U.S. exists, and 0 otherwise	867	0.4	0.5	Trade Compliance Center
Inflation rate	in percent, consumer prices	807	12.1	43.3	World Bank's World Development Indicators
Terms of trade	Index, net barter (2000=100)	748	105.7	25.1	World Bank's World Development Indicators
Gross domestic saving (share of GDP)	in percent	863	19.3	12.7	World Bank's World Development Indicators
Government consumption (share of GDP)	in percent	855	14.9	5.0	World Bank's World Development Indicators
FDI inflows (share of GDP)	in percent	850	4.0	4.4	World Bank's World Development Indicators
Nominal exchange rate change	in percent, national currency per USD, end of period	813	6.5	26.5	IMF's IFS database
Interest rate differential	in percent	739	8.4	14.2	IMF's IFS database
Growth in trading partners	in percent, only in 2008	41	-1.7	1.0	Ostry et al. (2012)