ESSAYS ON THE EFFECTIVENESS OF CAPITAL CONTROLS

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Abstract

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Financial globalization paired with the evident volatility of capital flows has sparked renewed interest in capital account restrictions on both inflows and outflows. This dissertation, composed of three essays, analyzes the effectiveness of these policy tools. The first chapter studies the effectiveness of capital inflow controls in insulating countries from foreign interest rate shocks. This chapter estimates a standard VAR augmented to include a capital inflow control index. To examine the systematic effect of capital controls on the economy, counterfactual VARs are constructed by “zeroing out” capital controls and their effects in the VAR system. Target-variable impulse responses are compared between the factual and counterfactual scenarios. The essay finds that capital controls are statistically and economically significant in protecting the domestic tradable sector from foreign interest-rate shocks for countries with a managed exchange rate regime.

The second chapter of this thesis presents a small-open-economy DSGE model that incorporates a learning-by-doing externality in the tradable sector. In the model, capital controls are the endogenous response of a benevolent government. The impulse responses generated by the theory model qualitatively match those from the empirical section in the first chapter.

Finally, the third essay, is an empirical analysis of the effects of unanticipated changes in capital outflow-controls in a sample of 31 countries during 1995-2010. Using as the yardstick of effectiveness the impact of changes in outflow-controls on net capital flows, this chapter finds that in countries with strong macroeconomic positions, a tightening of
outflow-controls did help reduce net outflows, and a relaxation helped reduce net inflows. Furthermore, the chapter finds that innovations to capital controls are very important in explaining movements in net inflows.
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CHAPTER 1

MEASURING THE SYSTEMATIC EFFECT OF CAPITAL CONTROLS

1.1 Introduction

Expansionary monetary policies in advanced economies have had spillover effects on emerging economies. Investors, attracted by higher yields, have shifted their portfolios into less developed markets. The magnitude and cyclical nature of these transactions have raised concerns among policy makers about the potential loss of macroeconomic stability and competitiveness of the export sector in recipient countries (Ostry et al. 2011). In order to prevent possible financial Dutch disease effects from increased flows of international capital, some recipient countries have imposed capital controls.¹

Although used widely, empirical evidence on the effectiveness and reliability of capital controls has been inconclusive.² This chapter argues that the inability of previous studies to provide a definitive answer regarding the effectiveness of controls can be explained by two shortcomings. First, due to the scarcity of cross-country indices on capital account restrictions on inflows and to the difficulty in defining what constitutes a “success” on the implementation of controls, the bulk of the empirical literature on this subject has been based at the country case-study level (Magud and Reinhart 2006). Second, due to the lack

¹Financial Dutch disease refers to the effects of foreign exchange inflows that result in real exchange rate appreciation, factor reallocation, and a contraction in the manufacturing sector. For the purpose of this chapter, capital controls on inflows can be considered as any type of restriction that governments impose to the flow of funds from foreign markets into the home country.

²See Magud and Reinhart [2006] and Dooley [1995] for surveys of empirical and theoretical work on capital controls.
of counterfactuals to evaluate these economic policies, researchers have tried to measure the effectiveness of controls by assuming that these policy tools are exogenous random variables, and contrasting the experiences of countries with and without capital controls or by looking at the effect of unanticipated changes in capital controls.\(^3\)

This chapter addresses the first issue by taking advantage of an index based on a set of measures of capital account restrictions developed by Schindler [2008]. This index uses information from the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Schindler [2008] exploits the IMF’s post-1996 disaggregated reporting of different categories of capital account transactions and provides the only index distinguishing between controls on inflows and outflows. Most importantly, this index provides a unified framework to measure the intensity of inflow controls across countries, thereby allowing researchers to analyze the effectiveness of controls in a multi-country setting. The goal of this essay is to uncover some common dynamic patterns across emerging markets which occur as a result of implementing capital controls on inflows. At the individual country case study level, these patterns could be left unobserved.\(^4\) One drawback of this approach is that when estimating the pooled data system, slopes and intercepts are restricted to be the same across countries, which assumes away heterogeneity in the sample. To address the heterogeneity in the sample, this chapter divides countries into smaller sub-groups based on common characteristics among group members and then analyzes the behavior of target variables for each sub-group. By doing this, necessary conditions (but not sufficient) are discussed for controls to be effective.

The most important finding of this chapter is that the implementation of capital controls cannot be treated as an exogenous random variable, contrary to previous research. Ignor-

\(^3\)This chapter will refer to the study of unanticipated shocks to a capital controls index as the “shock approach”.

\(^4\)Gavin and Theodorou [2005] show that macro models like this one perform much better in cross sections rather than time series. Also due to the quality of data in emerging markets, degrees of freedom are significantly increased by pooling data, therefore increasing the efficiency and power of the analysis.
ing policy endogeneity can lead researchers to the wrong conclusion that the treatment is making the patient sicker, when in fact this conclusion is an artifact of self-selection bias. As has become standard in the literature studying capital controls, this chapter will deal with the endogeneity of controls by using structural vector autoregressive model (VAR) simulations. Most of the empirical literature on the effectiveness of controls has focused on the effects of unanticipated changes in capital controls on the economy. This “shock approach” provides researchers a clean way to identify cause and effect dynamics of policy innovations. Following the discussion of Bernanke et al. [1997], I argue that relying on that type of analysis only answers the question of the effectiveness of unexpected, exogenous capital controls. Therefore, the “shock approach” ignores that capital controls are often implemented by policymakers (and expected by the private sector) in response to macroeconomic conditions. In order to get a more accurate measurement of the effectiveness of endogenous policy tools, this study analyzes the dynamics of anticipated policy innovations of capital controls in response to non-policy shocks.

As in Miniane and Rogers [2007], this chapter studies the effectiveness of capital controls in insulating countries from unanticipated US monetary policy shocks in a multi-country setting.\(^5\) Countries are pooled and a panel VAR is calculated by imposing same slopes and intercepts across countries. This chapter augments the analysis of Miniane and Rogers [2007] in two ways. First, it includes Schindler [2008] capital inflow control index as a variable in the PVAR specification. By doing this, and in contrast to Miniane and Rogers 2007, impulse responses of target variables become functions of the intensity of inflow controls. Second, following the same methodology proposed by Sims and Zha [2006], and Bachmann and Sims [2011], this chapter builds counterfactual scenarios by constructing hypothetical sequences of unanticipated US monetary policy shocks to the system so as

\(^5\)Miniane and Rogers [2007] study the response of countries to a twenty five basis point increase in the US Federal Funds Rate. Since the present chapter is interested in studying the effectiveness of controls on inflows, it focuses on the effects of expansionary US monetary policy represented by a one hundred basis point reduction to Federal Funds Rate.
to leave the systematic response of a propagation variable (in this case, the presence/lack of capital controls) zero at all horizons. A comparison of this hypothetical response with the actual impulse response allows this chapter to quantify how important the endogenous response of capital controls is as an insulating mechanism to foreign financial shocks and preventing the occurrence of financial Dutch disease effects.\footnote{Miniane and Rogers [2007] try to build counterfactuals by analyzing the experiences of countries with and without capital controls. As it is argued in the main text, this is equivalent to assuming that capital controls are exogenous random variables.} As Hamilton and Herrera [2001] point out, this is equivalent to “zeroing out” the capital control equation in the panel VAR and the capital control effects in the non-capital control equations.

In the full panel of twenty emerging markets, no significant evidence is found to indicate that capital controls play any role in insulating countries from Dutch disease effects triggered by unanticipated foreign interest-rate shocks. Although capital controls increase on impact in response to a one percentage point reduction in the US Federal Funds Rate, the hypothetical impulse responses of target variables, in which the response of capital controls is held constant, are very similar to the actual responses. However, once the panel is divided into smaller more homogenous sub-groups, significant differences in responses between the factual and counterfactual scenarios are observed. The difference is largest in countries with an exchange rate anchor against the US dollar. In these countries two years after impact and when controls are fixed at zero, the real exchange rate is three percent higher and industrial production is almost one and a half percent lower on average in comparison to actual scenarios with capital controls. This result is in line with Miniane and Rogers [2007], Flood and Rose [2010], and Towbin and Weber [2011]. These studies find that countries with managed exchange rate policies are better able to insulate output and exchange rates from foreign shocks. This chapter goes one step further and suggests that capital controls play a significant role in insulating managed exchange rate regimes from international financial shocks.

The remainder of this chapter is organized as follows. The next section presents the
empirical strategy and the data that underlies this chapter’s analysis, empirical results are presented in Section 1.3 and Section 1.4 concludes.

1.2 Data and Empirical Strategy

1.2.1 Data

This chapter studies twenty emerging markets that have experienced reversals in their paths toward financial account liberalization over the 1995:1 to 2007:12 time period. Months when gross inflows were negative were dropped from the analysis, since this chapter is interested in the effect of capital controls when foreign capital is flowing into these economies. This chapter addresses the inherent endogeneity of capital controls by including an index of the intensity of capital controls in the econometric analysis. The index employed, which is the only one that distinguishes between inflows and outflows, is a set of measures on capital control restrictions developed by Schindler [2008]. This index uses information from the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Financial and economic data for all of the countries except the U.S. were obtained from the IMF’s International Financial Statistics database. Data for the U.S. were obtained from the St. Louis Federal Reserve FRED database. All variables are seasonally adjusted. For the capital control index, the annual value was assigned for each month in that year. The estimation is robust to various interpolation methods of the capital control index. The exchange rate is defined as the nominal exchange rate, in local currency units per US dollar, times the ratio of the US price level over the price level in the respective emerging market.

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7The sample consists of the following countries: Argentina, Bolivia, Brazil, Bulgaria, Chile, China, Czech Republic, Hungary, India, Indonesia, South Korea, Malaysia, Mexico, Philippines, Romania, Russian Federation, South Africa, Thailand, and Turkey. The sample selection criteria was based on the availability of monthly data for the target variables of interest.
1.2.2 Identifying US Monetary Shocks

A structural VAR will be denoted with the following specification (ignoring the constant term):

$$\Lambda_0 y_t = \Lambda_1 y_{t-1} + \ldots + \Lambda_p y_{t-p} + \varepsilon_t,$$

(1.2.1)

where $y_t$ is a $(k \times 1)$ vector of data and $\varepsilon_t$ is a $(k \times 1)$ vector of structural shocks that are needed to be uncorrelated with one another. $\Lambda_0$ is the $(k \times k)$ impact matrix that contains the contemporaneous relations among variables. Since the matrix $\Lambda_0$ may not be diagonal, one cannot estimate equation (1.2.1) directly. The reduced form of (1.2.1) can be specified as

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + e_t,$$

(1.2.2)

where $A_p = \Lambda_0^{-1} \Lambda_p$ and $e_t = \Lambda_0^{-1} \varepsilon_t$ for $p = 1, \ldots, n$.

An advantage of using a VAR analysis is that every variable is interdependent and endogenous. The $y_t$ variable is described by an autoregressive representation and each equation of the system is estimated using ordinary least squares (OLS). The main drawback of this method is that it is a reduced form estimation procedure. Therefore, it does not provide the researcher any economic interpretation. Thus some structure needs to be introduced in the estimation. Equation (1.2.2) can be estimated by ordinary least squares, but since $A_p$, and $\Sigma_e$ have fewer free parameters than $\Lambda_0$ and $\Sigma_\varepsilon$, some restrictions have to be imposed on $\Lambda_0$ to uniquely recover the structural form. More precisely, if there are $k$ variables, $\frac{k(k-1)}{2}$ restrictions are required. This chapter will follow the same restriction identification as Eichenbaum and Evans [1995], and will add a commodity price index and the Schindler [2008] index of capital inflow controls to their benchmark model specification. Therefore, the model consists of an index of commodity prices (CP), U.S. industrial production (Y), U.S. consumer prices (P), emerging market industrial production (Y*), emerging market interest rate (r), the U.S. Federal Funds Rate (FFR), the ratio of non-borrowed reserves to total reserves in the United States (M), the exchange rate in local currency unit per US
dollar (s), and Schindler [2008] capital control index for the emerging market (CCI). All the variables are in log levels except for interest rates and the capital control index.\footnote{Sims [1986] argues that coefficients estimated in levels from a VAR with possible non-stationary time series are consistent.} As is standard in the literature, the following recursive order of the variables will be imposed: (CP, Y, P, Y*, FFR, M, CCI, r, s). The identification of this VAR model entails computing the Cholesky decomposition of the variance-covariance matrix of $\Sigma$, where $\Sigma$ is the estimable variance-covariance matrix of reduced-form errors, $e_t$. The structural shock, $\epsilon_t$, is identified as an orthogonal shock to the FFR, normalized to be equal to a one hundred basis point reduction on impact. With this ordering there is going to be a contemporaneous effect of FFR on M, CCI, r, and s and a lagged effect on the remaining variables. In line with the original analysis of Eichenbaum and Evans [1995], this corresponds with the assumption that the US federal reserve uses CP, Y, P, and Y* as contemporaneous feedback rules to determine US monetary policy; this, in turn, will have an instantaneous effect on M, CCI, r, and s. More importantly, for the analysis of capital controls in emerging markets, it is assumed that controls will have a contemporaneous effect on their interest rate and the exchange rate, and a one month lagged effect on industrial output.

The model is estimated in a panel format, using the nine variable specification described above, by imposing common intercept and slopes across all countries. Finally, impulse responses to a FFR shock are computed. Equation (1.2.2) can be written in companion form, so it can be represented as a VAR(1) by defining $\xi = [y_t, y_{t-1}, \ldots, y_{t-p}]'$ and $v_t = [e_t, 0, \ldots, 0]$ as,

\[
F = \begin{bmatrix}
A_1 & A_2 & \ldots & A_p \\
I & 0 & \ldots & 0 \\
0 & I & \ldots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & \ldots & I & 0
\end{bmatrix},
\]
and

$$\Sigma_v = \begin{bmatrix}
\Sigma_e & 0 & \ldots & 0 \\
0 & 0 & \ldots & 0 \\
0 & 0 & \ldots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & \ldots & 0 & 0 
\end{bmatrix}.$$  

The VAR($p$) can now be written as:

$$\xi_t = F \xi_{t-1} + v_t, \quad (1.2.3)$$

where $\xi_t$ and $v_t$ are $kp \times 1$ vectors and $F$ is a $kp \times kp$ matrix.

The impulse response for variable $i$ to the fifth structural shock at horizon $h = 1, \ldots, H$ is denoted by:

$$IRF_i(5, h) = F^{h-1} \Lambda_0^{-1}(i, 5) \quad (1.2.4)$$

That is, the IRF values to a FFR shock for the capital control index ($i=7$) will be in row seven column five, for $h = 1, \ldots, H$.

1.2.3 Isolating the Role of Controls

The purpose of the empirical exercise in this chapter is to construct a counterfactual scenarios to a foreign shock (in this case an unanticipated reduction in the FFR), by holding capital controls fixed at all forecast horizons. This counterfactual analysis follows closely from the analysis of Bachmann and Sims [2011]. Comparing the hypothetical impulse response with the actual response enables this chapter to quantify the effectiveness of capital controls on inflows in insulating countries from unanticipated foreign shocks to the FFR. As Hamilton and Herrera [2001] point out, this is equivalent to setting all of the coefficients on the lagged capital controls to zero and dropping the equation for capital controls from the simulation.
The construction of the counterfactual consists of holding capital controls fixed in response to a substantial reduction in the FFR, which in turn requires setting

\[ \text{IRF}_7(5, h) = 0 \]  

(1.2.5)

at each forecast horizon, \( h \). In this case, 7 is the position indicator of the response of capital controls and 5 denotes an index for the position of the FFR shock. A hypothetical sequence of capital control innovations, \( \varepsilon_{7,h} \) is constructed in order for equation (1.2.5) to be satisfied at each horizon, \( h \). On impact, this requires that:

\[
\Lambda_0^{-1}(7, 5) + \Lambda_0^{-1}(7, 7) \ast \varepsilon_{7,1} = 0,
\]

Therefore, the required capital control innovation on impact is:

\[
\varepsilon_{7,1} = -\frac{\Lambda_0^{-1}(7, 5)}{\Lambda_0^{-1}(7, 7)}.
\]

The required values for subsequent capital control innovations can be recursively estimated as:

\[
\varepsilon_{7,h} = \frac{\text{IRF}_7(5, h) + \sum_{j=1}^{h-1} F^{h-j} \Lambda_0^{-1}(7, 5) \ast \varepsilon_{7,j}}{\Lambda_0^{-1}(7, 7)},
\]

where \( h = 1, \ldots, H \). The impulse responses to the FFR shock holding capital controls equal to zero at all horizons \( h \) are computed as:

\[
\text{IRF}_i(5, h) = \text{IRF}_7(5, h) + \sum_{j=1}^{h-1} F^{h-j} \Lambda_0^{-1}(7, 5) \ast \varepsilon_{7,j},
\]

for \( i = 1, \ldots, 9 \).

The difference between \( \text{IRF}_i(5, h) \) and \( \text{IRF}_7(5, h) \) will quantify the endogeneity or systematic effect of capital controls in the economy.
1.2.4 Inference

Statistical inference in the literature is commonly carried out by examining the difference between the factual and counterfactual impulse response functions, measured against the bootstrapped standard errors of the factual (unconstrained) VAR. This chapter argues that this common treatment is deficient in that the impulse responses from the constrained VAR are just as much random variables (functions) as they are in the unconstrained system. This chapter, using Runkle 1987 bootstrapping method, applies the following algorithm for statistical inference:

1. Estimate the PVAR(p) in equation (1.2.2) and generate 1,000 bootstrap replications $\hat{A}^*$ from:

   \[ y_t^* = \hat{A}_1y_{t-1}^* + \hat{A}_2y_{t-2}^* + \ldots + \hat{A}_p y_{t-p}^* + e_t^*. \]

   This can be denoted in matrix companion form by

   \[ \xi_t^* = \hat{F}\xi_{t-1}^* + \nu_t^*. \]

2. Calculate 1,000 impulse responses for each generated variable $i^*$ to the fifth structural shock at horizon $h = 1, \ldots, H$:

   \[ \text{IRF}_{i^*}(5, h) = \hat{F}^{s-h-1}\Lambda_{0}^{*-1}(i^*, 5). \] (1.2.6)

   (a) Construct 1,000 adjusted impulse responses holding capital controls fixed at zero at each horizon $h$:

   \[ \text{IRF}^*_i(5, h) = \text{IRF}_{i^*}(5, h) + \sum_{j=1}^{h-1} F_i^{s-h-j}\Lambda_{0}^{*-1}(7, 5) \varepsilon_{i,j}^*. \] (1.2.7)

---

9Bootstrapping for the panel was done by generating initial conditions separately for each country as in Runkle (1987), but sampling from the entire panel vector of residuals. This was done to account for possible cross-country correlations.
3. Sort the 1,000 impulse responses, $IRF^*_i(5,h)$, and the 1,000 values capturing the
differences between $IRF^*_i(5,h)$ and $IRF^*_i(5,h)$.

4. Finally, the empirical distributions obtained from the bootstrap simulations are used
to calculate the empirical distribution for the difference between the factual and coun-
terfactual scenarios.\(^{10}\)

1.3 Results

Figure (1.1) and figure (1.2) show impulse responses for the US and the panel of twenty
emerging market countries to a one hundred basis point reduction in the FFR. The dashed
lines represent actual OLS point estimates. The shaded gray regions are confidence bands
that include two-thirds of the unconstrained bootstrap estimates, constructed according to
Runkle [1987] procedure. Dotted lines represent the counterfactual (constrained) impulse
responses.

The responses of US variables are in line with the findings in the literature. A drop in
the Fed funds rate and a rise in NBR is accompanied by an inverse hump-shaped response
of industrial output. The hump is larger and more persistent than in previous studies (see
Faust et al. 2003). The fact that despite a reduction in the Fed funds rate, prices do not
increase a year after impact is in line of what with what the literature calls the “price puzzle”
(Eichenbaum 1992). Sims 1992 proposes the inclusion of a commodity price index in the
VAR seems to possibly solve the puzzle. This puzzle is present despite the inclusion of a
commodity prices index.

In figure (1.2) we see that in the entire sample of emerging countries, there was no sig-
nificant response of capital controls to an unanticipated one hundred basis point reduction
in the FFR. There is a very small tightening of controls six months after impact, but the

\(^{10}\)The probability that the response difference under the two scenarios is calculated by counting up the
total months that $\triangle IRF = IRF^*_i(5,h) - IRF^*_i(5,h)$ is positive and dividing it by the total number of $\triangle IRFs$. 

Figure 1.1. This figure shows impulse responses of US variables to a one hundred basis point reduction to the US Federal Funds Rate. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The FFR is measured in basis points while the rest of the variables in percents.

response is almost insignificant. The currency depreciates on impact, and overshoots for two months until about four months after impact. After the FFR stabilizes, around eight months after impact, the currency appreciates. However, these dynamics are not significant due to the width of the confidence bands.¹¹ The industrial production in emerging markets responds to the US shock by initially contracting, and then recovers quickly five months after impact.

So far nothing has been said about the effectiveness of controls in insulating these countries from international shocks. Miniane and Rogers [2007] try to address this issue

¹¹The exchange rate is denoted as local currency unit per US dollar. A positive movement is therefore considered a depreciation of the currency.
Figure 1.2. This figure shows impulse responses of twenty Emerging Market countries to a one hundred basis point reduction to the US Federal Funds Rate. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The controls index ranges from 0 to 1, with 1 being the most restrictive. The FFR is measured in basis points, while output and the exchange rate in percent.

by dividing their sample between countries with high capital controls and countries with low capital controls, and concluded that there are no differences in the impulse responses of the two groups. This chapter argues that the Miniane and Rogers [2007] exercise led them to face a problem inherent in any evaluation of economic policies, self-selection bias. It is crucial to recognize that policies are not exogenous random variables, e.g., a hospital is not a place that makes people sick – sick people go there on purpose. Previous studies have done their best to study the effects of endogenous policies, but they could not get a definitive answer since it is impossible to run controlled experiments on countries. That is why, in the same spirit as Sims and Zha [2006], Bernanke et al. [1997], and specifically Bachmann and
Sims [2011], this chapter’s contribution is to build counterfactual scenarios by constructing hypothetical sequences of FFR shocks to the system so as to leave the systematic response of a propagation variable (in this case the presence/lack of capital controls) zero at all horizons. A comparison of this hypothetical response with the actual impulse response would quantify how important capital controls are as an insulating mechanism against a foreign financial shock.

The dotted lines in figure (1.1) and figure (1.2) depict the counterfactual scenario when the response of controls is fixed at zero at all horizons. As expected, whether emerging countries impose capital controls or not in response to a FFR shock, does not have any effect on US variables. It also appears that controls do not provide any insulation for the panel of emerging countries, since there is no economic or statistical difference between the responses in the two scenarios. Table (1.1) presents some descriptive statistics of the bootstrap estimates of the difference between factual and counterfactual impulse response functions. Although the difference in the responses of output and the exchange rate are positive more than fifty percent of the time, the difference between the two scenarios is small in an economic sense.

This chapter argues that these results have to be discounted, since to estimate the panel VAR model, coefficients and intercepts for all of the countries in the sample are assumed to be the same. This implies that Brazil and the Philippines have the same policy functions in response to a shock to the system. In order to capture some of the inherent heterogeneity in the sample, countries are divided into more homogenous sub-groups. Panel VARs are estimated for each sub-group.\(^{12}\)

Some of the recent policy analysis on the management of capital inflows mentions that the efficiency of controls is limited in countries with highly developed and liquid financial markets (Ostry et al. 2011). Figure (1.3) shows the impulse responses of the countries

\(^{12}\)For presentation purposes, only responses of the Fed funds rate and emerging market’s variables are presented. The entire responses are included in Appendix 1.
TABLE 1.1

DESCRIPTIVE STATISTICS FOR DIFFERENCE IN RESPONSES, TWO YEARS AFTER FFR SHOCK

<table>
<thead>
<tr>
<th>Sample</th>
<th>Variable</th>
<th>Mean</th>
<th>Std Deviation</th>
<th>Prob. Diff. &gt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>Exchange Rate</td>
<td>−0.17</td>
<td>0.087</td>
<td>42.96%</td>
</tr>
<tr>
<td></td>
<td>Ind. Production</td>
<td>0.1</td>
<td>0.046</td>
<td>60.34%</td>
</tr>
<tr>
<td>Small market</td>
<td>Exchange Rate</td>
<td>1.61</td>
<td>0.77</td>
<td>80.41%</td>
</tr>
<tr>
<td></td>
<td>Ind. Production</td>
<td>0.04</td>
<td>0.3234</td>
<td>48.25%</td>
</tr>
<tr>
<td>Floaters</td>
<td>Exchange Rate</td>
<td>−0.09</td>
<td>0.1250</td>
<td>45.6%</td>
</tr>
<tr>
<td></td>
<td>Ind. Production</td>
<td>0.02</td>
<td>0.0348</td>
<td>52.5%</td>
</tr>
<tr>
<td>Managed</td>
<td>Exchange Rate</td>
<td>2.88</td>
<td>0.8802</td>
<td>89.05%</td>
</tr>
<tr>
<td></td>
<td>Ind. Production</td>
<td>1.40</td>
<td>0.4679</td>
<td>91.6%</td>
</tr>
</tbody>
</table>

NOTE: Table (1) presents the mean and standard deviation of the difference between impulse responses of the factual and counterfactual scenario, denoted in percentage points. Prob. diff. >0 is the probability that the difference between the scenarios is positive during a two year window.
Figure 1.3. This figure shows impulse responses of countries with a small financial market to a one hundred basis point reduction in the US Federal Funds Rate. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The controls index ranges from 0 to 1, with 1 being the most restrictive. The FFR is measured in basis points, while output and the exchange rate in percent. Countries: Argentina, Bolivia, Bulgaria, Indonesia, Turkey, and Romania.

in the sample with an average share of less than one half a percent of the size of the US stock market capitalization.\textsuperscript{13} Countries with a small market cap responded to the US FFR shock with a larger and significant increase in capital controls as compared to the full sample. Moreover, now there are more pronounced differences in target variables of interest. Specifically, the contraction of tradable output and the appreciation of the currency are higher when controls are fixed at zero (dotted line). Table (1.1) shows that the mean difference for the response of output between the two scenarios is still small. In contrast,

\textsuperscript{13}Market capitalization values were obtained from Standard & Poor’s Global Stock Markets Factbook 2010.
we see that the currency in the counterfactual (constrained) scenario appreciates an average of close to two percent more compared to the factual (unconstrained). The probability that this difference is positive in a period of two years is around 80 percent.

Mundell [1968] in his famous textbook International Economics indirectly talks about an impossible trinity: it is impossible to have a managed exchange rate, an open capital account, and monetary policy independence at the same time. Miniane and Rogers [2007] explain that differences in exchange rate policies can explain differences in the responses of target variables to foreign monetary disturbances. Flood and Rose [2010] also talk about how countries with floating exchange rates face higher cross-country synchronization of business cycles and higher volatility of macroeconomic variables. Finally, Towbin and Weber [2011] find that floating exchange rates do not insulate output from external shocks.

In order to extend these previous analysis by exploring the role of controls in countries with a managed exchange rate regime, the sample is divided into countries with policies that manage their currencies and countries that freely float their currency. Figure (1.4) shows the impulse responses of floaters and figure (1.5) shows the responses of managed exchange rate regimes.

In comparison to the previous groups, floaters respond to the FFR shock by liberalizing their capital account. The response of controls is not statistically significant, and there is no economic or statistical difference between the responses for the currency and foreign industrial production under the factual and counterfactual policy scenarios. Table (1.1) shows that liberalization of controls is actually harmful for floaters, since it causes a marked contraction on industrial production accompanied by an appreciation of the currency.

Countries with an active management of the exchange rate respond most aggressively to the FFR shock by increasing controls by as much as a 0.1 increase in the Schindler [2008] index. Shutting off the response of capital controls to an external shock considerably

\[14\] Countries where divided into these two groups by using IMF’s 2009 de facto exchange rate regime classification.
Figure 1.4. This figure shows impulse responses of countries with a freely floating exchange rate regime to a one hundred basis point reduction in the US Federal Funds Rate. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The controls index ranges from 0 to 1, with 1 being the most restrictive. The FFR is measured in basis points, while output and the exchange rate in percents. Countries: Brazil, Chile, Czech Republic, Hungary, Korea, Mexico, Philippines, South Africa, and Turkey.

...
Figure 1.5. This figure shows impulse responses of countries with a managed exchange rate regime to a one hundred basis point reduction in the US Federal Funds Rate. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The controls index ranges from 0 to 1, with 1 being the most restrictive. The FFR is measured in basis points, while output and the exchange rate in percents. Countries: Argentina, Bolivia, China, India, and Malaysia.

Chapter adds to their analysis and shows that the systematic effect of capital controls is strongest under a managed exchange rate regime.

Carlstrom and Fuerst [2006] discuss the merits of the counterfactual approach developed by Bernanke et al. [1997] and applied in this chapter. Based on the Lucas [1976] critique, there is the possibility that if the process followed by the policy of implementing capital controls differed from the historical pattern, other equations of the system might have behaved differently as well. There is some evidence of this in the results of this chapter, since the responses of US CPI and the commodity price index appear to slightly differ
across regimes (figure A.3). This could raise the question of whether the VAR estimated in this chapter is stable under both factual and counterfactual scenarios. To address this issue, chapter 2 develops a fully specified DSGE model that captures the endogeneity of capital controls and helps to validate the empirical results presented in this chapter.

1.4 Conclusion

This chapter answers the question of whether or not capital controls are a sensible policy response in order to insulate emerging economies from international monetary shocks. It does so by highlighting the importance of the systematic effect of this policy response on target variables prone to financial Dutch disease. The chapter finds endogenous capital controls to be statistically and economically significant in protecting the domestic tradable industry from foreign interest-rate shocks for countries with an actively managed exchange rate regime.

While there is no denying that access to foreign financing benefits emerging economies by allowing them to smooth consumption inter-temporally and finance productive investment, it is not possible to ignore the potential detrimental effects of large and volatile temporary capital inflows in these economies. By providing a new way to analyze the merits of capital controls, this chapter sheds some light on the importance for policymakers of having capital inflow controls in their policy toolkit.
CHAPTER 2

CAPITAL CONTROLS AS A SECOND BEST POLICY

2.1 Introduction

Due to the ongoing global financial economic crisis, capital controls on inflows are again back in fashion. Having recovered their appetite for risk, investors have been increasingly shifting their portfolios towards emerging markets during the last two years figure (2.1). Furthermore, due to strong fundamentals in these economies and a weak U.S. dollar, domestic currencies in emerging markets have considerably appreciated, maintaining (and in some cases increasing) interest rate differentials with developed markets. Policy makers in these countries, trying to maintain competitiveness on their exports while at the same time preventing asset inflation, have resorted to the use of one of the most controversial monetary policy tools: controls on the capital account. Capital controls on inflows can be considered as any type of restriction that governments impose to the flow of funds from foreign countries into the home country. That is, for example, if an individual in the home country borrows money from abroad, the agent would have to pay a twenty percent tax on the amount he/she borrowed. These type of restrictions vary across countries from a small tax to outright prohibition. Magud and Reinhart [2006] justify the use of these monetary instruments by governments based in the following arguments: fear of currency appreciation, fear of short term and volatile inflows, fear of large inflows, and the fear of losing monetary autonomy.

Despite the renewed interest in capital controls, there is not a standard theoretical
method to study the effectiveness or the welfare implications of these policy instruments.\footnote{Dooley [1995], and Magud and Reinhart [2006] provide extensive surveys of the literature.} Both empirical and theoretical papers have failed to provide conclusive evidence in favor or against the implementation of controls. Despite the lack of consensus, some papers that have found a positive effect of short term controls on inflows. For example, Edwards [2007] studies whether restrictions on the capital account can effectively reduce the probability of facing a large contraction on international capital flows. Edwards finds that the marginal effect of having a more open capital account to be positive and statistically significant, but small in magnitude. According to Ostry et al. [2011] developing countries that had some type of restrictions on the capital account during the 2007-08 financial crisis ended up with significantly lower levels of debt. This allowed them to have less of a credit boom (and the consequences described above) during good times, and also helped these markets to avoid a significant bust during bad times.

This chapter goes one step forward, and discuss the possibility of capital controls as
a second best policy in the presence of a market imperfection. Following Romer [1986] and in the same spirit of Lama and Medina [2010], a learning-by-doing externality is introduced in the tradable sector of a small open economy (SOE) model. Firms in this sector take this externality as given in their production process, whereas a central planner would internalize this spillover. This feature provides a propagation mechanism where a reallocation of resources away from the tradable sector reduces its future productivity. Finally, data is generated from the model under different degrees of capital controls, and responses of target variables to a foreign interest shock are calculated.

As in Reinhart and Smith [2002] and Kitano [2011], capital controls on inflows are modeled as taxes on foreign debt interest-rate payments. The model shows that at the optimal rate, capital controls on inflows provide nearly a one percent welfare gain compared to a regime with no capital controls. At the same time, the theoretical model shows that a regime imposing capital controls in response to a sudden reduction in the world interest rate (an increase in net inflows) can prevent a contraction in the tradable sector and reduce the appreciation of the real exchange rate in the short-run as compared to regimes with no capital controls. Finally, under a regime with capital controls, resources will be directed toward the most productive sector in the economy, effectively increasing tradable output and bringing the policy close to the planner solution. Both of these results are in line with the empirical results.

Finally, in order to study the validity of the empirical approach described in chapter 1, data is simulated (both in a regime with and without capital controls) from a two sector SOE dynamic stochastic general equilibrium (DSGE) model prone to financial Dutch disease type of effects. Specifically, the purpose of the model is to confront issues about the validity of the empirical approach discussed in the last chapter that can be raised from the Lucas [1976] critique.  

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2 In line with Bianchi [2011] and Jeanne and Korinek [2010].

3 Asking such a counterfactual question raises a host of issues, if the process followed by the policy of
The remainder of the chapter is organized as follows. The next section presents the theoretical model. Section 2.3 presents the theoretical results. Section 2.4 concludes.

2.2 The Model

The small-open-economy model consists of a representative household, two industries (tradable and nontradable), and a benevolent government. It extends Arellano [2009] by including a learning-by-doing externality in the tradable sector and households are allowed to have restricted access to international credit markets. The learning-by-doing externality in the tradable sector follows directly from Cooper and Johri [2002] and is incorporated into the model along the lines of Lama and Medina [2010]. Firms in the tradable sector do not take into account the learning-by-doing process in their production process. Since the planner solution internalizes this process in the production of tradables, this sector will face increasing returns to scale on the aggregate level, while constant returns to scale technology at the firm level (Romer 1986). This externality can produce an inefficient allocation of resources during an episode of sudden capital inflows, making this economy prone to experiencing financial Dutch disease effects due to under-production in the tradable sector. Following Reinhart and Smith [2002] and Kitano [2011], the policy intervention tool to address the learning-by-doing externality will be a tax on foreign-debt interest rate payments.

2.2.1 Households

Households in the economy maximize their expected lifetime utility and have preferences over consumption and leisure:

\[ U = E_0 \sum_{t=0}^{\infty} B^t \left( c_t^\omega (1-h_t)^{1-\omega} \right)^{1-\gamma} - 1. \]  

(2.2.1)

implementing capital controls differed from the historical pattern, other equations of the system might have behaved differently as well. For this issue, see Sims [1986].
\( \beta \) is a subjective discount factor. Household consumption, \( c_t \), consists of nontradable consumption \( c_{N,t} \), and tradable consumption, \( c_{T,t} \), and has a constant elasticity of substitution form:

\[
    c_t = \left[ \phi (c_{T,t})^{-\mu} + (1 - \phi) (c_{N,t})^{-\mu} \right]^{-\frac{1}{\mu}}.
\]

Labor, \( h_t \), is allowed to move freely between the two sectors \( (h_t = h_T + h_N) \), making the wage households receive the same in both sectors.

The flow budget constraint, in tradable good terms, is as follows:

\[ B_t = \left(1 + r^d_t \right) B_{t-1} - w_t h_t - r^k_t k_t - r^i_t + p_{N,t} c_{N,t} + c_{T,t} + i_t + \frac{\kappa}{2} \left( \frac{B_t - \bar{B}}{\bar{B}} \right)^2. \] (2.2.2)

\( B_t \) denotes the household’s foreign debt position, \( p_{N,t} \) is the relative price of nontradables in terms of tradables (equivalent to the real exchange rate in this model), \( k_t \) is capital, \( i_t \) is investment, \( 4 \frac{\kappa}{2} \left( \frac{B_t - \bar{B}}{\bar{B}} \right)^2 \) is the cost of adjusting the country’s foreign debt position, \( T_i \) denotes government lump sum transfers, and \( \Pi^f_i \) are dividends received from firms. The interest rate at which the households can borrow from international markets is given by:

\[
    r^d_t = (1 + \tau (B_t)) \exp(-\eta_t) r^*.
\]

\( \tau (B_t) \) denotes taxes on foreign debt interest rate payments and, following Kitano [2011], have the following functional form:

\[
    \tau (B_t) = \frac{\tau}{2} \left( \frac{B_t - \bar{B}}{\bar{B}} \right)^2,
\]

where \( \tau \) is a parameter representing the intensity of the tax, and \( \bar{B} \) denotes the economy’s steady state foreign debt position. Foreign debt interest rate payments are based on the world interest rate \( r^* \), which is exogenously determined, and subject to a random distur-

\[ ^4 \text{Investment is in terms of tradables only.} \]
bance term denoted by $\eta_t$. Finally, $r_t^k$ is the rental rate of capital and $w_t$ is the real wage.

The process of capital accumulation is given by:

$$k_{t+1} = (1 - \delta) k_t + i_t - \frac{\phi}{2} \left( \frac{k_{t+1} - k_t}{k_t} \right)^2,$$

where $\frac{\phi}{2} \left( \frac{k_{t+1} - k_t}{k_t} \right)^2$ represents a capital adjustment cost.

Optimality conditions for consumption, labor, foreign debt, and capital are:

$$1 - \frac{\varphi}{\varphi} \left( \frac{c_{N,t}}{c_{T,t}} \right)^{-(\mu + 1)} = p_{N,t},$$

$$\omega \frac{1 - h_t}{1 - \omega} = \frac{p_{N,t}}{w_t},$$

$$-\lambda_t \left( 1 - \kappa \left( \frac{B_t - \bar{B}}{\bar{B}} \right) \right) + \beta \left( 1 + \exp(-\eta_t) r^* (1 + \tau (B_t) + \tau' (B_t) B_t) \right) E_t [\lambda_{t+1}] = 0,$$

and

$$-\lambda_t [1 + \phi (k_{t+1} - k_t)] + \beta E_t \left[ \lambda_{t+1} \left( 1 + r_t^k - \delta + \phi (k_{t+2} - k_t + 1) \right) \right] = 0.$$

The marginal utility of consumption is denoted by:

$$\lambda_t = \omega c_t^{\omega(1-\gamma)-1} (1 - h_t)^{(1-\omega)(1-\gamma)}.$$

2.2.2 Firms

There are two sectors in this economy: tradable and nontradable. Firms in both sectors are competitive. Following Lama and Medina 2010, the production of tradables in this
economy is subject to a learning by doing externality. Firms in this sector choose labor and capital to maximize profits, and produce output according to a Cobb-Douglas:

\[ Y_{T,t} = A_{T,t} l_t^\alpha k_t h_{T,t}^{1-\alpha}. \]  

\[ (2.2.8) \]

\[ A_{T,t}, k_t, \text{ and } h_{T,t} \] denote an exogenous productivity shock, capital, and labor, respectively with both \( \alpha \) and \( \xi \) between zero and one. Average organizational capital in the production of tradables is denotes by \( l_t \), and is specified as in Cooper and Johri [2002]:

\[ l_{t+1} = l_t^\zeta Y_{T,t}^\psi, \]  

\[ (2.2.9) \]

with \( \zeta + \psi = 1 \). The rationale behind this learning by doing mechanism is that production in the tradable sector increases the experience of workers, and this further improves productivity in the future. As in Romer [1986], individual firms assume that they cannot affect the aggregate stock of organizational capital, so they take \( l_t \) as given. This makes firms infer that they are facing a constant returns to scale technology, making the problem of the firm quite standard. On the other hand, a social planner would observe that \( 2.2.8 \) is an increasing return to scale technology at the aggregate level, therefore considering the effect of the learning by doing mechanism in production via the experience gained. One can think of this externality as a moving cost from the tradable to the nontradable sector, and if this cost is not internalized by firms, it will have considerable implications for the economy’s aggregate welfare levels.

Firms in the nontradable sector produce output with a simple technology that is linear in labor and is described by:

\[ Y_{N,t} = A_{N,t} h_{N,t}, \]

where \( A_{N,t} \) is a sector specific exogenous productivity shock. Labor is perfectly mobile across sectors. Firms in the two sectors obtain their inputs for production from the house-
hold, so that in equilibrium the wage rate equals the marginal productivity of labor and the rate of return on capital equals the marginal productivity of capital. Since in equilibrium marginal productivity of labor across sectors are equalized, we get

\[ w_t = (1 - \alpha) \frac{Y_{T,t}}{h_{T,t}} = p_{N,t} \frac{Y_{N,t}}{h_{N,t}}. \]  

Finally, the optimality condition for capital is

\[ r^k_t = \alpha \frac{Y_{T,t}}{k_{T,t}}. \]  

2.2.3 Government

For simplicity, it is assumed that the government runs a balanced budget. Its revenue, the tax on interest payments made by the banks, is rebated back to households as lump sum transfers,

\[ T_t = \tau(B_t) \exp(-\eta_t) r^* B_t. \]

2.2.4 Equilibrium

The market clearing conditions for labor and the two production sectors are:

\[ h_t = h_{T,t} + h_{N,t}. \]

\[ Y_{N,t} = c_{N,t}. \]

\[ Y_{T,t} = c_{T,t} + i_t. \]

The competitive equilibrium of this model is defined as the state contingent sequences
of allocations and prices

\[
\left\{ c_{N,t}, c_{T,t}, k_{t+1}, h_t, h_{N,t}, h_{T,t}, p_{N,t}, B_t, r_t^k, w_t \right\}_{t=0}^{\infty},
\]

such that 1) households maximize expected utility subject to their budget and time constraints taking prices as given, 2) firms maximize profits subject to their technology taking input prices as given, and 3) markets clear.

2.2.5 Parameterization

The parameters used to solve and simulate the model are listed in Table (2.1). The time frequency is supposed to be quarterly. All of the parameters with the exception of tradable production technology are obtained from similar studies of small open economies and are typical parameters used in the real business cycle literature. The parameters for the tradable production are obtained from Cooper and Johri [2002]. Cooper and Johri [2002] estimate parameters for equations 2.2.8 and 2.2.9 simultaneously using 2-digit manufacturing data for the US. In order to fully identify the parameters of the system, some restrictions have to be imposed. For the purpose of these chapter, the parameters used correspond to their estimation assuming increasing returns to scale in the production function. It is worth noting that from all their identification methods, assuming increasing returns to scale is the only one that produces all estimates of production parameters to be significantly different from zero.

The parameter for the foreign debt adjustment cost is the smallest possible value close to zero, so that any effect on domestic interest rates is primarily driven by debt levels and capital controls.\(^5\) The model is solved numerically by taking log-linear approximations of the equilibrium conditions around the steady state.

\(^5\)This parameter cannot be set equal to zero, since bond holding costs are necessary to ensure bond holdings do not display a unit root Schmitt-Grohe and Uribe [2003]
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign interest rate</td>
<td>( r^* )</td>
<td>0.02</td>
<td>Standard</td>
</tr>
<tr>
<td>Share of tradables in consumption</td>
<td>( \varphi )</td>
<td>0.45</td>
<td>Uribe and Yue [2006]</td>
</tr>
<tr>
<td>Subjective Discount Factor</td>
<td>( \beta )</td>
<td>0.98</td>
<td></td>
</tr>
<tr>
<td>Inv. elast. of intertemp. sub.</td>
<td>( \gamma )</td>
<td>2</td>
<td>Acosta et al. [2009]</td>
</tr>
<tr>
<td>Elast. of sub., consumption</td>
<td>( \omega )</td>
<td>0.22</td>
<td>Acosta et al. [2009]</td>
</tr>
<tr>
<td>Elast. of sub., tradables</td>
<td>( \mu )</td>
<td>0.316</td>
<td>Acosta et al. [2009]</td>
</tr>
<tr>
<td>Foreign debt adjustment cost</td>
<td>( \kappa )</td>
<td>0.0003</td>
<td>Author</td>
</tr>
<tr>
<td>Parameter for investment adj. cost</td>
<td>( \phi )</td>
<td>2.2</td>
<td>Acosta et al. [2009]</td>
</tr>
<tr>
<td>Capital share</td>
<td>( \alpha )</td>
<td>0.33</td>
<td>Cooper and Johri [2002]</td>
</tr>
<tr>
<td>Labor share, tradable sector</td>
<td>( \Phi )</td>
<td>0.67</td>
<td>Cooper and Johri [2002]</td>
</tr>
<tr>
<td>Learning rate</td>
<td>( \xi )</td>
<td>0.26</td>
<td>Cooper and Johri [2002]</td>
</tr>
<tr>
<td>Output elasticity, org. capital</td>
<td>( \psi )</td>
<td>0.5</td>
<td>Cooper and Johri [2002]</td>
</tr>
<tr>
<td>Depreciation rate, org. capital</td>
<td>( \zeta )</td>
<td>0.5</td>
<td>Cooper and Johri [2002]</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>( \delta )</td>
<td>0.025</td>
<td>Lama and Medina [2010]</td>
</tr>
</tbody>
</table>
This chapter assumes that the processes for the shocks affecting the economy are:

\[
\ln(A_{T,t}) = 0.95 \ln(A_{T,t-1}) + \varepsilon_{T,t}, \varepsilon_{T,t} \sim N \left(0, \sigma_T^2\right), \sigma_T = 0.007, \tag{2.2.12}
\]

\[
\ln(A_{N,t}) = 0.95 \ln(A_{N,t-1}) + \varepsilon_{N,t}, \varepsilon_{N,t} \sim N \left(0, \sigma_N^2\right), \sigma_N = 0.0035, \tag{2.2.13}
\]

and

\[
\eta_t = 0.98 \eta_{t-1} + \varepsilon_{\eta,t}, \varepsilon_{\eta,t} \sim N \left(0, \sigma_\eta^2\right), \sigma_\eta = 0.01. \tag{2.2.14}
\]

The persistence parameters and the standard deviations for the technology in both sectors are obtained from Lartey [2008]. The parameters for the foreign interest rate are estimated using the US three-month treasury bill rate.

2.3 Results

2.3.1 Welfare

This section follows closely from Schmitt-Grohe and Uribe [2004]. This chapter measures the welfare gains in terms of the fraction of consumption required for households under a regime with no capital controls to be as well off as households under a regime with capital controls. I calculate this welfare value under different degrees of capital controls, represented by \(\tau\) in the model, and then calculate the tax rate that maximizes household’s expected lifetime utility. The regime with no capital controls (\(\tau = 0\)) will be denoted by B, and will be considered the benchmark model. On the other hand, the regime imposing capital controls (\(\tau > 0\)) will be denoted by C. The conditional welfare for each regime is
represented by

\[ V^B_0 = E_0 \sum_{t=0}^{\infty} \beta^t U \left( c^B_t, h^B_t \right), \]  
(2.3.1)

and

\[ V^C_0 = E_0 \sum_{t=0}^{\infty} \beta^t U \left( c^C_t, h^C_t \right), \]  
(2.3.2)

where \( c^i_t \) and \( h^i_t \) represent the contingent plans for consumption and hours under regime \( i \), with \( i = B, C \). Let \( \Psi^{lbd} \) denote the fraction of regime \( C \)'s consumption required in order for households in regime \( B \) to have the same welfare levels as households in regime \( C \). Therefore, welfare is redefined as:

\[ V^C_0 = E_0 \sum_{t=0}^{\infty} \beta^t U \left( \left(1 + \Psi^{lbd}\right) c^B_t, h^B_t \right). \]

Given the functional form of utility represented in equation (2.2.1), \( \Psi^{lbd} \) can be written as

\[ \Psi^{lbd} = \left\{ 1 - \left[ \frac{(1 - \gamma) V^B_0 + (1 - \Theta_t)^{-1}}{(1 - \gamma) V^C_0 + (1 - \Theta_t)^{-1}} \right]^{1/(1-\gamma)} \right\}. \]  
(2.3.3)

The welfare gain is computed through a second order approximation of equation (2.3.3). Figure (2.2) shows the welfare gain described in equation (2.3.3) under different values of \( \tau \). It can be seen from this graph that, in an economy with a learning by doing externality (dashed line), welfare is an increasing function in the intensity of capital controls up to \( \tau = 0.03^6 \), meaning that 0.7 percent of household consumption should be transferred to a regime with no capital controls in order for households in that regime to have the same expected level of utility as households in a regime with capital controls in place. As will be explained in the next section, a regime that addresses the learning by doing externality by restricting households from financing tradable consumption with foreign borrowing, will successfully prevent resources from moving from the most productive sector in the

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6 The tax is equal to 2.75%.
Figure 2.2. This figure shows welfare gains from capital controls in terms of the fraction of consumption required for households under a regime with no capital controls to be as well off as households under a regime with capital controls. The horizontal axis measures the intensity of capital controls through the parameter $\tau$. The vertical axis measures the welfare benefit (in terms of consumption) of different degrees of capital controls. The dotted line is the model without learning-by-doing. Dashed line is the model in which learning-by-doing is not internalized by firms. The solid and dash-dot line are the same scenarios as before, but with a lower learning rate.

economy, and thus increase an agent’s welfare. That is, when there is a learning-by-doing externality in this economy, restricting foreign borrowing can be considered close to a second-best policy.

The dotted line represents the welfare gain of capital controls under the model where the learning by doing is internalized by firms. As initially discussed in Uribe and Yue [2006] and expanded in Kitano [2011], capital controls are still an optimal response of a benevolent government, since the adjustment costs of foreign debt could be interpreted as an inefficiency of financial intermediation. Regardless, the welfare gain of capital controls is twice as big when the learning-by-doing is external to the firms as compared when it is internalized.
2.3.2 Model Dynamics

Figures 2.3 and 2.4 present impulse response functions of the model’s variables to a two standard deviation reduction in the world interest rate, $r^*$, under four scenarios. The dashed line represents the benchmark case when there are no capital controls in place and an external learning-by-doing externality in the tradable sector. A negative two standard deviation shock to the world interest rate increases net foreign borrowing, which in turn leads to higher consumption of both tradables and nontradables. The higher demand for nontradables increases wages and the relative price of nontradables (in this model the real exchange rate), causing labor to reallocate from the tradable to the nontradable sector. This reallocation of labor causes a contraction of output in the tradable sector. From equation (2.2.8) it can be seen that the initial contraction in the tradable sector will be exacerbated by a reduction in the level of organizational capital. The model does a good job of capturing Dutch disease effects in response to the increased availability of foreign financed tradable goods. Thus, it provides a role for government intervention since these effects negatively affect agents’ welfare.

The solid line represents the case where the optimal tax on foreign interest rate payments (calculated in the last section) is in place and there is a learning-by-doing externality. The tax makes foreign debt more expensive. Therefore, the amount of capital inflows is smaller compared to the case where there are no controls. With lower availability of foreign financed tradable goods, the appreciation of relative nontradables prices (i.e. the real exchange rate) is smaller, the contraction of the tradable sector is smaller, and the reallocation of labor to the nontradable sector is reduced as well.

Next, this chapter takes a look at the case where firms in the tradable sector internalize the learning-by-doing externality. The dotted line denotes the case when firms internalize the learning-by-doing process, and there are no capital controls. Since now firms take into

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7 For the equilibrium conditions when for this scenario, please see the appendix of this chapter.
account the externality, the contraction of the tradable sector is smaller as compared to the benchmark case. The domestic interest rate is also lower under this scenario, therefore net foreign debt and investment are larger as compared to the benchmark case. At the same time, the higher availability of domestically produced tradable goods increases the demand and relative price of non-tradables, with an appreciation almost equivalent to the regime with the externality and capital controls. Finally, dash-dot line represents a scenario where the learning-by-doing process is internalized and capital controls are in effect. The differences between the previous scenario are smaller as compared when the externality is present in the economy. The biggest difference is in the response of net foreign debt, where by reducing net inflows, capital controls reduce the waste of resources due to the adjustment costs of debt intermediation.

In conclusion, these results provide some theoretical support for the implementation of capital controls on inflows as a policy tool to protect the tradable sector. The benefits of controls are higher in the case of an economy with an externality in its tradable sector. Furthermore, these theoretical results qualitatively match the empirical results from chapter 1, showing that capital controls can be effective in insulating the real exchange rate and the tradable sector from foreign interest rate shocks.
Figure 2.3. This figure shows theoretical impulse responses to a two standard deviation reduction to the exogenous world’s interest rate. The dashed lines are the responses of a regime with no capital controls and a learning-by-doing externality. The solid lines represent the response of a regime with the optimal capital control intensity parameter, $\tau = .03$, and a learning-by-doing externality. Dotted lines represent impulse responses under a regime with no capital controls and no learning-by-doing. Finally the dash-dot line is a regime with capital controls and no learning-by-doing.
Figure 2.4. This figure shows theoretical impulse responses to a two standard deviation reduction to the exogenous world’s interest rate. The dashed lines are the responses of a regime with no capital controls and a learning-by-doing externality. The solid lines represent the response of a regime with the optimal capital control intensity parameter, $\tau = .03$, and a learning-by-doing externality. Dotted lines represent impulse responses under a regime with no capital controls and no learning-by-doing. Finally the dash-dot line is a regime with capital controls and no learning-by-doing.
2.4 Sensitivity Analysis

This section examines the model’s dynamics for alternative values of certain key parameters. While most of the parameters used in this chapter come directly from a large and standard strand of literature on small open economy models, they can be easily estimated from observable data. There are some parameters used in this exercise, that were obtained from studies that extrapolated their value rather than directly estimating them. This is the case of the parameters for the learning-by-doing mechanism. Estimating these parameters is impossible since these data is not observable to the researcher.

This section analyzes the sensitivity of the results to the share of organizational capital in the production function of tradables, the learning rate parameter $\xi$. This parameter is obtained from Cooper and Johri [2002], and corresponds to the identification scheme of assuming that the production function exhibits constant returns to scale. The value of $\xi$ is changed from 0.26 to 0.08. To be consistent with the analysis presented in this chapter, the aggregate production function of tradables will still exhibit increasing returns to scale, that is $\alpha + (1 - \alpha) + \xi > 1$. Figure 2.2 shows the welfare benefit under the lower learning rate in the tradable sector (solid line). Even though the welfare benefit of controls is smaller as the benchmark specification, still capital controls are welfare improving. As expected, changing the learning rate does not have any effect on the welfare of the internalized model, since both the dotted and dash-dot line overlay each other. Furthermore, controls are clearly a second-best policy in addressing this externality, since the welfare gain of controls is still considerably higher as compared to the regime with controls and learning-by-doing is not internalized by firms. As it is evident from figures 2.5 and 2.6, capital controls with an externality in the tradable sector (solid line) bring the economy dynamics closer to the planner’s solution (dotted lines). This is specially true in the dynamics of the tradable sector, since the responses are almost identical under the two scenarios. Regardless, with a smaller learning process in the tradable sector, the differences in the responses across the four scenarios are more muted as compared to the benchmark analysis.
Figure 2.5. This figure shows theoretical impulse responses to a two standard deviation reduction to the exogenous world’s interest rate. The learning rate, $\xi$, is equal to 0.08. The dashed lines are the responses of a regime with no capital controls and a learning-by-doing externality. The solid lines represents the response of a regime with the optimal capital control intensity parameter, $\tau = .03$, and a learning-by-doing externality. Dotted lines represent impulse responses under a regime with no capital controls and no learning-by-doing. Finally the dash-dot line is a regime with capital controls and no learning-by-doing.
Figure 2.6. This figure shows theoretical impulse responses to a two standard deviation reduction to the exogenous world’s interest rate. The learning rate, $\xi$, is equal to 0.08. The dashed lines are the responses of a regime with no capital controls and a learning-by-doing externality. The solid lines represents the response of a regime with the optimal capital control intensity parameter, $\tau = .03$, and a learning-by-doing externality. Dotted lines represent impulse responses under a regime with no capital controls and no learning-by-doing.

Finally the dash-dot line is a regime with capital controls and no learning-by-doing.
2.5 Conclusion

This chapter developed a two sector small open economy model with a leaning-by-doing externality in the tradable sector. In this model, capital controls are the endogenous response of a benevolent government to a foreign interest rate shock. Theoretical results are consistent with empirical results from the previous chapter.

While there is no denying that access to foreign financing benefits emerging economies by allowing them to smooth consumption inter-temporally and finance productive investment, it is not possible to ignore the potential detrimental effects of large and volatile temporary capital inflows in these economies. By providing a new way to analyze the merits of capital controls, this section sheds some light on the importance for policymakers of having controls in their policy toolkit.

Going forward the model will be extended to include occasionally binding borrowing constraints to test how effective are capital controls in reducing uncertainty in the economy. The extension will shown that controls induce households to acquire precautionary savings in case of sudden stops. In this framework capital controls will be welfare improving.
CHAPTER 3
EFFECTIVENESS OF CAPITAL CONTROLS ON OUTFLOWS

3.1 Introduction

Financial globalization paired with the evident volatility of capital flows has sparked renewed interest in capital account restrictions on both inflows and outflows. The literature on the effectiveness of inflow controls is extensive, and recent studies have attempted to determine under which circumstances restrictions should be used to deal with domestic and external imbalances during excessive surges. Their results suggest that controls on inflows are often successful at reducing appreciation pressures, allowing for more independent monetary policy and tilting the composition of flows toward longer term investments. A relaxation of outflow-controls can potentially serve a similar purpose. A tightening, on the other hand, has been used during episodes of capital flight and currency crisis. By countering speculative flows, authorities aim to stabilize the exchange rate, prevent the depletion of foreign exchange reserves and increase policy space.

Outflow-controls have been applied frequently, and descriptive evidence suggests that controls may have been effective in some cases (Spain 1992, Thailand 1998, Brazil 1999, Argentina 2001, Iceland 2008, Ukraine 2008). Empirical work on the effectiveness of outflow-controls comprises mainly case studies which tend to find only limited evidence for

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1 Co-authored with Sarah Sanya, Christian Saborowski and Hans Weisfeld

2 To the extent that capital account-related measures or prudential regulations mitigate the likelihood of excessive inflow surges, and lower vulnerabilities associated with these, restrictions and regulations affecting the international flow of capital could thus be associated with greater crisis resilience.

3 See Magud and Reinhart [2006], Dooley [1995] and Ostry et al. [2011]

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the effectiveness of outflow-controls in reducing net outflows and allowing for increased monetary policy autonomy (Magud and Reinhart 2006); at best, outflow-controls appear to lead to relatively short lived improvements (Ariyoshi and Kirilenko 2000). A widely accepted exception to this rule is the case of Malaysia which tightened outflow-controls in September 1998. Comparing the timing of the tightening with the recovery paths of key macroeconomic variables is at least suggestive of a close association between the two, if not of a causal relationship: immediately after controls were tightened, reserves recovered strongly – returning to pre-crisis levels – and the exchange rate stabilized, which allowed interest rates to fall without further increasing net outflows Figure (3.1). In more recent years, the Icelandic case received a fair amount of attention. In spite of concerns over the longer term costs of restricting the capital account, the short term goal of exchange rate stabilization appears to have been achieved Figure (3.2).\footnote{Exchange rate stabilized shortly after controls were imposed, while the control tightening also allowed interest rates to fall without a significant further drain on reserves.}

Few studies have analyzed econometrically whether or not the effectiveness of outflow-controls is confined to single country cases, and what the preconditions are for controls to be effective. Miniane and Rogers [2007] is one of only two studies that provide econometric analysis of the effectiveness of outflow-controls. They find capital controls to be ineffective in insulating countries from foreign monetary policy shocks. However, this study does not distinguish between inflow and outflow-controls. Schindler et al. [2009], the second study, focuses on outflow-controls and finds that they are more effective in advanced economies than in other countries, thanks possibly to advanced countries’ better institutional and regulatory quality. A weakness of Schindler et al. [2009] is its treatment of capital controls as exogenous variables, since controls tend to be introduced in response to capital flows they are likely endogenous.

This chapter analyzes econometrically whether outflow restrictions can be effective tools in managing capital flows and establishes preconditions that determine their suc-

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\footnote{Exchange rate stabilized shortly after controls were imposed, while the control tightening also allowed interest rates to fall without a significant further drain on reserves.}
Figure 3.1. Effectiveness of outflow-controls in Malaysia. In the first figure of the panel, REER stands for real effective exchange rate. It is measured in the left axis, any positive movement means an appreciation of the currency. The blue line is the nominal exchange rate, measured in local currency per US dollar. It is measured in the right axis, any positive movement means a depreciation. The second figure in the panel shows total reserves excluding gold, measured in millions of US dollars. The last figure of the panel shows the interest rate for a three month treasury bill. In all the figures, the vertical line in October 1998 is when capital outflow-controls were implemented.
Figure 3.2. Effectiveness of outflow-controls in Iceland. In the first figure of the panel, REER stands for real effective exchange rate. It is measured in the left axis, any positive movement means an appreciation of the currency. The blue line is the nominal exchange rate, measured in local currency per US dollar. It is measured in the right axis, any positive movement means a depreciation. The second figure in the panel shows total reserves excluding gold, measured in millions of US dollars. The last figure of the panel shows the interest rate for a three month treasury bill and money market rate. In all the figures, the vertical line in November 2010 is when capital outflow-controls were implemented.
cess. The guiding question in this chapter is whether an unexpected tightening of outflow-controls could reduce capital outflows and the risk of a balance of payments crisis. The analysis provides an econometric assessment of this question in a multi-country setting. It takes explicit account of the fact that a potential control tightening cannot be treated as an exogenous random variable: as in Miniane and Rogers [2007] a panel vector autoregressive (PVAR) approach is chosen to address the potential endogeneity between flows and controls. We identify the impulse responses of capital flows and other macroeconomic variables to a control tightening through a recursive ordering. This is the identification strategy for the exogenous variation of capital controls. Furthermore, in order to determine whether preconditions matter for the effectiveness of controls, and following Towbin and Weber [2011], we add interaction terms to the structural PVAR to evaluate impulse response functions at different percentiles of the distribution of indicator variables such as institutional quality, macroeconomic fundamentals and the tightness of pre-existing controls.

The results show outflow-controls can be an effective policy tool to manage capital flows under certain conditions: adding interaction terms to our structural PVAR model to evaluate impulse response functions at different parts of the distribution of indicator variables for institutional quality, macroeconomic fundamentals, capital market size and activity as well as the level of pre-existing controls. We find that an unexpected tightening of outflow-controls generally reduces gross capital outflows. However, the tightening also leads to a contraction in gross inflows – driven mainly by non-resident investors – which, in the basic PVAR specification, is larger in size than the contraction in outflows. Therefore, the overall result is a fall in net flows. Using as the yardstick of effectiveness the impact of changes in outflow-controls on net flows, we thus find that an unexpected tightening outflow-controls can be an effective tool to mitigate capital flight—excessive capital outflows and or the collapse of inflows—only in countries with strong macroeconomic and institutional settings. Similarly, controls are effective at increasing net inflows in countries with a basic level of pre-existing controls, suggesting that prior experience with
implementing controls matters. Finally, a variance decomposition of net inflows show that innovations to capital controls are very important in determining changes in net inflows, explaining as much as twenty percent of their variation.

The remainder of this chapter is organized as follows: Section 3.2 presents the data and the empirical approach taken in this study. Section 3.3 discusses the estimation results, and Section 3.4 concludes.

### 3.2 Data and Empirical Approach

The data used in the econometric analysis are from 31 predominantly emerging market economies.\(^5\) The sample was chosen based on data availability. In particular, quarterly data for the period 1995Q1-2010Q4 was required\(^6\). The sample has been selected on the basis of data availability at the required frequencies. An important criterion has been the start of the data set before the Asian financial crisis during which a variety of emerging market economies implemented capital outflow-controls in order to prevent capital flight. We excluded countries with capital control indices that were zero throughout the sample period. We measure outflow-controls using the index provided by Schindler [2008]. The index uses publicly available information from the IMF’s Annual Report on Exchange Arrangements and Exchange Restriction (AREAER). It exploits the IMF’s post 1996 disaggregated reporting of different categories of capital transactions. The index is a continuous variable ranging from zero to 1. As the index is only available at annual frequency, the annual value was assigned for each quarter in that year. This de jure index is the only measure

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\(^5\)The countries are: Argentina, Armenia, Bangladesh, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech Republic, Hungary, Iceland, India, Indonesia, Israel, Kazakhstan, Lithuania, South Korea, Malaysia, Mexico, Morocco, Philippines, Poland, Romania, Russian Federation, Singapore, South Africa, Sri Lanka, Thailand, Turkey, Venezuela

\(^6\)This was done so the PVAR could be estimated at a quarterly basis. Data at a high frequency is needed since the effect of controls are known to be short lived (Kokenyne and Baba 2011). An important caveat, is that excluding countries where data is not available at a higher frequency could cause a self-selection bias in this chapter’s empirical methodology.
TABLE 3.1

DEFINITIONS AND SOURCES OF VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital flows</td>
<td>Net Assets and Net Liabilities.</td>
<td>IMF, IFS (BOP section)</td>
</tr>
<tr>
<td>Controls</td>
<td>Index of Financial Openness</td>
<td>Schindler [2008], and IMF staff</td>
</tr>
<tr>
<td>CPI</td>
<td></td>
<td>IMF, IFS</td>
</tr>
<tr>
<td>Industrial Prod.</td>
<td>Seasonally adjusted</td>
<td>IMF, IFS</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>Nominal. Three month.</td>
<td>Haver</td>
</tr>
<tr>
<td>GDP growth</td>
<td>Percent /quarter</td>
<td>IMF, WEO</td>
</tr>
<tr>
<td>Inflation</td>
<td>Percent /year</td>
<td>IMF, WEO</td>
</tr>
<tr>
<td>Fiscal Balance</td>
<td>Percent of GDP</td>
<td>IMF, WEO</td>
</tr>
<tr>
<td>Current account</td>
<td>Percent of GDP</td>
<td>IMF, WEO</td>
</tr>
<tr>
<td>Real Exchange rate</td>
<td>Nominal XR*CPI(US)/CPI</td>
<td>IMF, IFS</td>
</tr>
</tbody>
</table>

we are aware of that distinguishes outflow from inflow controls and that is available for a large sample of countries. The remaining variables used in the analysis are defined in Table (3.1).

The estimation uses a panel vector auto regression (PVAR) approach. This approach, used previously by Miniane and Rogers [2007], treats all variables as potentially endogenous\(^7\). In particular, we assume that the relationship between the variables of interest is

\[^7\text{Some studies of capital controls tried to address endogeneity by using generalized methods of moments (GMM). The consistency of GMM hinges on the assumption that instruments are not weak. This assumption is violated when the variables show high persistence, as is very likely the case for capital controls.}\]
governed by a system of “structural” equations that, ignoring the constant term in what follows, can be written as:

\[ \Lambda_0 y_t = \Lambda_1 y_{t-1} + \ldots + \Lambda_p y_{t-p} + \epsilon_t, \]  

(3.2.1)

where \( \epsilon_t \) is a \((k \times 1)\) vector of structural shocks that are assumed to be uncorrelated with one another; \( A_0 \) is the \((k \times k)\) impact matrix that contains the contemporaneous relations among variables; \( y_t \) is a \((k \times 1)\) vector of data that, in the benchmark specification, includes the outflow-control index, industrial production, the interest rate, inflation, the USD exchange rate as well as a variable capturing net capital flows as a share of GDP. In additional exercises, the net capital flow variable will be replaced by gross inflows and gross outflows as well as net flows of assets and net flows of liabilities to get a better understanding of how a control tightening affects inflows and outflows as well flows of resident and non-resident investments.

Since the system described in 3.2.1 is under-identified, one cannot estimate it directly. The reduced form of equation 3.2.1 is given by

\[ y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + e_t, \]  

(3.2.2)

where \( A_p = \Lambda_0^{-1} \Lambda_p \) and \( e_t = \Lambda_0^{-1} \epsilon_t \) for \( p = 1, \ldots, n \).

Impulse response functions to structural shocks are identified by way of a Choleski decomposition. Equation 3.2.2 can be estimated by ordinary least squares, but restrictions have to be imposed on \( A_0 \) to allow identification of coefficients in the structural form. Identification is achieved through a Choleski decomposition of the variance-covariance matrix \( \Sigma_e \) of reduced-form errors \( e_t \). Equation 3.2.2 can be written in companion form by
defining $γ_t = [y_t, y_{t-1}, \ldots, y_{t-p}]'$ and $v_t = [e_t, 0, \ldots, 0]$,

$$F = \begin{bmatrix}
A_1 & A_2 & \cdots & A_p \\
I & 0 & \cdots & 0 \\
0 & I & \cdots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & \cdots & I & 0
\end{bmatrix},$$

and

$$Σ_v = \begin{bmatrix}
Σ_e & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & \cdots & 0 & 0
\end{bmatrix}.$$

The VAR($p$) can now be written as a VAR(1):

$$γ_t = Fγ_{t-1} + v_t,$$  \hspace{1cm} (3.2.3)

where $γ_t$ and $v_t$ are $kp \times 1$ vectors and $F$ is a $kp \times kp$ matrix.

The impulse response for variable $i$ to the $j$th structural shock at horizon $h = 1, \ldots, H$ is denoted by:

$$IRF_i(j, h) = F^{h-1}Λ_0^{-1}(i, j)$$  \hspace{1cm} (3.2.4)

The recursive ordering of the variance-covariance matrix requires the key assumption that a shock to the capital control index will affect all variables with the exception of output contemporaneously. The benchmark recursive ordering is as follows: 1) industrial production, 2) capital outflow-control index 3) real exchange rate, 4) interest rate, 5) inflation; 6) net capital flows. In this ordering capital flows are allowed to respond contemporaneously to changes in capital controls while the reverse only takes place with a lag. We chose this
ordering as we are interested precisely in the instantaneous effect of outflow-controls on net inflows of capital. A case could also be made for an ordering in which controls affect capital flows only with a lag. Indeed, it makes sense for policymakers to observe the behavior of interest rates, exchange rates, capital flows and other relevant macroeconomic indicators before deciding to use capital controls. However, one should consider that the de jure indicators are often measured with a lag, and depending on the nature and severity of the crises, countries may choose not to delay its deployment of capital controls. As both orderings have their respective merits, we test the robustness of our results to this and other alternative orderings.

In order to analyze different responses across countries in our sample, we follow Towlbin and Weber [2011] and extend the basic structural PVAR in 3.2.1 to allow for interaction terms. These interactions account for varying degrees of intensity in the outflow capital control index (cc), quality of institutions (qi) and macroeconomic fundamentals (mf). The government effectiveness index, which is based on 17 component sources, measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government’s commitment to such policies. The index values range from -2.5 (very poor performance) to +2.5 (excellent performance). For the macroeconomic fundamental index, we rank the countries in the sample along four dimensions - growth, inflation, fiscal and current account balances - and compute a country’s overall fundamentals rank as the simple average of its four ranks in each period.

The system in equation 3.2.1 can be written as:

$$y_t = \theta_1 y_{t-1} + \ldots + \theta_p y_{t-p} + w_t,$$

Where $$\theta_l = \beta_l + \zeta_l \times \text{group}_i$$, for $$l=1,\ldots, p$$ and $$\text{group}_i \in \{cc, qi, mf\}$$. The system is estimated in levels using two lags. In order to control for heterogeneity of intercepts in our sample,
country and time fixed effects are included. Inference is conducted via Runkle [1987]
bootstrap method. The confidence intervals that we present entail the minimum distance
that covers 90% of the estimates from 1,000 simulations.⁸

3.3 Estimation Results

We estimate the PVAR model described above and obtain dynamic responses of target
variables to an orthogonal shock to the capital control index. These impulse response
functions indicate the reactions over time of each variable in the system to an unexpected
shock to one of the variables. The shock is normalized to be equal to a change of 0.25 in
the outflow-controls index (tightening of controls).⁹

Using as the main yardstick of effectiveness the impact of controls on net flows, we find
no evidence that changes in capital controls were effective in the full sample of countries.
We interpret capital controls as effective if these successfully increase net inflows and do
not depreciate the exchange rate while allowing interest rates to fall (monetary policy in-
dependence). We estimate the basic PVAR model first including net inflow variable, and
subsequently including net flows in assets and net flows in liabilities as well as, finally,
gross inflows and gross outflows. The impulse responses of these capital flow measures
are compiled in Figure 3.3 along with the outflow-control index. The charts show im-
pulse responses to an increase of 0.25 in the capital control index. Solid lines represent the
impulse responses obtained from the OLS point estimates, dashed lines show 90 percent
confidence bands. A control tightening appears to reduce both gross outflows and gross
inflows, although the responses are not always statistically significant across the response

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⁸Both the estimation and inference were performed using Towbin and Weber 2011 IPVAR MATLAB
toolbox. For a more detailed explanation on the estimation and inference procedure see Towbin and Weber
2011.

⁹The estimation allows for one lag in each of the endogenous variables in the model. The results are
qualitatively robust to a change in the number of lags in the specification. See appendix for moments of the
outflow-capital control index.
interval. To shed some light on why net flows decline in response to the imposition of capital controls, we look at the responses of flows in net assets and net liabilities in Figure 3.3.

Our results show that foreign residents significantly cutback on their investments in the domestic economy in response to the imposition of outflow-controls even when domestic residents have lower outflows (cutback in their investments abroad). The substantial decline in gross inflows suggests that the difficulty in repatriating money implied by outflow-controls is becomes a deterrent to the inflow of foreign capital. This highlights the investment risk associated with the use of outflow-controls. The response of net inflows illustrates that the fall in gross inflows is disproportionately larger than the successful reduction in gross outflows. The effect is only slightly positive, and not significant. In

\[ \text{Following Schindler (2009), we define gross flows as: gross outflows} = \max(-\text{net assets flows},0) + \max(-\text{net liabilities flows},0); \text{ and gross inflows} = \max(\text{net assets flows},0) + \max(\text{net liabilities flows},0). \]
sum, we do not find evidence that capital outflow-controls are generally effective across our sample.

A tightening of controls appears to be more effective in countries which initially have a basic level of controls in place (figure 3.4 and figure 3.5). When analyzing the effectiveness of outflow-controls, it can be argued that the responses would be different between countries that have not substantially liberalized their capital accounts (e.g. China and India) and those that went down the path of financial and capital account liberalization and decided at some point to reintroduce controls. One would imagine that the former would have developed institutions and enforcement mechanisms to implement controls and also that these countries would have a lesser degree of integration to international financial markets (Magud et al, 2011). Following Towbin and Weber (2011), we proceed to evaluate the impulse response functions at different parts of the distribution of the capital control index. In particular, we are interested in whether controls are more effective in countries with a pre-existing framework of controls or in those that are generally very open. Figure 3.5 shows the impulse responses at high (75th percentile of outflow-control intensity) and low (25th percentile of outflow-control intensity) levels of pre-existing controls. In the case where outflow-controls are comparatively tight, further tightening still leads to a decline in gross outflows and inflows. However, the response of gross outflows significantly larger in magnitude than the fall in gross inflows. As a result, net inflows increase significantly, by about 5 percent of GDP on impact and 2.5 percent for the following 6 quarters, in response to the control tightening. In contrast, in the case of low pre-existing outflow-control intensity, controls are not effective at countering capital flight, with the response of net inflows remaining muted.

Moreover, outflow-control tightening appears to be effective in countries with well functioning institutions. We proceed to test whether the responses of the key variables in the PVAR differ depending on institutional quality as measured by the World Bank’s government effectiveness index. Figures 3.6 and 3.7 present impulse response functions at
Figure 3.4. Impulse responses based on capital control intensity index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. The responses of industrial production and the real exchange rate are in percent. The response of inflation and the interest rate is in percentage points. The response of the net inflow variable is in percent of GDP.
Figure 3.5. Impulse responses based on capital control intensity index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. All variables are in percent of GDP.
high (75th percentile of government effectiveness) government effectiveness and low (25th percentile of government effectiveness) government effectiveness. We find that controls are indeed effective at countering capital flight when institutional quality is high. In particular, net inflows increase by about 3 percent of GDP on impact and 2 percent thereafter in response to the shock. Conversely, controls are ineffective in the presence of low institutional quality. The intuition would be that institutional quality signals strong property rights protection and foreign investors will not be worried about the expropriation of their resources and they will simply adjust the returns on their portfolio to take into account this “additional cost of doing business”.

Also, changes in outflow-controls are also more effective in countries with favorable macroeconomic fundamentals. The hypothesis that the effectiveness of controls increases when macroeconomic conditions are favorable could reflect three forces that are not necessarily mutually exclusive. First, good fundamentals could be correlated with strong institutions thereby signaling the ability to implement controls in a manner that protects private property and creditor rights. This translates into a “stay” in foreign investor confidence in the country and prevents a widespread retrenchment of capital. Second, the use of controls in countries with good macro fundamentals signals could even and increases confidence in the policies of the government and signal that the country is taking steps to address the buildup of vulnerabilities and not developing an “anti-foreign investor bias”. This effect is likely to dominate if a country imposes outflow-controls in non crisis periods. This is in line with the so called “perverse effect” of capital inflow controls in Korea reported in International Monetary Fund [2011]. Finally, the implied cost of capital controls would be weighed against the need for portfolio diversification as well as the mandate of the investment fund. Therefore, the imposition of capital controls in a country, so long as it is not prohibitive, should not necessitate a mass rethinking of the attractiveness of the country to foreign investors or the investment mandate.

11 Similar results are obtained for different indicators of institutional quality.
Figure 3.6. Impulse responses based on government effectiveness index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. The responses of industrial production and the real exchange rate are in percent. The response of inflation and the interest rate is in percentage points. The response of net inflows variable is in percent of GDP.
Figure 3.7. Impulse responses based on government effectiveness index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. All variables are in percent of GDP.
We construct an index of macroeconomic fundamentals and study the effects of outflow-controls in countries with strong (75th percentile of fundamentals indicator) and weak (25th percentile of fundamentals indicator) fundamentals separately. We then evaluate the impulse response functions across different parts of the distribution of the composite index. Figure 3.8 shows that a control tightening increases net inflows at the peak by 4 percent of GDP, and net inflows remain elevated for more than one and a half years.

Finally, this chapter employs the “shock approach” discussed in Chapter 1. Despite providing a clean way to identify cause and effect dynamics of policy innovations in the capital control index, the method can have some drawbacks. Specifically, relying on this type of analysis only answers the question of the effectiveness of unexpected, exogenous capital controls. Therefore, the “shock approach” ignores that capital controls are often implemented by policymakers (and expected by the private sector) in response to macroeconomic conditions. In order to get a picture of how important are these innovations in the behavior of net inflows (and the validity of this chapter’s empirical approach), Table 3.3 presents a ten step variance decomposition of the net inflows variable. The variance decomposition will tell us how much of a change in a variable is due to its own shock and how much due to shocks to other variables. Since the identification of the VAR through a Cholesky decomposition, the ordering of the capital control index in the system plays a prominent role in the empirical results. Therefore, results are presented for the case when controls affect net inflows with a one quarter lag (lagged) and when controls affect net inflows on impact (contemporaneous).\(^\text{12}\) Clearly, of all the variables in the VAR system, innovations in the capital control index are the most important in explaining the movement of net inflows (apart from own innovations to net inflows). In almost all the analyzed groups, shocks to capital controls in the contemporaneous category explain twice as much

\(^{\text{12}}\)See the robustness section in the appendix of this chapter for impulse responses for alternative orderings of the capital control index.
Figure 3.8. Impulse responses based on macroeconomic fundamental index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. The responses of industrial production and the real exchange rate are in percent. The response of inflation and the interest rate is in percentage points. The response of net inflow variable is in percent of GDP.
Figure 3.9. Impulse responses based on macroeconomic fundamental index. Solid line OLS point estimates. Dashed lines are 90% confidence bands. The shock to the outflow-control index is normalized to be equal to 0.25. All variables are in percent of GDP.
TABLE 3.3

VARIANCE DECOMPOSITION OF NET INFLOWS

<table>
<thead>
<tr>
<th>Group</th>
<th>Y</th>
<th>C</th>
<th>XR</th>
<th>R</th>
<th>(\pi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged</td>
<td>1.57</td>
<td>0.65</td>
<td>1.10</td>
<td>0.08</td>
<td>0.02</td>
</tr>
<tr>
<td>Contemporaneous</td>
<td>1.57</td>
<td>1.75</td>
<td>0.08</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Gov. effect.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged</td>
<td>2.32</td>
<td>1.66</td>
<td>1.89</td>
<td>2.32</td>
<td>1.71</td>
</tr>
<tr>
<td>Contemporaneous</td>
<td>2.20</td>
<td>10.30</td>
<td>1.77</td>
<td>2.06</td>
<td>1.68</td>
</tr>
<tr>
<td>Controls intensity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged</td>
<td>3.82</td>
<td>1.62</td>
<td>1.33</td>
<td>0.25</td>
<td>0.06</td>
</tr>
<tr>
<td>Contemporaneous</td>
<td>2.93</td>
<td>18.89</td>
<td>1.13</td>
<td>0.20</td>
<td>0.05</td>
</tr>
<tr>
<td>Fundamentals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged</td>
<td>2.21</td>
<td>5.13</td>
<td>3.26</td>
<td>1.39</td>
<td>0.12</td>
</tr>
<tr>
<td>Contemporaneous</td>
<td>2.19</td>
<td>5.71</td>
<td>3.23</td>
<td>1.26</td>
<td>0.11</td>
</tr>
</tbody>
</table>

This table reports the share of the variance in net inflows accounted for the variation in output, \(Y\), outflow-controls, \(C\), real exchange rate, \(XR\), interest rate, \(R\), and inflation, \(\pi\), of the variation of net inflows as compared when controls have a lagged effect. These results shed light on the importance of precise timing by policymakers for the effectiveness of the implementation of these policy measures.
3.4 Conclusion

The chapter has described the conditions when capital controls can be effective in EME’s. Using the PVAR approach and a sample of 31 predominantly EMEs during the period 1995-2010, our empirical analysis clearly shows that capital controls can be effective under certain conditions and for a short period of time not exceeding 18 months. It should be noted that our yardstick for effectiveness of outflow-controls – the imposition of capital controls should lead to increase in net inflows— is superior to simply looking at the effects of capital controls on gross outflows. This distinction is important because the findings illustrate that capital outflow-controls are typically successful at reducing gross capital outflows, their use or tightening also leads to a sizable reduction in gross capital inflows as foreign investors reallocate capital away from the domestic economy. outflow-controls can thus be counterproductive in that net inflows fall in response to a control tightening.

Although we find outflow-controls can be effective, our results cautions against its use as a broad-brush panacea to managing capital flows. Indeed, when faced with a decision to implement capital controls policymakers in EME’s should carefully consider the following three factors that we show to be binding conditions for outflow-controls to be effective: First, good macroeconomic fundamentals; Second, solid institutional settings; and third, an existing level of outflow-controls implying the importance of the institutional set up to implement controls. That said, the experiences of Malaysia and more recently Iceland suggest that regarding capital outflows, where there is a will there is a way. However, the belief that discretion is the better part of valor, mean that countries must give primacy to policy measures that avoids the unpleasant domestic and plausible multilateral impact of such draconian measures. We also show unexpected capital controls to be very important in explaining changes in net inflows— with shocks to controls explaining sometimes as much as twenty percent of the variation in flows.

Regardless, the conclusion from this chapter is that countries should not use capital outflow-controls as a substitute for necessary macro adjustment to correct underlying im-
balances, although controls can be used to bridge the time lag it takes for macro prudential policies to take effect and provide policymakers some breathing space.
APPENDIX A

Appendix for Chapter 1

A.1  Impulse Responses of US Variables for Small Market Cap Sample

As in the VAR including the entire sample, drop in the Fed funds rate and a rise in NBR is accompanied by an inverse hump-shaped response of industrial output. In contrast to figure (1.1), the price puzzle is not present, and the shocks to the FFR needed to fix the controls response at zero appear to marginally affect the us CPI. Regardless the difference is small.
Figure A.1. This figure shows impulse responses of US variables to a one hundred basis point reduction to the US Federal Funds Rate. The sample of emerging markets is restricted to countries with a small market cap. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The FFR is measured in basis points while the rest of the variables in percents.

A.2 Impulse Responses of US Variables for Sample Based on Exchange Rate Regime

Figure (A.2) and figure (A.3) show the impulse responses of US variables under factual and counterfactual scenarios for the group of emerging markets with floating and managed exchange rate regimes respectively. The responses in figure (A.2) are very similar to the cases discussed above. The responses when the sample is restricted to countries with a managed exchange rate regime are different. Capital controls appear to considerable affect the response of the US CPI and commodity index to a reduction in the Fed funds rate. Capital controls appear to eliminate the price puzzle discussed in the main text, and further increase the price level in the US. These results shed some light into the effects of what have
Figure A.2. This figure shows impulse responses of US variables to a one hundred basis point reduction to the US Federal Funds Rate. The sample of emerging markets is restricted to countries with a freely floating exchange rate regime. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The FFR is measured in basis points while the rest of the variables in percents.

been described as “currency wars” between the US and the largest emerging economies. Authorities in these countries complain that easy monetary policy conditions in the US and Europe has flooded emerging economies with destabilizing capital inflows that appreciate their currency and produce a misallocation of resources. Their response has been to ratchet up capital controls, and discourage this excess liquidity to enter their economy. If these excess liquidity is not able to leave the US for example, then it is no surprising to see prices increase in the US due to capital controls in emerging economies.
Figure A.3. This figure shows impulse responses of US variables to a one hundred basis point reduction to the US Federal Funds Rate. The sample of emerging markets is restricted to countries with a managed exchange rate regime. The dashed lines are the estimated impulse responses. The shaded gray areas contain two-thirds of bootstrap estimates based on Runkle [1987]. The dotted lines are the impulse responses when capital controls are held fixed. The FFR is measured in basis points while the rest of the variables in percents.
APPENDIX B

Appendix for Chapter 2

B.1 Internalization of the Learning-by-Doing

This chapter assumes that there is a large number of firms in the tradable sector, which take the learning-by-doing externality on the economy as given, therefore assuming that they face a constant returns to scale production technology. In contrast to this, the planner takes into account this externality in the production of tradables, therefore facing instead an increasing returns to scale production technology (Romer 1986). Following Lama and Medina [2010], when the problem of the firm is internalized, the problem of the firms in the tradable sector becomes:

\[ \Pi_t = \max_{l_{t+1}, k_{t+1}, h_{t+1}} E_t \left\{ \sum_{i=0}^{\infty} \Lambda_{t+i} \left[ Y_{T,t} - \omega_t h_{T,t} - r_t^k k_t \right] \right\} \]

subject to

\[ h_{t+1} = h_t^{\xi} Y_{T,t}^\psi \]  \hspace{1cm} (B.1.1)

Where \( \Lambda_{t,i} \) is the stochastic discount factor. The first order conditions of the firm are given by:

\[ w_t = F_{h_{T,t}} + \Theta_t G_{h_{T,t}} \]  \hspace{1cm} (B.1.2)

\[ r_t^k = F_{k_{T,t}} + \Theta_t G_{k_{T,t}} \]  \hspace{1cm} (B.1.3)
$\Theta_t = E_i \left\{ \Lambda_{t,t+i} \left[ F_{t,t+1} + \Theta_{t+1} G_{T,t+1} \right] \right\}$ \hspace{1cm} (B.1.4)

where $Y_{T,t} = F \left( A_{T,t}, l_t, k_t, h_{T,t} \right)$ is the production function of home goods, $l_{t+1} = G \left( A_{T,t}, l_t, k_t, h_{T,t} \right)$ is the law of motion of organizational capital, and $\Theta_t$ is the shadow price of organizational capital. When firms internalize the learning-by-doing mechanism, equations B.1.2-B.1.4 should replace the first order conditions of firms in the tradable sector presented in the main text.
APPENDIX C

Appendix for Chapter 3

C.1 Robustness

In this section several robustness exercises are conducted to the econometric specification as well as the variables included in the empirical model described in the main text. The response of the net inflows variable is evaluated at the 75th percentile of the distribution of each of the indicators (capital control intensity, government effectiveness and macroeconomic fundamentals) discussed above.

First, industrial production is substituted with real GDP in the benchmark model. This robustness check is conducted since industrial production tends to be very volatile and only represents a small fraction of total economic activity for many emerging markets.\(^1\) Second, the VAR (6) model presented above is augmented to a VAR (7) that includes an inflow control index as an additional variable; this is to alleviate omitted variable concerns with respect to the correlation between changes in intensity of outflow and inflow controls. Third, the model is tested for sensitivity to different lag specifications. Finally, the robustness of the findings are tested to different orderings of the variables included in the VAR. In the alternative ordering presented here, outflow controls are allowed to respond contemporaneously to capital flows. In addition, the ordering assumes that controls will not respond to changes in net inflows contemporaneously.

\(^1\)For purposes of the robustness check, GDP is assumed to be equal in every quarter of a given year for all countries for which quarterly data is not available.
The results of these robustness tests are presented in Figures ?? - C.3 and are broadly consistent with the chapter’s main findings. Figure ?? illustrates the robustness of the fact that outflow controls are effective in countries with a high pre-existing intensity of capital controls. As shown, the path of the impulse response function is somewhat sensitive to increasing the number of lags in the VAR, but the dynamics of the impulse response functions only begin to vary after about 3 quarters. Moreover, the response is positive across the horizon of 6 quarters in all cases. Including real GDP in the regression instead of industrial production does not impact the results notably; neither does the inclusion of an index of inflow control intensity. The most notable change in the response function occurs when changing the ordering of the variables in the VAR, specifically, allowing outflow controls to be affected contemporaneously by all variables in the VAR.2 In this case the response of net inflows to an increase in control intensity becomes much smaller. However, the response remains positive across the response horizon and peaks at about 1.2 percent of GDP.

Figure C.2 shows that the finding that outflow controls are effective in countries with high government effectiveness is relatively robust across most specifications as well. Changing the lag structure of the PVAR has implications for the dynamics of the net inflows variable, but the positive effect of a tightening of controls remains. Including an index of inflow control intensity or substituting industrial production with GDP in the PVAR does not alter the shape or the magnitude of the response in a notable way. However, when changing the ordering of the variables in the PVAR, the response of net inflows becomes significantly more muted. The response is no longer positive on impact and peaks at only about 0.5 percent of GDP.

Figure C.3 illustrates the robustness of the finding that outflow controls are effective in

\[ \text{Cardoso and Goldfajn (1997) explain that the reason of no contemporaneous response of capital flows to controls could be the following: Investment projects may take more than one quarter to react to new legislation and part of the reaction of the capital market will be reflected in price movements. Given the delays inherent to the legislative system, the assumption of controls not reacting on impact to other shocks on the system (other than output) seems plausible.} \]
countries with good macroeconomic fundamentals. The impulse response of net inflows to an increase in capital control intensity is indeed very robust to changes in the PVAR specification. Neither the change in the ordering of the variables in the PVAR nor the inclusion of an index of inflow control intensity nor the substitution of the industrial production variables by GDP have an important impact on the shape or the magnitude of the impulse response functions. The response is also very robust to changes in the lag structure of the PVAR; only when reducing the lag structure to one a somewhat pronounced drop in the magnitude of the response is observed. In sum, results that outflow controls are effective in countries with high pre-existing intensity of capital controls or strong macroeconomic fundamentals are very robust to changes in the econometric specification. The result that countries with good institutions can use controls as an effective policy instrument is robust across most checks but disappears when the recursive ordering of the outflow-control index is changed.
Figure C.1. Net inflows response to an unexpected increase in the outflow controls index for high capital control intensity group. Solid lines represent OLS point estimates. The shock to the outflow control index is normalized to be equal to 0.25. 1) VAR (6) including quarterly real GDP instead of industrial production. 2) VAR (7) including index on inflow controls. 3) VAR (6) with capital outflow controls affecting all variables with a lag. Figure 9b: VAR (6) with different lag specifications.
Figure C.2. Net inflows response to an unexpected increase in the outflow controls index for high Government Effectiveness group. Solid lines represent OLS point estimates. The shock to the outflow control index is normalized to be equal to 0.25. 1) VAR (6) including quarterly real GDP instead of industrial production. 2) VAR (7) including index on inflow controls. 3) VAR (6) with capital outflow controls affecting all variables with a lag. Figure 9b: VAR (6) with different lag specifications.
Figure C.3. Net inflows response to an unexpected increase in the outflow controls index for good Macroeconomic Fundamentals group. Solid lines represent OLS point estimates. The shock to the outflow control index is normalized to be equal to 0.25. 1) VAR (6) including quarterly real GDP instead of industrial production. 2) VAR (7) including index on inflow controls. 3) VAR (6) with capital outflow controls affecting all variables with a lag. Figure 9c: VAR (6) with different lag specifications.
BIBLIOGRAPHY


