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Real and Nominal Effects of Exchange Rate Regimes

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REAL AND NOMINAL EFFECTS OF EXCHANGE RATE REGIMES

A Dissertation Presented

by

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DEDICATION

To my beloved Kary

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ABSTRACT

REAL AND NOMINAL EFFECTS OF EXCHANGE RATE REGIMES

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This dissertation explores some of the macroeconomic effects of exchange rate regimes and the role of real exchange rate on capital accumulation and growth. The first essay analyzes the factors that promotes *episodes* of accelerated capital accumulation that last seven years or longer. After identifying 189 such episodes, I rely on econometric analysis to explore: (i) the conditions that increase the likelihood of an episode taking place, (ii) the presence of structural change during episodes, and (iii) the characteristics that distinguish episodes that are sustained beyond the final year from those that are not. Turning points in investment tend to be preceded by fast growth, stable and undervalued currencies, low inflation, and low capital inflows, especially on the portfolio account. During the episodes, economies experience a shift in their economic structure, from agriculture toward the manufacturing sector. Sustained episodes seems to be related to trade openness, low incidence of macroeconomic crises, a relatively closed capital account, and low dependence of natural resources, but these results are not very robust. The second essay explores the relation between exchange rate regimes and real exchange rate misalignments in an unbalanced panel of 100 countries, spanning the period 1979-2010. The propensities to adopt a particular exchange rate regime are estimated using different exchange rate regime determinants, and the results are used to create a control group to compare with the countries that adopt a peg. The comparison of countries that use pegs with countries that have similar characteristics, but use more flexible arrangements, suggest that pegs are associated with more overvaluation. The results are robust to different exchange rate regime classifications, misalignment indexes, and matching estimators. The third and final essay discusses the effects of Inflation Targeting in Latin-American countries during the period 2000-2015. Some authors have argued that there is a flaw in the way in which the system has been conducted in the region. In good times, the Central Banks are reluctant to cut interest rates, but in bad times they are willing to raise interest rates very aggressively, adding a procyclical bias to monetary and exchange rate policies. Using different econometric techniques, I find that these Central Banks, with the exception of Chile, suffer from "fear of floating" (i.e., the Central Bank combat depreciations more aggressively than appreciations), and that this is more pronounced for the case of Brazil and Mexico, as the literature have argued.

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INTRODUCTION

This dissertation presents three papers on exchange rate policies and real exchange rates. The unifying theme is that policies, in particular the choice of the exchange rate regime, have considerable space to influence the behavior of the real exchange rate. Why focusing on real exchange rates? It is arguably the single most important macro price for a small open, non-developed economy. It is known that the real exchange rate affects output and employment, inflation, the balance of payments, and as a recent literature have argued, it can have growth enhancing effects as well.

For a long time, the literature on exchange rates and growth identified real exchange rate misalignment as an explanation only for slow growth. It is easy to see how overvaluation can be associated with shortages of foreign exchange reserves, poor incentives to invest in tradable activities (which are usually the locus of technical progress and capital accumulation), and economic stagnation.The history of Latin-America and Africa is plagued with examples of how real exchange rate overvaluation leads to balance of payments crises of different kinds.

For that literature, undervaluation was also seen as a bad policy. The reason is that undervaluation was associated with high inflation and debt overhangs, for example as in Latin America during the so called "Lost Decade" in the 1980s. Thanks to the growth miracle of the South East Asian countries, China and India, but also to some respectable macroeconomic performance of countries like Chile and Colombia during the 1980s, some authors consider that undervaluation may favor growth (Rodrik, 2008; Razmi, Rapetti, and Skott, 2012a). The chapter on "Investment Surges" take a look at episodes of sustained capital accumulation, and it includes an analysis of the role of different policies related to exchange rates in promoting growth.

Inspired by Hausmann et. al. (2005), and after identifying 189 such episodes, I rely on econometric analysis to explore the conditions that increase the likelihood of an episode taking place, the presence of structural change during episodes, and the characteristics that distinguish episodes that are sustained beyond the final year from those that are not. The results suggest that turning points in investment tend to be preceded by fast growth, stable and undervalued currencies, low inflation, and net capital outflows, especially on the portfolio account. During a typical episode, economies experience structural change, shifting resources from agriculture to manufactures. Finally, sustained episodes seems to be related to trade openness, low incidence of macroeconomic crises, a closed capital account, and low dependence of natural resources, but these results are not as robust as the previously described results.

The exchange rate regime is the main policy tool to affect the moments of the distribution of the nominal exchange rate, and I would argue this also applies to the real exchange rate as well under certain circumstances. It is not hard to see how extremely rigid exchange rate arrangements, like a currency board or dollarization, can create scenarios in which the domestic currency becomes badly overvalued, and yet there is no way to correct relative prices because non-tradable prices are rigid in the downward direction.

But for a large part of the profession, the exchange rate regime does not really matter, except for a short-period of time. This point of view argues that choice of the exchange rate arrangement determines nominal magnitudes such as the nominal exchange rate, or the price level, but that real variables like the real exchange rate, are determined somewhere else. This is of course a corollary of the well-known proposition that money is neutral for an open economy set-up.

Despite how popular is the assumption that money and exchange rate regimes are neutral, there are tons of examples of “hard pegs” that are abandoned due to their inability to correct relative prices, and of the most striking empirical facts is how closely the real exchange rate tracks the nominal exchange rate when inflation is moderate. In a nutshell, non-neutrality does not seems to hold.

There are several reasons why this is the case, including the existence of multiple equilibrium, hysteresis, or real rigidities that prevent full price adjustment. When neutrality fails, monetary and exchange rate policies can have important real effects. The chapter on “The Effects of the Exchange Rate Regime on Real Exchange Rate Misalignments” explores these issues using matching models.

More precisely, the second essay analyses the relation between exchange rate regimes and real exchange rate misalignments. As far as I know, this is one the few papers that analyzes the influence of the exchange rate policy on misalignment. For sure this is the first paper to use matching models to compare countries that use pegs with countries that have similar characteristic, but use more flexible arrangements. The results suggest that pegs are associated with more overvaluation, and are robust to different exchange rate regime classifications, misalignment indexes, and matching estimators. Hence, the exchange rate regime is not neutral.

Even if one is willing to accept that the exchange rate regime is neutral, there are very good reasons to analyze the impacts of the different exchange rate regimes. Policy can affects other moments of the distribution, such as the variance or the skewness, and the adjustment path after a disturbance may depend on whether the exchange rate is held fix or it is allowed to float (hence it can take jumps). Finally, the exchange rate regime may not affect the long-run level of the real exchange rate, but it can react different to similar shocks with opposite signs, so the actual real exchange rate spent more time on the overvaluation than on the undervaluation side.

The chapter on “Asymmetric Monetary and Exchange Rate Policies in Latin-American Countries using Inflation Targeting” tackles that problem. I analyze how the implementation of Inflation Targeting in small open and non-developed economies have affected the behavior of the exchange rate. Although it is usually recommended that countries on Inflation Targeting should let the exchange rate float freely, in practice Central Bank intervention was widespread in Latin-America and East Asia.

Authors such as Barbosa-Filho (2015) and Ros (2015) have argued that there is an flaw in the way in which Inflation Targeting has been conducted in the Latin-American region, in particular in Brazil and Mexico. In good times, the Central Bank is reluctant to cut interest rates, but in bad times is willing to raise interest rates very aggressively, adding a procyclical bias to monetary and exchange rate policies. Interestingly, the exact opposite pattern seems to be present in East Asia (see Pontines and Siregar, 2012)

A quick preview of my results is as follows. Using different econometric techniques, I find that these Central Banks, with the exception of Chile, suffer from “fear of floating”, and that this is more pronounced for the case of Brazil and Mexico, as the literature have argued. Furthermore, the policy response was implemented mainly via changes in foreign exchange reserves, and not in interest rate (or capital controls), as the intuition and the casual observation suggest.

To summarize, this dissertation presents three papers on the relation between exchange rate regimes and real exchange rate determination, as well as some novel results on the relation between real exchange rate and capital accumulation and growth.

CHAPTER 1

INVESTMENT SURGES: AN EXPLORATION OF THEIR DETERMINANTS, STRUCTURE AND SUSTAINABILITY ISSUES

1.1 Introduction and Related Literature

Economists have recognized the central role of capital accumulation in determining growth since the late eighteenth and the early nineteenth century at least. Indeed, any discussion of growth or development-related issues is incomplete without some words on investment. The country-level determinants of investment, however, remain controversial. While earlier studies tended to focus on variables such as the cost of capital and aggregate demand, the literature since the eighties has been dominated by models based on intertemporal optimization, in a frictionless world, or in the presence of capital market imperfections, irreversibility, convex adjustment costs, and financial constraints.[1] More recent literature has explored the role of economic and political institutions broadly defined.

This paper takes a different approach to the question. Instead of focusing on the effect of correlates on the level of investment, I direct my attention to the identification of national-level episodes of *sustained* per capita capital stock growth. After some informal analysis, I use Probit and Logit regressions to identify variables that significantly affect the probability

[1]Strictly speaking convex adjustment cost are a friction, but they are necessary to avoid abrupt jumps in the level of the capital stock in models that use continuous time, so they are a standard component of an otherwise frictionless model. Other approaches, such as Nickell (1978) and Skott (1989, chapter 4) rely on firm heterogeneity, and have non-convex adjustment cost at the firm level, but a smooth investment function at the aggregate level.

of an investment episode taking place. I then explore the sectorial employment and value added dynamics of the identified episodes. Lastly, I classify the episodes in "sustained" and "non-sustained" and I analyze the determinants of sustainability.

The existing theoretical and empirical literature identifies several determinants of investment. One could alternatively locate these determinants in financial markets, in the markets for goods and services, or in the broader landscape of institutions and macroeconomic policies. The classical approach emphasizes the profit rate. In the simple Keynesian approach to business cycles, expectations of future aggregate demand conditions play a central role along with uncertainty and the cost of capital. Neoclassical models, as elaborated by Jorgenson (1963) and later work, are based typically on firms that choose capital and labor inputs to maximize the net present value of future net cash flows, and assign a central role to relative factor prices in determining the long-run value of capital labor ratio. Diminishing returns to capital ensure that the rate of capital stock growth is similar across long-run steady states, although a new literature explores the role of constant and increasing returns to scale (Romer, 1986).

In more recent micro-founded models with rational agents that optimize over an infinite horizon, the path of investment over time is determined by the consumption-smoothing behavior and convex capital stock adjustment costs, but shocks to permanent income can influence the trajectory of saving and investment. Other complications incorporated in the recent literature include the irreversible nature of investment in capital goods, uninsurable idiosyncratic risks, financial market imperfections, and the lumpiness of investments, among others.[2]

[2]Empirical studies such as Benhabib and Spiegel (2000) have also incorporated the level of financial and institutional development as a determinant of investment.

Open economy considerations add further complexities. A positive terms of trade shock, for example, could boost investment not simply by increasing wealth (and hence saving), but also by increasing the value of the marginal product of capital, attracting foreign capital flows as a result. Empirical studies since Horioka and Feldstein (1980), however, have found robust support for a continued strong correlation between investment and domestic saving. The so-called Balance of Payments Constrained Growth model (Thirlwall, 1979) asumes trade is balanced in the long run, so it also predicts a strong correlation of domestic savings and domestic investment.

As valuable as existing theoretical and empirical studies are, most of these do not appear to give adequate weight to the unstable nature of investment, even though the role of investment fluctuations over the business cycle tends to be widely recognized. Indeed, extended upturns and downturns in investment appear to be a fact of life, while periods of high investment sustained over decades tend to be relatively rare.

These upturns and downturns tend to be geographically dispersed and differences in investment rates among seemingly similar countries tend to be persistent. Table 1.1 highlights some of these facts. For example, while East Asia experienced investment-GDP ratios of 31.7 percent over the period 1960-2014, accumulation in Latin American and Caribbean countries stagnated at 20.9 percent, while South Asia experienced an even lower average rate. Moreover, countries appear to experience phases of high and low investment, and similar saving rates across countries tend to give rise to different investment rates.

Considering the empirical evidence, identifying the nature of the turning points could, therefore, yield interesting insights into the growth process. Let us think, for example, in terms of the Solow growth model with exogenous technological change. In the steady state, the capital to output ratio (in terms of the effective labor force) is constant, as is the capital to labor ratio. Factors that affect savings could affect the steady state level of output per capita but only through the transitional dynamics. This is illustrated by Figure 1.1 where a change, such as a policy-induced increase in the saving rate at time 0, leads to level effects but no growth effects in the long-run.

These inter-steady state dynamics, however, could last for significant periods of time. For example, employing the Cobb-Douglas version of a general form production function, assuming a one-third income share of capital, and assuming the rates of capital depreciation, labor force growth, and technological progress to be 4, 1, and 2 per cent, respectively, yields a half-life of approximately 15 years. Thus, deviations from the equilibrium level of per capita output seem to persist for sustained periods of time.[3] Incorporating human capital to increase the capital share to 0.66 changes the number to approximately 29 years. Given the rather long time horizons involved, identifying the determinants of trend changes therefore becomes an interesting exercise.

In models with endogenous growth,[4] such as the AK family of models, policy changes that affect investment behavior lead to permanent changes in steady state rates of capital and output growth even in the absence of exogenous technological progress. Figure 1.1b, where a policy shock increases the growth rate at time 0, illustrates our discussion. Rodrik (2008) argues for instance, that the tradable sector in developing countries is more affected by market imperfections and externalities. In Rodrik's story, a policy of sustained real exchange rate undervaluation, in this second-best world, can act to counter these externalities by boosting tradable sector profitability, accelerating growth.

Other models feature multiple equilibria, where the relationship between policy variables and investment is not linear since small movements across thresholds can cause switching from a low investment state to a high investment one and vice-versa. Thus, identical initial economic conditions could give rise to different growth rates of capital stock, and a country

[3]Specifically, $-\, ln(0.5)/((1-0.33)(0.04+0.01+0.02)) \approx 14.8$.

[4]In the sense that policy can affect steady state growth rates *permanently*.

could be stuck in low or high capital accumulation equilibria for extended periods of time. The factors that push economies on to high accumulation trajectories, therefore, attain particular salience. Benhabib and Gali (1995) provides a survey of these kinds of models.[5]

On a broader note, models which incorporate deviations from full employment over extended periods of time naturally generate endogenous growth, even in the presence of constant returns to scale and even when technological progress is absent. The famous Harrod-Domar model, and in the context of a developing economy with underemployment and dual labor markets, the Lewis model, are well-known examples. The endogenous nature of the steady state rate of capital accumulation in these models provides another reason to focus on sharp historical break points in investment rates.

To summarize, in most models of long-run growth there is considerable room for policy, structural and institutional factors to affect the trajectory and/or the steady state level of the capital to population ratio. The focus of this paper is on turning points that lead to a sustained upsurges in investment. In order to explore the nature of these turning points, I zoom in on long-term trends rather than on short-run fluctuations. I investigate the conditions before, during, and after episodes using econometrics. I rely on several criteria for identifying an investment surge as discussed in the next section. This approach minimizes the role of volatility, irreversibility, and lumpiness and other factors that are likely to render open to question empirical specifications based on smooth distributions of underlying variables. It also aims to separate temporary/cyclical investment booms from sustained surges. The goal is to focus on such surges at the national level and, unlike most empirical studies, we include data for both advanced and developing economies. For this purpose, I use capital

[5] The idea of growth traps appears in variants of the traditional big push model such as Rosenstein-Rodan (1943), Murphy et. al. (1989), and Skott and Ros (1997), where it is the *level* of capital stock that varies between multiple steady states.

stock data from the Penn World Tables 8.1, which is comparable across countries and has the largest possible coverage.

A body of analysis has appeared in recent years that identifies turning points in macroeconomic aggregates. Hausmann et. al. (2005) identify episodes of acceleration in output growth. Freund and Pierola (2012) carry out a similar exercise for export surges, while Montiel (2000) and Rodrik (2000) analyze consumption booms and saving transitions, respectively. To the best of our knowledge this is the first attempt to identify determinants of sustained investment surges using a similar technique.

Why bothering with capital accumulation, rather than output growth? Is it not output growth a more important variable, for example in terms of welfare? Also, should not we expect that capital and output will grow at the same rate in the long-run? I believe there are good reasons to focusing on capital, rather than just sticking with output. First, it may worth to explore the dynamics of capital accumulation, as a complementary and robustness checks of previous estimation that use output only. Second, although it may seem that fast capital accumulation cannot be sustained without fast output growth, the timing and the composition may matter. For instance, fast output growth in sectors with very low capital intensity are possible, or the growth process may involve a period of capital deepening; in both cases total capital may growth at a different pace than total output for significant periods of time.

An example may clarify this. Suppose that output grows very fast in a non-tradable sector, such as a services. A filter based on output growth may detect an episode here, but a filter that relies on the capital stock may not. Contrast this with an example in which both output and capital growth very fast, for example if the manufacturing sector led the expansion. Now both filters should detect an episode.

This is truly important because service led growth may not be as sustainable as manufacturing led growth, due to bottlenecks in the external sector or low productivity growth. In a nutshell, we need to know what happens to capital accumulation, and not only to output growth, to understand the nature of the growth process. Thus, my exercise is a complement of papers such as Hausmann et. al. (2005).

The structure of the paper is as follows. After this introduction, section 1.2 describes the episode identification methodology and describes the empirical approach. Section 1.3 analyzes the factors that precede investment accelerations, while section 1.4 presents some robustness checks and additional results. Section 1.5 then illustrates the changes that typically occur in economic structures during episodes. Section 1.6 examines the characteristics of episodes that are sustained beyond the episode years. Finally, section 1.7 concludes.

1.2 Episode Identification

In this section I describe the filter that I use to identify episodes of investment surges.[6] To be identified as the starting point of an investment surge, a candidate observation must satisfy the following criteria: a) annual per capita capital stock growth over a 7-year period must be over 3.5 percent; b) annual per capita capital stock growth must have accelerated by at least 2 percentage points during the 7-year period; and c) the level of capital per capita seven years after the end of the acceleration episode must exceed its historical peak.

Criteria (a) ensures that the capital stock per capita grows at a rapid rate. Criteria (b) ensures that the growth rate deviates significantly from the pre-episode average. Criteria (c) avoids picking investment surges that are pure recoveries from periods of capital stock destruction due to events such as war, major political upheavals, and natural disasters. These criteria are similar to the ones used in Hausmann et. al. (2005).

[6] The data comes from Penn World Table 8.1; this is a large panel of 167 countries spanning the period 1950-2011.

A few comments are in order. Using the criteria “the level of capital per worker seven years after the beginning of the acceleration episode must exceed its pre-episode level” yields a very similar result (almost the same list of episodes is selected). The reason is that there is a very high correlation (0.9795) between population and employment in the data from Penn World Tables 8.1 used in this paper. It is also worth to notice that criteria c) is rarely binding.

In light of (a), (b) and (c), the first step is to obtain the fitted growth rate of capital per worker over each 7-year window. Specifically, I estimate the following rolling regression for every country individually (notice I am not using a panel):

$$ln(k_{it}^w) = \alpha_{it}^w + g_{it}^w * t + u_{it} \tag{1.1}$$

Where k_{it}^w is the capital to population ratio, t is a time-trend, and w denotes the 7-year rolling estimation window.[7] The parameters α^w and u are the intercept and the error term respectively.[8] The coefficient estimate $\hat{g^w}$ is therefore the fitted 6-year growth rate of capital per capita, and as such, is a projection of the growth rate in the 7 year period considered. This is better than simple averages, because it minimizes the impact of outliers, and it is better than using the median growth rate, because I can capture non-linearities, for instance if level of the per capital stock evolves exponentially (as we should expect during an episode).

I define an investment acceleration episode as one where both the fitted growth rate $\hat{g^w}$ and the acceleration of the capital stock growth ($\Delta\hat{g^w}$) exceed certain thresholds. For our baseline filter, as already noted, I consider the case where capital per capita must grow

[7]Let us assume that a 7 year period starts in 1960. Then 1961, 1962, 1963, 1964, 1965, and 1966 are part of the window. The year 1967 is excluded.

[8]Strictly speaking, I have no interest in the term α_{it}^w, but estimating an equation without intercepts creates unnecessary complications.

more than 3.5 percent a year on average over a 7-year window and accelerate by at least 2 percentage points during the same period, compared to the previous 7-year window.

Having calculated the fitted growth rates and after applying the filtering criteria, it is still necessary to identify the beginning year of each episode. This is because in most cases a number of contiguous years will satisfy the growth and acceleration thresholds. For example, a country's capital per capita may grow on average more than 3.5 percent and accelerate more than 2 percent over the 7-year windows beginning in 1973, 1974, and 1975. It is therefore important to rule out two of these three candidate years. This is accomplished using Chow tests for each candidate year separately, and then compare the goodness of fit for each one. Formally, I estimate:

$$ln(k_{it}) = \alpha_i + t[\beta_{1i}(t < \tau) + \beta_{2i}(t > \tau)] + u_{it} \tag{1.2}$$

Where $(t > \tau)$ is an indicator function that is equal to one for the candidate year τ and the years afterwards, and zero otherwise, and $(t < \tau)$ is an indicator function that is equal to one for the years before the candidate start year τ and zero otherwise. Equation (1.2) is a spline regression with a common intercept.

My routine runs (1.2) setting τ equal to each year on my sample, and for every country. I then obtains the regression F-statistic.[9] I then choose the candidate year for τ that yields the maximum F-statistic as the starting year of the investment acceleration episode. Notice that I am not testing for structural break. Rather I am assuming that the break exist. Finding structural break is the job of the filter.[10] Here I am picking what it seems to be the year that makes such break more likely. Furthermore, I allow for overlapping episodes, provided

[9]Thus, I set $\tau = 1960$, $\tau = 1961$, $\tau = 1962$, and so on, for each country on the sample.

[10]Thus, it is possible that either β_{1i} or β_{2i}, or both, are not significant, but this is hardly the case if the filter does a god job detecting episodes.

that the starting dates are at least 5 year apart. For example, if the starting date chosen by (2) is 1970, and 1975 satisfies the criteria a), b), and c), I consider it as another separate episode.[11]

In order to ensure the robustness of the empirical results presented in the next sections I also apply the episode filter using increasingly "stricter" growth and acceleration thresholds. The "strict" filter considers the case where the average annual growth rate of capital per worker exceeds 5 percent and accelerates by at least 3 percentage points. The "very strict" filter then raises the thresholds to 7 and 4 per cent respectively. While the first filter picks up 189 episodes, the second picks 100, and the third a total of 38.

Figure 1.2 shows a typical episode detected by the first filter. I choose the case of South Korea because it is well know for it recent history of fast growth. The dashed red lines are placed on the episode starting years. They clearly look like structural breaks in the series of per capita capital stock. It is a well know fact that capital accumulation accelerated very fast after a devaluation in 1964, and that South Korea sustained growth at a rapid pace afterwards for at least three more decades. Our filter does a good job and detects an episode right after that devaluation. Growth also gained momentum during the mid 1970s and 1980s, as it is reflected on the figure. Notice that for a fast growing country like South Korea, successive episodes require an increasing growth rate of capital per capita. Indeed, growth increased from 7.91 in the first episode, to about 10.2 and 10.7 in the second and third, and comparing the 7 year period before each episode, growth accelerated by 7, 2.81 and 3.12 percentage points.[12]

[11] I follow Hausmann et. al. (2005). They suggest this, but surprisingly, their list of episodes does not feature any overlap.

[12] Notice these are "OLS" growth rates, not simple averages. They were estimated using (1.1).

Tables 1.2, 1.3, 1.4 , 1.5, and 1.6 include the full list of episodes (using the first filter). Episodes seems to be a relatively common phenomena. Even countries that are not associated with fast growth (i.e., Sub-Saharan African countries) seem to have experienced several of them. However, our filter does not pick an abnormally large number of episodes. Excluding all the years during which an episode cannot take place, Hausmann et. al. find an unconditional probability for the occurrence of an episode of about 2.68%. Using a similar approach, I find that the unconditional probability of the occurrence of an episode is 2.25%, slightly below the figure reported by Hausmann et. al. for GDP growth.[13] This number looks reasonable, considering that I am using a different data sample and our variable of interest is capital accumulation and not per capita output.[14]

Table 1.7 displays the unconditional probabilities by decade and region (using the first version of the filter). These probabilities were calculated by taking the ratio of the number of episodes in each region during a particular decade divided by the total number of years an episode could take place. Overall, Europe and North America have the lowest probability (a little bit more than 1 per cent) of an episode taking place while East Asia has the highest (3.95 per cent). The former is what one would expect if there are diminishing returns to capital accumulation in the Solow sense; richer economies endowed with larger per capita capital stock tend to growth slower. Among middle and low-income countries, Sub-Saharan Africa has the lowest probability (2.06 per cent). In terms of decades, the 1970s and the

[13]The unconditional probability is defined as the ratio of episodes over the number of years where an episode can potentially take place. I exclude the second, third, fourth, and fifth year from an episode, because an episode cannot take place then. The years before 1956 and after 2005 are also excluded because due to the nature of the filter, an episode can only be identified between 1956 and 2005 (there is not enough data before and after).

[14]Using data from Penn World Tables 8.1, I find a probability of around 3% using GDP per capita instead of capital stock per capita.

2000s have the highest probability of an investment surge for any region, with a probability of 2.99 and 4.5 per cent respectively.

I also estimate the probability of an episode taking place for each quintiles of per capita income, where the first quintile denote the 20 % observations with the lowest income per capita, and the fifth quintile the 20 % observations with the highest income, in both cases on a given year.[15] As reported in table 1.8, countries in the middle quintile of global income are the most likely to experience an investment surge. This result appears to contradict the literature that suggest that there is a "middle income trap", but it is consistent with the recent findings of Ye and Robertson (2016), who find that only a small fraction of countries identified as "trapped" are actually in a trap. Moreover, this is to be expected if the investment surge is associated with accumulation in the modern sector and the depletion of the pool of hidden unemployment in the backward sector (see section 1.5 for a discussion). And not surprisingly, the upper-most income quintile has the lowest probability of the occurrence of an episode.

1.3 Empirical Analysis

What factors can trigger episodes? To answer, I analyze what variables can explain the turning points in the series of per capita capital stock. Because there is some uncertainty regarding the precise starting date, I create a dummy variable that takes the value of one the first year of an episode, one year before and one year after, and zero otherwise. That dummy variable is included as the dependent variable in a series of limited dependent variable models. The years where an episode cannot take place (before 1956, after 2005, the third, fourth,

[15]This procedure avoids the obvious problem of comparing the income of country in 1950 with the income of the same country in 2000, because the distribution is computed for each year separately. Thus, even if Congo doubled its per capita income from 1950 to 2000, what matters is the per capita GDP compared to the per capita GDP of the rest of the sample in each year.

and fifth year after the starting of an episode) are excluded, as suggested by Hausmann et. al. (2005).

As control variables I use covariates that reflect external and internal factors, policy and institutional aspects that may trigger a structural change in the rate of capital accumulation. All these variables were selected to control for all the potential factors highlighted by the literature on the determinants on investment. The timing of the control variables is the same as the starting date of each episodes, but some covariates are defined as averages of the previous 3-5 years. I describe these main control variables in some detail, and the next sub-section presents the Probit analysis to explain factors that trigger episodes. The table 1.9 contains a short description of the variables, as well as their precise definition:

1. To control for macroeconomic conditions and economic policy, I include Rodrik's (2008) undervaluation index (*Underval81*), the degree of fiscal procyclicality (*Fiscal*), the one year lagged rate of per capita GDP growth (*Lag_Growth*), the one year lagged per capita capital stock (*Lag_KL*), the rate of inflation (*Inflation*), and an index of exchange rate stability (*XR_Stability*).[16] The expected sign of the undervaluation index is positive, as a recent literature suggest that real exchange rate undervaluation may favor growth (Rodrik 2008, Razmi, Rapetti and Skott, 2012). The lagged growth rate is included to capture the accelerator effect, so fast past growth will increase the likelihood of an episode. The lagged per capita capital stock accounts either for convergence or for the presence of sluggish adjustment of the capital stock, so a larger per capita

[16]To compute the undervaluation index, I follow Rodrik's three step procedure: i) I construct a real exchange rate index using relative prices from Penn World Table 8.1; ii) I regress our real exchange rate index on per capita GDP and a set of time fixed effects; iii) I estimate the residuals from the previous regressions to construct the undervaluation index. The residuals constitute the undervaluation index. A positive residual denotes "undervaluation", while a negative residual denotes "overvaluation".

capital stock will decrease the likelihood of an episode.[17] Regarding fiscal procyclicality (measured as the correlation of the de-trended government consumption to de-trended GDP), I expected a negative sign, as more pro-cyclical policies increase the volatility of the economy, and higher volatility may increase the required rate of profit to justify investment decisions (holding everything else constant, this reduces investment). The relation between inflation and growth is non-linear, so the expected effect of inflation is positive when inflation accelerates from very low levels, but negative once inflation hits a threshold that the literature places somewhere between 20-40 percent (Bruno and Easterly, 1998). Finally, exchange rate stability can favor investment, but a stable exchange rate may reflect the adoption of a hard peg which are notorious for exhibiting a tendency towards real exchange rate overvaluation and crisis. However, I also control for crisis and real exchange rate undervaluation, so more exchange rate stability should have a positive effect on capital accumulation and growth, once these effects are taken into account by our other control variables.

2. To control for external factors, I include a variable that captures net capital flows to GDP (*NET_Inflows*), the FED reserve Federal Funds interest rate (*FFend*), an index of the US stock market volatility (*Global_uncertainty*), an index of terms of trade (TOT), the "de facto" degree of trade openness (*Trade*), and the degree of capital account openness (*KA_open*).[18] The expected sign of capital inflows is ambiguous, as

[17] Thus, if capital per capita changes as a function of the difference of the "target" and the "actual" level of per capita capital stock, an increase in capital stock may lower the rate of capital accumulation. As an example, consider the following specification $\dot{k} = \alpha(k^* - k)$, where $\dot{k}$ is the change in per capita capital stock, α is the adjustment speed, k^* is the target per capita capital stock and k is the actual per capita capital stock. It follows that $\frac{\partial \dot{k}}{\partial k} < 0$.

[18] The original data on capital flows comes from Broner et. al. (2013), and it is presented as a ratio of the trend of nominal GDP, to reduce the influence of short-run fluctuations and presumably the effects of price and exchange rate changes. Because the balance of payments data is current dollars, GDP at current prices should be used. There seems to be a problem with Broner et. al. data: the figures on total NET inflows

they could increase total investment, or they could crowd-out productive investment if flows are mainly portfolio flows (i.e., they can appreciate the real exchange rate and reduce manufacturing investment). For the same reasons, the sign of the degree of capital account openness is also ambiguous. To gain further insights, I eventually replace capital inflows by the variables (*Port_Inflows*), (*FDI_Inflows*), and (*Reserves*) that represent portfolio and FDI net inflows, and the change in gross foreign exchange reserves.[19] Increases in Federal Funds interest rate and in the volatility of the stock market may increase financial constraints and reduce credit, thus I expect them to have a negative effect on capital accumulation. Higher terms of trade can boost investment in favored sectors, but they can also have negative repercussions due to "Dutch-Disease" effects. Finally, countries that are more open to trade can exploit the economies of scale of the world market, so an episode is more likely in more open countries. But in the past some inward oriented strategies also featured a very fast growth thanks to a protected manufacturing sector (i.e., Brazil in the 1960s and 1970s), so the expected sign of the trade variable is also ambiguous.

3. To control for other internal factors, I include a variable that reflects the presence of crises (banking, currency, debt, etc.) in the 5 years before an episode (*Crisis_5y*), the share of natural resource rents on GDP (*Rents*), and per capita GDP (*Capita_GDP*). The expected sign of the crisis variable is negative, as the presence of crises may severely disrupt long-term prospects, depressing investment. The variable (*Rents*) proxies for natural resource availability or for natural resource dependence, and as such it can have

seems to be 100 times larger than the figures of each component individually considered. Thus, I choose to multiply the original data by 1/100. This produce a set of consistent estimations.

[19]The variables *Port_Inflows*, *FDI_Inflows*, and *Reserves* are constructed using a similar logic than *NET_Inflows*, and they contain the 3 year average of net portfolio and net FDI inflows, and the change in the foreign exchange reserves, divided by the trend of nominal GDP. The same procedure was used to construct the variable *NET_Inflows*.

opposite effects on capital accumulation; an increase in the stock of natural resources that can be profitable exploited may enhance investment in natural-resource intensive sectors, but it may also generate "Dutch-Disease" effects, reducing investment in the manufacturing sector. Finally, the expected sign of per capita GDP is ambiguous, as the relation between income and the likelihood of an episode is non-linear (the results depends on whether convergence holds or not).

4. To control for institutional characteristics, I include a human capital index (*Human_Capital*),[20] and the durability of the political regime (*Durable*).[21] I expect an ambiguous effect of the human capital index on the likelihood of an episode; the reason is that the effect of income and education and growth and capital accumulation is notably non-linear; positive if we start from a low level of development, but possibly negative after some middle-income threshold. Regarding the durability of the political regime, the expect sign is also ambiguous, as political and institutional stability can favor economic stability, but they can also lock in policies that are not conducive to economic growth.

The table 1.10 defines the control variables and presents their summary statistics, as well as their expected effect (+/-) on the likelihood of an episode taking place. In the next section I present the baseline specifications, robustness tests and additional results.

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[20]The Human Capital Index from Penn World Tables 8.1 is based on years of schooling (Barro and Lee, 2013) and the returns to education (Psacharopoulos, 1994).

[21]I tried other variables related to the quality of the institutions (prevalence of civil wars, indexes of the quality of democracy), but they often result in non-significant coefficients, their signs change depending on the specification, and so on.

1.3.1 Episode Determinants. Main Results

To analyze the determinants of sustained investment surges, I introduce our episode dummy as the dependent variable on a series of Probit regression that features the set of control variables described in the previous sections. The table 1.11 show the baseline results.

My findings suggest that some variables consistently stand out as statistically significant at standard levels.[22] More precisely:

1. The degree of real exchange rate undervaluation (*Underval81*) correlates positively with the likelihood of an investment surge episode taking place. A one percent increase in the undervaluation index raises the probability of an episode by between 2.9 to 7.7 percent, depending on the specification. These results are statistically significant at 1 or 5 per cent.[23]

2. The lagged per capita growth rate (*Lag_Growth*) correlates positively with the likelihood of an episode. A one percent increase in the previous year growth rate raises the probability of an episode by between 57.6 and 80.3 percent, depending on the specification. This is a very large number, and these results are always statistically

[22]Through this paper I stick with Probit as the baseline model, and I choose to report the average marginal effect. Reporting the marginal effects holding the other variables at their sample means is another common option, but some of our results (in particular when our sample becomes small due to the inclusion of covariates with limited coverage) feature very low coefficients. This is specially true for the estimations that use the second and the third version of the filter. There is not specific reason why marginal effects evaluating everything else at the sample mean is representative, and thus the average marginal effect may be preferable. However, this creates an additional complication, as some of the programs for the models from the Logit family presented in tables 1.1 and 1.2 on the Appendix A, the Re-logit and the Firth Logit (see columns 2 and 3), do not permit to estimate the average marginal effects. In that case I report the log of the odd ratios (I explain their interpretation soon). The only purpose of that set of tables is to check parameter consistency, so that is enough.

[23]Notice these results suggest that the level of the real exchange rate affects the rate of growth. See section 1.4.1 for a discussion that involves changes in the real exchange rate and their effects on the likelihood of an episode taking place.

significant at 1 per cent, which suggest that the accelerator effect is an important driver of sustained capital accumulation.

3. The lagged per capita capital stock (*Lag_KL*) correlates negatively with the probability of an episode taking place. A one percent increase in the previous year per capita capital stock lowers the probability of an episode by between 2 and 14.4 percent. These results are always statistically significant at 1 per cent confidence. This may suggest the presence of convergence or adjustment cost and lags in the dynamics of the capital stock. However, per capita GDP and human capital are positively correlated with the likelihood of an episode; a 1 per cent increase make an episode between 8.2 and 8.3 per cent more likely for GDP, and between 12.5 and 13.2 per cent for human capital. This suggest that unconditional convergence does not fit the facts. Adjustment cost or conditional convergence are a better story.

4. The ratio of net capital flows to the nominal trend of GDP (*NET_Inflows*) in the previous 3 years significantly decreases the likelihood of an investment surge. The average marginal effect varies between -0.003 to -0.004, so a 1 per cent increase in the ratio of capital flows to GDP seems to reduce the likelihood of an episode taking place between 0.3 and 0.4 percent points. Notice that when I include portfolio flows (*Port_Inflows*), FDI flows (*FDI_Inflows*), and the change in Reserve assets (*Reserves*) separately (columns 5 and 7), only the portfolio flows are statistically significant. This suggest that "speculative" portfolio flows, and not "productive" FDI flows seems to produce the observed result.[24]

[24] However, the definition of portfolio flows and FDI flows is based on conventions. Not all the FDI flows are productive. A purchase of less than 10 per cent of the existing assets is classified as "portfolio", but more for larger purchases the flows are classified as "FDI". Moreover, FDI flows include both the purchase of existing assets and new plants.

5. Increases in the Federal Funds rate (*FFend*) or in the US stock market volatility (*Global_Uncertainty*) lowers the likelihood of an episode taking place. This suggest that changes in the international context matter. Either because the financial condition explain downturns and upturns in the US business cycles, or because they influence global liquidity. A 1 percentage point increase in the Federal Funds rate reduces the likelihood of an episode taking place by about 1.1-1.6 percentage points. Interestingly, during the period of the late 1970s, when the Federal Funds rate increase dramatically, the number of total episodes falls considerably. During the 1982, when the Latin American Debt Crisis started and financial markets were in a state of turmoil, no new episodes started. These results are statistically significant at 1 or 5 percent.

6. Higher inflation, captured by (*Inflation*), seems to reduce the probability of an episode taking place. The effect ranges from -0.031 to -0.088, although not all the coefficients are significant at standard levels, and only the last two are significant at 10 per cent. In words, a 1 percentage increase in the rate of inflation makes an episode about 3.1 or 8.8 percentage point less likely. This result is consistent with the findings that show that high inflation is bad for growth (Bruno and Easterly, 1998); however, the relation is probably non-linear, so our specification may not capture the entire story.

7. Human capital and per capita GDP are positively associated with the probability of an episode taking place, and the results are significant. More precisely, a 10 per cent increase in the human capital index increases the likelihood of an episode by around 1.2 - 1.3 per cent, while a 10 per cent increase in per capita GDP seems to raise it by about 0.8 percentage point. These results are statistically significant at 1 and 5 percent. This is consistent with out previous results, and suggest that absolute convergence does not hold. Poorer countries are less likely to experience an episode than richer countries.

8. The durability of the political regime seems to reduce the probability of an episode taking place, but by a very small amount. A 1 per cent increase in the duration lowers the probability by 0.1 percent. That is a very small number, and the results are significant at 10 percent in one specification, and at 5 percent in the other. In table 1.10 we can verify that the variable *Durable* ranges from zero to 202 years, with an average of about 22 years. Thus, an increase in 1 years lowers the probability of an episode taking place by about 0.5 percent.

To my surprise, factors such as the terms of trade or the natural resource rents are not statistically significant (at least not consistently). The results say that natural resources and terms of trade do not explain why episodes take place, but they also say that these factors do not explain why episodes do not take place either. In other words, natural resources and terms of trade are neither good or bad for capital accumulation: according to our estimation they are irrelevant.[25]

Could reverse causation be an issue, however? I should note that the structure of the exercise minimizes this possibility. I am looking for correlates from data that include the years that precede the investment episodes (at least for some covariates). Strictly along the time dimension reverse causality is probably not an issue. Next, let's take a look at some of the significant variables, starting with the undervaluation index. An investment boom that increases domestic spending in the non-tradable sector should *appreciate* the real exchange rate through the spending channel, for instance in a simple Mundell-Fleming framework. The baseline monetarist framework that incorporates purchasing power parity and some version of the quantity theory should also predict a similar effect through the real balances channel. Moreover, analysis in a portfolio framework with imperfect substitution between money and

[25] A word of caution. As in any regression, this could reflect the fact that in some episodes natural resources and terms of trade are extremely important, while in some others they are not, or it could reflect the fact that they do not matter.

other assets should lead to qualitatively similar expectations. In all these cases, reverse causality works in a direction that leads us to believe that the effect of undervaluation is, if anything, biased downwards (i.e., capital accumulation is associated with real appreciation and possibly with currency overvaluation if the real exchange rate appreciates too much).

One could construct a scenario where an *unanticipated* and *permanent* productivity shock in the non-tradable sector leads to both a real depreciation and a boost to investment. It is also possible that future changes in productivity may trigger growth today, so reverse causation is, in principle, possible for growth rate. I plan to examine this possibility in the subsection that explores the role of leads and lags.

Consider now the lagged capital stock. The negative sign indicates that, if there is reverse causation, then an investment episode leads to a fall in the per capita capital stock, a very unlikely scenario. A similar reasoning applies to capital flows, the Federal Funds interest rate and the rate of inflation. If reverse causation is a problem, then an episode should trigger a capital outflow, a reduction in the Federal Funds rate, and a reduction in the rate of inflation. All of these scenarios seems very unlikely. If anything, an episode should lead to capital inflows and an increase in the rate of inflation, and presumably no effect on the Federal Funds rate. Summing up, causality is probably not a important concern.

1.4 Robustness and Other Results

To tackle the question on how robust are the results, I present a set of alternative specifications. Perhaps the main source of concern is the sensitivity to sample changes. As I include additional covariates, some of the previous results may fail to hold. A way to mitigate this problem is to stick with the smallest sample possible. Thus, I eliminate all the observations that do not have the entire set of covariates. The results are displayed in table 1.12. It is very good news to see that the results hold using the smallest sample possible.

On the next set of tables I replicate the results displayed 1.11 using OLS and Logit (tables 1.13 and 1.14) instead of Probit.[26] As a general rule, the results hold, except that *Underval81* is not significant in the last two columns for the Logit models. The Appendix A presents other models from the limited dependent variable family, for robustness control.

As another check, I implement the baseline specifications, but using the second and third versions of the filter, which are more strict. The second filter considers the case where the average annual growth rate of capital per capita exceeds 5 percent and accelerates by at least 3 percentage points. The third filter raises the thresholds to 7 and 4 respectively.[27] The main plot holds, but with a few exceptions. Using the second filter (see table 1.15), crises in the past now account for a reduced likelihood of an episode taking place, while per capita GDP is not significant in one specification, and significant at 10% in the other one. Moreover, the capital flow variables no longer explain episodes, except for reserves (which increase the likelihood of an episode taking place). Finally, natural resources seems to affect the likelihood of an episode taking place using the third filter (see table 1.16), but the sign is not stable and the coefficient is very small (between -0.002 and 0.001). Notice that comparing the third filter with the first, undervaluation becomes more important (at least in the last specifications), while lagged growth and lagged per capita capital stock diminish their impact on the probability that a typical episode takes place.

[26]The interpretation of the OLS models is a little bit tricky. Take for example the coefficient associated with the degree of undervaluation in column number 1 of table 1.13, equal to 0.031. In words, an increase of 1 per cent in undervaluation increases the Episode Dummy by 3 per cent, and the result is significant at 1 per cent. However, if I predict the underlying probabilities, they may not be bounded by 0 and 1. Nevertheless, the coefficients are unbiased if the usual assumption are satisfied. Roughly speaking if the error term is uncorrelated with the explanatory variables, there are no measurement errors in the independent variables, and so on.

[27]Keep in mind that this reduces the number of episodes from 189, to 100 and 38, so an episode becomes are very rare events as we add covariates. Luckily, the Re-Logit and Firth-Logit models (designed to deal with rare events) suggest that this is not an issue. See the Appendix A for the results using these models.

For additional robustness checks, I modify the basic filter in different ways. It may be argued that the best criteria for choosing a starting date is simply to pick the first year that meets the three criteria of the original filter. One set of specifications exclude the Chow test, so I choose the starting date based on a "first come first serve basis" (the first year that is selected by our filter is automatically selected as the starting date). The other sets of specifications change the size of the window from 7 year to 5 and 9, and I consider total capital accumulation rather than per capita capital accumulation. These alternative specifications are necessary because the size of the window on the original filter is arbitrary, and because total capital accumulation is also be a very meaningful variable on its own.

The table 1.17 display the results excluding the Chow test, and they suggest that there are no fundamental differences when compared with the baseline results. The tables 1.18 and 1.19 shows what happens when I use a 5 and a 9 year window. Shortening the window seems to "kill" the significance of some coefficients (see columns 3, 4 and 5 for undervaluation and inflation), but other variables are still significant (i.e., human capital). Using a 9 year window suggest that the previous result still hold, but now the terms of trade and natural resource rents seems to decrease the likelihood of an episode taking. This may suggest that the factors that explain longer episodes may differ from the factors that explain shorter episodes. I explore the issue of sustainability in more detail in the section 1.6. The results in table 1.20 suggest that using total capital stock rather than per capita capital stock does not affect the main results except for human capital and per capita GDP (depending on the specification), but other variables like de facto trade openness, capital account openness and inflation become highly significant.

Finally, I consider an alternative undervaluation index. This is one of the most interesting variables due to a new literature that analyzes the relation between growth and real exchange rates (as the aforementioned study by Rodrik, 2008). Because there are multiple ways to define real exchange rate misalignment, it makes sense to try alternative definitions.

Consequently, I replace *Underval81* with *PPP*, an index constructed using IMF multilateral real exchange rate, taking the deviation from the sample mean (for each country).[28] This new variable captures deviations from Purchasing Power Parity (and hence the name *PPP*), provided that we believe that the real exchange rate reverts to its mean during the span of our sample, which includes up to around 35 years between the 1970s and the 2000s. Although it may seems strange to omit the Balasa-Samuelson effect, it is by no mean clear that PPP is a bad theory of exchange rate determination in a very long-run sense, and some studies were able to find supporting evidence for it using non-linear econometric techniques (Taylor et. al. 2001). Notice that there is an extra difficulty when comparing the results, as *PPP* includes only one third of the observations than the most basic results (column 1).

The table 1.21 displays the results using this new real exchange rate misalignment index.[29] While in some specifications the effects of *PPP* on the likelihood of an episode taking place are no longer significant, the size of the effects is very similar to our original specification, except for the first estimation, which suggest a rather weak average marginal effect of around 0.009. However, we should keep in mind that these results suggest that exchange rate does not matter, or that *PPP* is not the best theory to define the implicit notion of equilibrium real exchange rate.

1.4.1 Large Changes in the Covariates

In this subsection I adopt a different approach to analyze the determinants of sustained investment episodes. Instead of the levels of the covariates, I introduce "covariate-booms",

[28]Notice that unlike *Underval81*, each level of this real exchange rate index is meaningless when considered alone, and it cannot be compared across countries. An effective real exchange rate of 100 for Brazil is not necessarily lower than 120 for Belgium, but we can compare it with a 90 for Brazil during a different time period.

[29]A positive PPP index denotes "undervaluation", while a negative value denotes "overvaluation".

that capture abnormally large changes in the independent variables (i.e., extremely high terms of trade, large changes in the degree of capital account openness).

To capture these large changes, I create the new variables *Underval_change*, *Growth_boom*, *Rents_boom*, *TOT_boom*, *Trade_boom*, *KAopen_boom* and *NET_boom*[30]. These are dummies variable that are equal to one when the average change over a 3 year period is on the upper 5th quintile of the original variables (Undervaluation, per capita GDP Growth, Natural Resource Rents, Terms of Trade, Trade Openness, Capital Account Openness and NET capital inflows). I also add the variables *Regime_change* and *Fiveregime*, defined as the average change over 3 years of the Reinhart and Rogoff (2004) exchange rate regime index, and a dummy that takes the value of one if there is a change of more than three points (up or down) in the polity index.[31]

Almost all the expected signs are ambiguous (except for growth) because all the variables may reflect very favorable conditions, but they can also have important side effects (as the "Dutch Disease") or reflect crises (i.e., large changes in the undervaluation index, changes in the Reinhart and Rogoff index, or changes in the Polity IV index of democracy). The table 1.22 displays the results. Four variables stand out:

1. A change in the exchange rate regime (*Regime_change*) correlates negatively with the likelihood of an investment surge episode taking place. As the index classifies countries into hard pegs (1), soft pegs (2), intermediate (3), freely floating (4), "freely falling" (5), moving up means adopting a more flexible regime.[32] Thus, a jump from one

[30]I also include a "boom" variable for FDI and Portfolio flows, as well as the change in reserves.

[31]The "Coarse" classification from Reinhart and Rogoff includes 5 categories, from the less flexible (1) to the more flexible (5). Hence, higher values means more flexibility. The source for the political index is the Polity IV database; the index provides scores from -10 (less democratic) to 10 (more democratic).

[32]Number (5) represents currency crises, and it is associated with observations with more than 40 percent of inflation.

category to the next one reduces the likelihood of an episode by around 1-2 percentage points.

2. Very high growth rates (*Growth_Boom*) significantly increase the likelihood of an investment surge taking place. The average marginal effect varies between 0.050 to 0.067, an important effect. A "growth boom" increases the likelihood of an episode taking place by 5 or 6.7 percentage points.

3. Large natural resource discoveries, captured by (*Rents_boom*) increase the likelihood of an episode taking place. The average marginal effect varies between 0.031 to 0.043 depending on the specification, which translates into an increase in the probability between 3.1 and 4.3 percentage points.

4. Large increases in the degree of trade openness, captured by (*Trade_boom*) increase the likelihood of an episode taking place, provided that I include capital flows and political variables (as in columns 4 and 5). The magnitude of the coefficients varies between 0.029 to 0.037 on the significant specifications.

Overall, these results also suggest that accelerator effects, exchange rate stability, natural resources and trade openness seems to be very important determinants of investment surges. While the first two results are consistent with the baseline findings, the last two are not. This may suggest that natural resources and trade openness are non-linearly related with the likelihood of an episode taking place.

1.4.2 Lags and Leads

The previous specifications do not directly address the issue of non-contemporaneous effects of the different covariates on investment. By construction, my regressions analyze the impact of the control variables on the contemporaneous probability of an episode taking place. The definition of our dependent variable already captured some of the uncertainty regarding the starting point of an episode, and some variables (like those related to capital flows, the crisis variable, and the degree of fiscal procyclicality) are defined as averages over a three or five year period before an episode.

But what if an increasing in one of these variables three years ago (even if it is already an average of past values) makes an episode more likely today? In this section I introduce lags and leads up to five years for some control variables that may have a non-contemporaneous effect on capital accumulation, such as the undervaluation index, the growth rate, the per capita capital stock, the terms of trade, the share of natural resource rents, and the net capital flows variables.[33] To avoid any multicolinearity issues, I exclude all the other covariates and include the lags and leads one by one. I report the results including only 1, 3 and 5 lags or leads.

The results using lags are reported in the tables 1.23, 1.24, and 1.25, while the results for leads are presented in the tables 1.26, 1.27, and 1.28. Let us take a look at the estimation that use lags first. The variables become less significant, but the sign are consistent with the previous results. Including only the lags shows that the effect of undervaluation is significant and positive, while the effects of capital flows are negative, but usually not significant (results not reported here). Lagged per capita capital stock is statistically significant in all the specification with any lag combination, but the size of the effect is very small (for practical purposes, is almost zero). Interestingly, terms of trade become significant in several specifications and the sign is still negative.

[33]While lags are useful to capture non contemporaneous effects of the covariates on the probability of an episode taking place, leads can help to uncover reserve causality and endogeneity issues. Consider for example the effect of undervaluation. If future undervaluation is positively correlated with the likelihood of an episode taking place, this may suggest that reserve causation could be an issue, or that expectations of future level of the real exchange rate matter.

Regarding the estimations that use leads instead of lags, the capital stock per capita and the growth rate stand out as the most significant variables, with the same sign as in the original estimations. This is good news because it suggest that the result are robust, but it increases our concerns regarding endogeneity issues. The result may suggest that future growth is responsible for turning points in investment, or alternatively, it could be the case that there is reserve causality between capital accumulation and growth.

Table 1.29 displays an estimation using a full battery of lags and leads (as well as contemporaneous effects) of growth and capital stock per capita on the probability of an episode taking place. We can see that including lags, leads and contemporaneous effects does not destroy the statistical significance of the coefficients associated with the growth rate, before, after and during the beginning of an episode. This suggest that fast growth precedes a typical episode. Thus, it seems more likely that future growth matters because of the effects on investment during the last phase of an episode, rather than because agents anticipate the future rates of growth. Alternatively, capital accumulation also matters for growth (there is reverse causation). I cannot choose among any of these possibilities with the evidence that I have at hand, and more work may be need to asses the importance of expectations or the endogeneity of growth in my estimations.

1.4.3 Determinants by Country Type

This section explores the determinants of episodes by country characteristics. I separate the sample into Manufacturing and Non-Manufacturing countries. To create the classification, I combine information on the share of value added of the manufacturing sector on total value added and the share of manufacturing exports on total exports. The data comes from World Development Indicators rather than from the Groningen Growth and Development Centre (which will be used in the next section), because the former has a broader coverage.

When both the value added and the export shares are larger than the year world average in most of the sample (at least in half of the years), I consider that country as manufacturer producer for the entire sample (1950-2011). When very little data is available (some countries have less than 10 or even 5 observations for one of the series), I only consider the longer series. When no data exist that country is excluded, except a well known example: there is no data for Taiwan, but I included into the group of manufacturing countries. Countries like French Polynesia, Haiti, Kosovo, Puerto Rico and New Caledonia are classified as manufactures according to World Development Indicators data, but there is no PWT 8.1 capital stock data for them, so at the end of the day they are out of the sample and I do no bother to classify them. The rest of the countries are de facto considered non manufacturer producers, even if there is no World Development Indicators data for them.[34]

Table 1.30 contains the results for manufacturing countries only, while the table 1.31 show the same results for the group of non-manufacturing countries only. It worth to notice several features of the results. The degree of real exchange rate undervaluation matters for the first baseline specification only for manufacturing countries, while it only matters for the last specification for non-manufacturing countries. The reverse seems to be true for the lagged growth rate and the lagged capital stock.

Rather than a true difference due to the variables included, this could be a side-effect of using different samples. There seems to be no clear picture. To control for this, the tables 1.32 and 1.33 use the smaller sample possible. This exercise suggest that undervaluation

[34]The final list of manufacturing countries is: Armenia, Austria, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Cambodia, Canada, China, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, El Salvador, Estonia, Finland, France, Germany, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Korea, Kyrgyzstan, Latvia, Lesotho, Lithuania, Macao, Macedonia, Malaysia, Malta, Mauritius, Mexico, Morocco, Netherlands, Pakistan, Philippines, Poland, Portugal, Romania, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Taiwan, Tajikistan, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, United States, and Vietnam.

seems to be more important for the non-manufacturing group, and that lagged growth is more important for the manufacturing group.

Human capital and GDP per capita seems to be very important for manufacturing countries, a result consistent with the new literature on economic growth that emphasizes divergence due to increasing returns (a feature that seems to be more prevalent for manufactures). FDI flows are significant and positive for non-manufacturing countries; moreover, the capital flows variable display a similar pattern than in our original results, but the effects seems to be larger for manufacturing countries (thus, the size of the coefficient seems to be more than twice as a large in manufacturing countries, -0.009 vs. -0.004 for non-manufacturing). As in the baseline results, global factors seems to decrease the likelihood of an episode in both types of countries.

As a second exercise, I consider whether non-developed countries are "different".[35] My first set of specifications includes countries for Africa, Asia and Latin-America only. Other classifications are possible. For example, Rapetti, Razmi and Skott (2012b) consider three alternative definitions of developed countries: 1) Rodrik's criteria (GDP per capita larger than 6.000 US$ using a PPP measure), "'Developed I"; 2) A per capita GDP larger than 50 per cent of the US per capita GDP, "Developed II"; and 3) the standard classification of international organizations such as the IMF and the World Bank, "Developed III".

Tables 1.34, 1.35, 1.36, 1.37 include the results, for Asian, African and Latin-American countries only, and countries that do not satisfy the criteria (1), (2), and (3), respectively. It is possible to verify that some variables are still significant and very important. More precisely, lagged growth and lagged capital stock have the same sign as in the baseline specifications, and they are significant at standard levels. The variables associated with the international

[35]The literature on the effects of real exchange rates on growth suggest that non-developed countries are indeed different. The real exchange rate is a more important macroeconomic price than for developed countries (Razmi, Rapetti, and Skott, 2012b; Rodrik, 2008).

context, capital flows and crises are almost always significant and have the correct sign, and the coefficients are a little bit larger (which make sense for the case of non-developed economies). The variable undervaluation has the correct sign in all the specifications, but it becomes non-significant most of the time; although the number of observations is not that larger in several equations, in several cases its significance drops after including covariates that eliminate very few observations. This is what happens in tables 1.36, 1.37, when comparing column (3) and (4). The number of observation falls by about 5 % (not a big deal), but the effect of undervaluation becomes smaller and non-significant, suggesting that after controlling for everything else, that variable no longer matters.

To conclude this subsection, countries do differ in terms of level of development and the shares of manufactures on total GDP. But from our regressions it seems difficult to highlight a clear difference attributable to country group specific characteristics. However, it seems to be the case that while undervaluation matters for non-manufacturing countries, lagged growth is important for manufacturing producers. On the other hand, capital flow variables negatively affect almost all the types of countries, except for FDI flows that seems to make episodes more likely in non-manufacturing countries.

1.5 Episode Structure

The task for this section is to analyze the "structure" of a typical episode. By "structure" I mean the composition of output and employment. Are there any signs or evidence of structural change somewhere close to the starting date for an average episode? A priori, there are reasons to expect a "yes" for an answer. If capital accumulation is driven by growth in the modern sector, it is plausible to observe some shift of resources from other sectors, like agriculture, to manufactures.

I will also explore the evolution of exports and imports during an episode. It seems plausible that during a typical episode the tradable sector will expand by more than the non-tradable sector. This process will probably involve an increase in exports, but also more imports of capital goods and intermediate inputs. The trade balance will worsen as imports will increase faster than exports, although this may depend on the evolution of the real exchange rate.

To address the issue of structural change, I show the evolution of the shares of value added and employment of manufactures, agriculture and the tradable sector over time, including years before, during, and after an episode. I plot the mean and the 95 per cent confidence interval (the upper and the lower bound). I consider 3 years before an episode, the 7 year window, and 3 years after. Thus, an episode starts at t=4 and ends at t=10.

To construct the data, I create a new database with episodes as identifiers. This implies that there could be some degree of overlapping for some countries that experience consecutive episodes. For instance, if a country has an episode starting at 1960, and another starting at 1965, then there are two options: 1) to use the same info twice (i.e., the year 1964 is t=8 in one episode, and t=3 in another); 2) to discard one of the episodes (the second one).

I opt for option 2), so the next results that I show do not include the second episode. This seems to be the best option. This avoids the problem of counting some observations twice, but what is more important, these observations are part, by definition, of episodes of very fast capital accumulation; otherwise there will be no consecutive episodes and hence no overlap. Because these episodes of very fast growth are well-known examples of resource shifts that involve industrialization, our results are, if anything, biased against finding evidence of structural change.

The first six graphs (1.3, 1.4, 1.5, 1.6, 1.7, and 1.8) show the evolution of the share of value added for agriculture, manufactures, and the overall tradable sector, which includes the previous two plus the mining sector. The data comes from the Groningen Growth and Development Centre. The data from World Development Indicators is also available, and it has a broader coverage, but it does not include the level of disaggregation that I need, and it does not includes employment.[36]

The data shows a clear pattern that involves a falling share of agriculture and an increasing share of manufactures, both in terms of employment and value added. The share of the tradable sector seems to decline during an episode, both in terms of employment and value added. My decisions to include agriculture in the tradable sector drives these results.[37] This evidence is consistent with a "Lewisian" story of economy development (Lewis, 1954), where backward economies growth very fast by shifting resources from the agricultural sector, which has a lower level of productivity and lower productivity growth, to the modern sector. Given the productivity differentials, this shift is consistent with capital accumulation and economic growth.

If there is "hidden unemployment" in the backward sector, during this process of structural change the re-allocation of resources can take place with little wage pressures, so the profit rate in the modern sector can remain more or less constant despite fast capital accumulation. Thus, the evidence from value added and employment data is connected with the results from sections 3 and 4. For example, in an open economy set-up, real exchange rate undervaluation is associated with a high profit rate in the modern sector. The variables associated directly or indirectly with the level of real exchange rates, like capital flows, terms of trade and capital account openness, can affect the profitability in the tradable sector. [38].

[36]The full list of countries includes: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Hong Kong, Indonesia, India, Japan, South Korea, Mexico, Malaysia, Peru, Philippines, Singapore, Thailand, Taiwan, Venezuela. The period spans from 1950 to 2005.

[37]Had I choose to exclude agriculture, we will probably observe exactly the opposite. There are good reasons to include agriculture in the tradable sector, but also in the non-tradable sector. In Latin-American and developed countries agriculture is usually part of the modern sector, while in some parts of Africa and Asia agriculture is (or it was not so long ago) mainly part of the backward sector.

[38]Razmi, Rapetti and Skott (2012) provide an open economy model with a "Lewisian" flavor.

The data suggest that the process of structural change seems to be preexisting. The trends in value added and employment indicates so. The share of agriculture was declining and the share of manufactures increasing before a typical episode starts (see what happens during years 1, 2, and 3). An episode does not necessarily trigger the process of structural change, but it rather seems to be a consequence of the re-allocation of resources from the backward to the modern sector of the economy. Alternatively, an episode may be responsible for an acceleration of the process of structural change.

After the end of an episode the behavior of agriculture and manufacturing seems to differ. While the agricultural sector seems to stop shrinking, manufacturing continues to grow afterwards. This may suggest that the end of an episode coincides with a slow down in the process of absorbing the surplus of labor from agriculture. It is reasonable to expect some reduction in the rate of growth if the surplus is absorbed, but it could also be the case that growth stops for other reasons.[39]

The size of the shifts from agriculture to manufacturing suggest that the process of structural change was extremely important during the episodes. In terms of magnitudes, the fall in agriculture seems to be more dramatic than the increase in manufactures, suggesting that other sectors like services also increase their share. For example, comparing the first and the last year of a typical episode, the agricultural share of value added and employment fall from about 18 and 43 percentage points to 15 and 38, while the manufacturing share of value added and employment increase from around 17 and 14 percentage points to 19 and 15 percentage points. Of course these are well-known patters in the literature on development.

[39]For this particular finding, removing overlapping observations implies that this is a somehow more robust result, the reason being that some of the episodes will continue in the future, and in fact will lead to another episode, but because the next data is not there, the years t = 8, t = 9, and t = 10 will presumably display an ongoing process of structural change.

It is also interesting to analyze what happens to exports and imports during a typical episode. The figures 1.9, 1.10, and 1.11 show a clear pattern: both imports and exports as a share of GDP increase, but imports by more than exports, so the trade balance worsens. The numbers suggest that the trade balance worsens from an average of -4 percentage points of GDP to about -7 percentage points. This is driven mostly by an abrupt increase in imports, from about 40 to about 46 percentage points of GDP, while exports increase from 36 to about 39 percentage points of GDP. Interesting, imports seems to stabilize at a higher level after the end of an episode, while exports seem to keep growing faster than GDP.

Notice that this behavior of the tradable sector is consistent with the behavior of manufacturing and agriculture. I expect that the fast growth of the manufacturing sector requires large imports of capital goods and intermediate inputs that are usually not produced domestically in non-developed economies at early stages of development. I also expect a strong positive effect on exports that probably last longer than the positive effects on imports, for at least two reasons. Once the capital goods are installed, imports may not need to keep growing as fast as before for a while, and there could be some import substitution in the manufacturing sector.

To summarize, a typical episode of sustained capital accumulation in our sample features a certain dose of structural change. Output and employment shifts from agriculture to manufactures. Imports and exports increase, but imports growth faster, so the trade balance worsens over time. This is fully consistent with the "old" theory of development. Whether future episodes will feature the same type of structural change is a matter of debate.[40]

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[40]Some recent papers have focused on the increasing importance of services. See for example Eichengreen and Gupta (2011).

1.6 Sustainability of Capital Accumulation After Episodes

The final task is to analyze why capital accumulation is sustained after some episodes and not sustained after others. This section extend the original filter to account for the behavior of capital accumulation during the years after the end of an episode. The problem is how to define sustainability. Several definitions are possible. An easy way out is to expand the window to include up to 12 years, instead of the original number of 7. The findings using the baseline Probit models and extending the window are reported in table 1.38.

Interestingly, most of the main results hold, but the statistical significance of growth disappears once we include additional controls. This could suggest that lagged growth is not as important as in the original results. Fast growth may trigger a process of capital accumulation, but it may not be an important factor sustaining the process of long-term growth itself. Although this is surprising, because it is hard to believe that the capital stock can growth very fast without fast output growth, this could very well reflect the fact that spurts of growth are not enough to sustain capital accumulation. Another possibility is that an average episode may involve some form of capital deepening, so capital grows faster than output at least for a while.

Three new variables are now significant at standard levels. Namely, exchange rate stability, trade openness and natural resource rents as a proportion of GDP. An increase in one percent in the index of exchange rate stability makes an episode about 1.5 and 5.3 percentage points less likely. More open economies are also associated with long lasting episodes; an increase in trade openness of one percent raises the likelihood by about 4 per cent. Finally, an increase in one percent in the share of natural resources over GDP decrease the likelihood of an episode taking place by 0.2 per cent. The number may seem small, but the differences across countries and years can be very large. Specifically, in table 1.10 we can verify that the variable *Rents* ranges from 0 to about 90 per cent. Thus, a country with the largest share of natural resource rents to GDP is about 20 per cent less likely to experience an episode than a country with no natural resource rents.

A second method to analyze the issue of sustainability combines a 12 year window with the original criteria that uses 7 year. I use the 12 window to detect long lasting episodes, and then I go back to the original filter to classify as "sustained" those episodes that are selected both by the filter with 7 and 12 year windows. Because the starting dates imply some overlapping and some disagreement between the filters, I allow for a 3 year difference between them. For example, an episode may be identified for China starting in 1990 using a 7 year window, but the filter with a 12 year window may select 1993 as the starting date. In that case the original episode is classified as sustained, while if the window picks another date, let's say 1994, then the episode that starts in 1990 is not consider sustained.[41]

The main reason to resort to this procedure, rather than just sticking with a 12 year window is that now I can compare the results. The table 1.39 display the fraction of sustained of episodes by region. The fraction of sustained episodes is very large, suggesting that most episodes picked-up by the original filter are sustained. The table also shows that in Asian and European countries, the fraction of sustained episodes is larger than in Africa and Latin-America and the Caribbean. As expected, Sub-Saharan Africa displays the lower fraction of sustained episodes, but interestingly, about half of them are very long-lasting. The table 1.40 replicates the previous exercise using income quintiles instead of regions. Perhaps surprisingly, I could not find substantial differences by income levels.

The tables 1.41 and 1.42 show the econometric results using Probit models. There are not very large differences between sustained and non-sustained episodes, except for some changes in the size of the coefficients, and some changes in the statistical significance (although once again we should keep in mind that the number of observations often becomes very low). It

[41]Luckily, this overlap never happens for the episodes that also have value added and employment data.

is worth to notice that the coefficient associated with undervaluation becomes very large for sustained episodes, from 0.056 to up to 0.312. This implies that now a 1 percent increase in undervaluation makes an episode 30 percent more likely. However, non-sustained episodes are also associated with undervaluation, so we can only distinguish episodes by the degree, and not by the sign or the statistical significance of the coefficients. Per capita GDP now makes non-sustained episodes more likely.

Lagged growth is not significant in both cases, considering columns (3), (4), and (5). The sign becomes negative in table 1.41, and it is still positive in table 1.42. This is consistent with the findings displayed in table 1.38: growth seems to be more relevant for non-sustained episodes of capital accumulation.

Another method to consider sustainability issues consist in defining a new dummy variable that is equal to one when the criteria for an episode are met, and when capital per capita growth is at least as fast as 3.5 per cent in the following 7-year window. The new results using only episodes that met this new criteria are shown in table 1.43. As in other estimations, the coefficients associated with undervaluation and lagged growth become less significant in the last two estimations, but unlike in some of the previous results, now both variables have a positive sign. We should keep in mind that changes in the sample may explain these results. However, the number of observations only fall by about 40, suggesting that this is not the main issue. Against my own priors, higher terms of trade are associated with episodes where growth afterwards is as fast as during the episode. Human capital and per capita GDP are positively associated with this types of episodes, suggesting that growth is more stable after an episode in more developed economies.

As a fourth and final method, I run a Multinomial Probit defining three outcomes, no episode (=0), non-sustained episode (=1) and sustained episode (=2) (using the filter with a 12 year window to define sustainability). The results are shown in tables 1.44 and 1.45. There seems to be noticeable differences. For instance, undervaluation is no longer significant once we account for factors such as crises in the previous five years, natural resource booms, trade and capital account openness, and the like. All these factors are not significant for the non-sustained episodes. More precisely, natural resource rents, capital account openness and crises make a sustained episode less likely, while trade openness make them more likely. As before, Human Capital, and lagged growth are important drivers of sustained episodes, but they don't always matter for non-sustained episodes. Interestingly, this new set of results do not suggest that lagged growth is negatively correlated with sustained episodes, but rather the opposite seems to be true (lagged growth is associated with sustained episodes, and not with unsustainable ones).

Because the sample drops dramatically from equation 2 to equation 3 (see columns 2 and 3), the tables 1.46 and 1.47 use the smallest sample possible. These tables confirm that for non-sustained episodes, undervaluation matters, for sustained the picture is less clear: when the sample is restricted, undervaluation no longer makes sustained episodes more likely. This exercise confirms that lagged growth does not make a non-sustained episode more likely after including additional covariates, but past growth seems to predict sustained episodes, even if a stick with the smallest sample possible.

To conclude, the picture that emerges from this section is not very clear, but some factors can be highlighted. Specifically, growth is less significant and even negatively correlated with the likelihood of sustained episodes taking place on some specifications. Variables such as trade openness, exchange rate stability and natural resource rent seems matter, although this depends on how I define "sustainable" episodes. Finally, it is worth to remember that, as expected, Asian countries display the higher share of sustained episodes of capital accumulation. The reasons why Asian countries succeed remains an area for future research, as regression analysis was not able to present a clear-cut case.

1.7 Concluding Remarks

This paper has attempted to uncover the characteristics of sustained episodes of investment acceleration at the country level. I find that episodes are very common, with each country experiencing at least one in a 50 year period on average. The likelihood of an episode taking place varies non-linearly with per capita GDP. Advanced economies have a lower probability of experiencing an episode while low- to middle-income countries have higher probabilities. Usual suspects (a.k.a, East Asian countries, China and India) are more likely to experience an episode than slow growing countries (a.k.a., African countries).

My preliminary econometric exercises ask three main questions: What are the determinants of an episode? What happens during an episode? Why some episode last longer than others? Regarding the first question, the results indicate that sustained surges in investment tend to be preceded by stable and undervalued real exchange rates, low inflation, net capital outflows, fast growth in the past, high per capita income and human capital, and favorable external conditions. I do not find strong evidence that shows that natural resources or terms of trade are detrimental (nor particularly beneficial) for episodes of capital accumulation.

These preliminary results were subject of a battery of robustness tests and checks. I showed that the results hold using Probit, Logit and OLS models, and that controlling for rare events or for a nested choice structure do not lead to dramatic changes in the results. Using different specifications and alternative definitions of the filter also leads to similar outcomes. More precisely, extending or contracting the window, adding lags, changing the criteria, introducing alternative covariates or using different samples (manufacturing vs. non-manufacturing countries, developed vs. non-developed) do not make a big difference.

Regarding the second question, I find evidence of structural change. During an episode, or more precisely a few years before (the trends seems to be pre-existing), employment and value added shift from agriculture to manufactures, and imports and exports increase, but the overall trade balance worsens. These results are consistent with structural change as a source of growth, as suggested by the development literature which emphasized increasing returns, surplus labor, endogenous productivity gains, and so on. However, my sample was limited and, as a recent literature has suggested, growth and capital accumulation may be service-lead in the future.

Regarding the third and final question, I was not able to find very clear patterns that allows us to distinguish sustained from non-sustained episodes. Fast growth seems to be less significant for long-lasting episodes, more trade openness, more exchange rate stability, a closed capital account, and less dependence on natural resource rents seems to matter. However, all these findings depends on how I define sustainability. Alternatively, unobserved variables or changes in the sample may explain the aforementioned difference, but in any case the results are not very robust.

What do our results tell, when I contrast them with the findings of the literature? Although it is very difficult to compare my own numbers with the results of, for example, Hausmann et. al. (2005), due to sample and database differences, several of my findings suggest that output growth and capital accumulation seems to go hand-in-hand. The composition of episodes by income levels and regions do suggest that the lion share of both episodes based on output growth and episodes based on capital growth seems to be located in East Asian countries, but other typical low and middle income regions such as Latin-America, Africa, or post World War II Europe as well.

Thus, my findings are not in strong disagreement with those that are derived from a filter based on output, and I also find that past output growth is good for capital accumulation in the next 7-year window. It seems likely that the episodes of fast output growth also feature fast capital accumulation. A story based on the fast growth of a low capital intensive sector (which implies fast output growth with slower capital accumulation), or based on capital deepening (which implies fast capital growth with slower output growth) requires a different set of findings. The discussion and results presented on section 1.5 illustrate that the manufacturing sector typically led the expansion, reinforcing the conviction that it is generally the case that output and capital move together.[42]

Furthermore, I was able to find some evidence that variables associated with the external sector, such as real exchange rate undervaluation, and low capital inflows, make an episode a more likely event. These results are in line with Freund and Pierola's (2008) analysis that shows how large real depreciations accelerate manufacturing export growth.

[42]A constant capital-output ratio is consistent with "Harrod-neutral" technical progress (also known as labor saving), and with Kaldor "stylized facts" (Kaldor, 1961).

Table 1.1: Investment and saving across regions as a percent of GDP, 1960-2014

	Gross domestic savings	Gross fixed capital formation
East Asia & Pacific	31.7	28.4
Latin America & Caribbean	20.9	19.7
High income: OECD	23.6	23.7
Middle East & North Africa	29.0	22.1
South Asia	18.7	19.8

Source: World Bank's World Development Indicators

Table 1.2: List of Episodes (Asia)

Country	Year	K/L Growth	Acceleration
Bangladesh	1993	3.79	2.56
Bangladesh	1998	5.49	2.2
Bhutan	1981	5.24	2.26
Bhutan	1989	7.52	3.11
Cambodia	2001	6.84	4.54
China	1957	5.55	2.5
China	1972	5.56	2.46
China	1990	8.26	2.9
Hong Kong	1962	6.37	2.76
Hong Kong	1978	6.78	2.49
India	2000	6.1	2.02
India	2005	8.4	3.16
Indonesia	1971	4.08	4.56
Indonesia	1976	6.25	2.79
Indonesia	1989	7.26	2.1
Indonesia	2004	5.06	2.1
Japan	1960	9.75	2.95
Korea, Republic of	1964	7.91	7
Korea, Republic of	1973	10.2	2.81
Korea, Republic of	1985	10.7	3.12
Laos	1988	4.48	4.52
Laos	2001	7.1	3.4
Macao	1973	6.98	2.07
Macao	1991	6.92	2.61
Macao	2001	5.94	4.51
Malaysia	1967	4.73	3.62
Malaysia	1972	7.16	3.76
Malaysia	1988	7.37	3.66
Maldives	1976	9.65	8.53
Maldives	1981	10.4	4.01
Maldives	2003	11.2	4.91
Nepal	1970	4.03	3.42
Nepal	1975	5.81	2.67
Pakistan	1960	4.04	5.72
Philippines	1972	4.29	3.1
Philippines	1977	6	2.65
Singapore	1970	10.5	4.48
Singapore	1992	6	2.13
Sri Lanka	1975	4.53	2.1
Sri Lanka	2003	5.28	2.2
Taiwan	1960	3.97	3.82
Taiwan	1965	9.03	5.63
Taiwan	1970	11.4	3.1
Taiwan	1988	9.11	2.21
Thailand	1959	3.93	4.5
Thailand	1964	7.34	4.09
Thailand	1990	9.77	3.73
Vietnam	1990	8.45	6.11
Vietnam	1995	10.2	2.86

Table 1.3: List of Episodes (Africa & the Middle East)

Country	Year	K/L Growth	Acceleration
Angola	1990	3.51	4.66
Bahrain	1980	4.78	2.14
Botswana	1970	11.4	6.63
Botswana	1985	7.14	2.88
Burkina Faso	1967	3.63	3.54
Burkina Faso	1978	5.52	2.3
Cape Verde	1968	6.68	3.17
Cape Verde	2005	7.41	3.89
Comoros	1963	4.14	2.1
Congo, Dem. Rep.	1980	3.79	2.09
Congo, Republic of	1980	8.63	6.84
Congo, Republic of	2005	5.82	8.14
Cote d'Ivoire	1975	4.68	2.92
Egypt	1971	4.04	3.84
Egypt	1976	10.9	8.44
Egypt	1994	5.65	2.04
Egypt	2004	7.19	2.09
Equatorial Guinea	1971	7.47	3.11
Equatorial Guinea	1991	27.6	24.2
Equatorial Guinea	1996	29.7	11.3
Gabon	1974	8.22	3.93
Gambia, The	1988	3.76	5.36
Gambia, The	1998	4.19	2.46
Guinea	2001	6.4	4.34
Iran	1956	4.92	2.3
Iran	1965	7.83	2.03
Iran	1973	9.97	3.16
Iraq	1978	6.75	4.01
Israel	1956	3.68	2.38
Israel	1970	7.06	2.68
Jordan	1977	9.07	2.47
Kuwait	1989	8.96	10.1
Kuwait	2000	4.35	2.32
Kuwait	2005	6.7	3.64
Lebanon	1983	4.5	4.63
Lebanon	2005	4.57	4.26

Table 1.4: List of Episodes (Africa & the Middle East, continued)

Country	Year	K/L Growth	Acceleration
Lesotho	1969	3.72	3.35
Lesotho	1974	10.1	7.44
Lesotho	1990	6.41	2
Malawi	1969	6.13	2.5
Malta	1956	3.58	2.43
Malta	1965	6.3	2.48
Mauritania	1971	7.01	2.47
Mauritania	2005	4.97	2.11
Mauritius	1973	3.59	4.01
Mauritius	1984	3.57	2.45
Morocco	1971	4.6	3.82
Morocco	1999	3.54	2.21
Morocco	2004	6.03	2.9
Mozambique	1997	3.61	3.77
Namibia	1967	3.91	2.09
Namibia	2005	5.05	2.47
Nigeria	1972	6.91	2.04
Oman	1974	5.7	2.95
Oman	2005	8.53	4.93
Rwanda	1981	4.5	3.83
Rwanda	1988	6.13	2.2
Rwanda	2005	6.94	5.4
Sao Tome and Principe	1989	3.77	4.36
Saudi Arabia	1976	3.91	3.78
Saudi Arabia	2005	3.77	3.49
South Africa	2003	3.92	3.16
Sudan	1994	12.2	11.6
Sudan	1999	13.9	3.05
Swaziland	1971	7.3	2.08
Syria	1976	4.89	2.24
Tanzania	1968	4.06	2.28
Tanzania	2005	5.01	3.74
Togo	1976	4.93	2.1
Tunisia	1973	5.32	2.05
Uganda	1994	4.25	3.37
Uganda	2003	5.64	2.17
Yemen	1993	4.84	6.16
Yemen	2003	4.82	2.15

Table 1.5: List of Episodes (Latin America & the Caribbean)

Country	Year	K/L Growth	Acceleration
Antigua and Barbuda	1980	6.46	2.3
Antigua and Barbuda	1985	8.77	2.02
Antigua and Barbuda	2002	4.24	2.55
Bahamas	1979	3.76	4.96
Bahamas	1993	3.89	2.14
Barbados	1967	4.64	2.29
Belize	1988	3.59	4.57
Bermuda	2004	3.52	2.89
Brazil	1972	6.86	3.08
Chile	1964	5.66	2.21
Chile	1994	6	2.72
Colombia	1990	4.05	2.62
Colombia	2003	3.72	3.44
Costa Rica	1967	3.63	2.11
Costa Rica	2005	4.69	2.21
Dominica	1980	5.44	2.4
Dominica	2005	3.82	2.04
Dominican Republic	1968	5.17	5.78
Dominican Republic	1993	5.22	2.6
Ecuador	1975	4	2.25
El Salvador	1971	3.66	4.25
El Salvador	1991	3.57	2.8
Grenada	1979	9.8	3.73
Jamaica	1967	3.57	2.14
Panama	1964	3.61	2.87
Panama	1969	6.96	4.29
Panama	1994	4.54	3.61
Panama	2005	7.3	5.84
Paraguay	1969	3.53	2.19
Paraguay	1974	8.06	5.26
Peru	2005	5.2	4.08
St. Kitts & Nevis	1987	7.88	3.2
Suriname	1972	7.24	2.84
Suriname	1998	4.1	2.73
Trinidad & Tobago	1956	3.89	2.53
Trinidad & Tobago	1976	8.92	2.82
Uruguay	1972	3.77	2.25
Uruguay	1977	4.99	2.27
Uruguay	2005	3.52	2.17

Table 1.6: List of Episodes (Europe & North America)

Country	Year	K/L Growth	Acceleration
Armenia	2003	8.69	6.34
Azerbaijan	2000	9.85	8.36
Belarus	2004	7.11	5.23
Bosnia and Herzegovina	1995	12.5	3.71
Bulgaria	1990	7.98	3.4
Bulgaria	1999	4.31	3.83
Bulgaria	2004	7.56	4.09
Cyprus	1972	6.59	2.02
Denmark	1960	5.48	2.1
Estonia	1999	6.35	2.34
Greece	1968	8.37	2.09
Greece	1999	3.55	2.17
Ireland	1997	7.44	4.71
Italy	1969	6.51	2.14
Kazakhstan	2005	3.76	3.02
Latvia	1999	4.33	2.96
Lithuania	2001	5.58	2.02
Montenegro	2004	5.73	4.5
Poland	1996	3.64	2.74
Portugal	1961	6.03	2.37
Romania	1974	10.5	2.43
Romania	2002	4.57	2.65
Spain	1963	7.39	2.45
Turkey	1970	6	2.42
Turkey	1985	4.58	3.63
Turkey	2003	4.54	2.46
Turkmenistan	2005	6.67	5.5

Table 1.7: Unconditional Probabilities by Region

Decade	1950s	1960s	1970s	1980s	1990s	2000s	Total
East Asia and Pacific	0.0286	0.0362	0.0574	0.0311	0.0403	0.0430	0.0395
Latin-American & Caribbean	0.0089	0.0259	0.0357	0.0160	0.0287	0.0432	0.0269
Middle East and North Africa	0.0508	0.0131	0.0833	0.0216	0.0196	0.0690	0.0380
South Asia	0.0000	0.0156	0.0556	0.0385	0.0172	0.107	0.0352
Sub-Saharan Africa	0.0000	0.0164	0.0280	0.0201	0.0180	0.0380	0.0206
Europe & North America	0.0000	0.0102	0.0062	0.0020	0.0162	0.0394	0.0111
Total	0.0092	0.0174	0.0299	0.0152	0.0211	0.0450	0.0223

Table 1.8: Unconditional Probabilities by Income

Decade	1950s	1960s	1970s	1980s	1990s	2000s	Total
1st Quintile	0.0351	0.0230	0.0271	0.0180	0.0240	0.0373	0.0250
2nd Quintile	0.0141	0.0229	0.0420	0.0217	0.0233	0.0382	0.0280
3rd Quintile	0.0500	0.0563	0.0647	0.0221	0.0244	0.0536	0.0407
4th Quintile	0.0000	0.0299	0.0432	0.0298	0.0234	0.0785	0.0357
5th Quintile	0.0000	0.0000	0.0122	0.0061	0.0133	0.0206	0.0119
Total	0.0092	0.0174	0.0299	0.0152	0.0211	0.0450	0.0223

Table 1.9: Variable Descriptions

	Description	Source
POLICY VARIABLES		
Underval81	Undervaluation index	PWT 8.1
Lag_Growth	Lagged Per Capita Growth Rate	PWT 8.1
Lag_KL	Lagged Per Capita Capital Stock	PWT 8.1
Fiscal	5 year corr. of GDP and Gov. Cons (dev. from trends)	WDI
Inflation	Rate of Inflation	WDI
XR_Stability	Exchange Rate Stability Index	[*]
INTERNAL VARIABLES		
Crisis_5y	Dummy for a crisis episode (previous 5 years)	[**]
Rents	Share or natural resource rent on GDP	WDI
Capita_GDP	Per Capita GDP	PWT 8.1
EXTERNAL VARIABLES		
NET_Inflows	Net capital Inflows / Trend GDP (3 year avg.)	[***]
FFend	Federal Funds Rate (end of period)	FRED
Global_uncertainty	Volatility of World Stock Market Index	FRED
TOT	Log of Terms of Trade	[****]
Trade	De Facto Trade Openness	PWT 8.1
KA_open	Capital Account Openness Index	[*]
INSTITUTIONAL VARIABLES		
Human_Capital	Years of education adjusted by the return of schooling	PWT 8.1
Durable	Political Regime Durability (years)	Polity IV

[*] Aizenman et. al. (2013)
[**] Laeven and Valencia (2012)
[***] Broner et. al. (2013)
[****] Spatafor and Tytell (2009)

Table 1.10: Summary Statistics and Expected Signs

	Observations	Mean	SD	Max / Min	Exp. Sign
POLICY VARIABLES					
Underval81	8275	0.0000	0.4086	2.1638 / -2.2791	+
Lag_Growth	8101	0.0198	.06401	-1.1106 / 0.6553	+
Lag_KL	8268	9.2650	1.3677	5.3269 / 12.7864	-
Fiscal	4609	0.3498	0.5085	1 / -1	-
Inflation	5852	0.3192	3.9813	237.73 / -0.1764	+/-
XR_Stability	7333	0.6939	0.3282	1 / 0.0013	+/-
INTERNAL VARIABLES					
Crisis_5y	3963	0.0664	0.2489	1 / 0	-
Rents	6591	10.0348	14.3107	89.3287 / 0	+/-
Capita_GDP	8275	8.4326	1.2324	5.2112 / 11.9692	+/-
EXTERNAL VARIABLES					
NET_Inflows	2769	0.0080	0.0759	0.8167 / -0.5092	+/-
FFend	9686	5.2991	3.3649	16.38 / 0.1	-
Global_uncertainty	5678	20.2568	6.4431	40.82 / 9.8	-
TOT	3493	4.6615	0.2871	5.8793 / 3.0576	+/-
Trade	6767	0.7675	0.5010	5.6206 / 0.0531	+/-
KA_open	5595	0.0000	1.5244	0.24390 / -1.8640	+/-
INSTITUTIONAL VARIABLES					
Human_Capital	6927	0.6913	0.3115	0.0180 / 1.2861	+/-
Durable	7499	22.1756	28.9124	202 / 0	+/-

Table 1.11: Baseline Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.029***	0.051***	0.077***	0.065**	0.068**
	(0.008)	(0.015)	(0.026)	(0.031)	(0.031)
Lag_Growth	0.576***	0.803***	0.792***	0.653***	0.640***
	(0.078)	(0.113)	(0.233)	(0.239)	(0.244)
Lag_KL	-0.020***	-0.035***	-0.065***	-0.142***	-0.144***
	(0.003)	(0.004)	(0.010)	(0.026)	(0.025)
Fiscal		0.030***	-0.001	0.030*	0.023
		(0.010)	(0.018)	(0.018)	(0.018)
Inflation		-0.031	-0.065	-0.083*	-0.088*
		(0.028)	(0.045)	(0.049)	(0.050)
XR_Stability		-0.001	-0.035	-0.046	-0.052
		(0.015)	(0.032)	(0.032)	(0.032)
Crisis_5y			-0.050***	-0.058***	-0.056***
			(0.018)	(0.018)	(0.018)
Rents			0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			0.003	-0.022	-0.029
			(0.021)	(0.024)	(0.026)
KA_open			-0.001	-0.004	-0.006
			(0.007)	(0.007)	(0.007)
NET_Inflows			-0.003*	-0.008***	
			(0.002)	(0.002)	
FDI_Inflows					-0.004
					(0.004)
Port_Inflows					-0.006***
					(0.001)
Reserves					0.007*
					(0.004)
TOT			-0.080*	-0.042	-0.058
			(0.044)	(0.048)	(0.048)
FFend			-0.016***	-0.011***	-0.011***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.005**	-0.005**	-0.004**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.125**	0.132**
				(0.055)	(0.055)
Capita_GDP				0.083***	0.082***
				(0.028)	(0.027)
Durable				-0.001*	-0.001**
				(0.000)	(0.000)
Pseudo R-squared	0.045	0.107	0.184	0.202	0.205
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.12: Probits with the Smallest Sample - Average Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81	0.062**	0.064**	0.071***	0.063**	0.068**
	(0.025)	(0.027)	(0.027)	(0.030)	(0.031)
Lag_Growth	0.976***	0.863***	0.742***	0.681***	0.640***
	(0.230)	(0.228)	(0.236)	(0.242)	(0.244)
Lag_KL	-0.044***	-0.045***	-0.063***	-0.148***	-0.144***
	(0.009)	(0.009)	(0.011)	(0.026)	(0.025)
Fiscal		0.006	0.023	0.029	0.023
		(0.018)	(0.019)	(0.018)	(0.018)
Inflation		-0.178**	-0.061	-0.081*	-0.088*
		(0.071)	(0.042)	(0.049)	(0.050)
XR_Stability		-0.038	-0.052	-0.046	-0.052
		(0.030)	(0.032)	(0.032)	(0.032)
Crisis_5y			-0.054***	-0.058***	-0.056***
			(0.018)	(0.018)	(0.018)
Rents			-0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			0.002	-0.019	-0.029
			(0.025)	(0.024)	(0.026)
KA_open			0.002	-0.005	-0.006
			(0.007)	(0.008)	(0.007)
NET_Inflows			-0.007***	-0.007***	
			(0.002)	(0.002)	
FDI_Inflows					-0.004
					(0.004)
Port_Inflows					-0.006***
					(0.001)
Reserves					0.007*
					(0.004)
TOT			-0.022	-0.058	-0.058
			(0.047)	(0.048)	(0.048)
FFend			-0.013***	-0.012***	-0.011***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.004**	-0.004**	-0.004**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.133**	0.132**
				(0.055)	(0.055)
Capita_GDP				0.087***	0.082***
				(0.027)	(0.027)
Durable				-0.001**	-0.001**
				(0.000)	(0.000)
Pseudo R-squared	0.090	0.106	0.180	0.204	0.205
Observations	1,029	1,029	1,029	1,029	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.13: Robustness OLS

Episode Dummy	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Underval81	0.031***	0.039***	0.079**	0.068**	0.066*
	(0.008)	(0.015)	(0.033)	(0.034)	(0.034)
Lag_Growth	0.515***	0.835***	0.673***	0.526**	0.513**
	(0.061)	(0.107)	(0.216)	(0.213)	(0.219)
Lag_KL	-0.020***	-0.034***	-0.063***	-0.125***	-0.126***
	(0.002)	(0.004)	(0.010)	(0.027)	(0.026)
Fiscal		0.023**	-0.006	0.017	0.017
		(0.009)	(0.019)	(0.019)	(0.019)
Inflation		-0.000	0.000	-0.000	-0.000
		(0.000)	(0.001)	(0.001)	(0.001)
XR_Stability		0.005	-0.011	-0.014	-0.015
		(0.015)	(0.030)	(0.031)	(0.031)
Crisis_5y			-0.063***	-0.064***	-0.062***
			(0.020)	(0.020)	(0.021)
Rents			0.002*	-0.000	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.005	-0.015	-0.016
			(0.021)	(0.023)	(0.024)
KA_open			0.001	-0.003	-0.005
			(0.008)	(0.010)	(0.010)
NET_Inflows			-0.002	-0.006***	
			(0.002)	(0.002)	
FDI_Inflows					-0.005
					(0.004)
Port_Inflows					-0.005***
					(0.002)
Reserves					0.006
					(0.004)
TOT			-0.059	-0.005	-0.008
			(0.039)	(0.031)	(0.031)
FFend			-0.016***	-0.011***	-0.012***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.005**	-0.005**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.103*	0.104*
				(0.062)	(0.063)
Capita_GDP				0.072**	0.073**
				(0.029)	(0.030)
Durable				-0.000	-0.001
				(0.000)	(0.000)
Constant	0.258***	0.387***	1.181***	0.828***	0.837***
	(0.024)	(0.042)	(0.217)	(0.174)	(0.173)
R-squared	0.026	0.057	0.103	0.101	0.102
Observations	6,230	3,298	1,084	1,041	1,029

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 1.14: Robustness Logits - Average Marginal Effects

Episode Dummy	(1) Logit	(2) Logit	(3) Logit	(4) Logit	(5) Logit
Underval81	0.028***	0.050***	0.076**	0.070	0.071
	(0.008)	(0.016)	(0.032)	(0.052)	(0.051)
Lag_Growth	0.567***	0.777***	0.775***	0.619**	0.615**
	(0.076)	(0.121)	(0.242)	(0.259)	(0.260)
Lag_KL	-0.020***	-0.034***	-0.063***	-0.148***	-0.150***
	(0.003)	(0.004)	(0.011)	(0.027)	(0.027)
Fiscal		0.031***	-0.004	0.031	0.023
		(0.011)	(0.020)	(0.019)	(0.019)
Inflation		-0.040	-0.078	-0.099	-0.100
		(0.036)	(0.056)	(0.060)	(0.061)
XR_Stability		-0.001	-0.035	-0.043	-0.050
		(0.015)	(0.034)	(0.035)	(0.035)
Crisis_5y			-0.050***	-0.057***	-0.055***
			(0.019)	(0.019)	(0.019)
Rents			0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			0.003	-0.020	-0.026
			(0.022)	(0.025)	(0.026)
KA_open			-0.001	-0.004	-0.007
			(0.008)	(0.008)	(0.008)
NET_Inflows			-0.003	-0.007***	
			(0.002)	(0.002)	
FDI_Inflows					-0.004
					(0.004)
Port_Inflows					-0.006***
					(0.001)
Reserves					0.006*
					(0.004)
TOT			-0.075*	-0.029	-0.044
			(0.045)	(0.052)	(0.051)
FFend			-0.016***	-0.012***	-0.012***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.005**	-0.005**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.119**	0.131**
				(0.060)	(0.060)
Capita_GDP				0.094***	0.092***
				(0.036)	(0.034)
Durable				-0.001*	-0.001**
				(0.000)	(0.000)
R-squared	0.049	0.103	0.178	0.199	0.203
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.15: Stricter Filter Probits - Average Marginal Effects

Episode Dummy II	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.024***	0.037***	0.057***	0.064***	0.065***
	(0.006)	(0.011)	(0.018)	(0.021)	(0.021)
Lag_Growth	0.328***	0.469***	0.722***	0.651***	0.569***
	(0.049)	(0.086)	(0.192)	(0.178)	(0.181)
Lag_KL	-0.011***	-0.017***	-0.028***	-0.060***	-0.069***
	(0.002)	(0.003)	(0.007)	(0.016)	(0.017)
Fiscal		0.003	-0.005	0.018	0.014
		(0.007)	(0.012)	(0.013)	(0.013)
Inflation		-0.003	-0.249*	-0.291**	-0.350**
		(0.006)	(0.129)	(0.132)	(0.157)
XR_Stability		0.016	-0.008	-0.031	-0.024
		(0.010)	(0.020)	(0.019)	(0.019)
Crisis_5y			-0.034**	-0.036***	-0.036***
			(0.014)	(0.013)	(0.013)
Rents			0.001**	-0.000	-0.000
			(0.000)	(0.000)	(0.001)
Trade			0.028**	0.010	0.003
			(0.012)	(0.013)	(0.015)
KA_open			0.002	0.002	0.001
			(0.004)	(0.004)	(0.004)
NET_Inflows			0.001	-0.003***	
			(0.001)	(0.001)	
FDI_Inflows					-0.001
					(0.002)
Port_Inflows					-0.001
					(0.001)
Reserves					0.007***
					(0.002)
TOT			-0.038	0.025	0.020
			(0.033)	(0.028)	(0.027)
FFend			-0.004**	-0.000	-0.001
			(0.002)	(0.002)	(0.002)
Global_Uncertainty			-0.001	0.000	0.000
			(0.002)	(0.001)	(0.001)
Human_Capital				0.106***	0.106***
				(0.030)	(0.031)
Capita_GDP				0.022	0.029*
				(0.017)	(0.017)
Durable				-0.001***	-0.002***
				(0.000)	(0.000)
Observations	6,445	3,420	1,123	1,080	1,068

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.16: Very Strict Filter Probits - Average Marginal Effects

Episode Dummy III	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.010**	0.007	0.062***	0.101***	0.116***
	(0.004)	(0.006)	(0.017)	(0.027)	(0.033)
Lag_Growth	0.111***	0.137***	0.388***	0.288***	0.189**
	(0.026)	(0.049)	(0.131)	(0.083)	(0.094)
Lag_KL	-0.004***	-0.006***	-0.015***	-0.031**	-0.031**
	(0.001)	(0.002)	(0.005)	(0.013)	(0.013)
Fiscal		0.000	-0.016*	0.021***	0.021***
		(0.004)	(0.009)	(0.008)	(0.008)
Inflation		-0.010	-0.215**	-0.199**	-0.341***
		(0.015)	(0.104)	(0.083)	(0.132)
XR_Stability		0.003	0.010	-0.010	0.001
		(0.006)	(0.013)	(0.010)	(0.010)
Crisis_5y			-0.003	-0.001	-0.003
			(0.010)	(0.006)	(0.007)
Rents			0.001***	-0.001*	-0.002**
			(0.000)	(0.001)	(0.001)
Trade			0.021***	0.016**	0.007
			(0.008)	(0.007)	(0.008)
KA_open			0.004	0.008**	0.011***
			(0.003)	(0.003)	(0.004)
NET_Inflows			0.001	-0.002**	
			(0.001)	(0.001)	
FDI_Inflows					0.002
					(0.001)
Port_Inflows					-0.000
					(0.001)
Reserves					0.005***
					(0.001)
TOT			-0.059**	0.016	0.021
			(0.030)	(0.024)	(0.027)
FFend			-0.002	0.001	0.001
			(0.002)	(0.001)	(0.001)
Global_Uncertainty			0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)
Human_Capital				-0.020	-0.068**
				(0.018)	(0.027)
Capita_GDP				0.037**	0.048**
				(0.016)	(0.019)
Durable				-0.001***	-0.001***
				(0.000)	(0.000)
Observations	6,607	3,512	1,146	1,103	1,091

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.17: 1st Year Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.040***	0.072***	0.098***	0.078**	0.080**
	(0.009)	(0.016)	(0.030)	(0.033)	(0.033)
Lag_Growth	0.346***	0.397***	0.788***	0.578**	0.542**
	(0.075)	(0.130)	(0.253)	(0.251)	(0.261)
Lag_KL	-0.024***	-0.038***	-0.065***	-0.151***	-0.156***
	(0.003)	(0.004)	(0.011)	(0.028)	(0.028)
Fiscal		0.038***	0.004	0.031	0.026
		(0.011)	(0.020)	(0.020)	(0.020)
Inflation		-0.081**	-0.022	-0.152**	-0.159**
		(0.036)	(0.034)	(0.071)	(0.073)
XR_Stability		0.002	-0.007	-0.014	-0.016
		(0.016)	(0.033)	(0.033)	(0.033)
Crisis_5y			-0.025	-0.030	-0.028
			(0.019)	(0.019)	(0.020)
Rents			0.000	-0.001	-0.002*
			(0.001)	(0.001)	(0.001)
Trade			-0.006	-0.030	-0.033
			(0.023)	(0.025)	(0.027)
KA_open			0.009	0.003	0.001
			(0.008)	(0.008)	(0.008)
NET_Inflows			-0.005***	-0.008***	
			(0.002)	(0.002)	
FDI_Inflows					-0.005
					(0.004)
Port_Inflows					-0.007***
					(0.002)
Reserves					0.007*
					(0.004)
TOT			-0.086*	-0.059	-0.078
			(0.046)	(0.052)	(0.052)
FFend			-0.016***	-0.012***	-0.012***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.004	-0.005**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.141**	0.148**
				(0.058)	(0.059)
Capita_GDP				0.091***	0.094***
				(0.031)	(0.030)
Durable				-0.001**	-0.001**
				(0.000)	(0.000)
Pseudo R-squared	0.036	0.094	0.160	0.178	0.182
Observations	6,129	3,260	1,068	1,035	1,023

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.18: 5 Year Windows Probits - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.028***	0.057***	0.024	0.027	0.028
	(0.009)	(0.016)	(0.024)	(0.028)	(0.028)
Lag_Growth	0.637***	0.888***	1.121***	0.937***	0.784***
	(0.082)	(0.125)	(0.256)	(0.267)	(0.272)
Lag_KL	-0.017***	-0.032***	-0.048***	-0.164***	-0.168***
	(0.003)	(0.004)	(0.009)	(0.025)	(0.024)
Fiscal		0.043***	0.030*	0.055***	0.046**
		(0.010)	(0.018)	(0.019)	(0.018)
Inflation		-0.026	-0.011	-0.007	-0.007
		(0.023)	(0.014)	(0.013)	(0.014)
XR_Stability		-0.002	-0.090***	-0.090***	-0.095***
		(0.015)	(0.031)	(0.031)	(0.031)
Crisis_5y			-0.087***	-0.087***	-0.084***
			(0.019)	(0.017)	(0.017)
Rents			0.001**	-0.000	-0.001
			(0.001)	(0.001)	(0.001)
Trade			0.046**	0.030	0.010
			(0.020)	(0.023)	(0.025)
KA_open			-0.005	-0.009	-0.011*
			(0.006)	(0.006)	(0.006)
NET_Inflows			-0.002	-0.006***	
			(0.001)	(0.002)	
FDI_Inflows					-0.000
					(0.003)
Port_Inflows					-0.005***
					(0.001)
Reserves					0.011***
					(0.003)
TOT			-0.096**	-0.057	-0.076
			(0.046)	(0.050)	(0.048)
FFend			-0.017***	-0.011***	-0.011***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.006***	-0.006***	-0.006***
			(0.002)	(0.002)	(0.002)
Human_Capital				0.192***	0.201***
				(0.052)	(0.051)
Capita_GDP				0.112***	0.111***
				(0.028)	(0.026)
Durable				-0.001**	-0.001***
				(0.000)	(0.000)
Pseudo R-squared	0.045	0.103	0.204	0.267	0.281
Observations	6,192	3,278	1,082	1,040	1,028

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.19: 9 Year Windows Probits - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.053***	0.060***	0.077***	0.097***	0.112***
	(0.019)	(0.020)	(0.021)	(0.024)	(0.024)
Lag_Growth	0.141	0.032	-0.007	-0.071	-0.080
	(0.130)	(0.131)	(0.135)	(0.139)	(0.136)
Lag_KL	-0.010	-0.009	-0.020***	-0.086***	-0.077***
	(0.006)	(0.006)	(0.007)	(0.019)	(0.019)
Fiscal		0.011	0.002	0.016	0.009
		(0.012)	(0.013)	(0.013)	(0.012)
Inflation		-0.086*	-0.011	-0.028	-0.038
		(0.044)	(0.019)	(0.027)	(0.029)
XR_Stability		0.007	0.008	0.010	0.004
		(0.022)	(0.023)	(0.021)	(0.021)
Crisis_5y			-0.011	-0.012	-0.010
			(0.013)	(0.013)	(0.013)
Rents			0.001	0.001	0.001
			(0.001)	(0.001)	(0.000)
Trade			-0.052***	-0.063***	-0.075***
			(0.019)	(0.019)	(0.021)
KA_open			0.010*	0.007	0.007
			(0.005)	(0.005)	(0.005)
NET_Inflows			-0.003**	-0.003**	
			(0.001)	(0.001)	
FDI_Inflows					0.001
					(0.002)
Port_Inflows					-0.004***
					(0.001)
Reserves					-0.000
					(0.003)
TOT			0.003	-0.023	-0.019
			(0.038)	(0.039)	(0.040)
FFend			-0.015***	-0.013***	-0.013***
			(0.004)	(0.003)	(0.003)
Global_Uncertainty			-0.003	-0.002	-0.003*
			(0.002)	(0.001)	(0.002)
Human_Capital				0.045	0.033
				(0.032)	(0.032)
Capita_GDP				0.088***	0.081***
				(0.024)	(0.023)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Pseudo R-squared	0.043	0.096	0.163	0.222	0.223
Observations	6,266	3,319	1,079	1,038	1,026

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.20: K Probits - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.012**	0.019**	0.087***	0.071***	0.082***
	(0.005)	(0.009)	(0.018)	(0.019)	(0.021)
Lag_Growth	0.149***	0.213***	0.512***	0.368***	0.310***
	(0.037)	(0.069)	(0.143)	(0.108)	(0.104)
Lag_K	-0.009***	-0.017***	-0.019***	-0.010***	-0.009***
	(0.001)	(0.002)	(0.004)	(0.003)	(0.003)
Fiscal		0.005	-0.009	0.010*	0.014**
		(0.006)	(0.008)	(0.006)	(0.007)
Inflation		-0.008	-0.404***	-0.290***	-0.350***
		(0.012)	(0.120)	(0.099)	(0.117)
XR_Stability		-0.001	0.030*	-0.014	0.003
		(0.010)	(0.017)	(0.014)	(0.013)
Crisis_5y			0.000	-0.007	-0.005
			(0.011)	(0.008)	(0.009)
Rents			0.001***	0.000	0.000
			(0.000)	(0.000)	(0.000)
Trade			0.021**	0.048***	0.054***
			(0.009)	(0.012)	(0.012)
KA_open			0.005*	0.010***	0.010***
			(0.003)	(0.003)	(0.003)
NET_Inflows			0.001	-0.002**	
			(0.001)	(0.001)	
FDI_Inflows					0.001
					(0.002)
Port_Inflows					0.000
					(0.001)
Reserves					0.004***
					(0.001)
TOT			-0.025	0.063***	0.051*
			(0.023)	(0.023)	(0.028)
FFend			-0.002	-0.002	-0.003*
			(0.002)	(0.001)	(0.001)
Global_Uncertainty			0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)
Human_Capital				-0.021	-0.063**
				(0.022)	(0.027)
Capita_GDP				-0.012*	-0.010
				(0.007)	(0.009)
Durable				-0.002***	-0.002***
				(0.000)	(0.000)
Pseudo R-squared	0.043	0.109	0.416	0.512	0.545
Observations	6,479	3,444	1,137	1,094	1,082

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.21: PPP Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
PPP	0.009	0.021	0.049	0.016	0.021
	(0.014)	(0.021)	(0.073)	(0.073)	(0.074)
Lag_Growth	0.486***	0.432***	0.641***	0.576**	0.509*
	(0.115)	(0.130)	(0.236)	(0.246)	(0.260)
Lag_KL	-0.023***	-0.032***	-0.059***	-0.098***	-0.085***
	(0.004)	(0.004)	(0.014)	(0.033)	(0.033)
Fiscal		0.013	-0.030	-0.025	-0.033
		(0.011)	(0.019)	(0.024)	(0.024)
Inflation		-0.158***	-0.039	-0.035	-0.039
		(0.058)	(0.045)	(0.041)	(0.041)
XR_Stability		0.003	-0.027	-0.024	-0.035
		(0.018)	(0.036)	(0.036)	(0.038)
Crisis_5y			-0.047**	-0.058**	-0.051**
			(0.022)	(0.023)	(0.023)
Rents			0.001	0.000	-0.000
			(0.001)	(0.001)	(0.001)
Trade			-0.001	-0.010	-0.025
			(0.024)	(0.026)	(0.031)
KA_open			-0.003	-0.006	-0.006
			(0.008)	(0.011)	(0.011)
NET_Inflows			-0.003	-0.006**	
			(0.002)	(0.003)	
FDI_Inflows					-0.001
					(0.004)
Port_Inflows					-0.004**
					(0.002)
Reserves					0.011*
					(0.006)
TOT			-0.102*	-0.100	-0.140**
			(0.055)	(0.069)	(0.063)
FFend			-0.011**	-0.010**	-0.009*
			(0.005)	(0.005)	(0.005)
Global_Uncertainty			0.001	0.001	0.001
			(0.002)	(0.002)	(0.002)
Human_Capital				0.068	0.053
				(0.059)	(0.064)
Capita_GDP				0.033	0.025
				(0.035)	(0.034)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Pseudo R-squared	0.050	0.136	0.224	0.193	0.204
Observations	2,175	1,611	620	597	585

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.22: Large Changes Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval_change	0.008	-0.007	-0.004	-0.014	-0.012
	(0.007)	(0.010)	(0.010)	(0.013)	(0.014)
Growth_boom	0.067***	0.050***	0.053***	0.062***	0.061***
	(0.007)	(0.010)	(0.010)	(0.013)	(0.013)
Rchange		-0.011**	-0.011**	-0.016**	-0.016**
		(0.005)	(0.005)	(0.007)	(0.007)
KA_open_boom		0.016*	0.017*	-0.004	-0.010
		(0.010)	(0.010)	(0.013)	(0.014)
Trade_boom		0.037***	0.029***	0.019	0.016
		(0.011)	(0.011)	(0.014)	(0.014)
TOT_boom		-0.009	-0.015	-0.009	-0.011
		(0.010)	(0.010)	(0.013)	(0.014)
Rents_boom			0.036***	0.043**	0.031*
			(0.012)	(0.017)	(0.017)
NET_boom				-0.015	
				(0.013)	
FDI_boom					0.011
					(0.013)
Port_boom					-0.009
					(0.013)
Reserve_boom					0.028**
					(0.013)
Fiveregime			-0.011	-0.004	-0.011
			(0.016)	(0.025)	(0.025)
Pseudo R-squared	0.027	0.037	0.045	0.052	0.058
Observations	6,125	2,920	2,761	1,620	1,587

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.23: Probits with Lag 1 - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81 [t-1]	0.021**	0.037**	0.022	0.042	0.045*
	(0.008)	(0.017)	(0.017)	(0.026)	(0.027)
Growth [t-1]	0.559***	0.748***	0.676***	0.937***	0.937***
	(0.076)	(0.132)	(0.126)	(0.211)	(0.231)
KL [t-1]	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t-1]		-0.110***	-0.095***	-0.111***	-0.108***
		(0.022)	(0.023)	(0.034)	(0.036)
Rents [t-1]		0.000		0.001*	0.001
		(0.001)		(0.001)	(0.001)
NET_Inflows [t-1]				-0.003**	
				(0.001)	
FDI_Inflows [t-1]					-0.003
					(0.002)
Port_Inflows [t-1]					-0.005***
					(0.001)
Reserves [t-1]					0.003
					(0.003)
Pseudo R-squared	0.053	0.071	0.050	0.107	0.115
Observations	6,230	2,089	2,179	1,174	1,160

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.24: Probits with Lag 3 - Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81 [t-3]	0.025***	0.033*	0.021	0.053*	0.053*
	(0.009)	(0.018)	(0.018)	(0.028)	(0.028)
Growth [t-3]	0.320***	0.426***	0.407***	0.317	0.409*
	(0.064)	(0.133)	(0.126)	(0.216)	(0.232)
KL [t-3]	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t-3]		-0.111***	-0.096***	-0.106***	-0.106***
		(0.022)	(0.023)	(0.035)	(0.035)
Rents [t-3]		0.000		0.000	0.000
		(0.001)		(0.001)	(0.001)
NET_Inflows [t-3]				-0.003*	
				(0.002)	
FDI_Inflows [t-3]					-0.003
					(0.004)
Port_Inflows [t-3]					-0.004**
					(0.002)
Reserves [t-3]					-0.002
					(0.003)
Pseudo R-squared	0.036	0.046	0.032	0.067	0.072
Observations	6,020	1,803	1,875	996	986

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.25: Probits with Lag 5 - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81 [t-5]	0.028***	0.017	0.021	0.023	0.023
	(0.009)	(0.019)	(0.019)	(0.027)	(0.027)
Growth [t-5]	0.082	0.225*	0.202*	0.073	0.126
	(0.053)	(0.135)	(0.121)	(0.208)	(0.236)
KL [t-5]	-0.000***	-0.000**	-0.000**	-0.000**	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t-5]		-0.067***	-0.064***	-0.037	-0.030
		(0.023)	(0.023)	(0.037)	(0.037)
Rents [t-5]		-0.000		0.001	-0.000
		(0.001)		(0.001)	(0.001)
NET_Inflows [t-5]				-0.001	
				(0.002)	
FDI_Inflows [t-5]					0.000
					(0.002)
Port_Inflows [t-5]					-0.003
					(0.002)
Reserves [t-5]					-0.004
					(0.004)
Pseudo R-squared	0.029	0.024	0.018	0.037	0.041
Observations	5,811	1,517	1,573	816	812

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.26: Probits with Lead 1 - Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81 [t+1]	0.017**	0.029*	0.016	0.021	0.021
	(0.008)	(0.015)	(0.015)	(0.021)	(0.021)
Growth [t+1]	0.676***	0.964***	1.066***	1.335***	1.254***
	(0.086)	(0.150)	(0.146)	(0.218)	(0.224)
KL [t+1]	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t+1]		-0.068***	-0.065***	-0.053	-0.052
		(0.021)	(0.022)	(0.034)	(0.032)
Rents [t+1]		0.001*		0.001	0.000
		(0.000)		(0.001)	(0.001)
NET_Inflows [t+1]				-0.005***	
				(0.001)	
FDI_Inflows [t+1]					-0.001
					(0.003)
Port_Inflows [t+1]					-0.004***
					(0.001)
Reserves [t+1]					0.010***
					(0.003)
Pseudo R-squared	0.064	0.078	0.073	0.132	0.150
Observations	6,428	2,372	2,480	1,346	1,330

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.27: Probits with Lead 3 - Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81 [t+3]	0.016**	0.017	0.005	0.004	0.002
	(0.008)	(0.014)	(0.013)	(0.019)	(0.019)
Growth [t+3]	0.586***	0.979***	1.064***	1.312***	1.134***
	(0.082)	(0.175)	(0.170)	(0.309)	(0.319)
KL [t+3]	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t+3]		-0.022	-0.018	0.012	0.027
		(0.020)	(0.020)	(0.033)	(0.031)
Rents [t+3]		0.001		0.001**	0.000
		(0.000)		(0.001)	(0.001)
NET_Inflows [t+3]				0.000	
				(0.001)	
FDI_Inflows [t+3]					0.008***
					(0.002)
Port_Inflows [t+3]					-0.001
					(0.001)
Reserves [t+3]					0.007***
					(0.003)
Pseudo R-squared	0.049	0.066	0.065	0.107	0.140
Observations	6,622	2,657	2,780	1,513	1,495

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.28: Probits with Lead 5 - Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81 [t+5]	0.014*	0.029**	0.016	-0.004	-0.002
	(0.008)	(0.015)	(0.014)	(0.018)	(0.019)
Growth [t+5]	0.271***	0.417**	0.484***	0.841***	0.686***
	(0.071)	(0.176)	(0.156)	(0.183)	(0.188)
KL [t+5]	-0.000***	-0.000**	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TOT [t+5]		0.030	0.023	0.058*	0.075**
		(0.019)	(0.018)	(0.031)	(0.032)
Rents [t+5]		0.000		0.001	0.000
		(0.000)		(0.001)	(0.001)
NET_Inflows [t+5]				0.004***	
				(0.001)	
FDI_Inflows [t+5]					0.008***
					(0.002)
Port_Inflows [t+5]					0.002
					(0.001)
Reserves [t+5]					0.002
					(0.003)
Pseudo R-squared	0.019	0.023	0.023	0.089	0.096
Observations	6,812	2,941	3,077	1,534	1,516

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.29: Probits with full set of lags and leads - Marginal Effects

Episode Dummy	(1) Probit
Growth [t-1]	0.198***
	(0.057)
Growth [t-2]	0.129**
	(0.056)
Growth [t-3]	0.118**
	(0.052)
Growth [t-4]	-0.036
	(0.047)
Growth [t-5]	-0.051
	(0.047)
Growth	0.168***
	(0.060)
Growth [t+1]	0.243***
	(0.064)
Growth [t+2]	0.179**
	(0.072)
Growth [t+3]	0.174**
	(0.070)
Growth [t+4]	0.132*
	(0.078)
Growth [t+5]	0.091
	(0.078)
KL [t-1]	0.000
	(0.000)
KL [t-2]	-0.000
	(0.000)
KL [t-3]	0.000
	(0.000)
KL [t-4]	0.000
	(0.000)
KL [t–5]	-0.000
	(0.000)
KL	-0.000***
	(0.000)
KL [t+1]	0.000
	(0.000)
KL [t+2]	-0.000
	(0.000)
KL [t+3]	0.000
	(0.000)
KL [t+4]	-0.000
	(0.000)
KL [t+5]	0.000**
	(0.000)
Pseudo R-squared	0.243
Observations	5,811

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.30: Probits for Manufacturing Countries Only - Average Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81	0.028**	0.043**	0.052*	0.020	0.023
	(0.013)	(0.018)	(0.027)	(0.025)	(0.026)
Lag_Growth	1.017***	0.977***	1.110***	0.907**	0.897**
	(0.140)	(0.188)	(0.355)	(0.354)	(0.367)
Lag_KL	-0.044***	-0.053***	-0.074***	-0.314***	-0.298***
	(0.005)	(0.006)	(0.012)	(0.055)	(0.053)
Fiscal		0.023*	0.019	0.019	0.010
		(0.014)	(0.024)	(0.024)	(0.024)
Inflation		-0.015	-0.012	-0.061	-0.070
		(0.030)	(0.013)	(0.063)	(0.062)
XR_Stability		-0.004	-0.084**	-0.027	-0.036
		(0.022)	(0.041)	(0.045)	(0.044)
Crisis_5y			-0.060**	-0.068***	-0.063***
			(0.024)	(0.024)	(0.024)
Rents			-0.001	-0.000	0.001
			(0.003)	(0.003)	(0.003)
Trade			0.006	0.027	0.023
			(0.024)	(0.032)	(0.037)
KA_open			-0.002	-0.005	-0.011
			(0.010)	(0.010)	(0.009)
NET_Inflows			-0.006**	-0.013***	
			(0.003)	(0.003)	
FDI_Inflows					-0.010
					(0.006)
Port_Inflows					-0.009***
					(0.003)
Reserves					0.011**
					(0.006)
TOT			-0.042	-0.104	-0.099
			(0.063)	(0.064)	(0.061)
FFend			-0.012***	-0.009**	-0.010**
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.000	0.001	0.001
			(0.003)	(0.002)	(0.003)
Human_Capital				0.200***	0.200***
				(0.069)	(0.070)
Capita_GDP				0.219***	0.204***
				(0.050)	(0.049)
Durable				-0.002***	-0.002***
				(0.001)	(0.001)
Pseudo R-squared	0.116	0.185	0.293	0.364	0.366
Observations	2,600	1,745	666	648	642

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.31: Probits for Non-Manufacturing Countries Only - Average Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81	0.010	0.034	0.282***	0.256***	0.265***
	(0.010)	(0.022)	(0.053)	(0.049)	(0.051)
Lag_Growth	0.409***	0.657***	0.429	0.374	0.004
	(0.081)	(0.135)	(0.266)	(0.233)	(0.251)
Lag_KL	-0.010***	-0.027***	-0.032**	-0.027	-0.023
	(0.003)	(0.005)	(0.014)	(0.035)	(0.032)
Fiscal		0.028*	-0.046**	-0.016	-0.024
		(0.015)	(0.021)	(0.023)	(0.021)
Inflation		-0.045	-0.625**	-0.287*	-0.263*
		(0.035)	(0.248)	(0.161)	(0.158)
XR_Stability		-0.008	0.033	0.026	0.025
		(0.021)	(0.058)	(0.049)	(0.046)
Crisis_5y			-0.075***	-0.054**	-0.043
			(0.029)	(0.026)	(0.027)
Rents			0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.006	0.025	-0.007
			(0.032)	(0.035)	(0.033)
KA_open			-0.006	-0.003	-0.002
			(0.010)	(0.011)	(0.011)
NET_Inflows			-0.001	-0.004**	
			(0.001)	(0.002)	
FDI_Inflows					0.012***
					(0.004)
Port_Inflows					-0.005***
					(0.002)
Reserves					0.006*
					(0.004)
TOT			-0.216***	-0.087	-0.084
			(0.071)	(0.067)	(0.072)
FFend			-0.015***	-0.017***	-0.018***
			(0.005)	(0.004)	(0.004)
Global_Uncertainty			-0.018***	-0.017***	-0.016***
			(0.004)	(0.003)	(0.003)
Human_Capital				-0.133	-0.162**
				(0.082)	(0.077)
Capita_GDP				0.044	0.058
				(0.047)	(0.044)
Durable				0.000	0.000
				(0.001)	(0.001)
Pseudo R-squared	0.026	0.075	0.354	0.381	0.400
Observations	3,630	1,553	418	393	387

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 1.32: Probits for Manufacturing Countries Only - Average Marginal Effects (Smallest Sample)

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81	0.045*	0.035	0.045*	0.018	0.023
	(0.023)	(0.026)	(0.026)	(0.025)	(0.026)
Lag_Growth	1.099***	1.060***	0.973***	0.903**	0.897**
	(0.350)	(0.349)	(0.349)	(0.358)	(0.367)
Lag_KL	-0.054***	-0.054***	-0.075***	-0.320***	-0.298***
	(0.010)	(0.010)	(0.012)	(0.055)	(0.053)
Fiscal		0.029	0.042*	0.019	0.010
		(0.025)	(0.024)	(0.024)	(0.024)
Inflation		-0.092	-0.012	-0.063	-0.070
		(0.062)	(0.014)	(0.064)	(0.062)
XR_Stability		-0.070*	-0.095**	-0.022	-0.036
		(0.039)	(0.042)	(0.045)	(0.044)
Crisis_5y			-0.066***	-0.066***	-0.063***
			(0.024)	(0.024)	(0.024)
Rents			-0.002	0.000	0.001
			(0.003)	(0.003)	(0.003)
Trade			0.010	0.037	0.023
			(0.029)	(0.034)	(0.037)
KA_open			0.003	-0.006	-0.011
			(0.010)	(0.010)	(0.009)
NET_Inflows			-0.008**	-0.013***	
			(0.003)	(0.003)	
FDI_Inflows					-0.010
					(0.006)
Port_Inflows					-0.009***
					(0.003)
Reserves					0.011**
					(0.006)
TOT			-0.027	-0.101	-0.099
			(0.063)	(0.064)	(0.061)
FFend			-0.010**	-0.009**	-0.010**
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			0.000	0.001	0.001
			(0.003)	(0.002)	(0.003)
Human_Capital				0.202***	0.200***
				(0.069)	(0.070)
Capita_GDP				0.225***	0.204***
				(0.050)	(0.049)
Durable				-0.002***	-0.002***
				(0.001)	(0.001)
Pseudo R-squared	0.101	0.117	0.175	0.256	0.248
Observations	642	642	642	642	642

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.33: Probits for Non-Manufacturing Countries Only - Average Marginal Effects (Smallest Sample)

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.160***	0.239***	0.240***	0.248***	0.265***
	(0.051)	(0.052)	(0.050)	(0.050)	(0.051)
Lag_Growth	0.736***	0.523**	0.346	0.381	0.004
	(0.268)	(0.254)	(0.231)	(0.235)	(0.251)
Lag_KL	-0.019	-0.012	-0.014	-0.035	-0.023
	(0.015)	(0.013)	(0.014)	(0.036)	(0.032)
Fiscal		-0.030	-0.030	-0.017	-0.024
		(0.024)	(0.023)	(0.023)	(0.021)
Inflation		-0.590***	-0.359**	-0.289*	-0.263*
		(0.221)	(0.175)	(0.164)	(0.158)
XR_Stability		0.018	0.037	0.023	0.025
		(0.048)	(0.052)	(0.049)	(0.046)
Crisis_5y			-0.057**	-0.054**	-0.043
			(0.026)	(0.027)	(0.027)
Rents			-0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.004	0.022	-0.007
			(0.033)	(0.035)	(0.033)
KA_open			-0.004	-0.005	-0.002
			(0.010)	(0.012)	(0.011)
NET_Inflows			-0.005**	-0.004*	
			(0.002)	(0.002)	
FDI_Inflows					0.012***
					(0.004)
Port_Inflows					-0.005***
					(0.002)
Reserves					0.006*
					(0.004)
TOT			-0.084	-0.092	-0.084
			(0.073)	(0.069)	(0.072)
FFend			-0.015***	-0.018***	-0.018***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.017***	-0.016***	-0.016***
			(0.003)	(0.003)	(0.003)
Human_Capital				-0.112	-0.162**
				(0.084)	(0.077)
Capita_GDP				0.051	0.058
				(0.049)	(0.044)
Durable				0.000	0.000
				(0.001)	(0.001)
Pseudo R-squared	0.099	0.199	0.356	0.369	0.400
Observations	387	387	387	387	387

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.34: Probits for Africa, Asia and LA - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.027**	0.028	0.052**	0.044*	0.043*
	(0.011)	(0.018)	(0.025)	(0.026)	(0.026)
Lag_Growth	0.572***	0.824***	0.735***	0.574**	0.673**
	(0.089)	(0.133)	(0.259)	(0.262)	(0.274)
Lag_KL	-0.012***	-0.035***	-0.059***	-0.094***	-0.095***
	(0.004)	(0.005)	(0.012)	(0.028)	(0.028)
Fiscal		0.032**	0.001	0.029	0.025
		(0.014)	(0.020)	(0.019)	(0.019)
Inflation		-0.083*	-0.324**	-0.278**	-0.274*
		(0.044)	(0.154)	(0.140)	(0.140)
XR_Stability		0.003	-0.034	-0.041	-0.048
		(0.019)	(0.036)	(0.036)	(0.036)
Crisis_5y			-0.048**	-0.061***	-0.058***
			(0.020)	(0.020)	(0.020)
Rents			0.001	-0.002**	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.014	-0.033	-0.019
			(0.024)	(0.027)	(0.027)
KA_open			0.003	0.005	0.002
			(0.007)	(0.008)	(0.008)
NET_Inflows			-0.005**	-0.011***	
			(0.002)	(0.002)	
FDI_Inflows					-0.014***
					(0.004)
Port_Inflows					-0.009***
					(0.002)
Reserves					0.007
					(0.004)
TOT			-0.101**	-0.028	-0.042
			(0.049)	(0.054)	(0.053)
FFend			-0.013***	-0.008**	-0.008**
			(0.004)	(0.003)	(0.003)
Global_Uncertainty			-0.006***	-0.006**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.067	0.084
				(0.057)	(0.056)
Capita_GDP				0.035	0.034
				(0.029)	(0.029)
Durable				0.000	0.000
				(0.000)	(0.000)
Pseudo R-squared	0.031	0.075	0.185	0.211	0.212
Observations	4,621	2,232	871	843	832

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.35: Probits for Non-Developed I - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.014	0.028	0.039	0.019	0.018
	(0.010)	(0.018)	(0.031)	(0.031)	(0.030)
Lag_Growth	0.625***	0.824***	1.188***	0.818**	0.888**
	(0.099)	(0.133)	(0.342)	(0.365)	(0.383)
Lag_KL	-0.021***	-0.035***	-0.081***	-0.089**	-0.083**
	(0.005)	(0.005)	(0.022)	(0.036)	(0.037)
Fiscal		0.032**	0.007	0.041	0.034
		(0.014)	(0.030)	(0.028)	(0.027)
Inflation		-0.083*	-0.886***	-0.772***	-0.809***
		(0.044)	(0.266)	(0.230)	(0.235)
XR_Stability		0.003	-0.151***	-0.166***	-0.166***
		(0.019)	(0.047)	(0.047)	(0.047)
Crisis_5y			-0.052**	-0.062***	-0.062***
			(0.025)	(0.024)	(0.024)
Rents			0.001	-0.002*	-0.001
			(0.001)	(0.001)	(0.001)
Trade			0.023	-0.025	-0.008
			(0.039)	(0.035)	(0.038)
KA_open			-0.002	0.009	0.008
			(0.010)	(0.009)	(0.009)
NET_Inflows			-0.005**	-0.015***	
			(0.002)	(0.003)	
FDI_Inflows					-0.027***
					(0.006)
Port_Inflows					-0.012***
					(0.002)
Reserves					0.015***
					(0.005)
TOT			-0.102*	0.019	0.025
			(0.057)	(0.067)	(0.062)
FFend			-0.012***	-0.004	-0.005
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.002	-0.003	-0.003
			(0.003)	(0.003)	(0.003)
Human_Capital				0.086	0.113*
				(0.064)	(0.063)
Capita_GDP				0.026	0.020
				(0.037)	(0.038)
Durable				0.001	0.001
				(0.001)	(0.001)
Pseudo R-squared	0.040	0.075	0.229	0.271	0.279
Observations	3,834	2,232	578	570	570

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.36: Probits for Non-Developed II - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.022**	0.041**	0.072**	0.051	0.053
	(0.010)	(0.019)	(0.030)	(0.034)	(0.034)
Lag_Growth	0.660***	1.006***	0.904***	0.701***	0.704***
	(0.089)	(0.140)	(0.267)	(0.270)	(0.273)
Lag_KL	-0.013***	-0.031***	-0.060***	-0.149***	-0.152***
	(0.004)	(0.006)	(0.013)	(0.030)	(0.029)
Fiscal		0.030**	-0.010	0.029	0.025
		(0.013)	(0.022)	(0.022)	(0.021)
Inflation		-0.040	-0.094*	-0.111*	-0.113*
		(0.036)	(0.056)	(0.058)	(0.058)
XR_Stability		-0.000	-0.037	-0.054	-0.060
		(0.020)	(0.037)	(0.037)	(0.037)
Crisis_5y			-0.060***	-0.067***	-0.066***
			(0.020)	(0.020)	(0.020)
Rents			0.001	-0.001	-0.002
			(0.001)	(0.001)	(0.001)
Trade			-0.007	-0.037	-0.041
			(0.028)	(0.028)	(0.029)
KA_open			-0.000	-0.003	-0.005
			(0.008)	(0.008)	(0.008)
NET_Inflows			-0.003*	-0.009***	
			(0.002)	(0.002)	
FDI_Inflows					-0.006
					(0.004)
Port_Inflows					-0.008***
					(0.002)
Reserves					0.007
					(0.004)
TOT			-0.106**	-0.050	-0.066
			(0.052)	(0.055)	(0.055)
FFend			-0.018***	-0.012***	-0.012***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.006**	-0.005**	-0.005**
			(0.003)	(0.002)	(0.002)
Human_Capital				0.144**	0.150**
				(0.062)	(0.062)
Capita_GDP				0.100***	0.100***
				(0.032)	(0.031)
Durable				-0.000	-0.001
				(0.001)	(0.001)
Pseudo R-squared	0.037	0.067	0.154	0.180	0.185
Observations	4,944	2,417	930	907	901

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.37: Probits for Non-Developed III - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.013	0.035*	0.074**	0.044	0.047
	(0.010)	(0.019)	(0.030)	(0.033)	(0.033)
Lag_Growth	0.564***	0.879***	0.899***	0.762***	0.754***
	(0.082)	(0.140)	(0.269)	(0.278)	(0.284)
Lag_KL	-0.007*	-0.029***	-0.059***	-0.134***	-0.138***
	(0.004)	(0.006)	(0.013)	(0.030)	(0.029)
Fiscal		0.029**	-0.021	0.014	0.011
		(0.014)	(0.021)	(0.021)	(0.021)
Inflation		-0.038	-0.079	-0.104*	-0.104**
		(0.032)	(0.049)	(0.053)	(0.053)
XR_Stability		-0.012	-0.038	-0.051	-0.057
		(0.021)	(0.038)	(0.038)	(0.037)
Crisis_5y			-0.053***	-0.061***	-0.060***
			(0.020)	(0.019)	(0.020)
Rents			0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.016	-0.047*	-0.049*
			(0.028)	(0.027)	(0.029)
KA_open			-0.000	-0.003	-0.005
			(0.008)	(0.009)	(0.009)
NET_Inflows			-0.003*	-0.008***	
			(0.002)	(0.002)	
FDI_Inflows					-0.006
					(0.005)
Port_Inflows					-0.008***
					(0.002)
Reserves					0.007*
					(0.004)
TOT			-0.125**	-0.058	-0.076
			(0.053)	(0.056)	(0.057)
FFend			-0.021***	-0.014***	-0.014***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.006**	-0.006**	-0.005**
			(0.003)	(0.002)	(0.002)
Human_Capital				0.116*	0.121*
				(0.064)	(0.063)
Capita_GDP				0.092***	0.092***
				(0.032)	(0.030)
Durable				-0.000	-0.000
				(0.001)	(0.001)
Pseudo R-squared	0.028	0.057	0.166	0.184	0.189
Observations	4,716	2,170	896	871	865

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.38: Long Lasting Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.025***	0.028**	0.028	0.035**	0.032*
	(0.007)	(0.012)	(0.018)	(0.017)	(0.018)
Lag_Growth	0.191***	0.223***	0.245	0.170	0.208
	(0.042)	(0.070)	(0.162)	(0.160)	(0.178)
Lag_KL	-0.014***	-0.020***	-0.040***	-0.057***	-0.053***
	(0.002)	(0.003)	(0.009)	(0.018)	(0.017)
Fiscal		0.014*	0.005	0.016	0.013
		(0.008)	(0.013)	(0.013)	(0.013)
Inflation		-0.001	-0.003	-0.021	-0.024
		(0.002)	(0.003)	(0.025)	(0.026)
XR_Stability		-0.015	-0.044**	-0.049**	-0.053***
		(0.011)	(0.020)	(0.020)	(0.020)
Crisis_5y			-0.012	-0.015	-0.015
			(0.013)	(0.012)	(0.012)
Rents			-0.000	-0.002**	-0.002**
			(0.001)	(0.001)	(0.001)
Trade			0.046***	0.042**	0.044**
			(0.016)	(0.017)	(0.018)
KA_open			-0.005	-0.004	-0.004
			(0.005)	(0.005)	(0.005)
NET_Inflows			-0.000	-0.002*	
			(0.001)	(0.001)	
FDI_Inflows					-0.001
					(0.003)
Port_Inflows					-0.002**
					(0.001)
Reserves					-0.001
					(0.002)
TOT			-0.046*	-0.012	-0.014
			(0.027)	(0.030)	(0.030)
FFend			0.002	0.002*	0.002*
			(0.001)	(0.001)	(0.001)
Global_Uncertainty			0.000	-0.002	-0.002
			(0.002)	(0.002)	(0.002)
Human_Capital				0.066*	0.065*
				(0.036)	(0.036)
Capita_GDP				0.007	0.005
				(0.016)	(0.015)
Durable				-0.001***	-0.001***
				(0.000)	(0.000)
Pseudo R-squared	0.033	0.061	0.143	0.182	0.183
Observations	6,374	3,380	1,100	1,063	1,051

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.39: Sustained Episodes by Region

Region	# of Episodes	% Sustained
East Asia and Pacific	35	71.43
Latin-American & Caribbean	38	60.53
Middle East and North Africa	30	60
South Asia	14	71.43
Sub-Saharan Africa	44	50
Europe & North America	28	70.34

Table 1.40: Sustained Episodes by Income

Region	# of Episodes	% Sustained
1st Quintile	41	60.98
2nd Quintile	39	69.23
3rd Quintile	50	52
4th Quintile	41	65.85
5th Quntile	18	66.67

Table 1.41: Sustained Probits - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.056	0.119*	0.169**	0.312***	0.298***
	(0.049)	(0.066)	(0.079)	(0.105)	(0.092)
Lag_Growth	0.869**	0.955**	-0.175	-0.462	-0.014
	(0.340)	(0.474)	(0.912)	(0.927)	(1.062)
Lag_KL	-0.044***	-0.074***	-0.130**	-0.172	-0.122
	(0.016)	(0.023)	(0.064)	(0.190)	(0.192)
Fiscal		0.040	0.038	0.196*	0.155
		(0.056)	(0.099)	(0.113)	(0.117)
Inflation		-0.250	-0.728*	-0.529	-0.558
		(0.163)	(0.417)	(0.366)	(0.384)
XR_Stability		0.024	-0.266	-0.246	-0.309
		(0.097)	(0.176)	(0.178)	(0.196)
Crisis_5y			-0.028	-0.256**	-0.255**
			(0.121)	(0.126)	(0.126)
Rents			0.001	0.002	0.005
			(0.004)	(0.008)	(0.008)
Trade			0.087	0.054	0.040
			(0.146)	(0.156)	(0.195)
KA_open			-0.056*	-0.064	-0.068
			(0.033)	(0.044)	(0.044)
FDI_Inflows					-0.033
					(0.026)
Port_Inflows					-0.029***
					(0.009)
Reserves					0.020
					(0.016)
TOT			-0.088	-0.113	-0.108
			(0.244)	(0.300)	(0.288)
FFend			-0.060***	-0.067***	-0.070***
			(0.011)	(0.014)	(0.012)
Global_Uncertainty			-0.014	-0.014	-0.017
			(0.010)	(0.010)	(0.011)
Human_Capital				0.167	0.087
				(0.324)	(0.314)
Capita_GDP				-0.063	-0.094
				(0.174)	(0.176)
Durable				-0.011**	-0.011***
				(0.004)	(0.004)
NET_Inflows			-0.008	-0.037***	
			(0.006)	(0.011)	
Pseudo R-squared	0.016	0.033	0.186	0.284	0.278
Observations	628	336	126	109	109

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.42: Non-Sustained Probits - Average Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Probit	Probit	Probit	Probit	Probit
Underval81	0.016***	0.039***	0.094***	0.122***	0.136***
	(0.006)	(0.011)	(0.024)	(0.028)	(0.029)
Lag_Growth	0.212***	0.309***	0.096	0.024	0.016
	(0.051)	(0.072)	(0.159)	(0.160)	(0.157)
Lag_KL	-0.006***	-0.015***	-0.023***	-0.100***	-0.095***
	(0.002)	(0.003)	(0.008)	(0.022)	(0.021)
Fiscal		0.016**	-0.000	0.018	0.011
		(0.007)	(0.014)	(0.015)	(0.014)
Inflation		-0.011	-0.018	-0.036	-0.042
		(0.015)	(0.021)	(0.028)	(0.027)
XR_Stability		-0.005	0.007	0.009	0.001
		(0.011)	(0.024)	(0.023)	(0.022)
Crisis_5y			-0.018	-0.018	-0.016
			(0.015)	(0.014)	(0.014)
Rents			0.001	0.001	0.000
			(0.001)	(0.001)	(0.001)
Trade			-0.059***	-0.067***	-0.080***
			(0.021)	(0.022)	(0.024)
KA_open			0.010*	0.007	0.007
			(0.006)	(0.006)	(0.006)
NET_Inflows			-0.004**	-0.003**	
			(0.001)	(0.001)	
FDI_Inflows					0.004
					(0.003)
Port_Inflows					-0.004***
					(0.001)
Reserves					-0.000
					(0.003)
TOT			0.014	-0.020	-0.024
			(0.040)	(0.041)	(0.044)
FFend			-0.015***	-0.013***	-0.013***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.003	-0.003*	-0.004**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.045	0.031
				(0.036)	(0.035)
Capita_GDP				0.103***	0.100***
				(0.028)	(0.027)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Pseudo R-squared	0.029	0.085	0.259	0.300	0.315
Observations	5,602	2,962	958	932	920

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.43: Growth Sustained After - Average Marginal Effects

Episode Dummy	(1) Probit	(2) Probit	(3) Probit	(4) Probit	(5) Probit
Underval81	0.016***	0.034***	0.042**	0.025	0.028
	(0.006)	(0.013)	(0.021)	(0.019)	(0.019)
Lag_Growth	0.222***	0.354***	0.379**	0.126	0.111
	(0.034)	(0.070)	(0.192)	(0.181)	(0.187)
Lag_KL	-0.008***	-0.020***	-0.058***	-0.120***	-0.117***
	(0.002)	(0.003)	(0.009)	(0.022)	(0.021)
Fiscal		0.014*	-0.000	0.029*	0.020
		(0.007)	(0.016)	(0.016)	(0.016)
Inflation		-0.086**	-0.033	-0.051	-0.054
		(0.036)	(0.046)	(0.052)	(0.053)
XR_Stability		-0.034***	-0.021	-0.035	-0.049*
		(0.011)	(0.028)	(0.027)	(0.027)
Crisis_5y			-0.034**	-0.045***	-0.044***
			(0.016)	(0.016)	(0.016)
Rents			0.001*	-0.001	-0.001*
			(0.001)	(0.001)	(0.001)
Trade			0.008	-0.017	-0.029
			(0.019)	(0.020)	(0.023)
KA_open			-0.002	-0.006	-0.008
			(0.006)	(0.006)	(0.006)
FDI_Inflows					0.000
					(0.003)
Port_Inflows					-0.005***
					(0.001)
Reserves					0.004
					(0.003)
TOT			0.098***	0.135***	0.124***
			(0.034)	(0.041)	(0.040)
FFend			-0.026***	-0.021***	-0.021***
			(0.004)	(0.004)	(0.004)
Global_Uncertainty			-0.000	-0.000	-0.001
			(0.002)	(0.002)	(0.002)
Human_Capital				0.173***	0.172***
				(0.048)	(0.048)
Capita_GDP				0.051**	0.045**
				(0.021)	(0.020)
Durable				-0.000	-0.000
				(0.000)	(0.000)
NET_Inflows			-0.000	-0.005***	
			(0.001)	(0.002)	
Pseudo R-squared	0.034	0.100	0.252	0.292	0.302
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.44: Multinomial Probit, Average Marginal Effect Case 1

Episode Dummy	(1) Mprobit	(2) Mprobit	(3) Mprobit	(4) Mprobit	(5) Mprobit
Underval81	0.013***	0.033***	0.071***	0.103***	0.112***
	(0.005)	(0.009)	(0.019)	(0.024)	(0.024)
Lag_Growth	0.170***	0.225***	-0.002	-0.082	-0.080
	(0.045)	(0.058)	(0.127)	(0.139)	(0.136)
Lag_KL	-0.005***	-0.013***	-0.021***	-0.084***	-0.077***
	(0.002)	(0.003)	(0.007)	(0.019)	(0.019)
Fiscal		0.013**	0.005	0.017	0.009
		(0.007)	(0.012)	(0.013)	(0.012)
Inflation		-0.008	-0.008	-0.031	-0.038
		(0.016)	(0.018)	(0.028)	(0.029)
XR_Stability		-0.003	0.003	0.011	0.004
		(0.010)	(0.022)	(0.021)	(0.021)
Crisis_5y			-0.012	-0.012	-0.010
			(0.013)	(0.013)	(0.013)
Rents			0.001	0.001	0.001
			(0.000)	(0.001)	(0.000)
Trade			-0.051***	-0.064***	-0.075***
			(0.018)	(0.019)	(0.021)
KA_open			0.009*	0.007	0.007
			(0.005)	(0.005)	(0.005)
NET_Inflows			-0.004***	-0.003**	
			(0.001)	(0.001)	
FDI_Inflows					0.001
					(0.002)
Port_Inflows					-0.004***
					(0.001)
Reserves					-0.000
					(0.003)
TOT			0.004	-0.016	-0.019
			(0.035)	(0.039)	(0.040)
FFend			-0.014***	-0.013***	-0.013***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.002	-0.002	-0.003*
			(0.001)	(0.001)	(0.002)
Human_Capital				0.038	0.033
				(0.033)	(0.032)
Capita_GDP				0.089***	0.081***
				(0.024)	(0.023)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# 0 Denotes no episode, 1 Non-Sustained Episode, 2 Sustained Episode

Table 1.45: Multinomial Probit, Average Marginal Effect Case 2

	(1)	(2)	(3)	(4)	(5)
Episode Dummy	Mprobit	Mprobit	Mprobit	Mprobit	Mprobit
Underval81	0.016**	0.016**	0.024	0.021	0.019
	(0.007)	(0.007)	(0.018)	(0.017)	(0.017)
Lag_Growth	0.403***	0.403***	0.737***	0.620***	0.610***
	(0.054)	(0.054)	(0.200)	(0.208)	(0.212)
Lag_KL	-0.015***	-0.015***	-0.042***	-0.086***	-0.089***
	(0.002)	(0.002)	(0.009)	(0.020)	(0.020)
Fiscal			-0.008	0.012	0.009
			(0.013)	(0.013)	(0.013)
Inflation			-0.060	-0.060	-0.063
			(0.062)	(0.059)	(0.063)
XR_Stability			-0.030	-0.043**	-0.042**
			(0.021)	(0.021)	(0.021)
Crisis_5y			-0.042***	-0.046***	-0.046***
			(0.013)	(0.013)	(0.013)
Rents			0.000	-0.003***	-0.003***
			(0.001)	(0.001)	(0.001)
Trade			0.041***	0.039**	0.039**
			(0.015)	(0.016)	(0.017)
KA_open			-0.010*	-0.012**	-0.014***
			(0.005)	(0.005)	(0.005)
NET_Inflows			0.000	-0.004**	
			(0.001)	(0.001)	
FDI_Inflows					-0.003
					(0.003)
Port_Inflows					-0.002*
					(0.001)
Reserves					0.004*
					(0.002)
TOT			-0.055*	-0.035	-0.036
			(0.029)	(0.030)	(0.030)
FFend			-0.004*	-0.001	-0.001
			(0.002)	(0.002)	(0.002)
Global_Uncertainty			-0.002	-0.001	-0.001
			(0.002)	(0.001)	(0.002)
Human_Capital				0.078**	0.077**
				(0.036)	(0.036)
Capita_GDP				0.031*	0.035*
				(0.018)	(0.018)
Durable				-0.001***	-0.001***
				(0.000)	(0.000)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

0 Denotes no episode, 1 Non-Sustained Episode, 2 Sustained Episode

Table 1.46: Multinomial Probit, Average Marginal Effect Case 1 (Smallest Sample)

Episode Dummy	(1) Mprobit	(2) Mprobit	(3) Mprobit	(4) Mprobit	(5) Mprobit
Underval81	0.013***	0.033***	0.071***	0.103***	0.112***
	(0.005)	(0.009)	(0.019)	(0.024)	(0.024)
Lag_Growth	0.170***	0.225***	-0.002	-0.082	-0.080
	(0.045)	(0.058)	(0.127)	(0.139)	(0.136)
Lag_KL	-0.005***	-0.013***	-0.021***	-0.084***	-0.077***
	(0.002)	(0.003)	(0.007)	(0.019)	(0.019)
Fiscal		0.013**	0.005	0.017	0.009
		(0.007)	(0.012)	(0.013)	(0.012)
Inflation		-0.008	-0.008	-0.031	-0.038
		(0.016)	(0.018)	(0.028)	(0.029)
XR_Stability		-0.003	0.003	0.011	0.004
		(0.010)	(0.022)	(0.021)	(0.021)
Crisis_5y			-0.012	-0.012	-0.010
			(0.013)	(0.013)	(0.013)
Rents			0.001	0.001	0.001
			(0.000)	(0.001)	(0.000)
Trade			-0.051***	-0.064***	-0.075***
			(0.018)	(0.019)	(0.021)
KA_open			0.009*	0.007	0.007
			(0.005)	(0.005)	(0.005)
NET_Inflows			-0.004***	-0.003**	
			(0.001)	(0.001)	
FDI_Inflows					0.001
					(0.002)
Port_Inflows					-0.004***
					(0.001)
Reserves					-0.000
					(0.003)
TOT			0.004	-0.016	-0.019
			(0.035)	(0.039)	(0.040)
FFend			-0.014***	-0.013***	-0.013***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.002	-0.002	-0.003*
			(0.001)	(0.001)	(0.002)
Human_Capital				0.038	0.033
				(0.033)	(0.032)
Capita_GDP				0.089***	0.081***
				(0.024)	(0.023)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Observations	1,029	1,029	1,029	1,029	1,029

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

0 Denotes no episode, 1 Non-Sustained Episode, 2 Sustained Episode

Table 1.47: Multinomial Probit, Average Marginal Effect Case 2 (Smallest Sample)

Episode Dummy	(1) Mprobit	(2) Mprobit	(3) Mprobit	(4) Mprobit	(5) Mprobit
Underval81	0.019	0.018	0.021	0.022	0.019
	(0.016)	(0.018)	(0.016)	(0.017)	(0.017)
Lag_Growth	0.822***	0.809***	0.641***	0.626***	0.610***
	(0.198)	(0.204)	(0.206)	(0.211)	(0.212)
Lag_KL	-0.032***	-0.034***	-0.046***	-0.087***	-0.089***
	(0.007)	(0.007)	(0.009)	(0.020)	(0.020)
Fiscal		-0.007	0.014	0.012	0.009
		(0.014)	(0.013)	(0.013)	(0.013)
Inflation		-0.105	-0.037	-0.061	-0.063
		(0.071)	(0.054)	(0.060)	(0.063)
XR_Stability		-0.044**	-0.048**	-0.043**	-0.042**
		(0.021)	(0.021)	(0.021)	(0.021)
Crisis_5y			-0.043***	-0.047***	-0.046***
			(0.012)	(0.013)	(0.013)
Rents			-0.004**	-0.003***	-0.003***
			(0.002)	(0.001)	(0.001)
Trade			0.051***	0.040**	0.039**
			(0.017)	(0.016)	(0.017)
KA_open			-0.007	-0.012**	-0.014***
			(0.005)	(0.005)	(0.005)
NET_Inflows			-0.003**	-0.004**	
			(0.002)	(0.001)	
FDI_Inflows					-0.003
					(0.003)
Port_Inflows					-0.002*
					(0.001)
Reserves					0.004*
					(0.002)
TOT			-0.004	-0.035	-0.036
			(0.033)	(0.031)	(0.030)
FFend			-0.001	-0.001	-0.001
			(0.002)	(0.002)	(0.002)
Global_Uncertainty			-0.001	-0.001	-0.001
			(0.002)	(0.001)	(0.002)
Human_Capital				0.078**	0.077**
				(0.036)	(0.036)
Capita_GDP				0.031*	0.035*
				(0.018)	(0.018)
Durable				-0.001***	-0.001***
				(0.000)	(0.000)
Observations	1,029	1,029	1,029	1,029	1,029

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

0 Denotes no episode, 1 Non-Sustained Episode, 2 Sustained Episode

Figure 1.1: Capital stock growth in the (a) Solow framework and the (b) AK framework

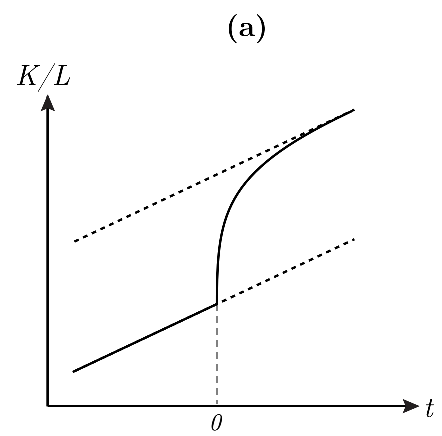


Figure 1.2: Episodes in South Korea

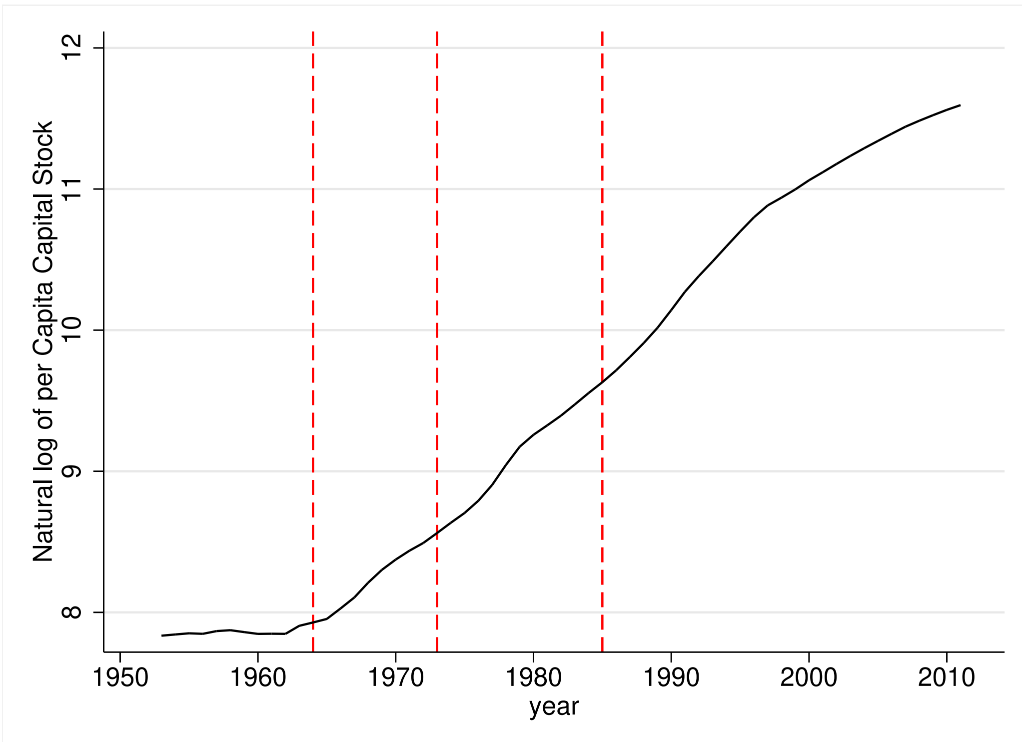


Figure 1.3: Agricultural Share of Value Added During Episodes

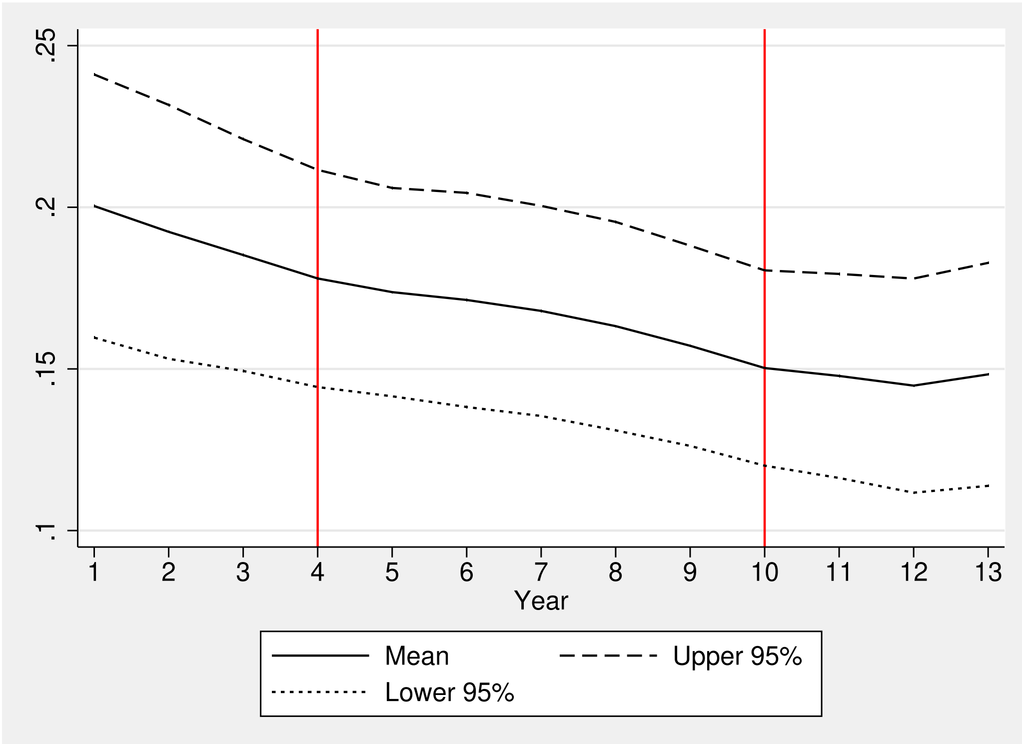


Figure 1.4: Agricultural Share of Employment During Episodes

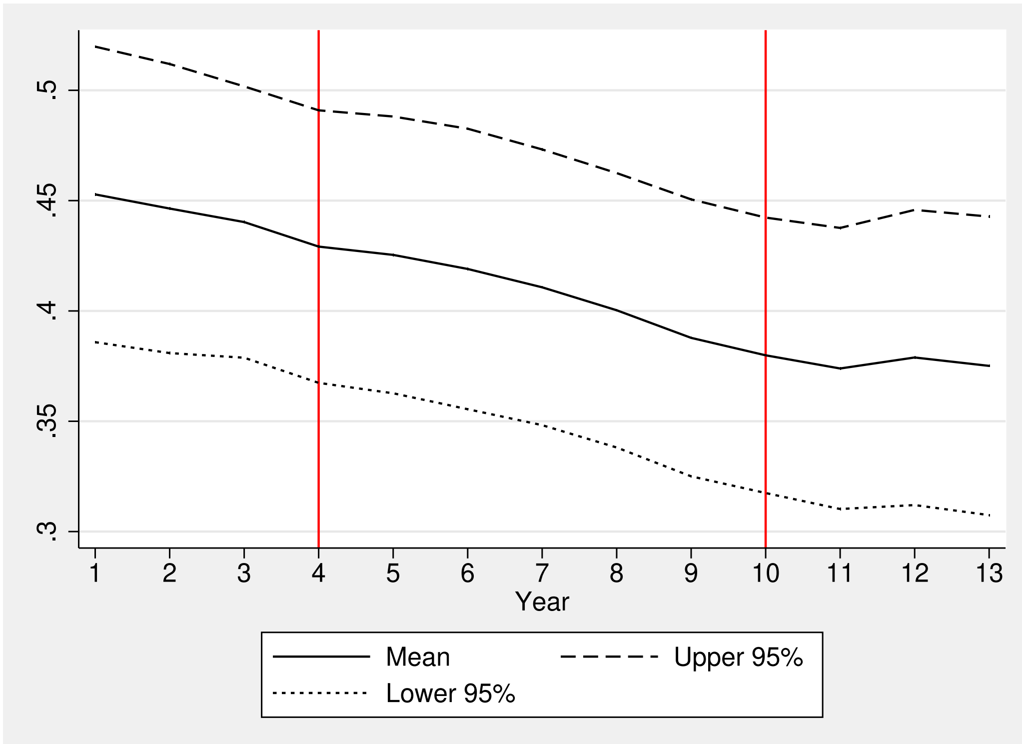


Figure 1.5: Manufacturing Share of Value Added During Episodes

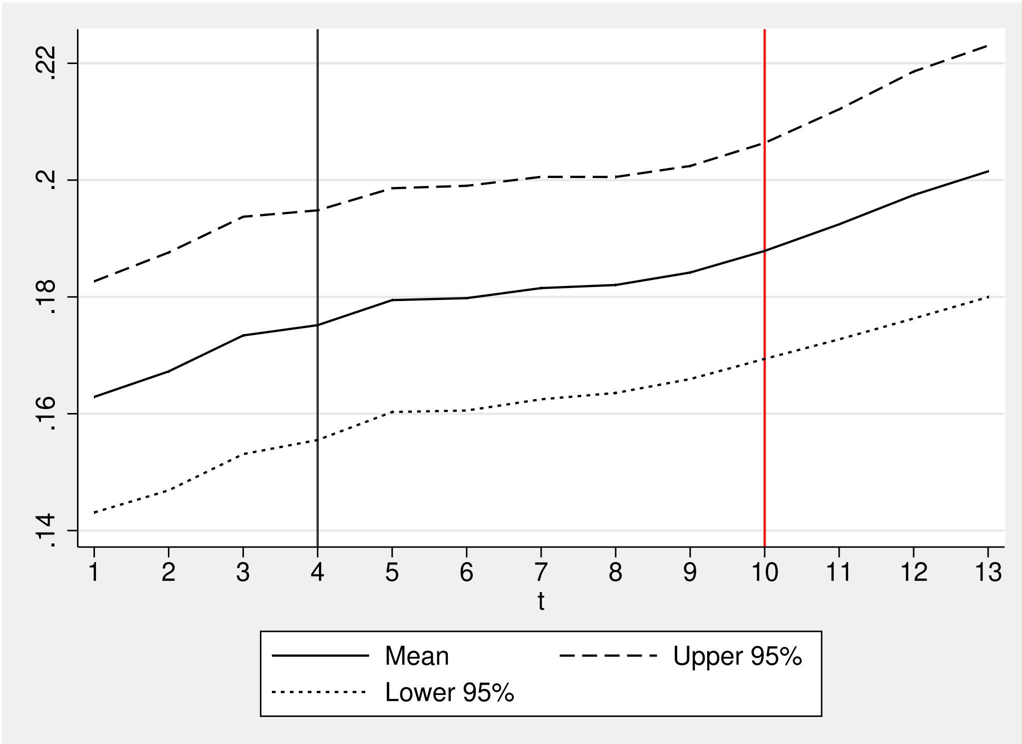


Figure 1.6: Manufacturing Share of Employment During Episodes

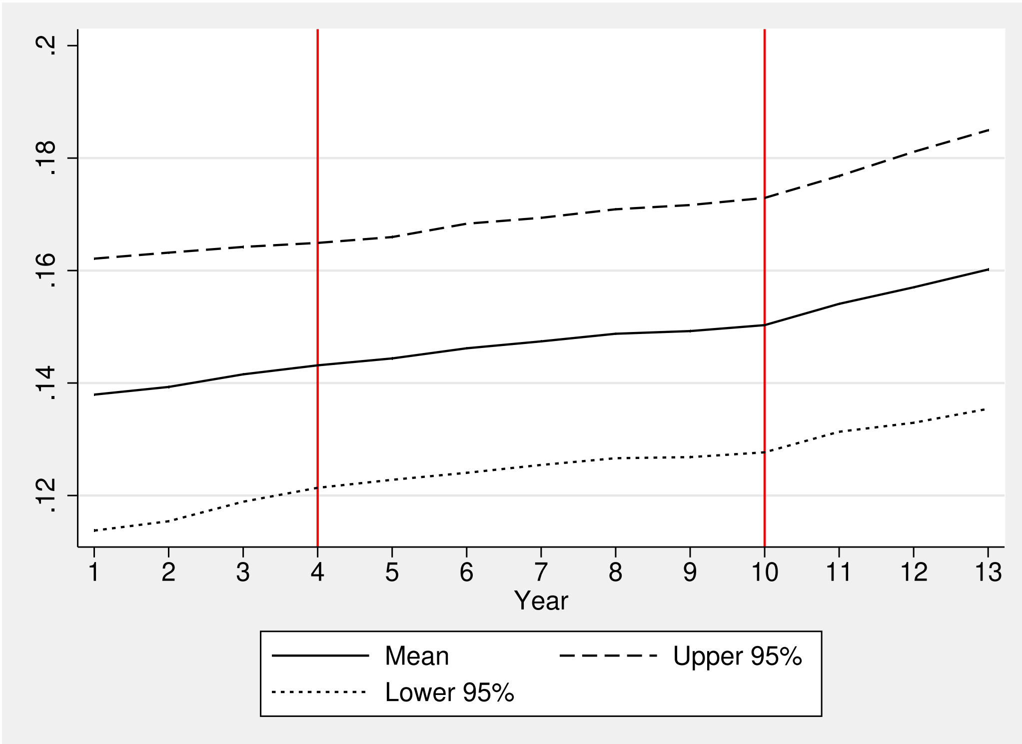


Figure 1.7: Tradable Share of Value Added During Episodes

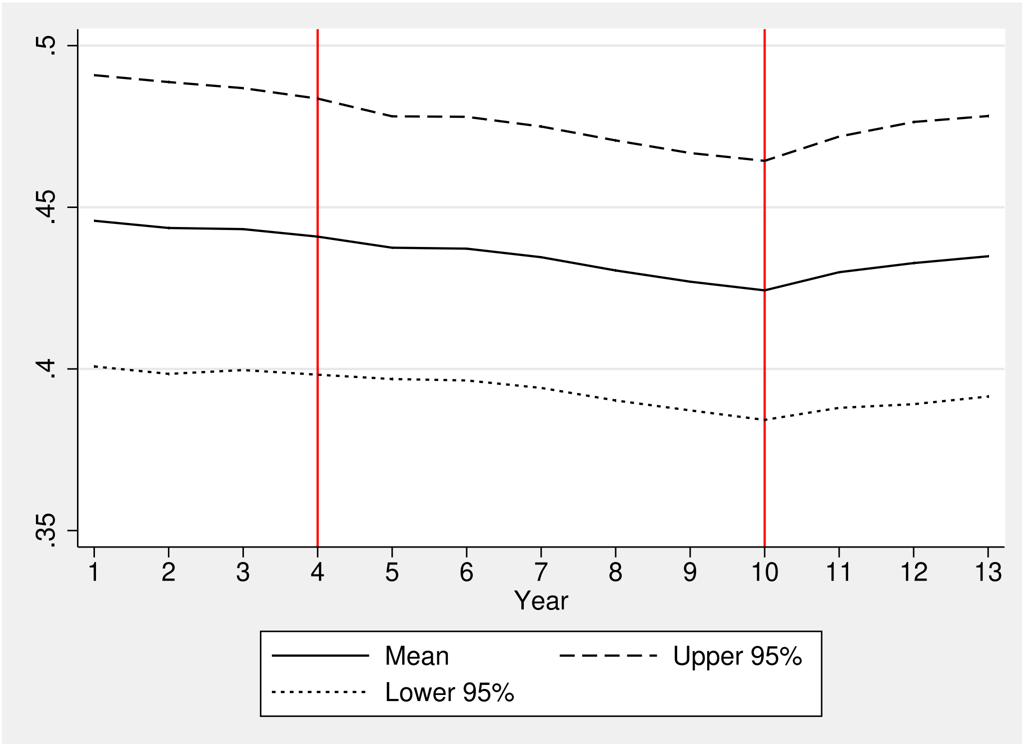


Figure 1.8: Tradable Share of Employment During Episodes

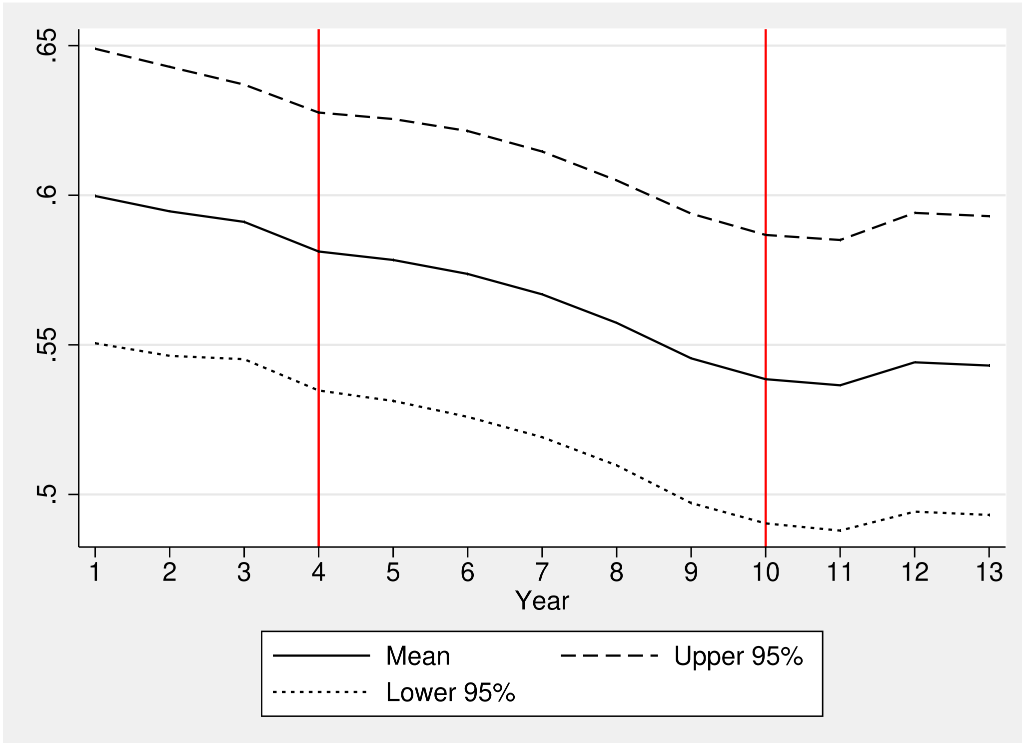


Figure 1.9: Trade Balance Share of GDP During Episodes

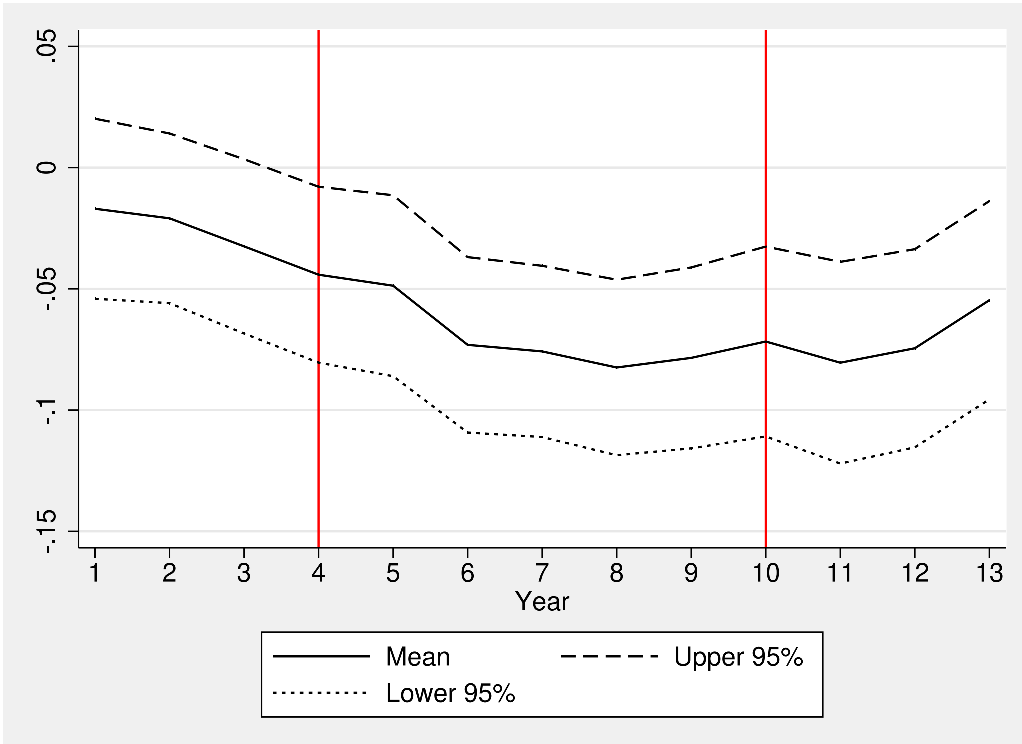


Figure 1.10: Export Share of GDP During Episodes

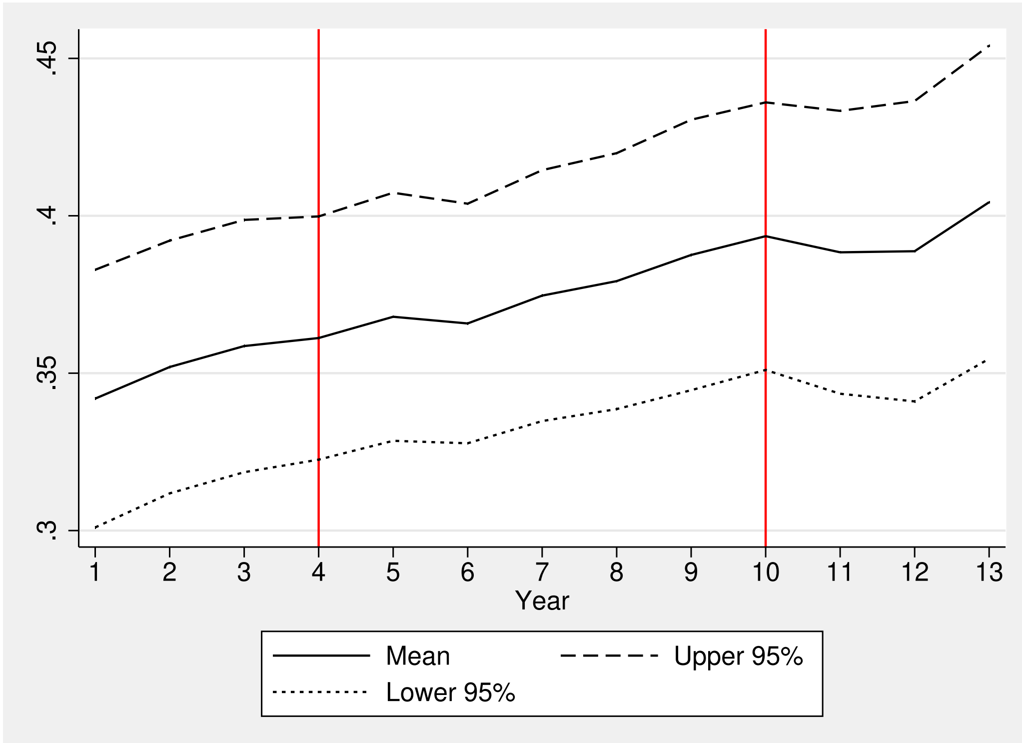
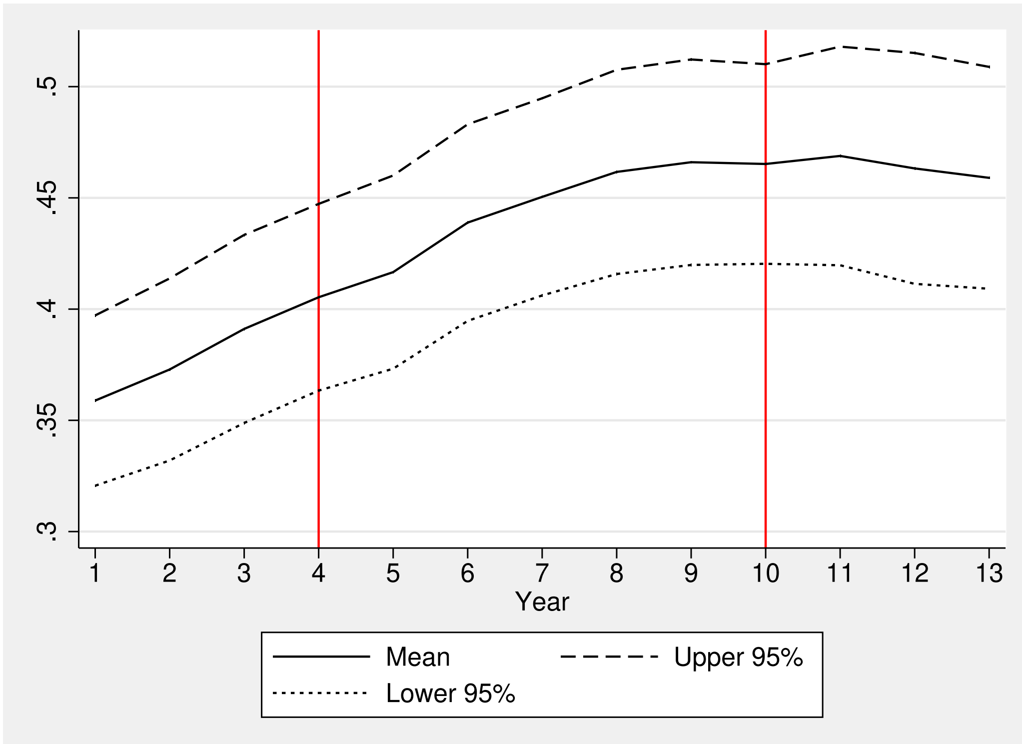


Figure 1.11: Import Share of GDP During Episodes



CHAPTER 2

THE EFFECTS OF EXCHANGE RATE REGIMES ON REAL EXCHANGE RATE MISALIGNMENTS

2.1 Introduction

After a period of macroeconomic stability and no currency crises at sight (2001-2009), the prolonged stagnation of the peripheral countries in the Euro-zone questions (again) the viability of extremely rigid exchange rate arrangements. As the number of countries that use Inflation Targeting has been growing steadily, from a few cases mainly in the developed world at the early 1990s, to almost 30 cases in the mid 2010s including several non-developed economies, increasing degrees of exchange rate flexibility look like an appealing option. Not so long ago it was predicted that intermediate regimes will disappear (Fischer, 2001), but in non developed countries the Central Bank intervenes heavily in the foreign exchange market, to deal with hot money flows or booming terms of trade; in practical terms intermediate options are alive and kicking. In a nutshell, the interest in discussing exchange rate regimes (henceforth ERRs) does not seems to fade away.

Policy-makers know that the different ERRs affect the mean, the variance, and the dynamics of the real exchange rate (henceforth RER) for relevant periods of time. Policy-makers agree that the RER is a key price that has a strong effects on output, inflation, income distribution, and on the balance of payments. But unlike policy-markers, theorists often like to assume that the evolution of RER is entirely shaped by "deep parameters", and that the choice of the ERR is, in principle, an irrelevant problem. Put it differently, the ERR only affects the nominal exchange rate and the price level: real variables like the RER only depend on preferences, endowments, and technology.

Consider for example a model of two identical countries, but one faces a given rate of devaluation per year, while the other implements a perfectly credible fixed ERR (so the rate of devaluation is zero). Furthermore, assume that due to price flexibility there is continuous full-employment and that both economies are small in world markets (so they takes international prices as given), and only tradables and non-tradable goods are produced. If inflation is correctly anticipated, those countries should only differ on their nominal variables: with zero output and employment growth, the first country will face a rate of inflation equal to the rate of devaluation, while the second country will face a zero rate of inflation (and a zero rate of devaluation).[1] The level of the RER should be the same in both cases, so the ERR is deemed to be neutral.[2]

Despite the attractiveness of the assumption that the ERR is neutral, important evidence shows that the ERR can have important effects on the evolution of the RER. In a classic study, Mussa (1986) shows that the RER tracks closely the behavior of the nominal exchange rate for long periods of time, in a group of developed countries before and after the collapse of Bretton Woods. Using a larger span of data for the United States and United Kingdom, Taylor and Taylor (2004) show that the RER tracks the nominal exchange rate in the short

[1]In this paper I will use the Latin-American convention. The RER is always defined as the relative price of tradable to non-tradable goods, unless otherwise stated. A devaluation of the exchange rate means an increase in the price of foreign currency in terms of domestic currency, while a revaluation means a decrease in the price of foreign currency in terms of domestic currency. The literature refers to "'pegs", "fixed" regimes, to denote arrangements with little exchange rate flexibility, and "flexible" or "floats" to denote arrangements with lots of flexibility. I use any of these terms. I call all the other cases "intermediate" regimes.

[2]This result only holds if the government returns the proceeds from the inflation tax to the private sector via lump-sum transfers. Otherwise ERR with higher rate of inflation will feature a different income distribution between the government and the private sector, that could produce different levels of expenditures. In turn, that can have an effect on the RER.

and medium run if inflation is moderate. Finally, the RER is more volatile under floats than under pegs (Krugman 1989, ch. 1; Cermeo and Sanin, 2015).[3]

Some theories try to explain why the ERR is not neutral. A popular story is that in a "sticky prices" world, if the exchange rate is fixed, the RER is also fixed for substantial periods of time.[4] With flexible prices, the choice of the ERR can lead to changes in the rate of inflation and on the stock of real balances. This also affects demand patters and the level of the RER, at least in the medium run. In the model proposed by Calvo and Rodriguez (1977), if inflation is correctly anticipated, different rates of inflation affect portfolio choices, the desired rate of accumulation of domestic assets, the balance of payments, and the evolution of the RER. If higher inflation rates induces the dollarization of portfolios, the adoption of ERR that features higher inflation rate will imply a temporarily more depreciated RER, as the private sector increases its saving rate to accumulate foreign exchange. Likewise, ERR with lower inflation rate (like hard pegs or currency boards) will experience a more appreciated RER (also temporarily).

In a similar vein, Reinhart et. al. (1994) show that a policy based on RER targeting can work for substantial periods of time, provided that a credibly policy commits to a specific path for future inflation or interest rates (depending on whether there are capital controls or full capital mobility). The underlying intuition is that the first order condition of a model that a features a cash in advance constraint makes consumption of tradables a negative function of the (nominal) interest rate, so if interest rates are high (low) today, tradable

[3]Baxter and Stockman (1989) and Stockman (1983) argue that causality runs from real shocks to the level of the RER. The problem with this explanation is that one would have to argue that the *fundamentals* that determine the RER are extremely volatile, which seems unlikely. See Krugman (1989, ch. 1) for a critique of that position.

[4]Most models in that tradition follow the structure of the old Mundell-Fleming model. But some newer microfounded models that combine elements from Real Business Cycle theory and the New Keynesian approach (for instance Monacelli, 2004), can also explain the findings of Mussa.

consumption is low (high), and the real exchange rate is high (low). It follows that some ERRs that imply a non-constant path for the interest rate, like a "passive crawling-peg", can sustain a higher RER than other arrangements (at least for a significant period of time).[5]

The theories discussed so far are short-run in nature, although the effects of ERR on the RER may last for prolonged period of time. Other theoretical models rely on the idea that the ERR affects the long-run behavior of relative prices. For example Broda (2006) develops a formal model that shows that pegs are associated with more output and employment volatility. Following the insights from implicit contract theory, the real wage and the price level should be higher under pegs if: a) firms are risk neutral and workers are risk averse; b) pegs increase output volatility. If a) and b) hold, then pegs are associated by RER appreciation.

Other mechanisms that can produce similar effect include wealth effects derived from a reduction in the inflation tax, or changes in the supply of non-tradable goods.[6] Finally, if non-tradable prices are rigid in the downward direction, it follows that exchange rate pegs can display persistent overvaluation: after some shock that requires an increase in the relative price of tradable to non-tradable goods, neither the price of tradables can increase (for instance if the international price is given) nor the non-tradable price can fall.

On a different theoretical ground, in models with hidden unemployment the non-tradable price is controllable by monetary policy (see Razmi et. al. 2012), so there is a close connection between the ERR and the RER. For instance, if the international price of the tradable good is given and monetary policy pins-down the price of non-tradable goods, then the RER is

[5] A crawling peg is system based on a rule for the rate of devaluation. The rule is often explicit, but it could implicit as well. While "passive crawling-pegs" set the rate of devaluation equal to past inflation or the difference between domestic and foreign inflation, "active crawling-pegs" set a particular rate of devaluation. Often "passive" regimes were used to target a particular level for the RER, while "active" regimes were implemented as disinflationary tools.

[6] See Rebelo and Vegh (1995) for further discussion.

determined directly by the policy determined exchange rate or by market forces when the exchange rate is allowed to float.

The empirical literature on the ERRs has also tested the effects of the ERR on prices and output. While the findings are not conclusive, the results usually show that the ERR is not neutral.[7] The main finding of the literature is that pegs are associated with lower inflation, but slower growth and more output volatility, while floats are associated with more inflation, but faster growth and less output volatility. The mechanism are not clear, but a recent literature has shown that a high RER is related to faster growth and to sustained capital accumulation (Rodrik, 2008), and that overvaluation leads to output stagnation and it is a good predictor of currency crises (Godlfjan and Valdes, 1998, 1999). Thus, it is possible that the ERR can affect growth through changes in the level of the RER.

This paper will analyze the effects of the ERRs on misalignments using Rubin's (1974) Propensity Score Matching (PSM henceforth) and another matching estimator (the Mahalanobis distance). To cut a long story short, I will proceed in three steps. In the first step, a RER misalignment index will be estimated following Rodrik (2008). In the second step, using different *de facto* and *de jure* ERR classifications, a propensity to adopt a peg will be estimated. In the third step, countries that have similar "propensities to peg" but different ERR in place will be compared using different matching algorithms, to analyze the impact of adopting a peg on RER misalignment.[8] Several robustness checks are implemented afterwards.

This paper contributes to the existing literature in the following way. To the best of my knowledge, few papers have analyzed the effect of the ERR on misalignment, and I

[7] An exception is perhaps, Rose (2011).

[8] Section 2.2.1 explains the meaning of *de facto* and *de jure* classifications.

am the first to analyze the effect of the ERR on misalignment using matching models. A comprehensive literature review is also provided.

This paper is structured as follows. After this introduction, section 2.2 present a comprehensive review of the relevant literature. Section 2.3 presents the econometric strategy, the main results, and several robustness checks. Section 2.4 concludes.

2.2 Literature Review

The literature on the ERRs discusses three main issues. How to classify the existing ERRs, why some ERRs are preferred, and what are the impacts of the different ERRs on several aspects of macroeconomic performance (prices, output, trade flows, etc.). This section discuses each of these points. A short summary of the recent literature that relates RER misalignment with long-run performance (economic growth) is also provided. The reason is that the role of RER misalignment on growth is one important motivation for looking at the effects of ERRs on the RER.

2.2.1 Measuring the ERRs

For many years, the IMF provided the only ERR classification available. The IMF reviewed and reported what countries declared to do. The IMF classification evolved over time, and it basically classified (and still classifies) the regimes into pegs, intermediates and floats. Most schemes will fit into this tripartite classification, perhaps including subcategories. For example, a work by Corden (2002) classified regimes into Monetary Unions, Dollarization, Currency Boards, Soft Pegs, Managed Floating, and Free Floating. Reinhart and Rogoff (2004) consider countries with a rate of inflation above 40% as a special category called "freely falling" or "hyper-floats".

There are some problems with the original IMF classification. The presence of "black markets" for currency, or the existence of systems of multiple exchange rates, represent a serious challenge to standard classification methods. How should we classify a country that pegs the exchange rate for commercial transactions, but uses a floating exchange rate for financial transactions?[9] Moreover, what policy-markers declare to do is not always what they really do in practice. To continue with the same example, a country may declare to use a fixed exchange rate, but the relevant nominal exchange rate could be a black market rate which is determined by market forces. Conversely, a country may declare to use a floating exchange rate regime, but most of the time the Central Banks intervenes in the foreign exchange market.[10]

To address this issue, several alternative *de facto* classifications were developed. Instead of relying on what policy markers claim they do (as in a *de jure* classification), a *de facto* classification aims to identify ERRs based on what policy markers really do. To accomplish that task, observed variables like the volatility of the nominal exchange rate or the changes in foreign exchange reserves, are combined to produce an alternative classification. Some approaches are a mixture of *de jure* and *de facto* elements, so I classify the different *de facto* classification into "Mixed" and "Pure".[11]

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[9] For example during Bretton Woods, many Latin-American countries adopted a system of multiple exchange rates. An official or commercial exchange rate was used to channel conventional imports and exports, and a financial exchange rate (often "unofficial" but other times perfectly legal) was used to deal with capital flows and special tradable goods (such as non traditional exports or luxury imports.). The commercial rate was usually set below the financial rate.

[10] In fact there is a whole literature on this phenomena, known as "Fear of Floating". This problem seems to be severe. In the words of Reinhart and Rogoff (2004, page 32): "Whether the official regime is a float or peg, it is virtually a coin toss whether the Natural algorithm will yield the same result". Thus, using IMF classification is like flipping coins (if tails the classification is correct, if heads the classification is wrong), while an alternative index (for example their "Natural algorithm") is more suitable.

[11] The description of the different classifications on the next pages is based mainly on the work by Tavlas et. al. (2008).

2.2.1.1 Mixed *De Facto* Classifications

Gosh et. al. (1997) classified regimes into "frequent" and "infrequent peggers", and the rest (floats and intermediate regimes) into a separate category (using the *de jure* classification by the IMF). The sample covered the period 1960-1999 and included 136 countries. Frieden et. al. (2001) classified 26 Latin-American countries in 4 categories according to their capacity to provide credibility and achieve competitiveness. The IMF (1999; 2003) and Bubula and Otker-Robe (2003), analyzed 190 self-described regimes (by the national authorities), covering the (monthly) period 1990-2001. These three papers assessed the movements of the exchange rate based both on the official and black markets. Some regimes were reclassified according to their realignment frequency, and some declared pegs were reclassified as managed floaters. From 1999 onward, this *de facto* coding replaced the IMF *de jure* coding in IMF publications. Bailiu et. al. (2003) and Gosh et. al. (2002) modified and reclassified the *de jure* classification based on observed ER volatility, for 60 countries during the period 1973-1988.

In a leading paper of the field, Reinhart and Rogoff (2004) rewrote the history of exchange rate regimes considering a methodology that captures the evolution of a market determined exchange rate, and that includes a careful review of the historical evidence. To produce their taxonomy, Reinhart and Rogoff designed an algorithm that combines *de jure* classifications of the exchange rate regime with an analysis of the actual behavior of the market determined exchange rate (which may be the black market rate if that market existed) in 153 countries for the period 1946-2001 using monthly data. Their data and their classification was subsequently extended to 2011.

Eichengreen and Leblang (2003), and Dubas et. al. (2005) estimated a Probit model with the *de jure* classification as the dependent variable and a set of economic and political determinants of ERR, to generate a list of deviations of the observed ERR from the official *de jure* classification. The paper by Eichengreen and Leblang analyzed 21 middle income countries using 5 years averages for 1870 to 1997, while Dubas et. al. covered 172 countries for the period 1971-2002, and it estimated a Multinomial Probit. Finally, a pioneering paper by Heller (1978) used Discriminant Analysis to identify floaters and fixers using different country characteristics.[12] The findings suggested that economic size, financial integration, the inflation differential, and the trade patterns seems to explain the choice of the ERR.

2.2.1.2 Pure *De Facto* Classifications

Levy-Yeyati and Sturzenegger (2005) constructed a *de facto* classification of exchange rate arrangements considering the volatility of nominal exchange rate and of the level of foreign exchange reserves, for 183 countries during 1974-2000. If a country displays a high level of exchange rate volatility and a low level of reserves volatility (compared to the means of the sample), then the country is *de facto* adopting a floating exchange rate, while if it displays a low level of exchange rate volatility and a high level of reserves volatility, is consider to be *de facto* using a peg. For intermediate cases, the ERR is classified as an "intermediate regime".

Poirson (2001) used the ratio of exchange rate volatility to foreign exchange reserves volatility to produce a "rigidity index" for 93 countries during 1990-1998. Shambaugh (2004) divided countries according to their exchange rate movements between pre-defined bands. De Grauwe and Schnabl (2005) used Z-scores to tabulate ERR for 18 countries during 1994-2004. Bénassy-Quéré and Coeuré (2006) used regression analysis to estimate implicit basket pegs as a linear combination of the movements of the US dollar, the Yen, and the Euro including 165 countries for the period 1994-2001. A similar approach was developed by Frankel and Wei (2008).

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[12] In a nutshell, Discriminant Analysis is a statistical procedure that involves finding the determinants of a particular outcome.

Should I use *de facto* or *de jure* classifications? A *de facto* classification is usually more informative regarding policy intentions. However, a *de jure* classification tends to be broader in terms of coverage by countries and years, but this is not always the case (for instance, the extended Reinhart and Rogoff classification is as large as the IMF classification). The *de facto* classifications seems to have the upper hand, but they have a big drawback: the different *de facto* classifications very often disagree with each other, and they suggest that the same country adopts different ERR during the same period (Tavlas et. al., 2008). Thus, in conducting empirical work it seems a good idea to draw from the different types of classifications to test the robustness of the results.

2.2.2 Choosing the ERR

In the literature, countries have different reasons to choose a particular ERR. Based on theory, I classify the reasons into the following categories: 1) Optimal Currency Area (henceforth OCA) and country size; 2) Sources of Shocks; 3) The Trilemma; 4) Pegs as a Source of Credibility; and 5) Liability Dollarization.[13]

According to the theory on OCAs, geographical areas that represent an OCA should adopt a common currency. An area is an OCA if their factors and goods markets are highly integrated. Thus, if labor and capital are highly mobile in a given area, they can move from part A to part B, for example if part A suffers from a negative real shock that lowers output. It follows that highly integrated countries are more prone to adopt a less flexible ERR, if not a common currency.[14] Factors related to country size also determine the ERR. Large countries are usually more closed and can potentially benefit from changes in the exchange rate, because those are typically translated into relative price chances when the bulk of the

[13]Levy-Yeyati et. al. (2010) for further discussion.

[14]Other factors that determine whether a given territory is an OCA includes how similar are the shocks faced by different countries.

goods is non-tradable. Exchange rate changes in a small open economies (like islands) have little effect on relative prices because most of the goods are tables (and their relative price structure is determined by the world market), so this kind of countries are more prone to adopt a peg.

The Sources of Shocks approach follows from the standard IS-LM-BP model. Using a "fix price" IS-LM model, Poole (1970) shows that the optimal monetary policy regime depends on the origin of the shocks. When real shocks predominate, pegging the money supply minimizes output volatility, while when nominal shocks are more important, pegging the interest rate minimizes output volatility. The IS-LM-BP model predicts that a fixed exchange rate will minimize output volatility when nominal shocks are prevalent, while a floating exchange rate will minimize output volatility when real shocks prevail.

There is no particular reasons to believe that Poole's analysis, or the results from IS-LM-BP, are accurate. For instance, they ignore inflation and, as Lahiri et. al. (2008) shows, if prices are flexible and financial markets are imperfect, the results should be reversed (a fixed exchange rate minimizes real volatility if real shocks are predominant, while a floating exchange rate work better under nominal shocks). Nevertheless, the key point is that different shocks may affect the choice of the ERR.

The Trilemma suggests that an open economy can chose any two of the following three desirable targets: a fully open capital account, an independent monetary policy, and a predetermined exchange rate (Obstfeld, Shaumbaugh, and Taylor, 2010). If the exchange rate is fixed and the capital account is fully open, monetary independence is lost. If there is a target for monetary policy and the authorities want to fix the exchange rate, capital controls should be imposed. Finally, if the the authorities want an autonomous monetary policy and a fully open capital account, then they cannot target the exchange rate.

A recent literature have tested the Trilemma explicitly. The main findings are that the Trilemma usually holds (Aizemann et. al., 2013), and that inconsistent policy choices are associated with lower growth and more inflation (Mandilaras, 2015). It does not follows that intermediate options are not possible; in fact reserve accumulation seems to make the Trilemma less binding. For our purposes, the main intuition is that the choice of the ERR is related to the degree of monetary policy independence and to the degree of capital account openness.

According to the Credibility Approach, in the words of Levy-Yeyati et. al. (2010), exchange rate pegs can act as "policy crutches for weak governments". For a country with a history of high inflation (or hyperinflation), the adoption of a hard peg is way to anchor expected inflation to regain macroeconomic stability and to enhance credibility. Perhaps the best known approach to justify such proposition was developed by Kydland and Prescott (1977) and Calvo (1978), to analyze the problem of dynamic inconsistency. In the classical closed economy problem, rules for monetary policy (rather than discretion) increase welfare if expectations are formed rationally. In the open economy set-up, a credible exchange rate peg (or an explicit path for the rate of depreciation) is equivalent to a rule, while a system such as managed floating or a fixed but potentially adjustable exchange rate is similar to discretion. Although the rules vs. discretion model is debatable, there is substantial historical evidence that suggests that hard pegs were used to stop hyperinflations and to regain credibility, for example in Latin American countries (see Frenkel and Rapetti, 2012).

Lastly, Liability Dollarization represents a serious treat to stability in non developed countries with poorly developed financial systems. For example if the banking system has a big share of foreign currency denominated deposits, or a large fractions of it stock of loans to non-tradable firms is dollarized, exchange rate volatility may affect the balance sheet of financial institutions, and governments may display "Fear of Floating" (Calvo and Reinhart, 2002). Thus, when the exposure to foreign currency risk is important, devaluations and revaluations have large balance sheets effects, so the central bank is willing to intervene in the foreign exchange market to avoid large swings in the exchange rate. When Liability

Dollarization is present, adopting a floating exchange rate becomes a very costly policy choice, and the adoption of a peg a very tempting option.

Our main goal is not to discuss the strengths and weakness of the five different approaches. Since the implementation of our econometric strategy requires the estimation of the importance of the different determinants, I will let the data speak for itself in section 2.3, when I estimate the propensity to adopt each ERR given a full set of explanatory variables derived from the five theories.

2.2.3 The Impact of the ERR on performance

The literature is also concerned about the impacts of different ERRs on macroeconomic outcomes. The existing studies can be classified according to the outcome variables analyzed (growth, inflation, price volatility, output volatility, and RER volatility), and the dimension of the data (time series vs. panel approaches). Part of the literature compared different international regimes over time. A paper by Bordo (2009) discussed the macroeconomic performance of ERR, focusing on the differences between the Gold Standard, Bretton Woods, and the recent period. The previous literature surveyed by Bordo finds that the Gold Standard was associated with more price stability, at the cost of increasing output instability (Bordo, 1981, Cooper, 1982, Klein, 1975, and Schwartz, 1986). Bordo also finds that the Gold Standard was the more resilient regime, followed by the current international "Non-system". Bretton Woods was ranked in the last place.[15]

Of particular interest is the relation between ERRs and growth. For the literature this is still a matter of debate, and different theoretical models suggest that the relation may work in

[15]Should we attribute the differences in performances to the ERR or to the time periods? For the largest part of this literature, based on a large sample of countries, but on a smaller time frame, is the ERR that matters, and not the time period. An exception is Grilli and Kamisky (1991). Based on monthly data between 1880 and 1986 for the United Kingdom and the United States, they show that with the exception of the post-World War II period, there is no necessary connection between the ERR and RER volatility.

opposite directions. Aghion et. al. (2005) developed a model where exchange rate volatility combined with poorly developed financial system may exacerbate the credit constrains faced by firms, reducing investment and growth. In the same vein, Gylfason (2000) argued that the macro-stability imposed by pegs (i.e., low inflation and less exchange rate risk) promotes openness, improving the efficiency of the economy. According to these papers, peg have the upper hand in terms of growth promotion.

On the other hand, there is plenty of evidence that show that pegs are crisis prone, in particular in a context of very open capital accounts. The main mechanism is that pegs promote the appreciation of the RER, which was found to be one important predictor of currency crises (Goldfajn and Valdes, 1998). Moreover, most of the overvaluation episodes feature an exchange rate peg, and the RER reverts back to a higher level not via domestic price deflation, but via a nominal depreciation (Goldfajn and Valdes, 1999). Consequently, pegs should be associated with more output volatility and less output growth.

In the same vein, Levy-Yeyati and Sturzenegger (2003) suggested that more flexible exchange rate regimes promote more growth in developing countries. Reinhart and Rogoff (2004) argued that crawling pegs feature the fastest growth rate among all the regimes. But Gosh et. al. (1997) presented mixed evidence. Thus, the impact on growth is still an open question.

2.2.4 The literature on exchange rate "misalignment" and growth

There is a growing literature that recognizes a role for the level of the RER in the process of capital accumulation. For a long time, the literature on exchange rates and growth identified RER misalignment as an explanation only for slow growth. Indeed, it is easy to see how overvaluation can be associated with shortages of foreign exchange reserves, poor incentives to invest in tradable activities (which are usually the locus of technical progress and capital accumulation), and economic stagnation. For that literature, undervaluation was also seen as a bad policy. The reason is that undervaluation was associated with high inflation and debt overhangs, for example as in Latin America during the so called "Lost Decade" in the 1980s.

Nowadays, thanks to the growth miracle of the South East Asian countries, China and India, but also to some respectable macroeconomic performance of countries like Chile and Colombia during the 1980s, some authors consider that undervaluation may favor growth. But as Eichengreen (2008) put it, the literature have spent more time doing empirical work than explaining the link between RER misalignment and growth.[16] An exception is Montiel and Serven (2009), who identified two competing views: the "capital accumulation channel" and the "tradable-led channel". According to the "capital accumulation channel", a higher RER increases (tradable) firms profits, so saving and investment (and growth) increase. According to the "tradable led channel", a higher RER re-allocates resources from the non-tradable to the tradable sector of the economy. If the tradable sector displays a special feature, for instance, if it has increasing returns to scale, or it provides foreign exchange reserves to relax the external constraint, then a higher RER promotes growth.

Gluzmann et. al. (2012) presented evidence favorable to the "capital accumulation channel". However, Montiel and Serven (2009) find no support for that channel, and not solid theoretical reasons to associate undervaluation with higher rates of saving (and hence according to them, with higher investment rates). The "tradable led channel" has received more theoretical support. If the tradable sector features increasing returns to scale or any externalities, market forces do not deliver a correct set of relative prices from the standpoint of economic development, so undervaluation can mitigate this problem and accelerate growth (Rodrik, 2008).

[16] See Libman (2014) for a comprehensive review (in Spanish) of the empirical literature that finds a positive association between undervaluation and growth. See Rapetti (2013b) and Frenkel and Rapetti (2014) for English reviews.

Other papers also formalized the "tradable led channel". Razmi et. al. (2012) developed a dynamic dependent economy model with hidden unemployment. The model features imported capital goods that enter in the production of tradable goods (in fixed proportions with labor). A higher level of the RER relaxes the external constraint, not by raising exports (at least in the short-run), but by creating more space for importing capital goods by reducing the domestic absorption of tradable goods. The higher the RER, the higher the room for faster capital accumulation and growth.

In a similar vein, Frenkel and Ros (2006) showed that undervaluation mobilizes resources from the backward non-tradable sector to the modern tradable sector of the economy. Korinek and Serven (2010) developed a dependent economy model that features learning external effects in the production of a tradable input. The aggregate production function uses both tradables and non-tradable inputs, but it behaves like an "AK" function with constant returns to capital. Since the authors assumed that the tradable input sector is more capital intensive, when the RER depreciates (by an amount that depends on the size of the learning externality), capital accumulation and growth accelerate.

2.2.5 Taking Stock

To summarize, there is vast literature that analyses the determinants, the measurement, and the impacts of ERRs. The determinants of ERR are many, and their importance seems to depend on the context, but the different reasons to adopt each ERR seems to be captured by the existing literature. However, it is not possible to overcome the difficulties related to the measurement issues. Each problem may require different classification schemes and strategies. Also, there is no consensus on impacts of different ERRs on macroeconomic performance, but there seems to be some ground to view pegs as crisis-prone, and to recognize the differential impacts on price and output volatility of pegs vs. flexible regimes.

Surprisingly, the new literature on the relation between RER and growth, is hardly ever related to the literature on ERRs and economic performance. The next sections attempt to fill this gap and present the empirical strategy and our main results.

2.3 Econometric Approach

This section estimates the effects of ERRs on RER misalignments using PSM and another matching estimator. The application of matching to macroeconomic theory is still scant, but there is a growing interest on the approach. For example, Lin and Ye (2012) applied PSM to compare the effectiveness of inflation targeting vs. hard pegs as dis-inflationary tools, Forbes and Klein (2013) discuss the responses to capital outflows and crises during 1997-1998, and Bussiere et. al. (2015) analyze the impact of RER appreciations on growth.

Matching has some advantages vis-a-vis an OLS regression.[17] Matching avoids the problem of choosing a functional form, the lag structure, or other details related to model specification. The reasons is that matching focuses the attention on treatment-status or policy changes. Furthermore, no assumption regarding the distribution of the variables is need, and matching puts most of the weight on comparable units, increasing the chances that we end up comparing similar individuals, so the size of the effects are more reliable.[18]

A particular form of matching is PSM. The idea behind PSM is to estimate the propensity of the individuals in the sample to adopt certain treatment or policy. After the propensity

[17] The results from matching can be contrasted with OLS, and in fact OLS is a particular form of matching. While OLS compares the means of each treated vs. un-treated individuals, matching compares the means of treated individiuals vs. similar non-treated individuals. More precisely, matching chooses a different set of weights than OLS: while matching puts most of the weight on those individuals who are most likely to be treated, an OLS regression puts most of the weight where the conditional variance of treatment status is largest; roughly speaking, where the probability of being treated is equal to the probability of not being treated (or just one-half).

[18] OLS does not requires any assumption regarding the distribution of the variables, but normality is imposed for inference.

is estimated, observations that have similar propensities to adopt the treatment or policy (according to some metric to be defined) are matched, and the effect of the treatment or policy on a determined outcome is analyzed comparing the means of the treated group and a control group (with a similar propensity, but with a different treatment or policy).[19]

In order to understand the intuition behind PSM and how it works, consider the following problem.[20] Let us assume that I want to analyze the effect of hospitalization on people's health. I collect a set of control variables that includes age, sex, income, medical history, and so on. I estimate the effect of hospitalization by including a dummy variable that takes value of one if a person is hospitalized, and zero otherwise. Comparing the means across hospitalized and non-hospitalized persons will not yield the correct answer to our inquiry, and the reason is straightforward: less healthy people are more likely to be hospitalized, so it is very likely that I will find a negative effect of hospitalization on health.

Although there are very good reasons to believe that being hospitalized is detrimental to health (i.e., an inter-hospitalization virus may affect hospitalized persons), I should be worried that our coefficients do not report the true effect of hospitalization on health, unless I find a good way to control for the source of bias, or if the health distribution is random across hospitalized and non-hospitalized units. A plausible approach to solve the problem is precisely matching, and more precisely PSM, as suggested by Rubin (1974). The idea of PSM is to estimate the propensity to being hospitalized for the individuals in my sample, given a set of control variables, and compare the mean health status of similar individuals (according to their propensity score); the key is some individuals are hospitalized and some

[19] In the ERR literature, the propensity to adopt a particular ERR is often estimated, and the effects of the ERR on the economy are usually analyzed. But the estimation of the propensity and the impacts are part of different papers. PSM allows to combine both approaches. Given that the choice of the ERR is not random, but depends on country characteristics and the environment, selection bias seems to be a potential concern. Fortunately, PSM can solve this problem in a straightforward way, by comparing similar individuals.

[20] I follow Angrist and Pischke (2009, ch. 3) here.

are not, but they have similar characteristics. The difference in their health status is precisely the true effect of hospitalization on health, provided that the probability of receiving the treatment does not depend on the treatment itself. This is PSM in a nutshell.

In practice, PSM proceeds in two steps. In a first step, the propensity score (also known as, the probability of receiving a treatment) is estimated. In a second step, the effect of the treatment on the variable of interest is computed by comparing individuals with similar propensity scores, but different treatment status.[21] More formally, let Y_i denote the outcome and D a dummy variable that takes value 1 if a given unit receives treatment, and 0 otherwise. I can observe individuals that receive treatment $Y_1 \mid D = 1$ and individuals that do not $Y_2 \mid D = 0$ (and with different health status, Y_1 and Y_2), but clearly I cannot observe the same individuals with different treatment status at the same time, or $Y_1 \mid D = 0$ and $Y_1 \mid D = 1$.

Moreover, I cannot observe how the effects of hospitalization on sick people differs from the effects of non-hospitalization, also on the very same sick people. This is the parameter of interest, the so called "Average Treatment Effect of the Treated" or "Average Treatment of the Treated" (ATET or ATT), defined as follows:

$$ATT = E[Y_1 \mid D = 1] - E[Y_0 \mid D = 1] \tag{2.1}$$

In words, the ATT is the difference between the health of hospitalized $E[Y_1 \mid D = 1]$ minus the health of those hospitalized, had they decided to stay home $E[Y_0 \mid D = 1]$. To create an

[21]To provide an example related to ERR literature, let us say that small islands are more likely to adopt a hard peg, and that I am interested in the growth effects of different ERRs. Then PSM will first estimate the probability of adopting a peg given that a country is, or is not, an island, and then it will compare countries with similar probabilities but different characteristics. So if Hong-Kong is as likely to peg as Iceland, but Iceland is floating while Hong Kong is on a hard peg, PSM will show the effect of adopting a peg on growth by comparing Iceland's growth rate with Hong Kong's growth rate. This is clearly a more satisfactory than just comparing the mean growth rate of pegs vs. the mean growth rate of flexible arrangements, which is precisely what OLS does.

environment in which the ATT can be estimated requires that sick people go to hospitals and similar people stay home, and that is why I can read $E[Y_0 \mid D = 1]$ as the effect on health of staying home. In practice I can only observe or estimate directly the Average Treatment Effect (ATE), defined as:

$$ATE = E[Y_i \mid D = 1] - E[Y_i \mid D = 0] \tag{2.2}$$

ATE is the difference between hospitalized people and not hospitalized people in general, an interesting but presumably inaccurate measure of the effect of the treatment or policy. To see this, notice that I can also write the ATE as:

$$ATE = E[Y_{1i} - Y_{0i} \mid D_i = 1] + E[Y_{0i} \mid D_i = 1] - E[Y_{0i} \mid D_i = 0] \tag{2.3}$$

In words, the observed difference across treated and non-treated individuals is equal to the average treatment of the treated ATT, plus a second and third term that together represents the selection bias. If and only if the selection bias is equal to 0, so $E[Y_{0i} \mid D_i = 1] = E[Y_{0i} \mid D_i = 0]$, then the estimation of the ATE gives us the true ATT. But notice that only happens if treatment is assigned randomly.[22]

A way to remove the selection bias is to condition on a given set of explanatory variables X. If I can find such a set of variables, the selection bias disappears after I condition on X, so if I call ρ the ATT:

$$\rho = E[Y_{1i} - Y_{0i} \mid D_i = 1] \tag{2.4}$$

$$\rho = \{E[Y_{1i} \mid X_i, D_i = 1] - E[Y_{0i} \mid X_i, D_i = 1] \mid D_i = 1\} \tag{2.5}$$

[22]Because then we can write the $ATE = E[Y_i \mid D = 1] - E[Y_i \mid D = 0]$, as in the previous expression, or as $ATE = E[Y_{1i} - Y_{0i} \mid D_i = 1]$. The reason being that $E[Y_i \mid D = 0] = E[Y_i \mid D = 1]$.

By virtue of the Conditional Independence Assumption $E[Y_{0i} \mid X_i, D_i = 0] = E[Y_{0i} \mid X_i, D_i = 1]$, then:

$$\rho = \{E[Y_{1i} \mid X_i, D_i = 1] - E[Y_{0i} \mid X_i, D_i = 0] \mid D_i = 1\} \tag{2.6}$$

So:

$$\rho = E[\rho_x \mid D_i = 1] \tag{2.7}$$

Where I defined $\rho_x = E[Y_i \mid X_i, D_i = 1] - E[Y_i \mid X_i, D_i = 0]$. Thus, after controlling for the set of covariates X, assignment is in fact random.

The implementation of PSM requires the following assumptions. *Assumption 1.a* (Unconfoundedness): $[(Y_0, Y_1)D \mid X]$. In words, this condition says that given a set of variables that are not affected by the treatment, potential outcomes are independent of the treatment. This condition states that the selection bias will be removed if I can correctly identify a control group after controlling for a set of covariates X. This condition is general and it applies to all matching models. The next condition is similar, but a little bit more precise for the purpose of using PSM models.

Assumption 1.b (Unconfoundedness given the PS): $[(Y_0, Y_1)D \mid P(X)]$. This condition is similar to 1.a, but it states that I can correctly identify a control group given the Propensity Score (which depends on our set of control variables X). Estimate the effects of treatments given the propensity score is is what PSM does.

A very important implication of "Unconfoundedness" is the "Ignorability assumption". In fact Assumption 1.a, or more precisely 1.b, is saying that no unobserved factor that can potentially explain the choice of the treatment status is left out once I control for whatever variables I choose to estimate the propensity score.

An extra implicit assumption is that there are no spill-overs: the treatment status of a given observation does not affect the treatment status of the rest; in economic theory this will amount to assuming perfect competition, or small country in our case.

Finally, I need another assumption. *Assumption 2* (Overlap or Common Support): $[0 < P(D = 1|X) < 1]$. This condition states that our individuals have some positive probability of being treated and a positive probability of being non-treated. In other words, I do not have individuals that are always treated or always untreated. This condition makes sure that comparable units exist.

Most of the time the propensity score is not available, so it should be estimated. That can be done using the appropriate model from the limited dependent variable family. After the propensity score is estimated, the next step is to decide which of the different available criteria for defining "similar individuals" should be used. This amount to choosing among the different matching estimators. I will quickly comment on the most popular ones that will be employed in the next section.[23]

Defining similarity is a two sided problem. First I should choose the metric to define distance, and then the matching estimator. PSM is a very specific kind of distance which relies on a single index, which is precisely the propensity score. Other popular option is the Mahalanobis distance. Mahalanobis distance is a multi-dimensional generalization of the idea of measuring how many standard deviations away is a point from the mean of the distribution. Mahalanobis distance is unit-less and scale-invariant. While models based on the propensity score are very good at minimizing the distance along the propensity score, the Mahalanobis distances is very good at reducing the distance along particular covariates.[24]

[23]See Kaliendo and Kopeining (2008) for a superb discussion of the most popular Matching estimators

[24]In this paper, I find that the estimator that uses the Mahalanobis distance is the best at reducing the difference across the determinants of the ERR while the rest do a very poor job.

Unlike PSM, Mahalanobis distance does not rely on a single index of "similiarity" (which is precisely the propensity score).

Now let us discuss the different matching models that use propensity scores. The Nearest Neighbor Matching chooses the partner for each observation based on the propensity score that are closer. Different kinds of Nearest Neighbor estimators exist. For example I can compare a given unit with the closest N individuals (where N is an integer). Or I can implement the Nearest Neighbor *with replacement*, so a given individual may act as a control for several units, or *without replacement* so a given unit is discarded once it is chosen as a match for a give unit.[25] More formally, the Nearest Neighbor chooses the N matches by minimizing the distance between the observations, or:

$$min \parallel p_i - p_j \parallel \tag{2.8}$$

Where p is the propensity score. The Radius Matching is a better option if the individuals are far apart. When this is the case, the Nearest Neighbor may pick up bad matches. To solve this, the Radius matching picks-up all individuals within a given radius. The main problem is how to determine the correct radius. More formally, the Radius Matching chooses:

$$\parallel p_i - p_j \parallel < r \tag{2.9}$$

Where r is the pre-specified radius. Finally, the Kernel and the Local Linear Matching are non-parametric methods that include all the observation in the sample, with lower weights for individuals that are far away. These estimators have lower variance, but they can they pick bad matches. In big samples the matching technique should not matter (they should provide

[25]A problem with this Matching Method with no replacement is that the order of the matching process matters, so the variables should be order randomly before the matching process starts.

the same answer as the sample size grows large), but in small samples some differences can arise (as we will verify soon). The weights are defined as:

$$w(i,j) = \frac{K(\frac{p_i - p_j}{h})}{\sum K(\frac{p_i - p_j}{h})} \tag{2.10}$$

Where h is the bandwidth parameter.

Standard errors reported by most statistical packages do not reflect the fact that the propensity scores are estimated on the first stage, so bootstrapping is needed. However, as Abadie and Imbens (2008) point out, this procedure fails for the Nearest Neighbor Matching, as it can lead both to a underestimation or an overestimation of the standard errors. In that case, a correction of standard errors suggested by Abadie and Imbens should be implemented. I will report bootstrapped standard errors for all our matching models, except for the Nearest Neighbor. For the latter, the Abadie and Imbens corrected standard errors will be reported.

For the estimation of the propensity scores, I use a Multinomial Probit model to calculate the probability of adopting a particular ERR, given a set of covariates chosen from the economic theory summarized on section (2.2.2).[26] More formally, I estimate the following model (for $i = 1, ..., n$):

$$Pr_i[ERR_i = h | x_{1,i}, x_{2,i}, ..., x_{k,i}] = p_{i,h} \tag{2.11}$$

In words, I estimate the probability that a given individual indexed by time and country adopts a particular ERR, indexed by h, given a full set of determinants x, discussed in section 2.2.2. As in any Multinomial Probit, the model has a latent variable representation with the following structure:

[26]Estimating a Multinomial Probit model for three options (fix, intermediate, float) seems to be a better option than a standard Probit model (fix vs. float), because I can exploit the richer structure of the ERR classifications. The estimations of the propensity scores will differ a lot, but the matching should provide similar control groups so the final estimation of the ATT should not be affected significantly.

$$
\begin{aligned}
ERR_{i,h=1} &= \beta_1 X + \epsilon_1 \\
ERR_{i,h=2} &= \beta_2 X + \epsilon_2 \\
ERR_{i,h=3} &= \beta_3 X + \epsilon_3
\end{aligned}
\tag{2.12}
$$

A country is more likely to peg if both $Pb[ERR_{i,h=1}] > Pb[ERR_{i,h=2}]$ and $Pb[ERR_{i,h=1}] > pb[ERR_{i,h=3}]$ hold, provided that $h = 1$ means that the country is on a peg, $h = 2$ means that the country adopts an intermediate regime, and $h = 3$ that the country adopts a flexible regime.

Once the model is estimated, I evaluate the covariates at the sample means to impute the propensity scores to the different observations of our sample to adopt each of the regimes. On the second step, I use the propensity scores to match observations using the different popular matching estimators to estimate the ATT comparing similar individuals that adopt a different ERR. The next subsection describes the data and presents the main results.

2.3.1 Data Description

Our empirical estimations require three main ingredients: an index of RER misalignment, a classification of ERRs, and a set of control variables. Given the presence of different estimations procedures, I will employ several alternatives definitions both for the misalignment index and the ERRs classification. More precisely, for the ERRs classifications, I will use 3 different ones: IMF *de jure* classification (IMF), Reinhart and Rogoff (RR) mixed *de facto* classification, and Levy-Yeyati and Sturzenegger (LYS) pure *de facto* classification. I stick with RR as the baseline because of its popularity on empirical work and its broad coverage in terms of years and countries. For the misalignment index, I will follow Rodrik (Rodrik, 2008, and also Mc-Donald and Viera, 2010), but I will present alternative specifications soon. I first presents the main results using RR and Rodrik's index, and then some robustness check using the alternative variables.

To construct Rodrik's misalignment index, I create a RER index for the $i-th$ economy at time t as the ratio of the nominal exchange rate, $xrat$, and relative prices from PWT (8.1), ppp. All the variables are expressed in natural logs:

$$ln(RER_{it}) = ln(xrat_{it}/ppp_{it}) \tag{2.13}$$

On the second step, I correct the RER index to account for the Balassa-Samuelson-Harrod effect.[27] This is done by including the RER index on the left-hand side of a regression, with a set of time fixed effects f_t and the natural log of per capita GDP (CGDP) of the $i-th$ country over the US per capita GDP (as a proxy of the ratio of tradable to non-tradable productivity of the domestic economy vis-a-vis the ratio of the rest of world) on the right-hand side. Hence, I estimate:

$$ln(RER_{it}) = ln(CGDP_{it}/CGDP_{(us)t}) + f_t + u_{it} \tag{2.14}$$

Where the term u_{it} represents the error term with the usual mean, variance and covariance structure. Finally, the misalignment index is the residual from the estimation of (2.14), or the difference between the "fitted values" from our previous regression $ln(\widehat{RER}_{it})$ and the "observed values" of $ln(RER_{it})$. Thus, I subtract the second equation from the first to obtain:

$$underval_{it} = ln(\widehat{RER}_{it}) - ln(RER_{it}) \tag{2.15}$$

The variable underval is comparable across countries and time periods. When underval is positive, the domestic currency is "undervalued", while when underval is negative, the domestic currency is "overvalued". The regression of relative per capita GDP on RER yields

[27]Best known as the Balassa-Samuelson effect, it says that due to faster productivity growth in the tradable sector, higher income countries usually have a lower relative price for the tradable good (a lower RER).

a coefficient of around -0.64, which means that an increase of 1% in per capita GDP leads to an appreciation of the RER of around 0.64%. Underval has a zero mean and a standard deviation of 0.41. These figures are line with Rodrik's (2008) original results using Penn World Tables 6.

Unfortunately, there are too many reasonable different ways to estimate the misalignment index. For example, I can add a different set of covariates to our second step, I can use different RER indexes, and so on. However, as some authors have pointed out (see Berg and Miao, 2010, for a discussion), some of the most popular indexes used in panel data studies are strikingly similar regardless of the control variables utilized, and specification with different combinations will not lead to substantially different results.[28] I will produce alternative misalignment indexes using additional covariates (terms of trade, government spending, net foreign assets), different RER indexes, and estimation techniques, in the section 2.3.2.

As I said, I use RR classification to the present the main results. Later on, I will use LYS and IMF classifications for robustness purposes. In order to obtain comparable results, I collapse the 5-way classification from the different classifications into three broad categories: pegs, intermediate, and floating. Pegs include monetary unions, currency boards and other hard pegs; intermediate include soft pegs and managed floaters; floating include clean floaters. To minimize the impacts of regime changes that are not long lasting, I include only observations for the ERR that last at least five years or more, including the first four years. Since the RR classification specifically considers countries that experience high inflation (above 40%, known as "freely falling regimes") but such a thing does not exists for the other classifications, I exclude all the individuals that are classified as "freely falling" by the RR criteria (even if use LYS or IMF classification). This also helps to compare the degree

[28] Perhaps the index will differ in absolute size, but changes in undervaluation will be similar, probably because most of the variation comes from movements of the $ln(RER_{it})$ itself.

of misalignment between “stable regimes”, because the “freely falling” category includes prolonged periods of high inflation and hyperinflation. The “freely falling” episodes also display the higher degree of undervaluation of the entire sample, so their exclusion is biasing the results against finding any negative effect of peg on undervaluation. In other words, the inclusion of “freely falling” will increase the absolute size of the coefficients reported in this section and in section 2.3.2; they should be considered a conservative estimation.

The decision to include only observations from those regimes that last at least five years avoids picking up the effect of regime changes, and helps to mitigate endogeneity concerns.[29] This reduces the number of observation that implement very flexible ERRs, but it seems a fair price to pay. However, it also makes impossible to partition the sample between developed and non-developed countries (as it is often done in the literature) because the number of developing countries that float for five years or more is scant. Fortunately, matching will presumably pair together countries that have similar policies and structural characteristics, so this is not an important concern if developed and non-developed countries differences can be captured by our controls.

The distribution (see the figures 2.1 and 2.2) shows that pegs are among the most common regimes, with roughly $50\% - 70\%$ of the observations, depending on the classification. Comparing *de jure* vs. *de facto* classifications it seems that pegs are not fully reported. Notice that restricting the sample to long-lasting regimes makes a small difference, despite reducing the sample size from the original figure of around 6900 to less than 5000. The main difference is the significant increase in the fraction of pegs in the LYS classification, from 60% to 80%.[30]

[29]When a peg is abandoned, the nominal exchange rate usually jumps up, so the degree of undervaluation increases.

[30]The fractions of pegs may look abnormally high, but we should keep in mind that we exclude the “freely falling” cases, which eliminates a substantial number of floaters from the sample.

For the covariates, I pick variables that fit the five different theories underlying the choice of the ERR (as discussed in section 2.2.2), and also the average value of the different ERR indexes from the 5-way classifications to control for the neighbor's ERR (called *region regime*).[31] All our variables have yearly frequency, or are averages over the twelve months, so I use yearly data. For the OCA theory, I include population (*pop*), area in squared kilometers (*areakm2*), a dummy variable for islands (*island*), a *de facto* trade openness indicator (*trade*) measured as exports plus imports over GDP, and the Theil index of export concentration that combines extensive and intensive margins (*diversity*).[32] I omit per capita GDP because that variable is used to calculate the variable *underval*, and this could lead to a violation of the assumptions of PSM. A dummy variable (*Development*) that takes value of 1 if a country is developed according to the IMF and World Bank classifications, and 0 otherwise, is included instead.

For the Sources of Shocks I include four measures of different nominal and real shocks: the 5 years variance of the ratio of broad money to GDP (*MRES_shock*), the 5 years variance of natural log of the terms of trade times the *de facto* trade openness (*TOT_shock*), the 5 years variance of the ratio of government consumption to GDP (*GOV_shock*), and the 5 years variance of the Federal Funds rate times the Chin-Ito Capital Account Openness Index (*RATE_shock*). Those four variables try to control for shocks, both real and nominal, and internal and external. Because the shocks associated with external factors, *TOT_shock* and *RATE_shock* are related to the degree of trade and financial integration with the rest of the world. I choose to weight them by the variables that capture how open are the external accounts.

[31]This is possible because the ERR are represented by a positive variable restricted between 1 and 5, in increasing order of flexibility.

[32]I use five years average to diminish the concern with endogeneity issues, both for the trade concentration index and trade openness. Notice that a higher level for the Theil index means lower diversification.

For the Trilemma, the Aizenman (2013) Monetary Independence Index (*MI*), and the Chin-Ito Capital Account Openness Index (*kaopen*) are included. For the Credibility View, I include the 5 years average ratio of domestic inflation over the median world inflation (*hinfla*) and a variable that captures the durability of the political regime (*durable*); for Liability Dollarization, the ratio of non-FDI foreign liabilities to GDP (in current dollars) is included (*LGDP*). The variable (*Dollar*) captures the degree of deposit dollarization (as estimated by Levy-Yeyati, 2006) as it is used in most studies, but I do not include it in our main calculation because it removes more than half of our 1,892 observations and I cannot estimate the models using the alternative ERR classifications.[33] Instead, I stick with the less appealing but easier to handle variable *LGDP*. Notice that the inclusion of (*Development*) may help to capture dollarization problems, since non-developed countries usually suffer from poor financial development and more exposure to liability dollarization.

After the introduction of the covariates, some observations are dropped from a large list of 167 countries spanning the period 1950-2011, included in the Penn World Tables 8.1, the latest version available when this paper was written.[34] The table 2.1 summarizes the main features of our control variables. The full description of the variables and the sources can be found in the table 2.2.

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[33]The main results using RR classification holds if I include it

[34]The final sample spans the period 1979-2010. The final list of countries included is: Albania, Argentina, Armenia, Australia, Azerbaijan, Bangladesh, Belarus, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Central African Republic, China, Colombia, Costa Rica, Ivory Coast, Croatia, Cyprus, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, Gabon, Gambia, Georgia, Ghana, Guatemala, Guinea-Bissau, Honduras, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Keyna, Republic of Korea, Kyrgyzstan, Kuwait, Lithuania, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mexico, Moldova, Mongolia, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Niger, Nigeria, Norway, Oman, Panama, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Slovak Republic, South Africa, Sri Lanka, Suriname, Sweden, Switzerland, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad & Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, Uruguay, Vietnam, Zambia, Zimbabwe.

This section presents our main results.[35] The baseline specifications are estimated using RR ERR classification and Rodrik's undervaluation index. First, I present table 2.3 which displays the expected signs of the coefficients (the probability of adopting a peg), as well as the observed results. The table 2.4 display the full results from the Multinomial Probit equation to analyze the impact of the different covariates on the probability of adopting each ERR (peg, intermediate and floating).[36]

As we can see in table 2.4, most variables have the expected sign and are statistically significant at 1% in at least one of the columns. For example, more trade openness, high inflation in the past, and a world interest rate shock, increase the likelihood of the adoption of a peg. On the other hand, more monetary independence increases the likelihood of floating, and more foreign financial liabilities over GDP makes a country more prone to adopting an intermediate regime. Regarding the shocks, the nominal internal shock *MRES_shock* make adopting a peg more likely, the interest rate shock *RATE_shock* makes floating less likely, while terms of trade and fiscal shocks make the adoption of an intermediate regime or floating more likely. Perhaps unexpected, the variables associated with size show that small countries are more likely to float, which goes against our priors.

The results should be interpreted as follows. Consider for instance the coefficient associated with Capital Account Openness for the first column -0.099. If a country has a completely open capital account (thus $Kaopen = 1$), then it is 9.9% less likely to adopt a peg. Regarding other coefficients, like the effect of a terms of trade shock on the probability of adopting a floating regime, considering that one standard deviation equals 0.470 (see table 2.1), an increase in one standard deviation means that a country is $0.064 * 0.4697 \approx 3\%$ more likely to adopt that regime. In other words, terms of trade shock have the wrong sign and

[35]The results are obtained using the Stata command PSMATCH2 developed by Leuven and Sianesi (2003).

[36]The coefficients are estimated by evaluating the covariates at their sample means.

the effects are very small. Notice that the results add-up, so the effect on regime 1 + effect on regime 2 + effect on regime 3 = 0, as it should be.

The results suggest that there are elements from the Trilemma, the Credibility approach, the Sources of Shock, and the Liability Dollarization hypothesis, that can account for ERR choices. I find some evidence against the OCA and the Sources of Shock approach (see Levy-Yeyati et. al., 2010, for an additional discussion of the empirical determinants of the ERR choice, and some empirical results). For example, I expect small countries to peg, but according to our results, it seems that big countries are actually more prone to adopting a peg than small countries. The same thing applies to the island dummy; islands seems to be more prone to float. We should keep in mind that our sample includes islands that are good examples of floaters, such as Australia, United Kingdom, Japan, and so on. However, I also have a control variable that captures the degree of development, so this is still a puzzling result.

Once the probability of adopting a peg is estimated, I can asses the effect of the ERR on undervaluation. The main results are reported in table 2.5. The ATT is estimated using the different matching models, and I also report an OLS estimation (a regression with underval as the dependent variable, and the the covariates from the Multinominal Probit model as controls). I implement five typical matching estimators: Kernel, Local Linear, Nearest Neighbor (with 5 neighbors and replacement and with 1 neighbor without replacement), and Radius (with a caliper parameter of 25%). Finally, I also estimate the model with the Mahalanobis distance. As we will discover soon, this makes sense given that the other matching algorithms are not very good at reducing covariate imbalances.

The main finding is that pegs are associated with more overvaluation of the domestic currency. The results holds both for the different Matching estimators and the OLS regressions including covariates. All the times the difference in means is statistically significant at 1%. OLS seem to be as good as the other matching models for detecting the sign of the effect of the ERRs, but we can see that OLS overestimates (in absolute terms) the true effect of pegs, although the differences are small. For example, using the Mahalanobis distance, the effect of adopting a peg is a reduction of 11.5% in the undervaluation index, vs. a reduction of 17% using an OLS specification.

To understand how bad is the selection bias, I use the same sample as in the matching models reported in Table 3, and I compare the mean of countries on a peg vs. the rest (excluding "free falling" and regimes that last less than 5 years). The results point out that the mean undervaluation for pegs is about −3.2%, vs. a mean for non-pegs of about 1.3%, and the difference is not statistically significant even at 10 %. Thus, a direct comparison of the mean shows that pegs are not different than non-pegs. But after I control for the propensity score (or the covariates that determine the choice of the ERR), the picture is completely the opposite.

To asses the quality of the Matching models, I report the pseudo R-squared from the propensity score estimation before and after matching, the numbers of treated variables off-support, and the mean and median bias before and after matching. This information is also reported in table 2.5. I have no off-support variables, but contrary to what I expect, the R-squared almost vanish only for the Mahalanobis distance.[37] More quality checks are discussed below.

Figure 2.3 displays the distribution of propensity scores before matching and after matching. The visual inspection suggest that there are important differences in the distribution before matching, and that the Nearest Neighbor (with 5 neighbors and replacement) does a perfect job. The distribution look so similar than it is impossible to see the dashed line. Figure 2.4 displays the histogram (by propensity scores) of the treated and non-treated vari-

[37]Once I match individuals with similar propensities to adopt each ERR, the pseudo R-squared should vanish because the covariates no longer explain the regime choice.

ables. The main goal is to verify whether for each treated variable I have similar non-treated individuals available. We can see that for most of the treated units, a unit with a similar propensity score but with a untreated status exist. Notice that most of the time I have very few treated variables "off-support", but there is either no treated variable on that bin, or there a plenty of other untreated "on-support". To ensure the quality of the results, I explicitly restricted our estimation to the region of common-support. Thus, if treatment and non-treatment do not overlap, those treated observation that have propensity scores where there is no overlap are automatically eliminated from the estimation.

I also addressed the issue of the quality of the matching estimators by looking at the differences of the covariates before and after matching. It is desirable that the differences by covariates between the control and the treatment group vanish after matching. Some authors report t-tests for the means before and after matching for each covariate. The point being to analyze if individuals were really different before matching, and if the process of matching was able to group together comparable units, so the differences in the mean of the treated and the control group is no longer significant. But as Austin (2007), Imai, King and Stuart (2008) argue, the t-test may be inappropriate for two main reasons. First, how similar are our observations is inherently an in-sample property, without reference to any broader population (and the samples compared may differ). Second, hypothesis testing can be misleading as measures of balance, because they often conflate changes in balance with changes in statistical power.

A better indicator of matching quality is the mean standardized bias, as it is reported on the graphs contained in figures 2.5 and 2.6.[38] Our results suggest that the covariates differ substantially before matching. After the application of the Local Linear, Kernel and Radius

[38]The mean standardized bias is defined as $MSB = \frac{100(X_C - X_T)}{\sqrt[2]{S_C^2 + S_T^2}}$, where the Xs are the means of the control (C) and treatment (T) units, and the Ss the variances.

matching, substantial differences seem to remain. The Nearest Neighbor (both with one and five neighbors) does not seem to do a better job. As a rule of thumb, some studies consider that an average of 3% to 5% bias as an acceptable threshold for each covariate, and we can verify that this rule is violated most of the time.

If we take a look at the graphs for the Malahanobis matching (see figures 2.5 and 2.6), it yields the best match in terms of bias reduction. The pictures suggest that after matching most of the difference across variables is wiped out, so the control group designed by our matching estimators looks good, except for a couple of covariates (monetary independence, trade openness, and the internal nominal shock). This good performance is not surprising because the Mahalanobis models attempts to minimize the standardized bias by covariate, instead of relying on a single index (the propensity score). However, some problematic covariates remain. This issue is further examined on section 2.3.2, for different ERR classification.

2.3.2 Robustness Checks

In the previous section I presented results using Rodrik's undervaluation index and the RR classification. For robustness, I replace the undervaluation index and the ERR classification with alternative misalignment indexes and classifications. For the alternative undervaluation indexes, I estimate a "fundamental" index that includes alternative covariates: net foreign assets, government spending over GDP and the terms of trade. The expectation is that an increase in any of those additional covariates will appreciate the RER.

I also estimate a "cointegration" index that add leads and lags to estimate a dynamic OLS specification for the baseline estimation (with per capita GDP as the only covariate); this is in fact the estimation of a cointegration equation corrected to account for small bias, and provides results that are consistent in the presence of unit roots in the RER and on per capita GDP.

Additionally, I estimate the undervaluation index using a multilateral index (instead of a bilateral index), the Real Effective Exchange Rate from IMF, which I call "REER". Finally, I added the deviation from the mean of the Real Effective Exchange Rate index provided by the International Financial Statistics from IMF to compute an alternative index, that I call "PPP".[39] These estimations are reported in table 2.6.

The results using different undervaluation indexes are reported in table 2.7. I only report the results from the Mahalanobis matching, since it provides the best match (in terms of bias reduction) among the different matching models. The main plot holds, but we can verify that the size of the effect does seem to change significantly, depending on which index I use. The results suggest that adopting a peg reduces undervaluation by roughly 13.1% and 21.4%. When the multilateral misalignment indexes are used, the ATT is between −18.4% and −21.4%, and when bilateral indexes are introduced, the size of the effect is between −13.1% and −13.7%. The Mahalanobis distance model seems to do an decent job at reducing the bias (both mean and median), except for the models based on multilateral RER. Interestingly, I still find OLS overestimate the absolute size of the effect for the bilateral indexes, but it underestimates the effects for the multilateral indexes.

It is known that different ERR classify the same observations differently, so I also replicate the results using LYS and IMF classifications. The results from the Multinomial Probit models (see tables 2.8 and 2.9) suggest some agreement between the RR and the LYS classifications, and somehow different results for the IMF model. The table 2.10 displays the main results using LYS classification. We can verify that under LYS, pegs display more overvaluation than RR, and that the ATT is bigger (in absolute terms) than the OLS estimation. The results are statistically significant at 1% for all the models. But notice that

[39] This last index is an index that is often constructed as a naive attempt to track deviations from Purchasing Power Parity. That is why I choose the name "PPP". Unfortunately, it features a smaller coverage, so it is hard to compare it with the original index "underval".

OLS under-represents the true effect of adopting a peg: while the model with Mahalanobis distance yields a large effect of -22%, the OLS estimation is only -14.8%. The other estimators report a lower effect using OLS. The results using the IMF classification (table 2.11) are the same as before: pegs and floats are overvaluation prone. Moreover, the results are also not too different from OLS. The model with Mahalanobis distance yields a coefficient of -12%, while the result for the OLS estimation is -13.6%.

The figures 2.7 and 2.8 report the distribution of propensity scores before and after matching for the LYS and the IMF classification. As before, except for the model with 1 neighbor, the distribution look pretty similar after matching. The figures 2.9 and 2.10 show the histograms of Propensity Scores by bins, and while some treated variables are off-support, in general the common support assumption holds (there is almost always a good match for each treated observation). Finally, the figures 2.11, 2.12, 2.13, and 2.14, show the standardized biases before and after matching. For the LYS classification I find again that the Mahalanobis model provides a reasonable reduction in the bias for most covariates, but the caliper model also does a decent job. For the IMF classification, it is nice to see that almost all the estimators are able to eliminate the imbalances after matching.

To summarize, I find that the choice of the undervaluation index does not matter (our results still hold), and while the LYS and IMF classification may affect the size of the effect, the results are statistically significant and the signs are the same. Interestingly, some of the new models have better properties than their counterparts when the RR is used. In particular, the large covariate imbalances that exist before matching are removed successfully by most estimators, provided that the LYS and IMF classifications are used.

Now I turn to explore additional robustness checks. Given that our treatment variable can be constructed in different ways, it is worth to ask whether it represent a true treatment. To do this, I create a simple placebo test. First, to each country that is using a peg using the RR classification I add 13 % undervaluation, to remove the observed treatment effect.

Likewise, when I use the LYS and IMF classifications I will add 22 % and 12 %, in line with the previous estimations. Next, I assign treatment status to observations on our sample using a dummy that randomly is equal to one or zero. Then I run the Mahalanobis model using the three classifications and the dummy as the variable that represents the ERR adopted. I repeat this procedure 5.000 times and I store the coefficients to create a distribution. The results are displayed in the figures 2.15, 2.16, and 2.17.

To pass the placebo test, our estimations should lay outside the 95 % bounds of these distributions of the "placebo coefficients". Otherwise they are not better than our fake treatment dummy variable, and that would be very bad news. Notice that all the three distribution have a mean of zero, and the distribution of the coefficient ranges from -0.04 to 0.04/0.06, depending on the classification. Contrast this with our estimations, with average effects that are always below -0.04, well outside the range displayed on the histograms. The lesson is that our treatment variables are clearly better than just assigning treatment status at random, even for the IMF classification (which supposedly does a bad job assigning treatment status).

As a further robustness check, I analyze the possible impact of "hidden-sources" of regime choice. Imagine that countries also chose ERRs based on unobservable and/or unmeasurable reasons (i.e., "love for pegs"). More formally, suppose that the probability of adopting a treatment (using a peg in our example) is given by:

$$P_i = P(D_i = 1 | x_i, u_i) = F(\rho x_i + \theta u_i) \tag{2.16}$$

Where x_i are the observed characteristics for the individual i, and u_i are the unobserved characteristics (also for i), and ρ and θ are groups of parameters that capture each of these types of effects. If there is no "hidden-bias", then $\theta = 0$. Most likely, this condition will not hold, and as a consequence, two identical individuals with the same x_i will have different probabilities of adopting the treatment.

Now assume that we have two paired individuals, i and j, and that F is the logistic distribution. The odds that individuals receive treatment are thus $\frac{P_i}{1-P_i}$ and $\frac{P_j}{1-P_j}$, and the odds ratios are:

$$\frac{\frac{P_i}{1-P_i}}{\frac{P_j}{1-P_j}} = \frac{e^{(\rho x_i + \theta u_i)}}{e^{(\rho x_j + \theta u_j)}} \tag{2.17}$$

If both individuals have identical characteristics (as suggested by the matching procedure), then the part associated with x will cancel out:

$$\frac{e^{(\rho x_i + \theta u_i)}}{e^{(\rho x_j + \theta u_j)}} = e^{\theta(u_i - u_j)} \tag{2.18}$$

So if there are no differences between unobservables $u_i = u_j$, or the unobservables do not matter $\theta = 0$, the odd ratio will be equal to one.

The procedure developed by Rosenbaum (2002) exploits these facts. The idea of the test is to ask how changing the values of θ and of $u_i - u_j$ affects the inference about the adoption of the treatment. Rosenbaum shows that the following bounds on the odds ratio that either of the two matched individuals will receive treatment exist:

$$\frac{1}{e^{\theta}} \leq \frac{P_i(1-P_j)}{P_j(1-P_i)} \leq e^{\theta} \tag{2.19}$$

There are some limitations with the Rosembaum bounds approach. It can only be applied by one to one matching, and it assumes that the treatment effects are additive.[40] Nevertheless, it can be used to construct bounds on the estimations of the ATT and their statistical significance, to asses the potential presence of unobserved sources of treatment status choice.

[40]Thus, the models that use Kernels, Radius, or more than one neighbor do not work. In our case, I can only use the Nearest Neighbor and the Mahalanobis distance.

Based on our original estimation, and using the Mahalanobis distance and the RR classification, the test suggest that the results are robust to up to 60% hidden heterogeneity.[41] In words, if 60% of the choice of ERR were explained by a variable not included in my list of covariates, I will still find that pegs are associated with more overvaluation.

The results are shown in table 2.12, and they should be read as follow: the first column shows how large is the hidden source of heterogeneity (i.e., 1.2 means 20 %). The columns "sig+" and "sig-" create a range for statistical significance, while the columns "CI+" and "CI-" create a range for the size of the ATT.[42] We can see that below 1.7, the results are statistically significant between 0 and 5.76 % (the numbers on the columns "sig+" and "sig-" are included in the interval 0-5.76 for Gamma $\leq$ 1.7), and the ATT is negative. Thus, if treated and non-treated groups differ to up to 60% in an unobservable variable, I will still find a negative and significant treatment effect.

Interestingly, the LYS and IMF classification are much more robust than RR. Tables 2.13 and 2.14 suggest that the results tolerate up to 170 % and 120% hidden heterogeneity, two very large numbers. To see this, notice that the effect of pegs are statistically significant up to Gamma = 270 and Gamma = 220 (see the columns "sig+" and "sig-"), and the coefficient is always in a negative interval (see columns "CI+" and "CI-"). This suggest that our result are not sensitive to unobservable variables (or observable but not included), that can explain ERR choice.

[41] According to figure 2.5, variables such as trade openness, monetary independence, as well as the two monetary shocks, display a very large standardized bias after matching. I removed them and re-estimation the robustness of our results to "hidden-sources" of regime choice. I find that the results survive even if regime treated and non-treated groups display up to 55% differences in these covariates. I also excluded the variables that have a mean that is statistically different between the treated and untreated group (trade openness, area, monetary independence, and regime durability), and the results tolerate up to 90% of "hidden-heterogeneity".

[42] The columns "t-hat+" and "t-hat-" show a range for the t-statistic.

2.4 Conclusions

This paper have explored the relation between ERRs and RER misalignments. After reviewing the vast literature on the choice, classification, and the effects of the ERRs on macroeconomic performance, I used several matching estimators to analyze the effects of ERRs on the degree of RER misalignment. The estimation yields some interesting results, which I can summarize as follow.

The different theories on ERR choice seem to provide interesting insights; many popular determinants of ERR choice have the expected sign and are statistically significant. More precisely, using RR classification, I find supporting evidence for the Trilemma, the Sources of Shock approach, the Credibility View, and Liability Dollarization hypothesis. Our findings seem to contradict the OCA theory, and against my own priors, the result suggests that small countries are more likely to float. Perhaps the inclusion of rich islands such as Japan or Australia is driving the results, but in any case this suggest that poor islands are not very likely to peg, or that rich islands are very likely to float.

Perhaps the main result of this paper is that pegs seems to be associated with more RER overvaluation. Moreover, this result does not seems to depend on the ERR classifications, or on the RER misalignment indexes that is used. I find that this result holds for multilateral indexes and ERR classification of different kinds.

The presence of significant covariate imbalance after matching suggest that some heterogeneity is either inherent to each ERR, or that the information available is not enough to remove the observed differences based on the set of matching models implemented. The main results were estimated using the RR classification, but even the best model in terms of bias reduction (the Mahalanobis distance) was far from perfect. Interestingly, the models that use the IMF classification seems to do a very good job in terms of bias reduction, which suggest that we should trust these results more. However, the size of the effects is similar to the original models (between -13.1% and -14.9% for the RR classification, and between

-10.4% and -15.7% for the IMF classification). The punch-line is that there is a set of estimations that we should trust, and the size of the effects do not differ much from the main specifications.

Finally, the placebo test and the Rosembaum Bounds estimations, show that our treatment variable represent a "true treatment" (i.e., it is better than random), and that the results are not sensitive to unobservable variables that can explain ERR choices.

Table 2.1: Summary Statistics

	Obs	Mean	SD	Min/Max
Optimal Currency Areas Variables				
Island	8274	0.2162	0.4117	0 / 1
Pop	8316	30.9971	111.7169	0.0407 / 1324.353
Trade	5997	0.7598	0.48613	0 .0721 / 4.2545
Diversity	7279	0.6566	0.6974	-0.0467 / 3.9339
Area	6626	849.9338	1968.85	2.6964 / 16572.62
Trilemma Variables				
MI	5596	0.4364	0.1770	0 / 0.9679
KA_open	5553	0.4290	0.3522	0 / 1
Sources of Shocks Variables				
MRES_shock	4505	0.2471	0.4700	0.0034 / 9.6182
Rate_shock	5553	2.1681	2.4856	0 / 15.5772
TOT_shock	4673	0.0295	0.0496	0 / 0.7497
GOV_shock	4949	0.0006	0.0019	0 / .0340
Liability Dollarization Variables				
Foreign_Liab	5652	6.0966	14.0971	0 / 318.0404
Dollar	2361	0.2542	0.2295	0 / 0.98
Credibility Variables				
Durable	7499	22.1756	28.9124	0 / 202
High_Infla	4249	0.3659	2.5683	-0.0425 / 65.1711

Table 2.2: Variable Descriptions and Sources

	Description	Source
Optimal Currency Areas		
Island	Island Dummy	Wikipedia
Pop	Population	PWT 8.1
Trade	*De Facto* Trade Openness (Exports + Imports)/GDP	PWT 8.1
Diversity	Theil Index of Export Diversification (Higher means less Diversification)	IMF WEO
Area	Total Area in KM^2	[*]
Trilemma		
MI	Monetary Independence Index (see source)	[**]
KA_open	Capital Account Openness Index (see source)	[**]
Sources of Shocks		
MRES_shock	Internal Nominal Shock (5 year variance of Broad Money/Reserves)	WDI
RATE_shock	External Nominal Shock (5 year variance of US FF rate * KA_open)	[**]
TOT_shock	External Real Shock (5 year variance of terms of trade * Trade)	[***]
GOV_shock	Internal Real Shock (5 year variance of government consumption)	WDI
Liability Dollarization		
Foreign_Liab	Non-FDI Foreign Liabilities to GDP	[****]
Dollar	Deposit Dollarization	[*****]
Credibility		
Durable	Political Regime Durability (years)	Polity IV Dataset
High_Infla	High Inflation (5 years average of domestic inflation/world median inflation)	WDI

[*] Gallup et. al. (1999).
[**] Aizenman et. al. (2013).
[***] Spatafor and Tytell (2009).
[****] Lane and Milesi-Ferretti (2001)
[*****] Levy-Yeyati (2006).

Table 2.3: Estimated Marginal Effects on ERR choices, RR

VARIABLES	Predicted	Observed	Statistical Significance
Region Regime RR	(-)	(-)	***
Developed	(-)	(-)	**
Island	(+)	(-)	***
Population	(-)	(+)	***
Trade Openness	(+)	(+)	***
Diversity	(+)	(+)	***
Area	(-)	(+)	***
Monetary Independence	(-)	(-)	***
Capital Account Openness	(-)	(+)	***
Int. Nominal Shock	(+)	(+)	**
Nominal Shock	(+)	(+)	***
TOT Shock	(+)	(+)	
GOV Shock	(-)	(+)	
L2GDP	(+)	(-)	***
High Inflation	(+)	(+)	***
Regime Durability	(-)	(-)	***

The +/- signs denote increase/decrease in the likelihood of adopting a peg
*** p<0.01, ** p<0.05, * p<0.1

Table 2.4: Estimated Marginal Effects on ERR choices, RR

VARIABLES	(1) Peg	(2) Intermediate	(3) Float
Region_regimeRR	-0.458***	0.520***	-0.063***
	(0.054)	(0.053)	(0.023)
Developed	-0.069**	0.079**	-0.009
	(0.033)	(0.031)	(0.011)
Island	-0.062**	-0.041	0.103***
	(0.027)	(0.026)	(0.008)
Population	0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Trade	0.416***	-0.201***	-0.215***
	(0.035)	(0.033)	(0.018)
Trade_diverse	0.051**	0.084***	-0.135***
	(0.024)	(0.020)	(0.023)
Area	0.000**	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Monetary_Indep	-0.169***	0.094	0.076***
	(0.061)	(0.059)	(0.024)
KA_open	-0.099**	0.152***	-0.053***
	(0.043)	(0.042)	(0.015)
TOT_shock	0.064	1.226***	-1.290**
	(0.542)	(0.416)	(0.647)
GOV_shock	4.165	-21.216*	17.050***
	(10.846)	(11.218)	(1.895)
Rate_shock	0.061***	-0.063***	0.003**
	(0.006)	(0.007)	(0.001)
MRES_shock	0.019	0.004	-0.023**
	(0.019)	(0.017)	(0.011)
Foreign_liab	0.005*	0.003	-0.008***
	(0.002)	(0.002)	(0.002)
Infla_history	0.017***	-0.006	-0.011***
	(0.004)	(0.004)	(0.003)
Durable	-0.002***	0.002***	-0.000
	(0.000)	(0.000)	(0.000)
Observations	1,679	1,679	1,679

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.5: OLS and ATE of RR ERR on Underval

Estimator	(1) Mahalanobis	(2) Nearest (5)	(3) Nearest (1)	(4) Kernel	(5) Local Linear	(6) Radius
OLS	-0.178***	-0.178***	-0.178***	-0.178***	-0.178***	-0.178***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
ATT	-0.131***	-0.149***	-0.135***	-0.143***	-0.142***	-0.127***
	(0.026)	(0.023)	(0.028)	(0.024)	(0.020)	(0.020)
Mean Bias Unmatched	33.26	33.26	33.26	33.26	33.26	33.26
Mean Bias Matched	8.016	26.01	26.79	24.51	26.79	23.74
Median Bias Unmatched	31.29	31.29	31.29	31.29	31.29	31.29
Median Bias Matched	7.66	24.67	27.39	24.79	27.39	21.35
Pseudo-R2 Unmatched	0.21	0.21	0.21	0.21	0.21	0.21
Pseudo-R2 Matched	0.06	0.16	0.18	0.15	0.18	0.15
Treated Observations (Off Support)	0	0	0	0	0	0
Observations	1679	1679	1679	1679	1679	1679

Boot-Strapped standard errors (100 replications) in parentheses for (1), (4), (5) and (6)
Abadie and Imbens (2008) standard errors for Nearest Neighbor
*** p<0.01, ** p<0.05, * p<0.1

Table 2.6: Estimation of Different Undervaluation Indexes

	(1) RER PWT	(2) RER PWT	(3) RER PWT	(4) REER IMF
Relative CGDP	-0.639***	-0.646***	-0.766***	-0.027
	(0.038)	(0.048)	(0.042)	(0.024)
Terms of Trade		0.086***		
		(0.014)		
Government Spending		-2.150***		
		(0.105)		
Net Foreign Assets		-0.026***		
		(0.006)		
$\triangle$Relative $CGDP_{t-1}$			6.171**	
			(2.917)	
$\triangle$Relative $CGDP_{t+1}$			13.433***	
			(3.271)	
Constant	0.376***	0.408***	0.347***	0.045***
	(0.050)	(0.085)	(0.049)	(0.000)
Observations	8,274	5,115	7,773	2,822
R-squared	0.078	0.217	0.093	0.158
Country FE	No	No	No	No
Time FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.7: OLS and ATT effects using different undervaluation indexes

Index	(1) Baseline	(2) Fundamental	(3) Cointegration	(4) REER	(5) PPP
OLS	-0.178***	-0.182***	-0.182***	-0.160***	-0.152***
	(0.026)	(0.027)	(0.027)	(0.026)	(0.028)
ATT	-0.131***	-0.131**	-0.137***	-0.184***	-0.214***
	(0.026)	(0.024)	(0.023)	(0.064)	(0.040)
Mean Bias Unmatched	33.26	33.26	33.26	42.20	42.20
Mean Bias Matched	8.02	8.02	8.02	12.75	12.75
Median Bias Unmatched	31.29	31.29	31.29	40.91	40.91
Median Bias Matched	7.66	7.66	7.66	11.09	11.09
Pseudo-R2 Unmatched	0.21	0.21	0.21	0.37	0.37
Pseudo-R2 Matched	0.06	0.06	0.06	0.17	0.17
Treated Observations (Off Support)	0	0	0	0	0
Observations	1679	1679	1679	973	973

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.8: Estimated Marginal Effects on ERR choices, LYS

VARIABLES	(1) Peg	(2) Intermediate	(3) Float
Region Regime (LY)	-0.461***	0.173***	0.288***
	(0.054)	(0.031)	(0.050)
Developed	0.191***	-0.193***	0.002
	(0.048)	(0.033)	(0.049)
Island	-0.170***	-0.083***	0.254***
	(0.029)	(0.025)	(0.030)
Population	0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Trade Openness	0.405***	-0.071**	-0.335***
	(0.045)	(0.028)	(0.051)
Diversity	0.254***	-0.088***	-0.166***
	(0.036)	(0.032)	(0.037)
Area	0.000**	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Monetary Independence	-0.330***	-0.028	0.358***
	(0.078)	(0.043)	(0.082)
Capital Account Openness	0.147***	-0.119***	-0.029
	(0.054)	(0.038)	(0.055)
Int. Nominal Shock	0.031***	0.002	-0.033***
	(0.006)	(0.004)	(0.006)
Nominal Shock	0.215**	-0.181**	-0.034
	(0.085)	(0.089)	(0.082)
TOT Shock	5.775***	-4.205***	-1.570*
	(0.823)	(0.867)	(0.813)
GOV Shock	217.606***	-432.371***	214.765***
	(49.919)	(86.757)	(40.569)
L2GDP	0.010	0.010	-0.019
	(0.024)	(0.016)	(0.025)
High Inflation	-0.006	-0.001	0.007
	(0.005)	(0.004)	(0.005)
Regime Durability	-0.000	0.002***	-0.001**
	(0.000)	(0.000)	(0.001)
Observations	780	780	780

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.9: Estimated Marginal Effects on ERR choices, IMF

VARIABLES	(1) Peg	(2) Intermediate	(3) Float
Region Regime (IMF)	-0.210***	0.135***	0.075**
	(0.041)	(0.040)	(0.032)
Developed	-0.019	0.123***	-0.104***
	(0.035)	(0.037)	(0.028)
Island	-0.109***	0.043	0.066***
	(0.033)	(0.032)	(0.023)
Population	-0.003***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)
Trade Openness	0.149***	0.161***	-0.310***
	(0.041)	(0.040)	(0.037)
Diversity	0.105***	-0.086***	-0.019
	(0.020)	(0.023)	(0.020)
Area	0.000	-0.000	0.000**
	(0.000)	(0.000)	(0.000)
Monetary Independence	-0.077	0.050	0.027
	(0.062)	(0.064)	(0.053)
Capital Account Openness	-0.346***	0.119***	0.227***
	(0.041)	(0.042)	(0.033)
Int. Nominal Shock	0.041***	-0.026***	-0.016***
	(0.006)	(0.006)	(0.004)
Nominal Shock	0.014	-0.011	-0.003
	(0.021)	(0.027)	(0.019)
TOT Shock	0.048	1.531***	-1.579***
	(0.412)	(0.441)	(0.513)
GOV Shock	-17.985*	-22.650*	40.635***
	(10.576)	(12.854)	(6.322)
L2GDP	0.060***	-0.036*	-0.025
	(0.022)	(0.019)	(0.016)
High Inflation	-0.011**	0.007**	0.004***
	(0.005)	(0.003)	(0.002)
Regime Durability	-0.000	-0.002***	0.002***
	(0.000)	(0.000)	(0.000)
Observations	1,723	1,723	1,723

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.10: OLS and ATE of LYS ERR on Underval

Estimator	(1) Mahalanobis	(2) Nearest (5)	(3) Nearest (1)	(4) Kernel	(5) Local Linear	(6) Radius
OLS	-0.148***	-0.148***	-0.148***	-0.148***	-0.148***	-0.148***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
ATT	-0.220***	-0.104**	-0.121**	-0.111**	-0.111***	-0.146***
	(0.024)	(0.046)	(0.059)	(0.056)	(0.045)	(0.053)
Mean Bias Unmatched	47.57	47.57	47.57	47.57	47.57	47.57
Mean Bias Matched	26.04	18.71	18.36	18.35	18.36	11.92
Median Bias Unmatched	43.45	42.62	42.62	42.62	42.62	42.62
Median Bias Matched	19.97	12.26	14.61	12.10	14.61	9.37
Pseudo-R2 Unmatched	0.42	0.16	0.14	0.16	0.14	0.11
Pseudo-R2 Matched	0.053	0.020	0.019	0.016	0.019	0.022
Treated Observations (Off Support)	0	127	127	127	127	127
Observations	726	744	744	744	744	744

Boot-Strapped standard errors (100 replications) in parentheses for (1), (4), (5) and (6)
Abadie and Imbens (2008) standard errors for Nearest Neighbor
*** p<0.01, ** p<0.05, * p<0.1

Table 2.11: OLS and ATT of IMF ERR on Underval

Estimator	(1) Mahalanobis	(2) Nearest (5)	(3) Nearest (1)	(4) Kernel	(5) Local Linear	(6) Radius
OLS	-0.136***	-0.136***	-0.136***	-0.136***	-0.136***	-0.136***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
ATT	-0.120***	-0.128***	-0.157***	-0.125 ***	-0.126***	-0.104***
	(0.021)	(0.023)	(0.027)	(0.024)	(0.031)	(0.023)
Median Bias Unmatched	31.38	31.36	31.36	31.36	31.36	31.36
Median Bias Matched	8.27	6.06	7.04	5.13	7.04	7.92
Mean Bias Unmatched	31.71	31.69	31.69	31.69	31.69	31.69
Mean Bias Matched	6.81	5.18	5.67	4.08	5.67	6.95
Pseudo-R2 Unmatched	0.23	0.23	0.23	0.23	0.23	0.23
Pseudo-R2 Matched	0.05	0.02	0.03	0.01	0.03	0.02
Treated Observations (Off Support)	0	112	112	112	112	112
Observations	1618	1627	1627	1627	1627	1627

Boot-Strapped standard errors (100 replications) in parentheses for (1), (4), (5) and (6)
Abadie and Imbens (2008) standard errors for Nearest Neighbor
*** p<0.01, ** p<0.05, * p<0.1

Table 2.12: Rosembaum Bounds (RR)

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	1.7e-12	1.7e-12	-.08316	-.08316	-.106396	-.059778
1.1	7.8e-16	1.2e-09	-.094935	-.071142	-.118452	-.048178
1.2	0	1.9e-07	-.105755	-.060378	-.129637	-.037669
1.3	0	.00001	-.115832	-.050779	-.139956	-.027978
1.4	0	.00022	-.12508	-.041931	-.149854	-.018644
1.5	0	.002382	-.133875	-.033766	-.159182	-.010354
1.6	0	.014688	-.142257	-.025984	-.16797	-.002574
1.7	0	.057578	-.149995	-.018513	-.17611	.004687
1.8	0	.156661	-.15743	-.011821	-.18402	.011479
1.9	0	.318264	-.164739	-.005422	-.19125	.017984
2	0	.514099	-.171419	.000461	-.198642	.024323
2.1	0	.697941	-.177614	.006151	-.205296	.030294
2.2	0	.836316	-.183956	.011423	-.211807	.036012
2.3	0	.92225	-.189667	.016587	-.217898	.041599
2.4	0	.96735	-.195386	.021516	-.223929	.046929
2.5	0	.987761	-.200708	.02631	-.229743	.051832
2.6	0	.995865	-.206079	.030997	-.235459	.056817
2.7	0	.998729	-.211151	.035406	-.24095	.061497
2.8	0	.999642	-.215754	.03965	-.246363	.066042
2.9	0	.999907	-.220491	.043957	-.251491	.070236
3	0	.999977	-.225036	.047786	-.256497	.074157

Table 2.13: Rosembaum Bounds (LYS)

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	0	0	-.163676	-.163676	-.191031	-.136879
1.1	0	0	-.176236	-.150877	-.204099	-.124361
1.2	0	0	-.18842	-.13957	-.215721	-.112413
1.3	0	0	-.199097	-.129178	-.226819	-.101515
1.4	0	4.8e-15	-.209055	-.11929	-.236704	-.091365
1.5	0	4.9e-13	-.218258	-.110022	-.24626	-.081841
1.6	0	2.5e-11	-.226877	-.101471	-.25489	-.073138
1.7	0	7.5e-10	-.234682	-.093566	-.263342	-.065053
1.8	0	1.4e-08	-.242252	-.085621	-.27184	-.057425
1.9	0	1.7e-07	-.249565	-.078712	-.279374	-.050335
2	0	1.5e-06	-.256192	-.071986	-.286778	-.043488
2.1	0	.00001	-.262742	-.065598	-.29369	-.037219
2.2	0	.000054	-.269462	-.059695	-.300293	-.031257
2.3	0	.000226	-.275447	-.054146	-.306578	-.025317
2.4	0	.000795	-.281104	-.048475	-.312589	-.01949
2.5	0	.002373	-.286805	-.04348	-.318219	-.013989
2.6	0	.006138	-.292086	-.038739	-.323633	-.008835
2.7	0	.013996	-.297295	-.033848	-.329081	-.003856
2.8	0	.02855	-.302091	-.02956	-.334369	.000934
2.9	0	.05276	-.306736	-.025181	-.339507	.005715
3	0	.089334	-.311271	-.020676	-.344426	.010175

Table 2.14: Rosembaum Bounds (IMF)

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	7.8e-16	7.8e-16	-.129485	-.129485	-.159409	-.100384
1.1	0	2.6e-13	-.140967	-.118187	-.171258	-.088564
1.2	0	3.0e-11	-.151411	-.107882	-.181969	-.077895
1.3	0	1.4e-09	-.16127	-.098533	-.192137	-.068004
1.4	0	3.6e-08	-.170385	-.08956	-.200867	-.058924
1.5	0	5.4e-07	-.178642	-.081189	-.208999	-.0503
1.6	0	5.3e-06	-.18653	-.07311	-.21672	-.041991
1.7	0	.000036	-.193791	-.066284	-.22427	-.034619
1.8	0	.000186	-.20028	-.059436	-.230777	-.028138
1.9	0	.000752	-.206267	-.052785	-.237653	-.021559
2	0	.002468	-.21231	-.046556	-.243834	-.014853
2.1	0	.006798	-.218189	-.04083	-.250088	-.009085
2.2	0	.016106	-.223414	-.035383	-.256168	-.003434
2.3	0	.033524	-.228414	-.030507	-.261584	.002131
2.4	0	.062392	-.2333	-.025592	-.266881	.007313
2.5	0	.105395	-.238101	-.021078	-.271667	.012579
2.6	0	.163689	-.242226	-.01635	-.276671	.017443
2.7	0	.236365	-.24721	-.012118	-.28168	.022277
2.8	0	.320454	-.251388	-.007824	-.286414	.027095
2.9	0	.411459	-.255661	-.003911	-.290827	.031759
3	0	.504209	-.259739	.000161	-.295296	.036274

Figure 2.1: Distribution of ERRs, full sample

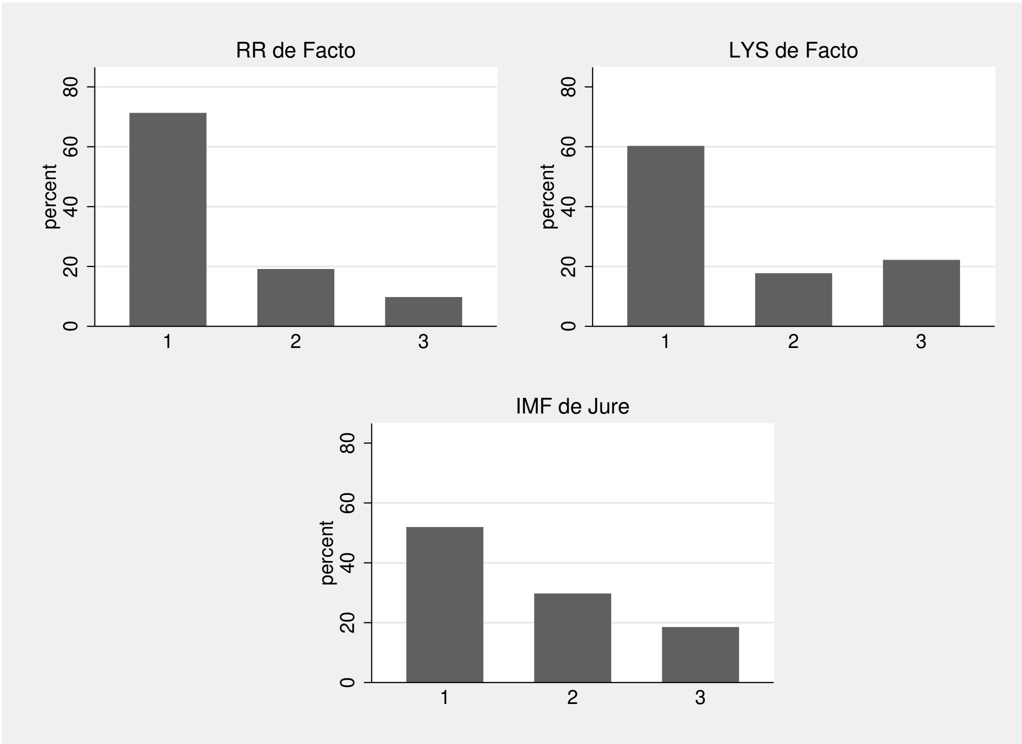


Figure 2.2: Distribution of ERRs, regimes that last more than 5 years

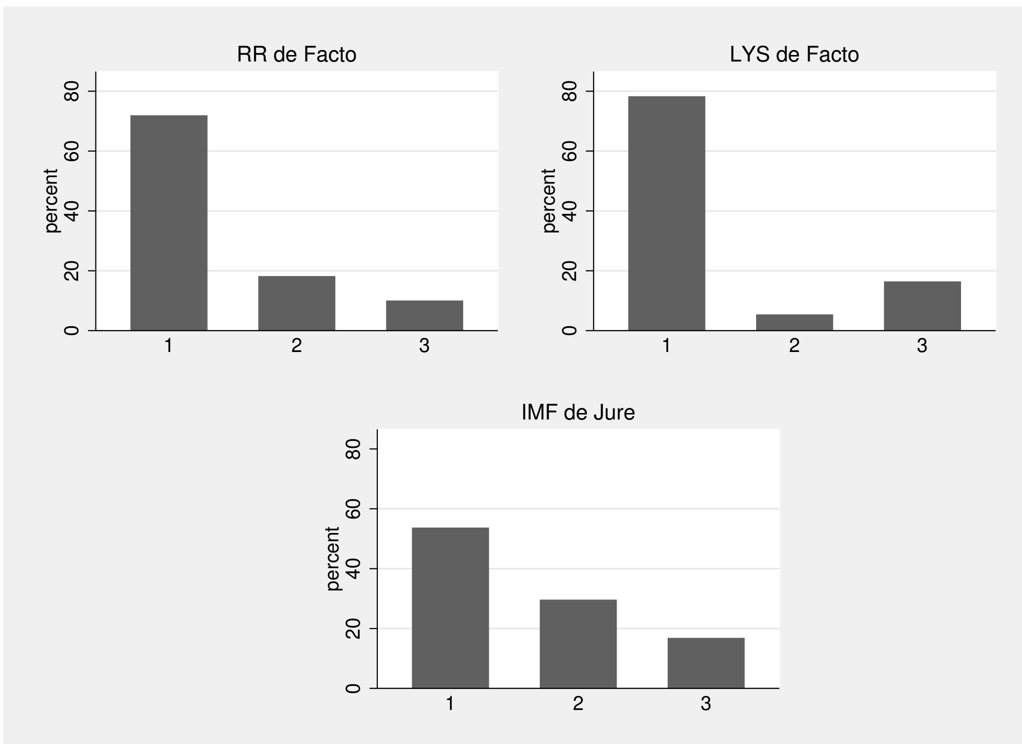


Figure 2.3: Distribution of Propensity Scores, before and after matching (RR)

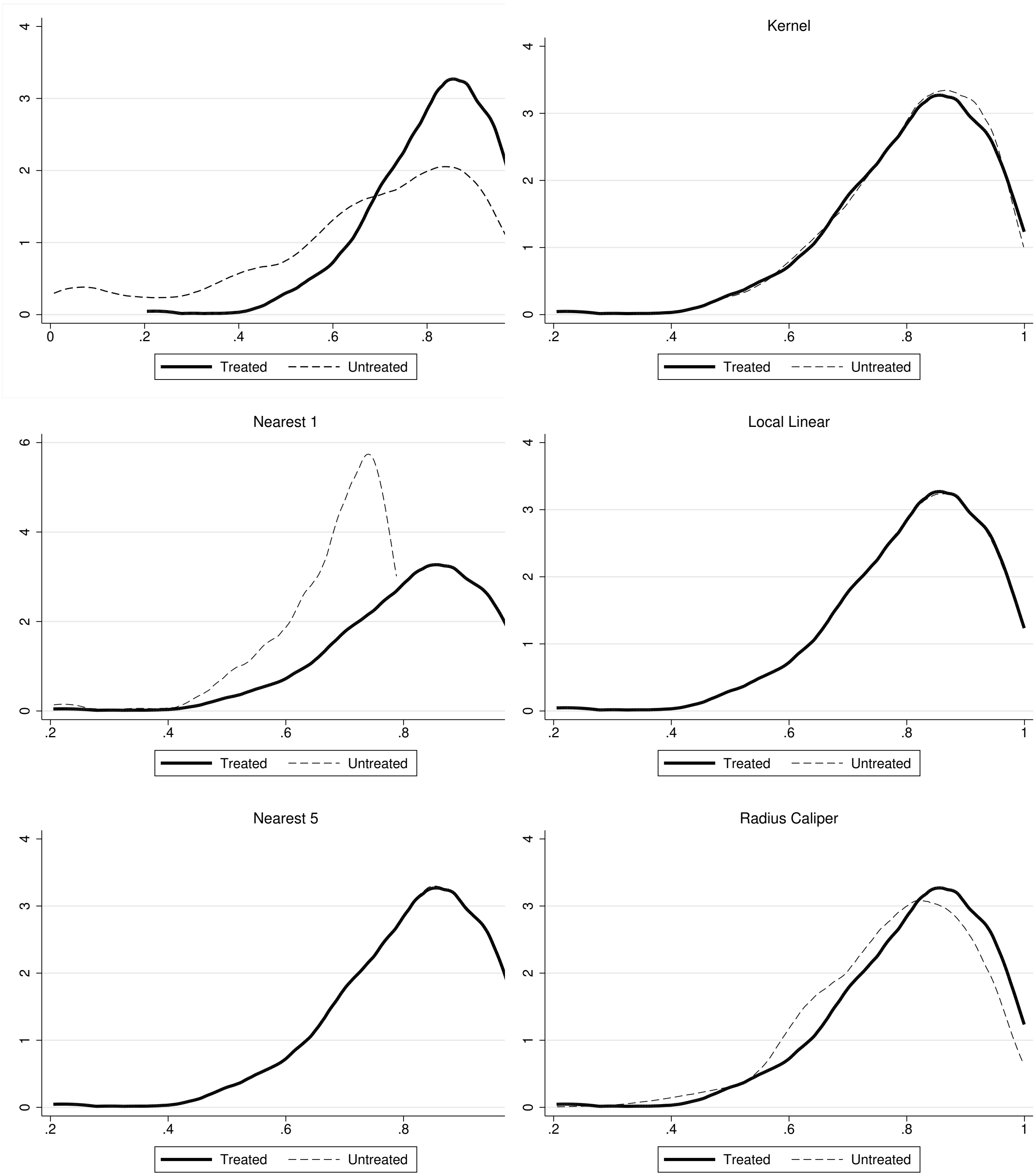


Figure 2.4: Histogram of Propensity Scores, On and Off Support Observations (RR)

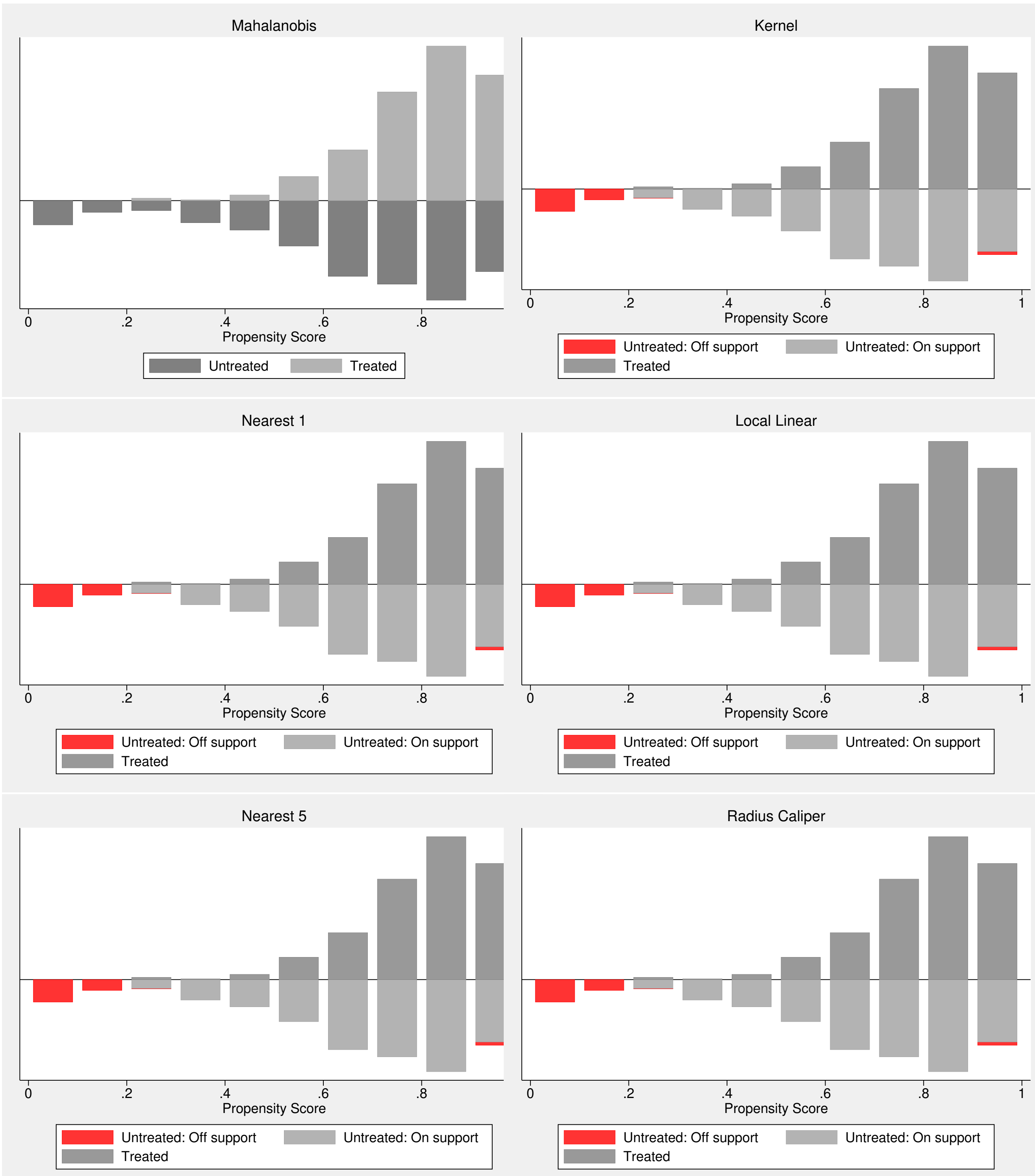


Figure 2.5: Covariates Imbalances, before and after matching (I), RR

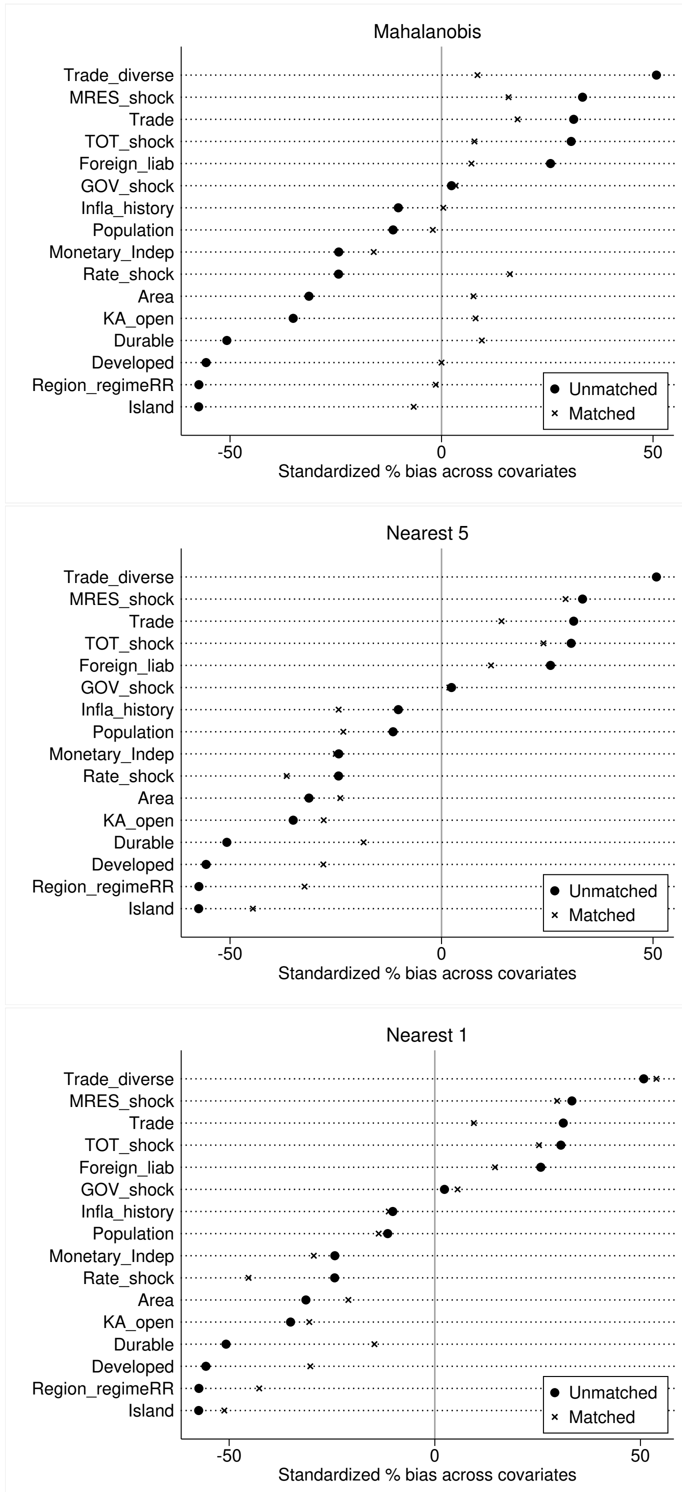


Figure 2.6: Covariates Imbalances, before and after matching (II), RR

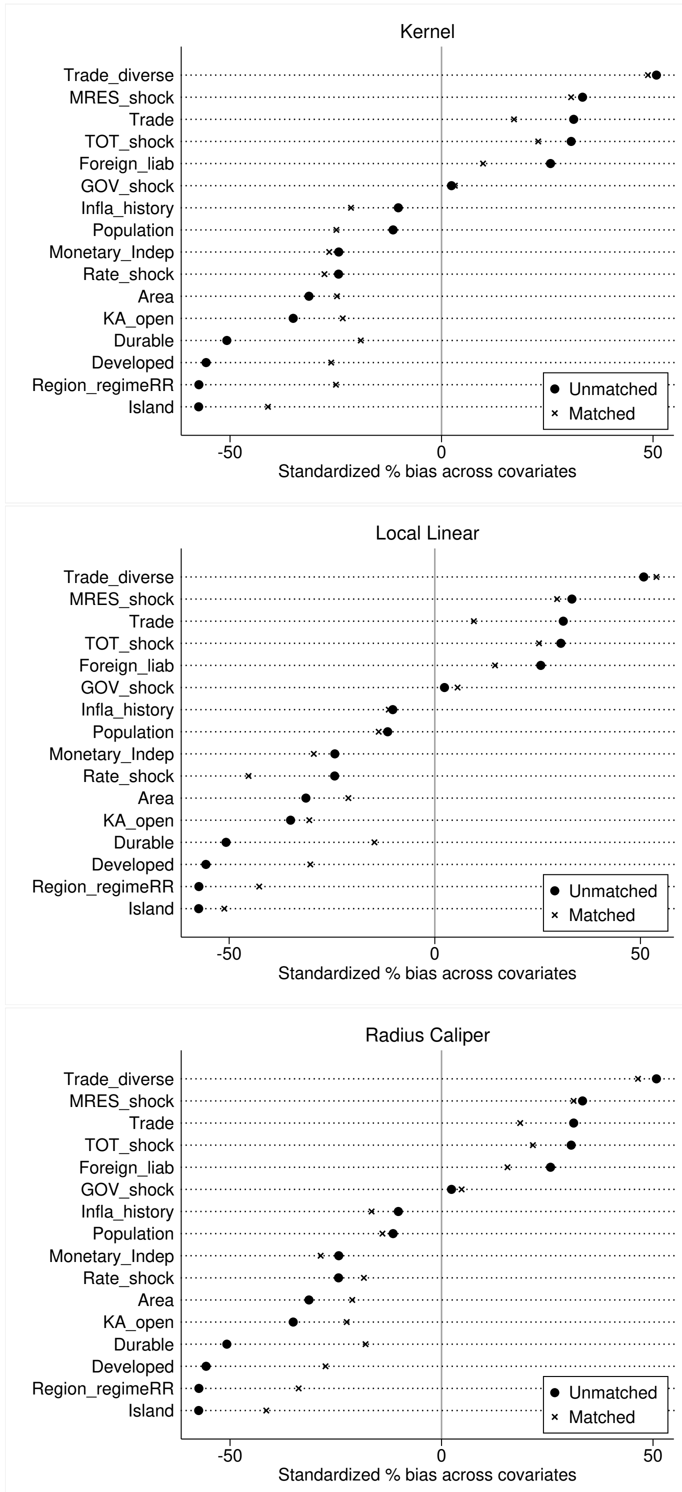


Figure 2.7: Distribution of Propensity Scores, before and after matching (LYS)

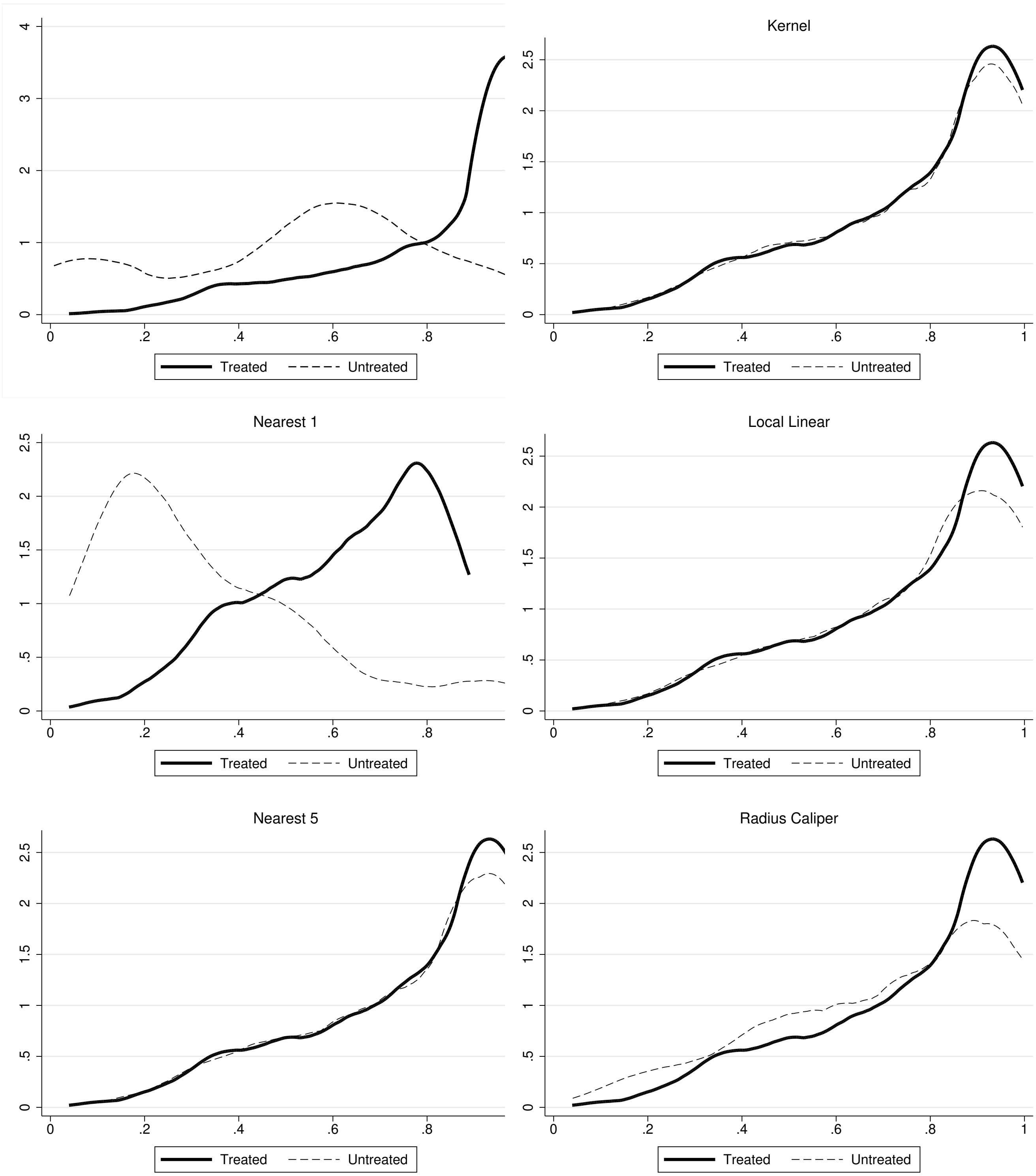


Figure 2.8: Distribution of Propensity Scores, before and after matching (IMF)

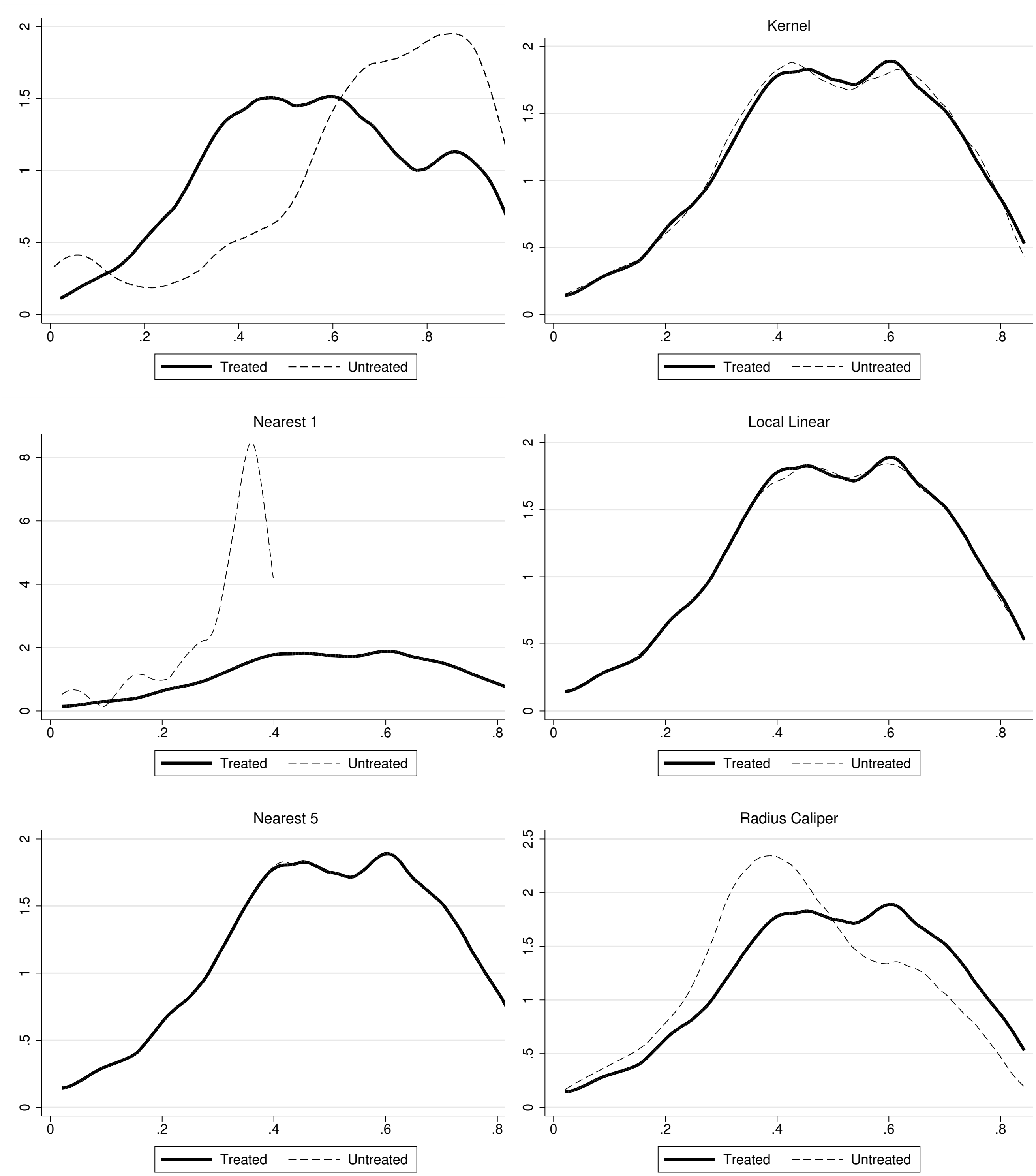


Figure 2.9: Histogram of Propensity Scores, On and Off Support Observations (LYS)

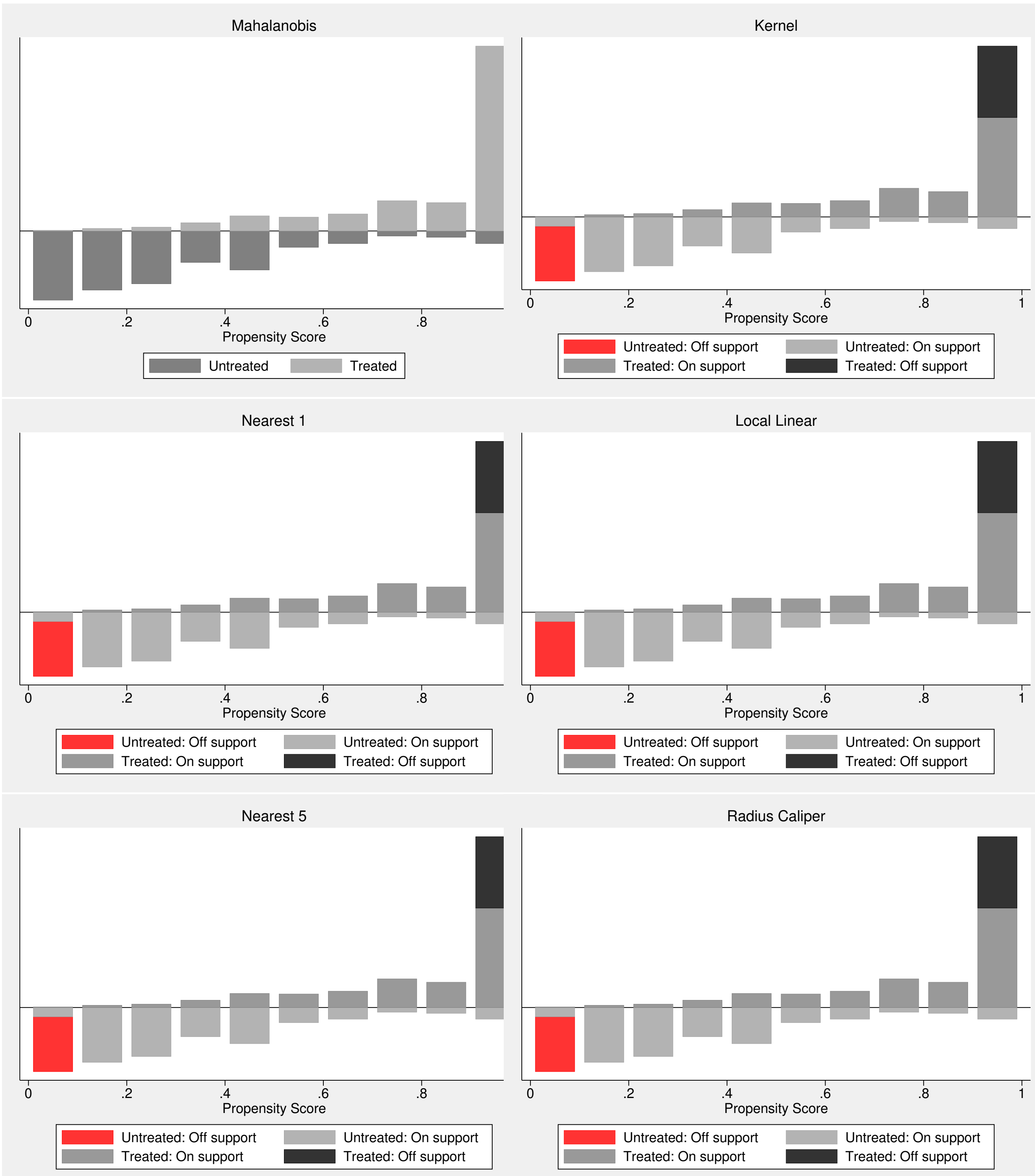


Figure 2.10: Histogram of Propensity Scores, On and Off Support Observations (IMF)

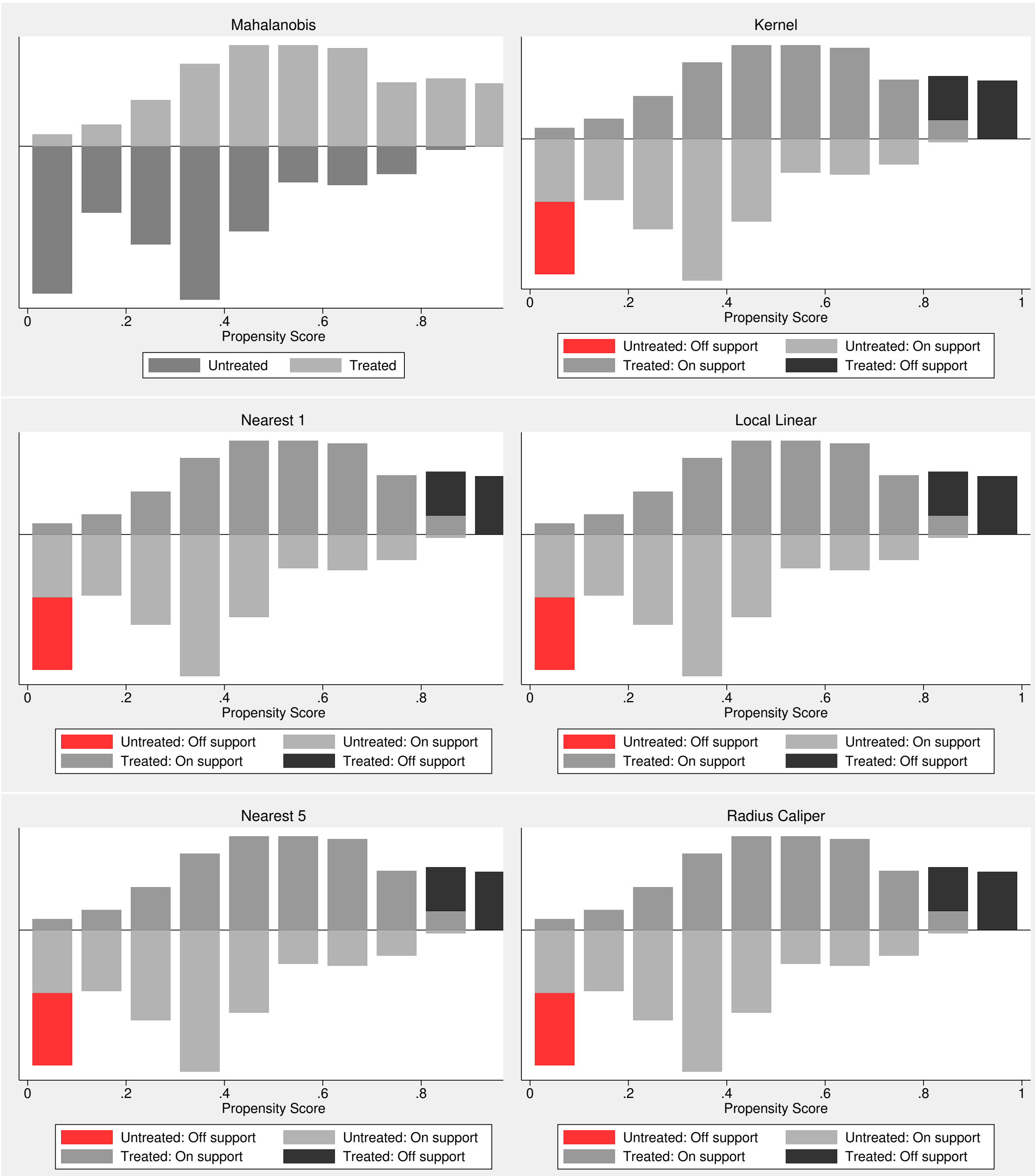


Figure 2.11: Covariates Imbalances, before and after matching (I), LYS

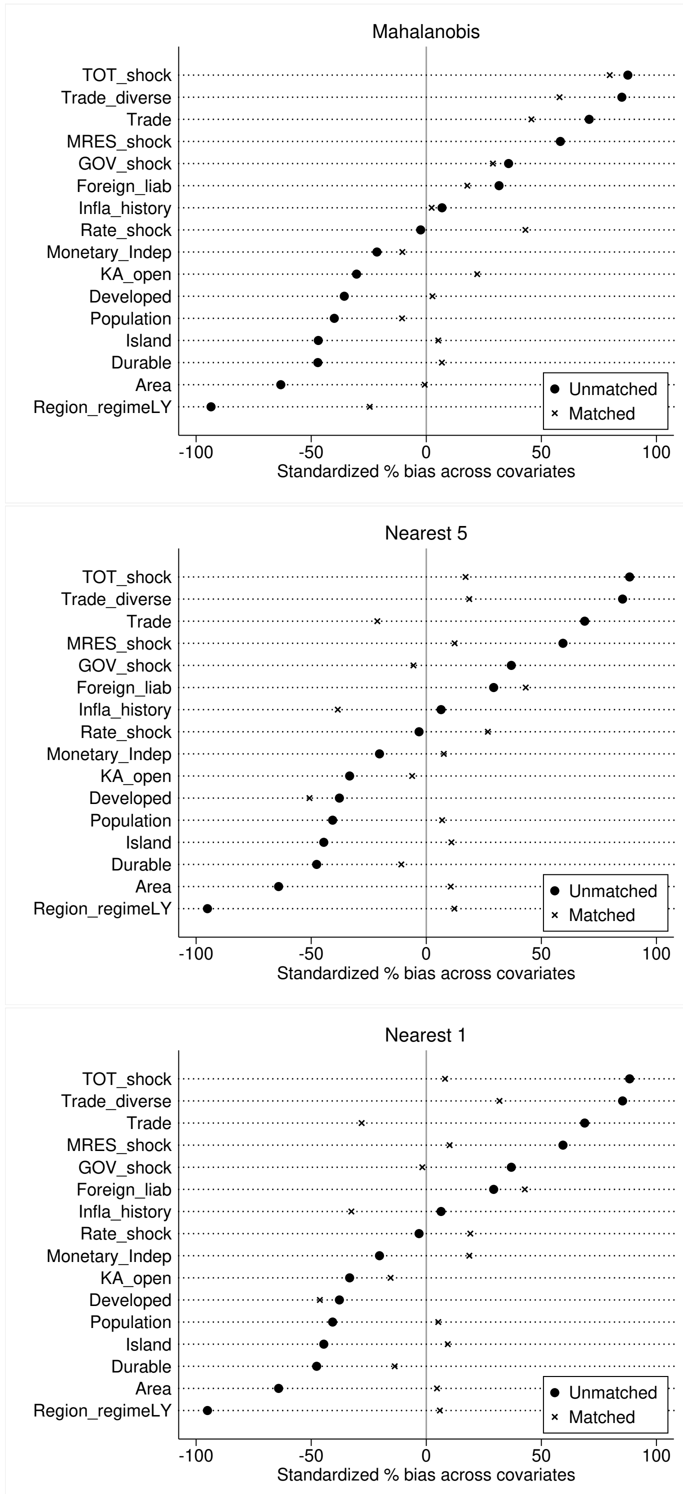


Figure 2.12: Covariates Imbalances, before and after matching (II), LYS

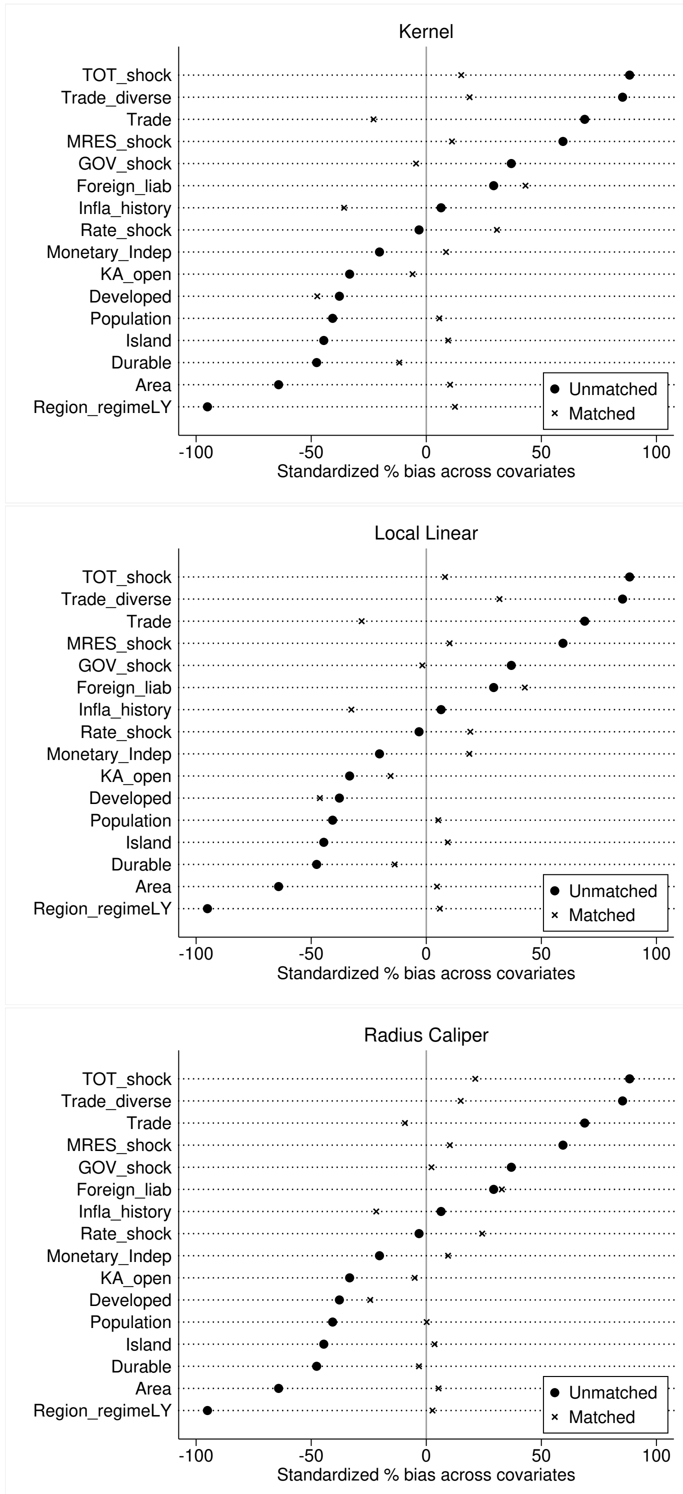


Figure 2.13: Covariates Imbalances, before and after matching (I), IMF

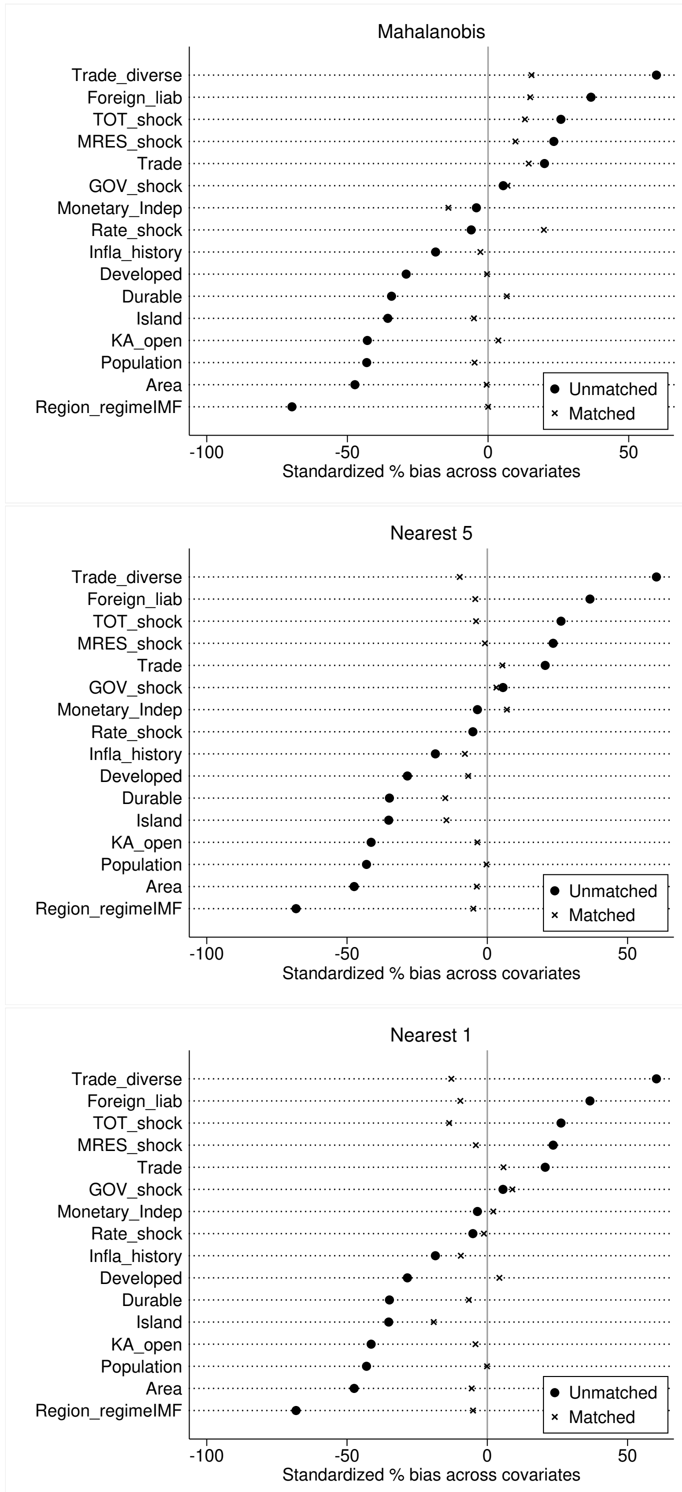


Figure 2.14: Covariates Imbalances, before and after matching (II), IMF

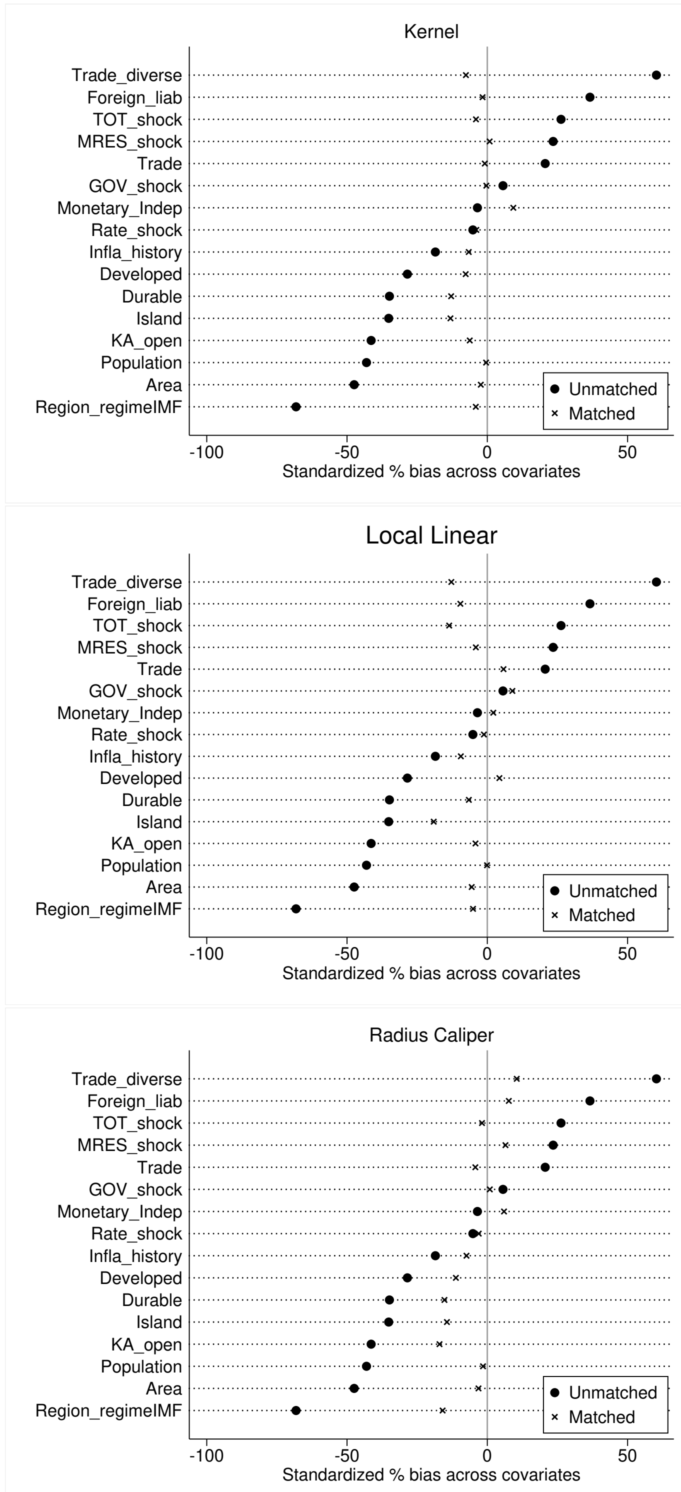


Figure 2.15: Placebo Testing (RR)

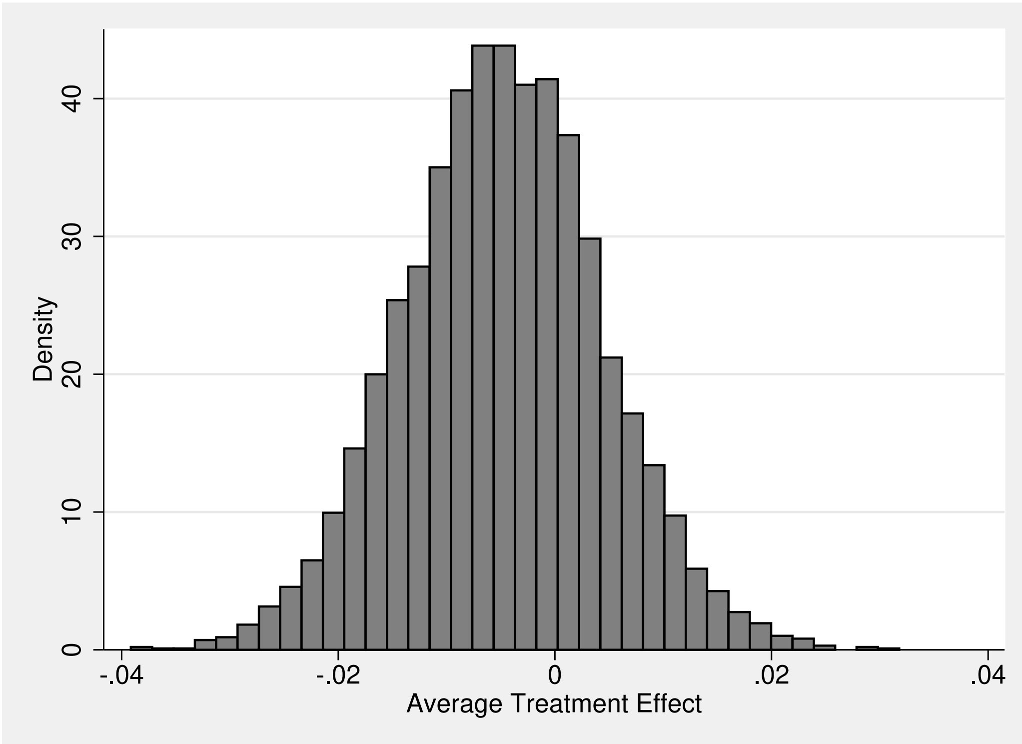


Figure 2.16: Placebo Testing (LYS)

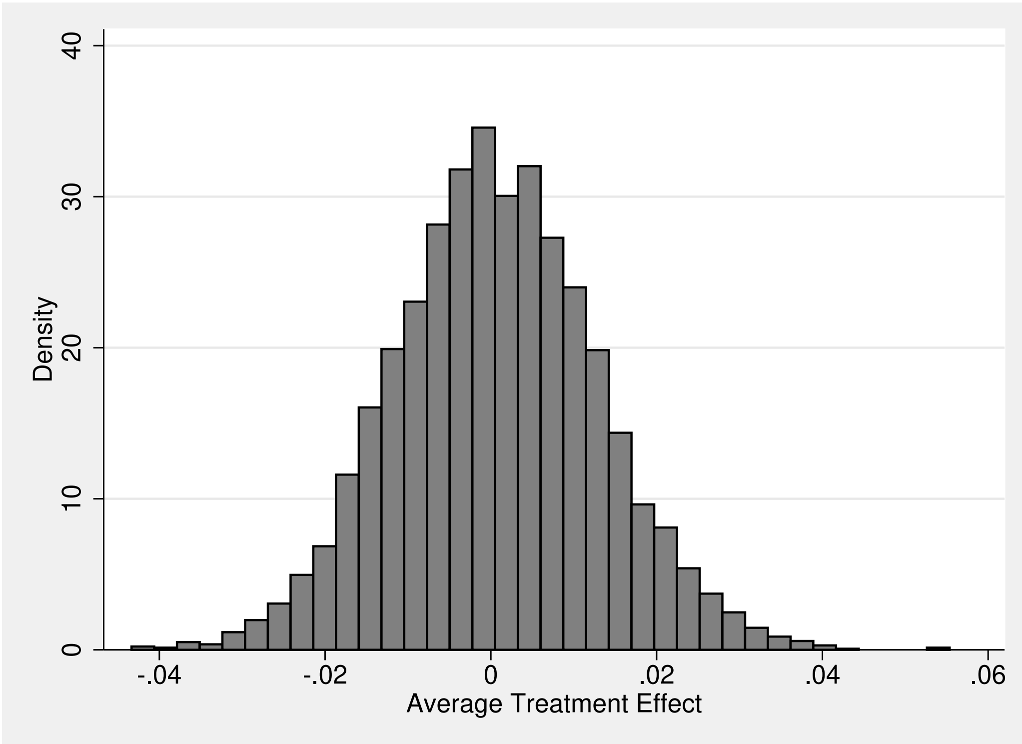
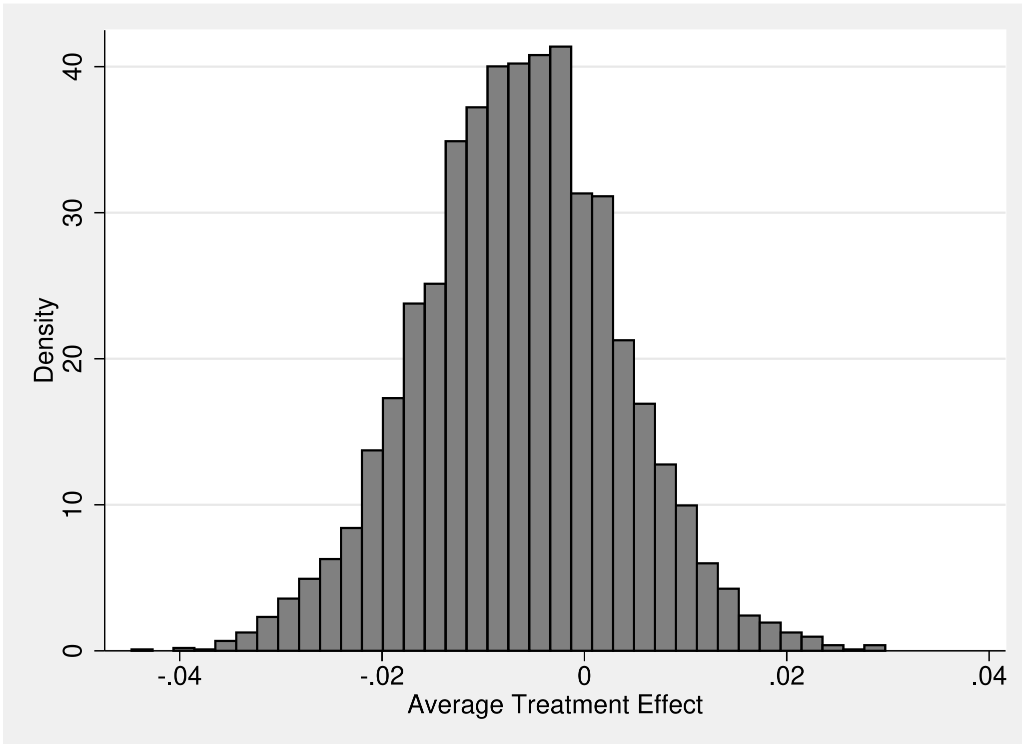


Figure 2.17: Placebo Testing (IMF)



CHAPTER 3

ASYMMETRIC MONETARY AND EXCHANGE RATE POLICIES IN LATIN-AMERICAN COUNTRIES USING INFLATION TARGETING

3.1 Introduction

During the last decades several developed and non-developed countries adopted more flexible exchange rate arrangements. More precisely, Inflation Targeting has become the poster child of exchange rate regimes. That regime works as follows. The Central Bank commits to deliver a low and stable rate of inflation, using as the main policy instrument a short-term interest rate. In an open economy set-up, countries on Inflation Targeting keep a relatively open capital account. The usual prescription is that they should refrain from intervening in the foreign exchange market and let the exchange rate float as freely as possible.

In practice this is hardly the case. As monetary policy is used to target inflation (and possibly the output-gap), changes in the interest rate may create large swings in exchange rates, well beyond what most Central Banks are willing to tolerate. In fact the theory does not necessary precludes sales and purchases of foreign assets by authorities (as well as other types of interventions), as long as they reflect attempts to cushion temporary shocks or other exchange rate movements not justified by economic fundamentals.

The largest Latin-American countries have adopted the framework, including Brazil (1999), Chile (1991), Colombia (1999), Mexico (2002), and Peru (2003). These countries are the perfect specimens to analyze how Inflation Targeting works on a set-up subject to a myriad of external nominal and real shocks. Although their exchange rate regimes are de facto much more flexible than in the past, their Central Banks intervened heavily in the foreign exchange market to cushion large movements in exchange rates (Chang, 2008).

There are good reasons to believe that this type of intervention was not implemented during episodes of appreciation and depreciation with the same intensity. Authors such as Barbosa-Filho (2015) and Ros (2015) have argued that the Central Banks of Brazil and Mexico have conducted an "asymmetric policy", tightening the stance of monetary policy too much when inflation accelerates, and softening it too little when inflation falls. Because the capital account of the balance of payments was extremely open, the required changes in the interest rate may have triggered movements in the exchange rate with a bias in the downward direction.[1] On the other hand, intervention in the foreign exchange market via sales of dollars (when exchange rate depreciates) may have been more pronounced than purchases of dollars (when the exchange rate appreciates).

This paper analyzes the nature of monetary and exchange rate policy in Latin-American Inflation Targeting countries. Using non-linear econometric techniques, I test whether the Central Banks from these countries were more willing to tolerate appreciations than depreciation, for the period 1999-2015. The purpose of my econometric estimation is to test for the presence of asymmetries in the evolution of the exchange rate. But because exchange rate may behave asymmetrically for reasons other than policy, I also estimate a set of Central Bank reaction functions for interest rates and reserve accumulation, to determine the impact of monetary and exchange rate policy on the observed exchange rate behavior.

A brief summary of my results is as follows: there are some signs that the Central Banks from Latin-America dislike depreciations more than appreciations, with the exception of

[1] In this paper I stick to the following convention: the exchange rate is defined as the number of units of domestic currency per unit of dollars, so a reduction in the exchange rate is an appreciation, while an increase is a depreciation.

Chile. Moreover, this behavior seems to be more pronounced for the cases discussed by Barbosa-Filho and Ros, Brazil and Mexico.

This paper is structured as follows. After this introduction, section 3.2 comments on the related literature. Section 3.3 describes the econometric techniques and presents the results. Finally, section 3.4 concludes.

3.2 Related Literature

The recent thinking in macroeconomics have converged on a sort of synthesis, known as the "New Consensus Macroeconomics". This consensus agrees on the desirability of an autonomous monetary policy, and how to conduct it. The interest rate has replaced monetary aggregates on the monetary policy rules. It has been shown that a fully microfounded model based on a representative and forward looking agent framework is able to determine the equilibrium without any reference to the quantity of money, provided that the interest rate rule is sufficiently sensitive to changes in the rate of inflation.

This is known as the "Taylor-Principle", and it is embodied in the famous "Taylor-Rule".[2] Intuitively, the principle says that the rate of interest should be increased by more than inflation when inflation increase above the inflation target, to avoid a feedback from higher inflation to lower real interest rates, and from lower real interest rates to more aggregate demand and higher inflation. Conversely, when inflation falls below the target, the interest rate should be reduced by more than inflation.

When the "Taylor-Principle" is satisfied, the equilibrium is "determined", so inflationary expectations are "anchored" by the inflation target.[3] It is believed, In the context of Dynamic

[2]Both are due to John Taylor (see Taylor, 1993).

[3]Equilibrium Determinancy in models with forward looking behavior means that the number of positive roots is equal to the number of non-predetermined variables, so the system can be placed into the equilibrium

Stochastic General Equilibrium (DSGE) models, that if there are no real frictions, stabilizing inflation implies the stabilization of the output-gap, and thus Inflation Targeting seems to be a cost free approach to control inflation. This very convenient feature is called the "Divine Coincidence", following the terminology of Blanchard and Gali (2007). Due to the popularity of the DSGE approach, it is not surprising that Inflation Targeting has emerged as the most popular macroeconomic regime.[4]

Although the record of Inflation Targeting in terms of inflation reduction (at no noticeable output cost) seems to be quite remarkable in some countries, there is some debate on whether the observed disinflation is due to the adoption of Inflation Targeting per see, or due to other global factors, for instance the emergence of China as a provider of cheap manufacturing goods. For example Ball and Sheridan (2003) suggest that "Inflation Targeting does not matter": dis-inflation has happened almost everywhere, not only in countries that adopted Inflation Targeting.

On the other hand, the reduction in the rates of inflation was not translated into fast output growth and employment opportunities in several non-developed economies (see for instance the volume edited by Epstein and Yeldan, 2009). It may not be correct to argue that Inflation Targeting per se is responsible for a disappointing macroeconomic performance. Rather, this seems to be the result of a set of policies mainly concerned with keeping inflation in single and lower digits, with little emphasis on the promotion of growth and development.

Perhaps an important but often neglected aspect of the debate on Inflation Targeting is related on how it is implemented in an open economy. Very often is implicitly assumed that the open economy set-up should work as if the economy were closed. The core propositions

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trajectory. For monetary policy models, when the "Taylor-Principle" is not satisfied, the number of positive roots is larger than the number of non-predetermined variables.

[4]See Bernanke and Mishkin (1997) for a more precise description of Inflation Targeting.

presumably apply in an open economy as well (i.e, interest rate should response to inflation shocks aggressively, etc.), but there are additional complications associated with additional monetary and real shocks from the rest of the world. Unsurprisingly, the effects of exchange rate fluctuations, and the scope of Central Bank interventions in the foreign exchange market are subject to intense controversies.

It is often claimed that Inflation Targeting requires a fully flexible exchange rate, but some authors believe that there is a role for Central Bank intervention (see Ball, 1999, for a discussion). In practice, for a small open economy there is no really such a thing as a fully flexible exchange rate regime. To let the exchange rate to be determined entirely by market forces is a luxury around the world, especially in non-developed economies. Central Bank often intervene to avoid large fluctuations of the exchange rate, and despite being banned from the policy debate, capital controls have not totally disappeared yet.[5]

Then, how does Inflation Targeting works in an open economy? Is a less than fully flexible exchange rate regime incompatible with Inflation Targeting? Although in non-developed countries the exchange rate regimes are much more flexible than in the past, there is substantial evidence that the Central Banks intervened heavily to cushion large movements in the exchange rates.[6] There are good reasons to believe that this type of intervention is not implemented during episodes of appreciations and depreciations with the same intensity. As discussed by Calvo and Reinhart (2002), when the financial system is highly dollarized, the Central Bank may fear that currency depreciations will trigger bank failures.[7] This behavior is often called "fear of floating". On the other hand, when competitiveness of the tradable

[5]See for example the new data set on capital controls by Fernandez et. al. (2015). Also see Chang (2008) and Céspedes et. al. (2014), for an analysis that shows how in Latin-American countries using Inflation Targeting, the Central Banks intervened heavily to control exchange rate fluctuations.

[6]See for example Chang (2008) for the Latin-American case.

[7]It is also possible that Central Banks fear the effects of depreciations on inflation, although the exchange rate pass-through have recently declined by non-trivial amounts.

sector is an issue, or when the policy makers want to build a "war chest" of foreign exchange reserves, the Central Bank may intervene to prevent currency appreciations, a phenomena known as "fear of floating in reverse", and illustrated by the recent East-Asian experience (Levy-Yeyati and Sturzenegger, 2007).

Some observers of the Latin-American cases argued that Inflation Targeting have introduced a bias in evolution of the exchange rate because the Central Banks react strongly to control depreciations, but more timid to fight appreciations (Barbosa-Filho, 2015, and Ros, 2015.[8] Unlike East-Asian countries that used interventions in the foreign exchange market to prevent appreciations (Pontines and Rajan, 2001, and Pontines and Siregar, 2012), Latin-American countries seem to intervene mainly in the opposite direction.

Also according to the observers of the Latin-American experience (Barbosa-Filho and Ros), it seems to be the case that Inflation Targeting is responsible for a persistent appreciation of the real exchange rate. Whether this process was permanent or temporary is not fully spelled out, although these authors seem to suggest that the appreciation was long-lasting. I personally do not find the argument that the effects of Inflation Targeting on the real exchange rate are permanent very convincing, and in fact the most recent experience illustrates how that regime can also accommodate large real depreciations.

[8] "There is a fundamental asymmetry in the way macroeconomic policy deals with changes in the exchange rate in developing economies, especially in Latin America. Because appreciations are deflationary and depreciations are inflationary in the short run, any democratic government tends to tolerate appreciations but fight depreciations of their currencies. In fact, the adjusting period of the economy after a depreciation of its domestic currency may be longer than the mandate of elected officials, and this creates an asymmetric response of democratic governments to changes in the real exchange rate," (Barbosa-Filho, 2015). "To the extent that the Central Bank reacts only to changes in the inflation rate it becomes very tempting for the monetary authority to subordinate the exchange rate to its inflation objectives or to respond in an asymmetrical way to appreciations and depreciations. There is then as a consequence a 'fear to depreciate', more than a 'fear of floating'. This tends to make monetary policy pro-cyclical in the fact of external shocks. For example, in the face of a negative export demand shock, which tends to lower economic activity, the monetary authority tends to moderate the pressure towards depreciation through an increase in interest rates which aggravates the recession", (Ros, 2015).

However, even if Inflation Targeting does not have an effect on the long-run level of the real exchange rate, this does not mean that an asymmetric policy do no have important implications. The rate of devaluation can be bounded, and thus certain shocks may not a produce a convenient re-allocation of resources. Furthermore, the distribution of the possible levels for the real exchange rate may become bounded. Consider the following example. Imagine that the real exchange rate index has a mean of 1. Assume that the real exchange rate remains constant in the long-run, but it can increase to 1.5, and decrease to 0.5, due to shocks if the Central Banks refrains from intervening in the foreign exchange market. Certainly, the real exchange rate may not fall below 0.5, but the Central Bank may also want avoid increases above 1.2.

Thus, an asymmetric monetary or exchange rate policy may not have an effect on the level of the long-run real exchange rate, but it may affect it short-run behavior or other moments of its distribution, like the variance of the skewness, and it can constraint the limit the adaptation of sectorial production and consumption to different shocks. Moreover, even if the long-run real exchange rate does not change (it remains 1 as in our example), an asymmetric policy may imply that the real exchange is more appreciated on average during a given span of time. If the tradable sector holds debt, then the unfavorable shocks increase its financial fragility, while the favorable shocks are not enough to compensate for the bad times. Thus, the tradable sector is hurt, in the sense that a different monetary and exchange rate policy will provide a higher relative price of tradable goods "on average".

The presence of asymmetries on monetary policy rules have been tested. Authors such as Barros-Campello et. al. (2016) have estimated asymmetric monetary policy rules using GMM for the European case. They find that the European Central Bank monetary policy is more sensible to changes in the output-gap when output is below the trend than when output is above. The authors also argue that their findings are not consistent with other explanations, such as non-linearities in the Phillips curve. Surico (2003, 2007) obtains similar results, and Dolado et. al. (2005) also find that the European Central Bank conducts an asymmetric policy, but with respect to changes in inflation and not with respect to changes in output.

The leitmotiv of this paper is the potentially existence of this type bias, but in the Latin-American context, and with more emphasis on exchange rate behavior. The next sections will analyze the behavior of the exchange rate in the main Latin-American countries using Inflation Targeting during the last 15 years.[9] The main questions are the following: are authors such as Barbosa-Filho (2015) and Ros (2015) correct? Are monetary and exchange rate policies in Brazil and Mexico (or in general in Latin-American countries using Inflation Targeting) asymmetric?

To tackle the questions, I follow Pontines and Sireger (2012) approach and I estimate a Panel Smooth Transition Autoregressive Model with three regimes (and two transition thresholds), and a Markov Switching model. These two models will estimate the upper and the lower bound of an exchange rate band, and the transition probabilities for different "regimes" (appreciations and depreciations), respectively, for the rate of change of the exchange rate. This is a simple way to test whether monetary and exchange rate policy in Latin-American countries using Inflation Targeting was in fact asymmetric, and whether there is "fear of floating" or "fear of depreciation" (or neither of both). As far as I know, this paper is the first to apply the models used by Pontines and Sireger (2012) to analyze East Asian cases, to the Latin-American countries.

In my view, Pontines and Sireger (2012) do not correctly identify the origin of the observed exchange rate behavior, and because it is possible that the exchange rate moves more in one direction due to factors other than monetary and exchange rate policy. Hence, I extend

[9]The largest countries from the region have adopted Inflation Targeting, including Brazil (1999), Chile (1991), Colombia (1999), Mexico (2002) and Peru (2003).

their approach by also estimating a set of reaction function for the reference interest rate and reserve accumulation, to analyze the role of Central Bank policies in shaping the observed exchange rate dynamics.

3.3 Exchange rate trends and empirical approach

Before presenting the empirical strategy, it is interesting to take a look at the evolution of one variable of interest: the nominal exchange rate. In the recent Latin-American experience, the Central Bank intervention in the foreign exchange market was widespread, as shown for example by Chang (2008). Precisely because the Central Bank can intervene to moderate exchange rate fluctuations, it is interesting to capture the overall pressures on the exchange rate excluding the effect of the sales and purchases of foreign assets due to policy reasons. This requires to remove the effect of the intervention somehow.

A popular method is to also look at the evolution of foreign exchange reserves and the interest rate to create an index of exchange rate pressure. One example is the Exchange Market Pressure Index (EMP), as proposed by Kaminsky et. al. (1998) and Reinhart and Kaminsky (1999). The EMP is calculated as follows:

$$EMP_{i,t} = \frac{\Delta xr_{i,t}}{xr_{i,t}} - \frac{\sigma_e}{\sigma_r}\frac{\Delta reserves_{i,t}}{reserves_{i,t}} + \frac{\sigma_e}{\sigma_{Int}}\Delta rate_{i,t} \tag{3.1}$$

Where $EMP_{i,t}$ is the Exchange Market Pressure Index,[10] $xr_{i,t}$ is the exchange rate (units of domestic currency per dollar), $reserves_{i,t}$ are gross foreign reserves, $rate_{i,t}$ is the domestic short-term reference rate. The variables σ_{xr}, σ_r, and σ_{Int} are the standard deviations of the rate of devaluation $\frac{\Delta e_{i,t}}{e_{i,t}}$, the rate of growth of foreign reserves $\frac{\Delta reserves_{i,t}}{reserves_{i,t}}$, and the change in the domestic rate $\Delta rate_{i,t}$.

[10]The subscripts represent country i in period t. I use 24 month rolling averages for the standard deviations. The data frequency is monthly.

Because the Central Bank can deal with them in different ways (i.e., for instance buying or selling reserves, or changing the interest rate), just looking at the evolution of the nominal exchange rate is not enough. For example, it is perfectly possible to observe no change in the exchange rate, despite the fact that the Central Bank is increasing the interest rate very aggressively (or selling reserves) to combat pressures towards devaluation. The idea of the EMP index is to capture all the pressures on the exchange rate.

The graphs included in figures 3.1, 3.2, 3.3, 3.4, and 3.5 show the EMP index for Brazil, Chile, Colombia, Mexico, and Peru during the 15 years spanning the period 2000-2015. They also display the natural log of the exchange rate ("ln of xr"), so the slope of the line captures the rate of devaluation. The figures clearly show that Latin-American Inflation Targeteres experienced significant pressures towards appreciation, but also important pressures towards depreciation. There general trend was appreciation, and that was only reverted recently by abrupt depreciations, but it is also evident that other factors, such as reserve accumulation, played a role by reverting exchange rate pressures, both upwards and downwards. For example, consider the figure 3.3 during 2012-2015. Most of the time Colombia experienced pressures towards appreciation, but it is evident from the picture that the exchange rate did not appreciate a lot, at it never cross the lower bound of 7.5 (remember the variable is the natural log of exchange rate).

As shown by Ponties and Sireger (2012), in East Asian countries using, "fear of appreciation" was the rule. Under pressures towards nominal appreciation, the Central Banks intervened more heavily when the exchange rate appreciated than when the exchange rate depreciated. Does this result holds for Latin-American countries as well? Or did the Central Banks intervened mainly in the opposite direction, as argued by Barbosa-Filho and Ros?

In the next subsections I follow the approach of Pontines and Sireger, and I estimate a set of logistic smooth transition auto-regressive models (also known as LSTAR models) and a set of Markov-Switching models, to find out whether exchange rate behavior displayed any sings of asymmetry. Then I expand the results by asking whether Central Bank was responsible for the observed developments, using a set of GMM type reaction functions for monetary policy and reserve accumulation.

The sample (for the non-linear models) spans the period 1999-2015, for Brazil, Chile, Colombia, Mexico, and Peru, the larger Inflation-Targeting countries in Latin-America. But unlike Pontines and Siregar (2012), who use monthly and weekly data for nominal exchange rates, I use daily data instead.[11]

3.3.1 LSTAR-2 and Markov-Switching Models

A natural approach to test if Latin-American central banks intervention was biased in one particular direction is to follow the methodology proposed by Pontines and Siregar (2012). They implement a set of LSTAR and Markov-Switching model for the nominal exchange rate in East Asian Inflation Targeteres. As far as I know, mine is the first attempt to use the same non-linear econometric models for the Latin-American case. I am certainly not aware of any similar attempt.

The advantage of the procedure suggested by Pontines and Siregar (2012) is that it provides as an output a precise size for both the lower and upper bound for the rate of change of the nominal exchange rate. In other words, a de facto exchange rate band is estimated.

[11]The data comes from the national Central Banks. Lower frequency data is often the result of the estimation of an average (monthly or yearly), so the lower frequency presumably the better, as the figures are subject to less manipulation, and additional information (i.e., more observations) increase the precision of the estimation.

More precisely, Pontines and Siregar (2012) implemented a LSTAR model to test for the presence of asymmetric bands for intervention in East Asian countries.[12] The basic model has the following form:

$$\Delta ln(xr_t) = \alpha_0 + \sum_{i=1}^{p} \alpha_i[\Delta ln(xr_{t-i})] + \{\beta_0 + \sum_{i=1}^{p} \beta_i[\Delta ln(xr_{t-i})]\}F[(\Delta ln(xr_{t-d})] + \epsilon_t \quad (3.2)$$

The variable of the interest is the log of the nominal exchange rate $ln(xr_t)$. In the equation (3.2), α_0 is the intercept, α_i (with $i = 1, ..., p$), stands for the autoregressive parameters, β_0 is the nonlinear intercept term, β_i (with $i = 1, ..., p$) represents the nonlinear auto-regressive parameters, and F is the transition function which characterizes the smooth transition dynamics between two regimes. The function F depends on the lagged term of the first difference of the log of the nominal exchange rate, $\Delta ln(xr_{t-i})$, where d is the delay lag length. Finally ϵ_t is a white noise with zero mean and constant variance.

The F function may adopt different forms. A natural starting point is the two-regime LSTAR-1 model with the following general logistic transition function, which takes values in the interval between zero and one:

$$F = \frac{1}{1 + e^{-\{\gamma[ln(xr_{t-d}) - c)]\}}} \quad (3.3)$$

Where $\gamma > 0$ is the slope parameter (which measures the speed of transition between regimes), c is the threshold parameter (which indicates the location of the transition) and $ln(xr_{t-d})$ is the transition variable with the associated delay parameter d. As in Pontines and Siregar's paper, $ln(xr_{t-d})$ represents the lagged change in the natural of log of the exchange rate. Notice that if γ approaches zero the model is linear, while if γ approaches infinity the

[12]See Terasvirta and Anderson (1992) and van Dijk et. al. (2002), for a discussion of the more general family of smooth transition autoregressive models.

model becomes a two regime model. In the intermediate case, the transition between the two regimes is "smooth" (hence the name of the model). The farther away the system is outside the band, the strong the effect of the non-linear part of the model. And the larger is γ, the larger the difference between regimes.

It turns out that a variant of the LSTAR-1 model is well-suited to test whether the Central Banks exhibits aversion to appreciations or depreciations. In particular, one can resort to the LSTAR-2 model suggested in Terasvirta (1998):

$$F = \frac{1}{1 + e^{-\{\gamma[ln(xr_{t-d})-c_L][ln(xr_{t-d})-c_H]\}}} \tag{3.4}$$

The main difference is that LSTAR-2 includes two transition parameters c_L, and c_H, for the lower and upper threshold. These threshold parameters capture the switching points between regimes, and hence their absolute size measure the relative tolerance of monetary authorities to exchange rate variations, as they capture they rates of change of the exchange rate at witch there is a change in the exchange rate behavior. Using equation 3.4 I can estimate a de facto exchange rate band.

Pontines and Siregar (2012) find that $|c_L| < |c_H|$ so East Asian central banks have an aversion to appreciations. This means that for East Asian countries, the authorities tolerated larger depreciations than appreciations. For example, if the upper bound is 6% and the lower bound is -2%, this means that there is a regime switch when the exchange rate moves up by 6% or down by 2%, triggering a reaction by the central bank which tends to move the exchange rate in the opposite direction (or at least to keep it constant).

Notice that the way the model is specified does not constraint the level of the nominal exchange rate. The exchange rate may appreciate by more in countries where $|c_L| < |c_H|$ than in countries where $|c_L| > |c_H|$. For example the nominal exchange rate may appreciate by 1% on a more or less permanent basis on a country with $c_L = -2\%$ and $c_L = 2\%$, and it may depreciate by 0.5% on a more or less daily basis if $c_L = -3\%$ and $c_L = 1\%$.[13]

Pontines and Siregar supplement their finding using a Markov-Switching model, to test whether the exchange rates were more likely to remain in the "upper" regime (given that they were already there) than to remain in the "lower" regime (also given that they were already there). These regimes can represent depreciations and appreciations, respectively.[14] The Markov-Switching model has the following form:

$$\Delta ln(xr_t) = \alpha_0(s) + \sum_{i=1}^{p} \alpha_i(s)[\Delta ln(xr_{t-i})] + \epsilon_t(s) \tag{3.5}$$

It is assumed that the regime variable s follows an irreducible ergodic two-regime Markov process with the following transition matrix P:

$$P = \begin{vmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{vmatrix} \tag{3.6}$$

Where the terms p denote the transitions probabilities. Thus, p_{11} is the probability that the rate of change of the exchange rate remains in the regime 1, given that the exchange rate was in regime 1 in the previous period, while p_{12} is the that the rate of change of the exchange rate will move to the regime 2, given that it was in regime 1 in the previous period, and so on.

Although Pontines and Siregar argue that their models capture mainly the motivations of the Central Banks in East Asia, it is possible that the observed behavior of the exchange

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[13]Keep in mind that the data shows persistent trends in the nominal (and also the real) exchange rates. See the evolution of the (natural log of) the nominal exchange rates in figures 3.1, 3.2, 3.3, 3.4, and 3.5.

[14]But that may not be the case. It is possible that the upper regime represents "depreciation" and the lower regime "less depreciation". However, most of the time in the five Latin-American cases the results from the Markov-Switching model suggest a mean rate of change that does not fit this problematic scheme.

rate is due to something else. Nevertheless, the estimations of the de facto bands and the average duration of each regime provide important information regarding the nature of the pressures that each Central Bank face. On the section 3.3.3 I deal with the problem.

3.3.2 Empirical Results

Now I am ready to implement the LSTAR-2 and the Markov Switching models discussed previously. The first step is to select the lag length for the models. I inspect the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC), although I choose the model with the lowest AIC value. As argued by Teravista (1998), using the BIC (which penalizes large models) often results in residuals with poor properties (i.e., serial correlation may remain in the residuals) and on the incorrect acceptance of the non-linear model (if a non-linearity test is implemented), among other problems. The AIC suggest that large auto-regressive models, between 7 and 19 lags, are preferred. More precisely, the criteria suggest to adopt an AR(16) for Brazil, an AR(7) for Chile, an AR(15) for Colombia, an AR(17) for Mexico, and an AR(19) for Peru. They may seem too large, but a large model is better than a bad model.

To determine the correct model from the STAR family, a non-linearity test could be implemented.[15] Alternatively, and following the literature, a particular model is implemented and later validated by the data (see Teravista 1998). I follow this approach here, and I adopt

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[15]Testing non-linearity requires taking a second order approximation around $\gamma = 0$ (that is, assuming a linear model) to estimate the following equation:

$$\Delta ln(xr_t) = \alpha_0^* + \sum_{i=1}^{p} \alpha_i^* [\Delta ln(xr_{t-i})] + \sum_{i=1}^{X} \sum_{i=1}^{p} \beta_i^* [\Delta ln(xr_{t-i}) \Delta ln(xr_{t-d})^X] + \epsilon_t \quad (3.7)$$

Where $X = 2, 3, 4$. In a nutshell, I should estimate an auto-regressive model of order p, with interaction terms that multiply each lag by the lag d (the lag decay length), by d^2, d^3, and d^4. Linearity requires to accept the null that all the interaction terms are statistically not different from zero. An LSTAR model is chosen if we can reject the null that the terms multiplied by d^3, and d^4 are not statistically significant, and that d and d^2 are statistically significant. Finally, if I jointly reject the null that all the interaction terms are significantly different from zero, I should specify an LSTAR-2.

a three regime logistic model (an LSTAR-2) because it fits my needs better, by allowing me to estimate a system of de facto exchange rate bands.[16] To chose the lag-decay length, I pick the one that fits the data better. Thus, I choose different values for d, from 1 to 12, I estimate the full set of models, and I pick the model with the largest F value.

Table 3.2 shows a summary of the result of the estimation of the LSTAR-2 models. I skip most of the autoregressive coefficients, but they are available on the tables 3.4 and 3.5. All the residuals pass the Portmanteau test for white noise (using 4, 8, and 12 lags) except for Mexico. For that country the residuals do not pass the heteroscedasticity test, but the estimations use robust standard errors to correct this. Table 3.2 also presents the ratio of variance of the residuals of the LSTAR-2 models to the variance of the residuals of the linear models. In all cases the residual variances are lower for the non-linear model, suggesting that using the non-linear model is a good idea.

We can verify that for most countries, the upper threshold is larger in absolute value than the lower threshold, except for the case of Peru. However, for Chile and Colombia the difference is very small, while for Brazil and Mexico the difference is large. While for the case of Brazil the upper threshold is 1.75%, for the lower threshold the number is -3.81% (see the column "Brazil"), and for the Mexican case the figures are 1.84% and -2.27%, respectively (see the column "Mexico"). Notice that these are daily rates of changes, so even the smaller numbers are very important figures.[17]

As a general rule, all the thresholds are statistically significant, except for the upper threshold in the estimation for Mexico. In the worst case scenario, this suggest that Mexican rate of change of the exchange rate is not clearly bounded from below. It is interesting to

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[16]Results from the non-linearity test suggest that the LSTAR-2 model should be preferred for Brazil, Chile and Colombia, but not necessarily for Mexico and Peru (see table 3.1).

[17]For example, a 1% daily rate of devaluation, considering 250 trading days a year (just to pick a reasonable number) implies an annual rate of increase of the exchange rate of about $1,200\%$!

notice that the speed of adjustment are very large for Chile and Colombia, suggesting an abrupt transition from the regimes outside the bands to the regime inside them. In the case of Brazil, Mexico, and Peru, the transition is much more smooth (see the rows "Speed of Adjustment"). Thus, the exchange rate seems to revert to the central part of the band faster in Chile and Colombia than in Brazil, Mexico, and Peru.

Table 3.3 shows a summary of result from the estimation of the Markov-Switching models. The full list of coefficient is reported on tables 3.6 and 3.7. Once again, except for the case Mexico, all the residuals pass the Portmanteau test for white noise (using 4, 8, and 12 lags), although they are heteroscedastic. But once again, the inclusion of robust standard errors come to the rescue.

Our main interest lies in the transition probabilities. The rows "Transition PB" on the table 3.3 displays the probabilities that there is a change in the regime. Both the lower and the upper regime are very persistent, but as a general rule, the lower regime is much more persistent, perhaps with the sole exception of Peru.

It is easier to understand what is going on if we take a look at the number of periods (in our case, days) that are associated with each transition probability. These figures are displayed in the rows "Expected Duration" (also from table 3.3). Notice that Brazil, Chile and Mexico display appreciations that last for very long periods of time (37, 33, and 64 days). Comparing this number with the duration of depreciations, we can verify that appreciation last more than three times more than depreciations (for Brazil and Chile), and more than six times for Mexico. For Colombia, while appreciation last longer than depreciations, the number is lower (22 days vs. 10 days). For Peru, appreciations last only 8-9 days, versus 6 days for depreciations. It is also worth to notice that for all the countries, for the upper regime, the variance of the rate of change of the exchange rate is about 3-4 times larger than for the lower regime, suggesting that appreciations represent a less turbulent scenario than depreciations.

To summarize, combining the results from the LSTAR-2 and the Markov Switching models, I find evidence that that exchange rate behaves asymmetrically mainly in Brazil and Mexico. For these cases, the lower threshold is larger in absolute value than the upper threshold. Moreover, the transition between regimes seems to be smoother than in Chile and Colombia (but not than in Peru). Notice this suggest that Brazil and Mexico are different than the other three countries, as suggested by the literature. As a general rule, appreciations seem to last longer than depreciation, and they are also less volatile. For Brazil, Chile, and Mexico, appreciations last at least three times as much as depreciation (but keep in mind that in Chile the exchange rate band looks symmetric and that transition between regimes seems to be less smooth).

3.3.3 GMM Reaction Functions

The previous sub-section shows that there is some evidence of asymmetric behavior of the exchange rate, at least for Brazil and Mexico, and that appreciations last longer than depreciations, perhaps with the exception of Peru where they last more or less the same. Are monetary or exchange rate policies to be blamed? Or to put the question differently: did the Central Banks deliberately behave in way such that the observed behavior of the exchange rate should be attributed to interest rate targeting or foreign exchange reserves accumulation? Although an answer that accounts for all the observed changes in exchange rates is beyond the scope of the present study, I can analyze if interest rate targeting and reserve accumulation show some sensitivity with respect to exchange rate changes. This is a simply way to test whether market forces or policies account for the findings of section 3.3.2.

This section estimates a set of reaction functions for Latin-American countries using Inflation Targeting, considering changes in the target interest rate and on the stock of gross foreign exchange reserves.[18]

I estimate a set of reaction functions using GMM because of the potential correlation between the error term and the independent variables. Instrument variables for GMM are selected from the observable information sets for the Central Bank. The instruments are the lags, from 2 to 12, of all the dependent variables, plus the natural log of the Federal Funds interest rate. The Newey-West heteroscedasticity and autocorrelation consistent (HAC) covariance matrix is used to eliminate the serial correlation in the error term. More precisely, I estimate the following two equations:

$$\Delta ln(rate_t) = \beta_0 + \beta_1 \Delta\pi_{t-1} + \beta_2(Y_{t-1} - \bar{Y}_{t-1}) + \beta_3 \Delta ln(xr_{t-1}) + u_t \tag{3.8}$$

$$\Delta ln(reserves_t) = \beta_0 + \beta_1 \Delta\pi_{t-1} + \beta_2(Y_{t-1} - \bar{Y}_{t-1}) + \beta_3 \Delta ln(xr_{t-1}) + u_t \tag{3.9}$$

Where $\Delta\pi_{t-1}$ is the increase in the rate of inflation, $(Y_{t-1} - \bar{Y}_{t-1})$ is the output gap, and $\Delta ln(xr_{t-1})$ is the rate of devaluation.[19] The u_t is the error term. All the variables are lagged one period.[20] Equations 3.8 and 3.9 are the kind of Taylor rules (augmented by the inclusion of the exchange rate changes) that the Central Bank supposedly follow under Inflation Targeting. Because they differ from usual Taylor-Rules, they deserve some comments. The

[18]Due to data limitations, the samples do not always coincide, and I use monthly data. Our sample includes, Brazil (April of 2000-July of 2015), Chile (January of 1999-January of 2014), Colombia (January of 1999-October of 2005), Mexico (February of 2009-July of 2015), and Peru (October of 2004-May of 2014).

[19]The output gap is defined as the deviation of monthly output from the HP trend, the inflation-gap is the difference between the annualized rate of CPI inflation and the target, and the reserves are the gross reserves. The interest rates are the central bank short-term interest rate (that explain why the sample is usually shorter for Mexico and Peru, which did not target an interest rate until 2002/2003). All the “rates” are defined as percentage points. Thus, a 5% inflation rate is 5, not 0,05. A 1% interest rate is not 0,01 (nor 1,01), but 1.

[20]The results hold if I use contemporaneous values and I add the first lag to the set of instruments.

inclusion of the change of interest rates as the dependent variable seems reasonable because the lagged interest rate is highly significant and close to one, and the result will not be affected due to this choice. It is possible to estimate a similar equation with the level of the (log) of the interest rate and the lagged (log) of the interest rate on the right hand side, but I also decide not to estimate such equation because doing so makes the comparison between equations (3.8) and (3.9) less appealing and it hardly affects the results.

Notice that the inclusion of the change in the rate of inflation, rather than deviations from the target, may seem strange. Because the definition of "deviation from the target" is not clear, I resort to this simple procedure.[21] The Appendix B presents results using the month-by-month deviation from the target (using the mean of the target). These additional estimation show that the gist of the results will not change by the inclusion of alternative definitions of the inflation-gap.

Finally, it may worth to consider that policy makers may react to changes in exchange rates by imposing capital controls, so our equations (3.8) and (3.9) may not capture the entire story. Implementing a similar equation with a measure of capital controls (or capital account openness) as the dependent variable is not plausible due to data limitations (most data set have yearly frequency), and the account of the most recent experience of Latin-American Inflation Targeting countries suggest that capital controls were not the main tool (see Chang, 2008). The five countries analyzed in this paper never departed from the "rules of the game" (keep the capital account relatively open, intervene occasionally in the foreign exchange market, and so on), with exceptions. In particular Brazil during the period 2002-2003 resorted to drastic measures, such as increasing the upper bound for the Infla-

[21]For example, should I use the deviation of the annualized rate of inflation from the annual target, the deviation of the accumulated inflation in the year from a target, or the deviation of the monthly inflation from a monthly target? For the target inflation, and considering that most Central Banks use a band for the target rather than a single number, should I consider the mean, the upper bound, or the lower bound?

tion Targeting when facing large exchange rate depreciation that triggered an acceleration of inflation. Even before and during the Presidency of the "left-wing" Lula da Silva capital controls were softened.[22] Thus, capital account regulation was not the main tool used to combat exchange rate pressures, and the experience suggest a long-run trend towards deregulation (at least until 2009-2010), but very little day-to-day adjustments.

The first set of results analyze the data as if monetary and exchange rate policies were symmetric. Tables 3.8 and 3.9 show the results for interest rates and reserves under the assumption of symmetry. Notice that all the model pass the Hansen's misspecification test.[23] The main interest lies in the coefficient associated with the rate of devaluation, β_3. Notice that they are only significant for the reserve accumulation equations, except for the case of Chile, where β_3 is not significantly different from zero in both cases. Moreover, the signs are negative, suggesting that when the exchange rate depreciates, reserves fall, while when the exchange rate appreciates, reserves increase.

To check for the presence of asymmetries more explicitly, I re-estimate the reaction function introducing a different variable for appreciations and depreciations. Now I estimate:

$$\Delta ln(rate_t) = \beta_0 + \beta_1 \Delta\pi_{t-1} + \beta_2(Y_{t-1} - \bar{Y}_{t-1}) + \beta_3 APP_{t-1} + \beta_4 DEP_{t-1} + u_t \tag{3.10}$$

$$\Delta ln(reserves_t) = \beta_0 + \beta_1 \Delta\pi_{t-1} + \beta_2(Y_{t-1} - \bar{Y}_{t-1}) + \beta_3 APP_{t-1} + \beta_4 DEP_{t-1} + u_t \tag{3.11}$$

The most interesting variables are APP_{t-1} and DEP_{t-1}. They represent variables that are equal to one when the exchange rate appreciates and zero otherwise, and equal to one when the exchange rate depreciates and zero otherwise, respectively (notice they are not dummy

[22]The presidential campaign of Lula was precisely the source of uncertainty that triggered capital outflows during the period 2002-2003.

[23]That means that I cannot reject the null that the models are correctly specified.

variables). The rest of the variables are defined as before. If monetary or exchange rate policy are asymmetric, then I should find that $\beta_3 = 0$ and $\beta_4 < 0$, or at least that $|\beta_3| < |\beta_4|$.

The tables 3.10 and 3.11 contain the results. Once again, all the models pass the Hansen's misspecification test. Consider the interest rate reaction function. We can see in table 3.10 that except for Brazil and Mexico, exchange rate movements are not significant. For Mexico, the coefficients are significant, but the signs are wrong (appreciations trigger an increase in the interest rate, while depreciations trigger a decrease), and for Brazil only depreciations affect interest rates. This suggest that interest rates do not usually react to exchange rate changes. This is not surprising at all: the interest rates used to conduct monetary policy are hardly changed as a much as the exchange rate, and one should not expect a Central Bank that targets inflation to worry about all exchange rate changes.

Consider now the behavior of reserves in table 3.11. We can find a very different picture here. The constant term is highly significant and positive, consistent with the large accumulation of foreign exchange reserves. More important for my purposes, we can also see that depreciations seems to reduce reserve accumulation, and the results are significant except for Chile. In other words, when the exchange rate goes up, the Central Bank losses reserves. This is interesting because it suggest that the symmetric exchange rate band observed in section 3.3.2 is not necessarily related to Central Bank policies (including both reserve accumulation and interest rate management) in all the countries. At least Chile seems to be an exceptional case.[24]

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[24]Perhaps the large Economic and Stabilization Fund is responsible for the observed exchange rate behavior. But according to the official statement the Fund has no explicit role in the foreign exchange market: "The Economic and Social Stabilization Fund (ESSF) was established on March 6th, 2007 with an initial contribution of US$ 2.58 billion, much of which (US$ 2.56 billion) was derived from the old Copper Stabilization Fund, which was replaced by the ESSF. The Economic and Social Stabilization Fund allows financing of fiscal deficits and amortization of public debt. Thus, the ESSF provides fiscal spending stabilization since it reduces its dependency on global business cycles and revenue's volatility derived from fluctuations of copper price and other sources. For example, budget reductions originated from economic downturns can be financed in part with resources from the ESSF, reducing the need for issuing debt. According to the

The Central Bank of Peru (a highly dollarized economy) seems to be the most averse country, closely followed by Brazil. Only in Mexico appreciations are significant, but the size of the effect is small. This suggest that reserve accumulation was significantly affected by currency depreciations, but not by appreciations.

To summarize, the estimation of reaction functions suggest that intervention in the foreign exchange market, except for a constant trend of reserve accumulation, was focused mainly on preventing depreciations. This behavior seems to explain the asymmetric behavior of the exchange rate, in particular for Brazil and Mexico. Interestingly, the Chilean Central Bank does not seem to care about the nature of the exchange rate fluctuations. This is consistent with the informal observation that Chile has the most flexible regime in the region. Although the estimations bounds the change of the exchange rate between -0.3 % and 0.3 %, suggesting the presence of a symmetric band, I could not find evidence that Central Bank policies are responsible for the observed evolution of the exchange rate: neither depreciations nor appreciations seems to trigger a change in the policy interest rate or reserves.

3.4 Conclusions

This paper analyzed the potential presence of asymmetries in the behavior of the exchange rate, for a group of Latin-American countries that adopted Inflation Targeting. Using daily data for the period 1999-2015, I implement a set of LSTAR-2 models to estimate the threshold for the changes in the exchange rate, and I find evidence that the lower threshold is larger in absolute value than the upper threshold, at least for Brazil and Mexico, and that transition between regimes is smoother in these countries and in Peru than in Chile and Colombia.

Fiscal Responsibility Law, the ESSF receives each year the positive balance resulting from the difference between the effective fiscal surplus and the contributions to the Pension Reserve Fund and to the Central Bank of Chile, discounting the payment of public debt and advances made the year before." (source http://www.hacienda.cl/english/sovereign-wealth-funds/economic-and-social-stabilization-fund.html)

I then proceed to implement a set of Markov-Switching models that highlights that appreciation usually last longer than depreciation, and they are less volatile. Moreover, Brazil, Chile, and Mexico show very long lasting appreciations (more than 30 trading days, about a month and half).

I extended the results to analyze the role of policy. Using a set of GMM equations, I estimate reaction functions for interest rates and reserve accumulation (using monthly data). I find that the observed asymmetric behavior of the exchange rate can be attributed (at least partially) to reserve accumulation, but not to interest rate policies. Interestingly, this result does not hold for Chile, consistent with the informal observation that this is the only country in Latin-America that is willing to tolerate larger fluctuations in the exchange rate in any direction.

The evidence that I was able to gather suggest that there is "fear of floating" in Latin-American countries using Inflation Targeting, with the exception of Chile, and that this behavior seems to be more pronounced for Brazil and Mexico. More precisely, in these two countries appreciations last longer than depreciations, the exchange rate band has a larger lower threshold, the transition between regimes is very smooth, and the Central Banks intervene mainly via sales of foreign exchange reserves when the exchange rate depreciates. This evidence is consistent with Barbosa-Filho (2015) and Ros (2015), and it contrast with the work of Pontines and Siregar (2012), who find that East Asian countries using Inflation Targeting display "fear of floating in reverse" or "fear of appreciation".[25]

[25] I am not aware of other author that have claimed a similar thing for the other three countries of my sample.

Table 3.1: Lagrange Multiplier "LM" Non-Linearity Tests

	Brazil	Chile	Colombia	Mexico	Peru
Lag Decay Length	3	11	7	4	1
			Linear Model Nested in LSTAR		
LM	376.6835***	-1307.7203	93.2464***	110.0916***	-463.2886
			Linear Model Nested in LSTAR-2		
LM	578.9817***	-920.5965	144.6916***	214.9019***	-316.8815
			LSTAR model Nested in LSTAR-2		
LM	221.0704***	298.9841***	52.5499 ***	107.4777***	132.5625***

*** p<0.01, ** p<0.05, * p<0.1

Table 3.2: LSTAR-2 Model

	Brazil	Chile	Colombia	Mexico	Peru
Lower Threshold	-3.8055***	-0.3110***	-0.3459***	-2.2718***	-1.1031***
	(0.0537)	(1.8850)	(0.0021)	(0.0026)	(0.0842)
Upper Threshold	1.7507***	0.3008***	0.2055***	1.8378	1.4677***
	(0.0873)	(0.0026)	(0.0017)	(.)	(0.0986)
Speed of Adjustment	4.3972	7577.5060	9327.3200	86.6119	12.9158**
	(7.0863)	(80147.43)	(59160.59)	(.)	(6.0913)
Linear σ^2	0.4137	0.1802	0.1727	0.1364	0.0453
Non-Linear σ^2	0.3457	0.1780	0.1697	0.1525	0.0421
Ratio	0.8354	0.9878	0.9827	0.8947	0.9299
Observations	4436	4436	4436	4436	4436
R-Squared	0.467	0.2187	0.2839	0.3837	0.1932

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Markov-Switching Model

	Brazil	Chile	Colombia	Mexico	Peru
			Lower Regime		
Transition Pb	0.9733	0.9696	0.9552	0.9846	0.8832
	(0.0048)	(0.0065)	(0.0073)	(0.0047)	(0.0146)
Expected Duration	37.4223	32.9040	22.3039	64.9711	8.5613
	(6.7705)	(7.0379)	(3.6313)	(19.9761)	(1.0669)
Variance	0.3557	0.2575	0.2091	0.2545	0.0725
			Upper Regime		
Transition Pb	0.8983	0.9057	0.8964	0.9148	0.8431
	(0.0222)	(0.0264)	(0.0167)	(0.0219)	(0.0235)
Expected Duration	9.8320	10.6001	9.6509	11.7398	6.3725
	(2.1457)	(2.9759)	(1.5544)	(3.0161)	(0.9558)
Variance	1.2112	0.7201	0.6836	0.7099	0.3128

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: LSTAR-2 Model Linear Part (Full List of Coefficients)

	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.0138	0.0102	-0.0035	0.0081	0.0010
	(0.0086)	(0.0081)	(0.0072)	(0.0051)	(0.0031)
L1	0.6507***	0.4782***	0.6060***	0.7162***	0.4320***
	(0.0221)	(0.0211)	(0.0487)	(0.0333)	(0.0269)
L2	-0.3646***	-0.1516***	-0.2983***	-0.4088***	-0.2435***
	(0.0406)	(0.0230)	(0.0543)	(0.0578)	(0.0226)
L3	0.2304***	0.1232***	0.1302**	0.2344***	0.1416***
	(0.0356)	(0.0234)	(0.0517)	(0.0369)	(0.0206)
L4	-0.1512***	-0.0001	-0.0573	0.2310***	-0.0448**
	(0.0346)	(0.0239)	(0.046)	(0.0442)	(0.0193)
L5	0.0739**	0.0080	-0.0023	-0.0345	0.0745***
	(0.0340)	(0.0243)	(0.0391)	(0.0441)	(0.0198)
L6	-0.0357	-0.0211	0.0098	0.0466	-0.0401**
	(0.0339)	(0.0233)	(0.0294)	(0.0443)	(0.0196)
L7	0.0082	0.0414**	-0.0230	-0.0112	0.0266
	(0.0312)	(0.0211)	(0.0577)	(0.0273)	(0.0233)
L8	0.0244		0.0572*	0.0568*	-0.0247
	(0.0300)		(0.0327)	(0.0323)	(0.0298)
L9	-0.0095		-0.0088	-0.0711**	0.0071
	(0.0289)		(0.0336)	(0.0307)	(0.0222)
L10	0.0630*		0.0258	0.0609**	-0.0285
	(0.0353)		(0.0317)	(0.0281)	(0.0231)
L11	-0.0605*		-0.0170	-0.070	0.0283
	(0.0295)		(0.0265)	(0.064)	(0.0216)
L12	0.0722		0.0081	0.237**	0.0111
	(0.0281)		(0.0313)	(0.109)	(0.0181)
L13	0.0026		0.0083	-0.0205	-0.0113
	(0.0239)		(0.0267)	(0.0191)	(0.0180)
L14	0.0073		-0.0021	-0.3260	-0.0050
	(0.0247)		(0.0244)	(.)	(0.0187)
L15	-0.0110		-0.0098	-0.0341*	0.0278
	(0.0292)		(0.0218)	(0.0199)	(0.0185)
L16	0.0489*			0.0406*	-0.0282
	(0.0227)			(0.0204)	(0.0197)
L17				-0.0516***	0.0155
				(0.0190)	(0.0188)
L18					0.0210
					(0.0168)
L19					0.0457***
					(0.0167)
Observations	4436	4436	4436	4436	4436
R-Squared	0.3364	0.2187	0.2839	0.3837	0.1932

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: LSTAR-2 Model Non-Linear Part (Full List of Coefficients)

	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.4875	-0.0104	0.0289**	-7.6688***	-1.5227
	(0.3767)	(0.0130)	(0.0134)	(0.0051)	(4.5099)
L1	0.0315	0.0593*	-0.0105	1.3603***	-24.1173***
	(0.1204)	(0.0300)	(0.0667)	(0.0333)	(7.2930)
L2	0.0735	-0.1954***	0.0614	0.3593***	-24.6934**
	(0.1521)	(0.0338)	(0.0782)	(0.0578)	(11.6151)
L3	-0.1411	0.0390	0.0175	1.4989***	34.6984**
	(0.1798)	(0.0345)	(0.0708)	(0.0369)	(17.7269)
L4	0.4407**	-0.1176***	-0.0065	35.2727	64.3030***
	(0.1837)	(0.0346)	(0.0582)	(.)	(12.8336)
L5	-0.4209**	0.0647*	0.0643	-0.1131***	-118.7485
	(0.1640)	(0.0344)	(0.0513)	(0.0441)	(114.5918)
L6	0.3677**	-0.0464	-0.0668	1.8344***	230.3089***
	(0.1759)	(0.0337)	(0.0442)	(0.0443)	(72.6696)
L7	0.2302	-0.0221	0.0577	-2.7652***	292.2510**
	(0.2400)	(0.0299)	(0.0640)	(0.0273)	(132.5638)
L8	-0.3729*		-0.1102**	4.3374***	-213.6767**
	(0.2138)		(0.0442)	(0.0323)	(101.1127)
L9	0.2776		0.0275	1.4860***	82.4195***
	(0.2710)		(0.0442)	(0.0307)	(30.0557)
L10	-0.1285		-0.0354	1.9861***	327.6850***
	(0.2183)		(0.0440)	(0.0281)	(23.8769)
L11	-0.1410		0.1161***	-0.8618***	-342.5000
	(0.2094)		(0.0441)	(0.0238)	(.)
L12	0.0047		0.0775*	-0.8647***	-94.8187***
	(0.2770)		(0.0449)	(0.0225)	(33.5089)
L13	-0.1530		0.0229	-0.1036***	-22.3516
	(0.1488)		(0.0431)	(0.0191)	(15.7596)
L14	-0.3481*		0.0289	-38.3190***	-175.8334***
	(0.2018)		(0.0422)	(0.0527)	(19.3134)
L15	0.3320		0.0554	2.9429***	57.7587***
	(0.2402)		(0.0384)	(0.0199)	(19.8360)
L16	0.1184			-0.1400***	295.1587***
	(0.2223)			(0.0204)	(97.2449)
L17				-2.6107***	226.1584***
				(0.0190)	(38.7235)
L18					314.4840***
					(39.2204)
L19					-327.6949***
					(57.8781)
Observations	4436	4436	4436	4436	4436
R-Squared	0.3364	0.2187	0.2839	0.3837	0.1932

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Markov-Switching Model Lower Regime (Full List of Coefficients)

	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.0082	-0.0024	0.0005	-0.0089*	-0.0028
	(0.0072)	(0.0049)	(0.0043)	(0.0050)	(0.0021)
L1	0.7090***	0.6747***	0.6328***	0.6733***	0.4438***
	(0.0228)	(0.0222)	(0.0238)	(0.0227)	(0.0339)
L2	-0.4306***	-0.3755***	-0.3356***	-0.4201***	-0.3173***
	(0.0268)	(0.0241)	(0.0264)	(0.0231)	(0.0168)
L3	0.2351***	0.2302***	0.2174**	0.2404	0.1584***
	(0.0254)	(0.0236)	(0.0263)	(0.0262)	(0.0191)
L4	-0.1555***	-0.1351**	-0.0903	-0.1640***	-0.1033***
	(0.0240)	(0.0240)	(0.0249)	(0.0267)	(0.0136)
L5	0.0896**	0.0755***	0.0786***	0.0993	0.0590***
	(0.0233)	(0.0220)	(0.0232)	(0.0261)	(0.0168)
L6	-0.0248	-0.0359	-0.0352*	-0.0877	-0.0416**
	(0.0262)	(0.0232)	(0.0206)	(0.0228)	(0.0168)
L7	0.1023	0.0062	0.0378	0.0452	0.0495***
	(0.052)	(0.0216)	(0.0208)	(0.0224)	(0.0158)
L8	0.0146		-0.0306	-0.0208	-0.0158
	(0.0264)		(0.0198)	(0.0217)	(0.0153)
L9	-0.0108		0.0342*	-0.0089	0.0232
	(0.0225)		(0.0195)	(0.0226)	(0.0149)
L10	0.0371*		0.0283	0.0057	-0.0420*
	(0.0218)		(0.0177)	(0.0233)	(0.0192)
L11	-0.0475*		0.0261	-0.064	0.0260
	(0.0228)		(0.0188)	(0.050)	(0.0197)
L12	-0.0529*		0.0111	0.017	-0.0124
	(0.0252)		(0.0201)	(0.024)	(0.0155)
L13	-0.0235		0.0217	-0.076*	0.0311*
	(0.0242)		(0.0169)	(0.046)	(0.0160)
L14	0.0547**		0.0116	0.074	0.0166
	(0.0216)		(0.0196)	(0.048)	(0.0157)
L15	-0.0406*		0.0138	-0.068	-0.0294
	(0.0240)		(0.0174)	(0.050)	(0.0202)
L16	0.0310			0.091	0.0235
	(0.0208)			(0.0223)	(0.0187)
L17				-0.0070	-0.0057
				(0.0189)	(0.0141)
L18					0.0127
					0.0152
L19					0.0077
					(0.0136)
Variance	0.3557	0.2575	0.2091	0.2545	0.0725
Observations	4436	4436	4436	4436	4436

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Markov-Switching Model Upper Regime (Full List of Coefficients)

	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.1053**	0.0336	0.0316	0.1124***	0.0060
	(0.0464)	(0.0245)	(0.0199)	(0.0407)	(0.0075)
L1	0.604***	0.4230***	0.5862***	0.6503 ***	0.3427***
	(0.0388)	(0.0471)	(0.0446)	(0.1028)	(0.0539)
L2	-0.3051***	-0.1814***	-0.2396***	-0.4112***	-0.1854***
	(0.0645)	(0.0427)	(0.0562)	(0.1246)	(0.0388)
L3	0.1511*	0.1099**	0.1026*	0.2200*	0.1203***
	(0.0727)	(0.0436)	(0.0519)	(0.1164)	(0.0325)
L4	-0.0034**	0.0178	-0.0484	-0.0898	-0.0010
	(0.0699)	(0.0484)	(0.0417)	(0.1033)	(0.0326)
L5	-0.1013	0.0320	0.0093	-0.1465	0.0800**
	(0.0935)	(0.0374)	(0.0375)	(0.1012)	(0.0319)
L6	0.0511	-0.0692	-0.0181	0.1820*	-0.0437
	(0.0784)	(0.0446)	(0.0366)	(0.0983)	(0.0322)
L7	0.0031	0.0562	-0.0137	-0.1418*	0.0099
	(0.0886)	(0.0631)	(0.0357)	(0.0751)	(0.0370)
L8	-0.0253		0.0050	0.1269	-0.0547
	(0.0700)		(0.0378)	(0.0883)	(0.0467)
L9	0.0325		-0.0097	-0.0424	0.0248
	(0.0823)		(0.0389)	(0.0956)	(0.0406)
L10	0.0320		-0.0147	-0.0302	-0.0365
	(0.0858)		(0.0407)	(0.0960)	(0.0383)
L11	-0.0453		0.0685	-0.005	0.0330
	(0.0714)		(0.0447)	(0.249)	(0.0374)
L12	0.0402		-0.0699	-0.098	0.0167
	(0.0931)		(0.0449)	(0.151)	(0.0320)
L13	0.0261		0.0188	0.227	-0.0303
	(0.0638)		(0.0435)	(0.166)	(0.0310)
L14	-0.1086		0.0176	-0.167	-0.0194
	(0.0892)		(0.0415)	(0.124)	(0.0311)
L15	0.0503		0.0263	-0.111	0.0744**
	(0.0720)		(0.0383)	(0.230)	(0.0295)
L16	0.0602			0.1354***	-0.0492
	(0.0428)			(0.0516)	(0.0320)
L17				-0.1575***	0.0211
				(0.0485)	(0.0332)
L18					0.0220
					(0.0302)
L19					0.0575*
					(0.0308)
Variance	1.2112	0.7201	0.6836	0.7099	0.3128
Observations	4436	4436	4436	4436	4436

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.8: GMM Estimation of Interest Rate Reaction Functions

Δ ln(Rate)	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.0002	-0.0065**	-0.0083***	-0.0033*	0.0086***
	(0.0029)	(0.0029)	(0.0015)	(0.0017)	(0.0023)
Δ Inflation (t-1)	0.2950***	0.1344***	0.1779***	-0.0017	0.0833***
	(0.0057)	(0.0400)	(0.0359)	(0.0055)	(0.0230)
Outputgap (t-1)	-0.0003	0.0008	0.0008**	0.0011*	0.0022**
	(0.0008)	(0.0009)	(0.0003)	(0.0006)	(0.0007)
Δln(XR) (t-1)	0.2199**	0.3888**	0.0166	0.0221	-0.0521
	(0.0897)	(0.1502)	(0.0580)	(0.0156)	(0.2546)
Observations	183	147	82	78	103
Hansen's J χ p-value	0.5273	0.2812	0.6157	0.9986	0.8821

Instruments: Lags 2/12 of Output-gap, ΔInflation,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table 3.9: GMM Estimation of Reserve Accumulation Reaction Functions

Δ ln(Reserves)	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.0110***	0.0031	0.0079***	0.0110***	0.0107***
	(0.0025)	(0.0021)	(0.0011)	(0.0011)	(0.0013)
Δ Inflation (t-1)	-0.0657*	-0.0037	0.0222	-0.0138	-0.0154***
	(0.0331)	(0.0069)	(0.0188)	(0.0106)	(0.0062)
Outputgap (t-1)	0.0011*	0.0018***	0.0006***	0.0014***	0.0006*
	(0.0006)	(0.0005)	(0.0001)	(0.0003)	(0.0003)
Δln(XR) (t-1)	-0.2307***	0.0222	-0.2303***	-0.0842**	-0.2428**
	(0.0580)	(0.0934)	(0.0420)	(0.0357)	(0.1194)
Observations	179	147	82	74	103
Hansen's J χ p-value	0.3998	0.5052	0.7820	0.1700	0.6098

Instruments: Lags 2/12 of Output-gap, ΔInflation,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table 3.10: GMM Estimation of Interest Rate Reaction Functions

Δ ln(Rate)	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.0013	-0.0065	-0.0116***	-0.0017*	0.0125**
	(0.0043)	(0.0060)	(0.0033)	(0.0010)	(0.0042)
Δ Inflation (t-1)	0.2949***	0.1344***	0.1806***	-0.0109	0.0788***
	(0.0403)	(0.0422)	(0.0391)	(0.0092)	(0.0227)
Outputgap (t-1)	-0.0002	0.0008	0.0008**	0.0019***	0.0024***
	(0.0008)	(0.0010)	(0.003)	(0.0007)	(0.0007)
Appreciation (t-1)	0.1774	0.3865	-0.2248	0.2531**	0.4560
	(0.1484)	(0.3256)	(0.2249)	(0.1050)	(0.5695)
Depreciation (t-1)	0.2243*	0.3894	0.1224	-0.1301*	-0.3710
	(0.1153)	(0.2386)	(0.0969)	(0.0615)	(0.3010)
Observations	183	147	82	78	103
Hansen's J χ p-value	0.4992	0.2695	0.6542	0.8652	0.8202

Instruments: Lags 2/12 of Output-gap, ΔInflation,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table 3.11: GMM Estimation of Reserve Accumulation Reaction Functions

Δ ln(Reserves)	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.0169***	0.0043	0.0079***	0. 0139***	0.0144***
	(0.0040)	(0.0044)	(0.0017)	(0.0017)	(0.0017)
Δ Inflation (t-1)	-0.0631*	-0.0040	0.0235	-0.0166*	-0.0097*
	(0.0034)	(0.0050)	(0.0194)	(0.0090)	(0.0054)
Outputgap (t-1)	0.0011	0.0017***	0.0006***	0.0013***	0.0007**
	(0.0007)	(0.0005)	(0.0002)	(0.0003)	(0.0003)
Appreciation (t-1)	0.0034	0.0705	-0.2189	0.0914*	0.0892
	(0.1337)	(0.1750)	(0.1430)	(0.0502)	(0.1140)
Depreciation (t-1)	-0.3200***	-0.0089	-0.2303***	-0.1707***	-0.5477***
	(0.0633)	(0.1716)	(0.0665)	(0.0534)	(0.2045)
Observations	179	147	82	74	103
Hansen's J χ p-value	0.3554	0.5013	0.7376	0.1848	0.5598

Instruments: Lags 2/12 of Output-gap, ΔInflation,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Figure 3.1: EMP and Natural Log of the Nominal Exchange Rate

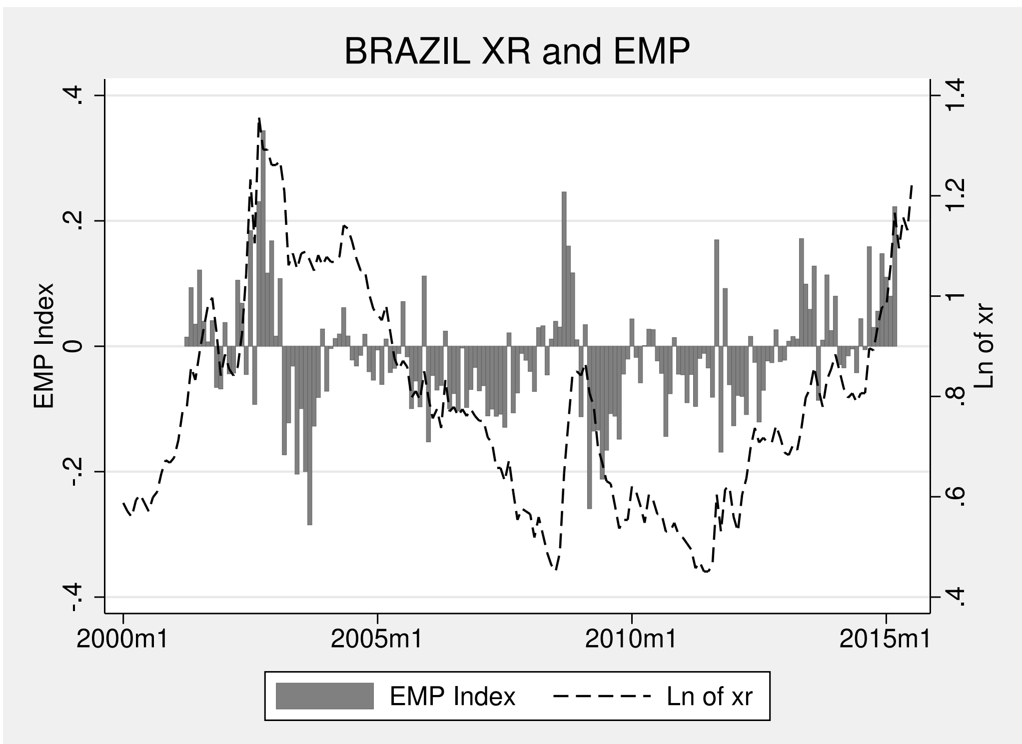


Figure 3.2: EMP and Natural Log of the Nominal Exchange Rate

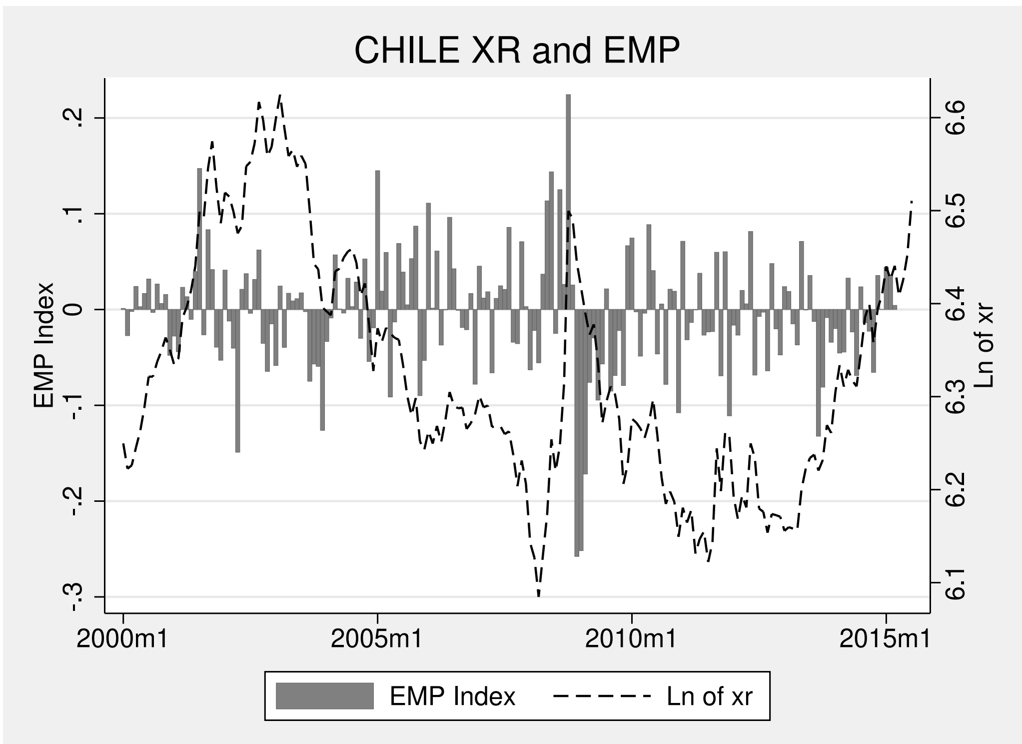


Figure 3.3: EMP and Natural Log of the Nominal Exchange Rate

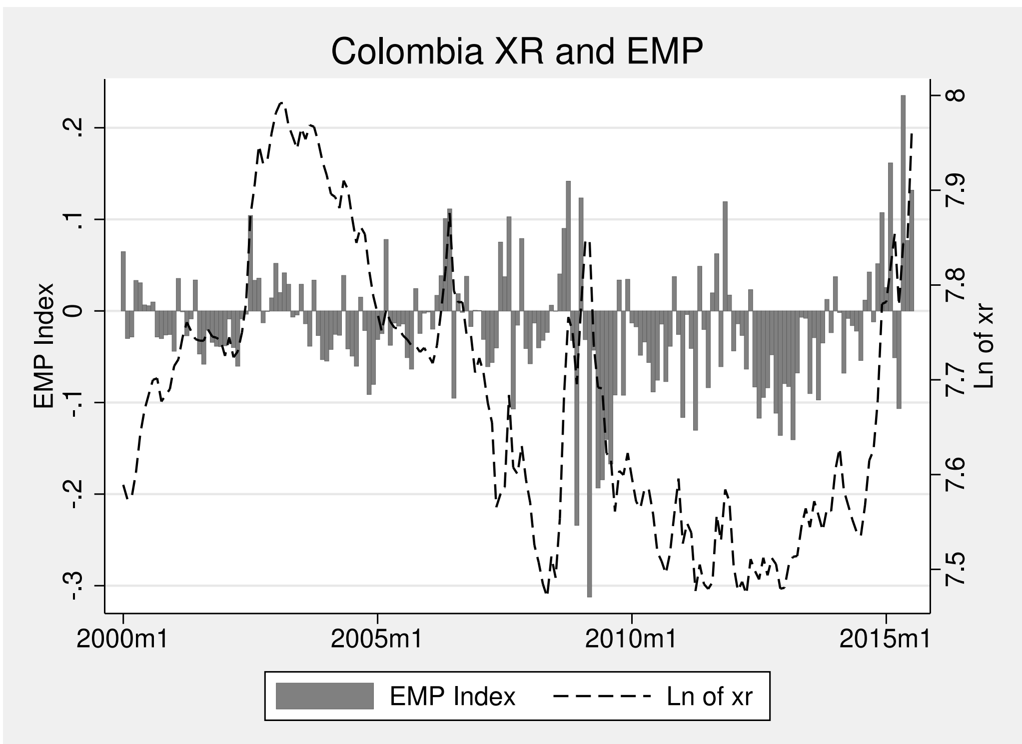


Figure 3.4: EMP and Natural Log of the Nominal Exchange Rate

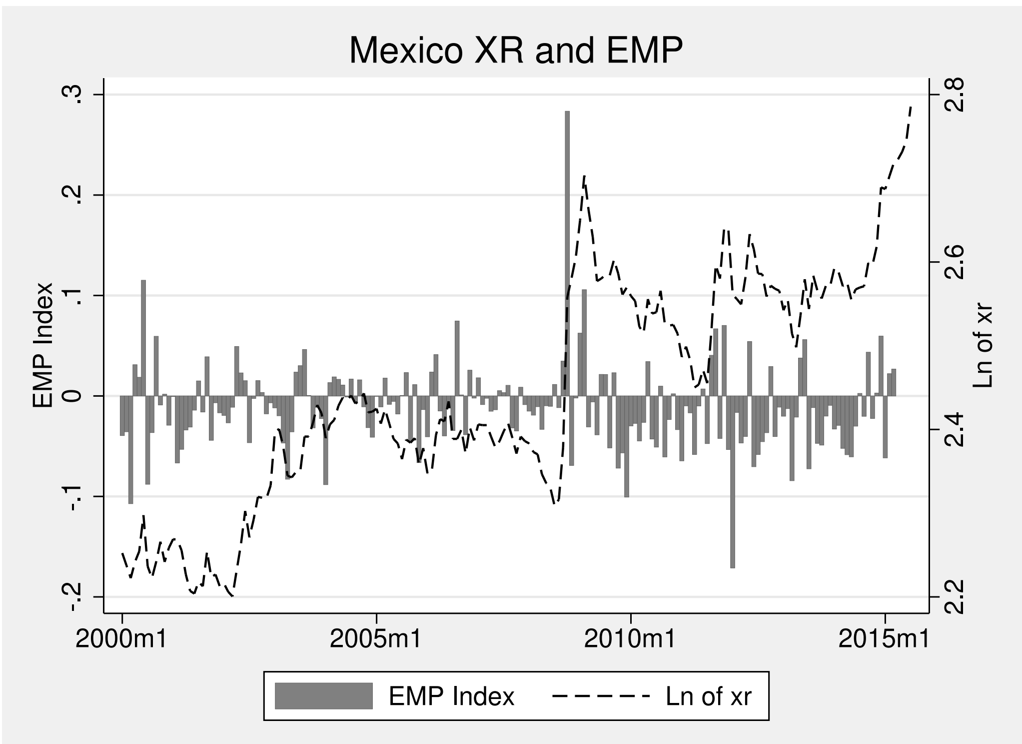
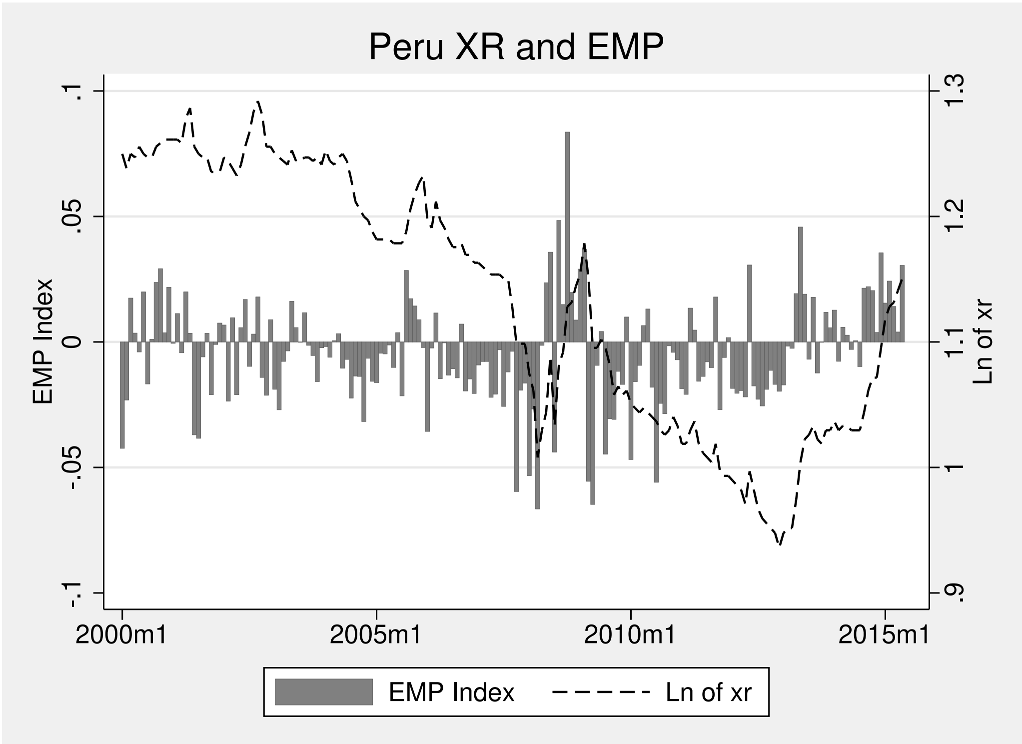


Figure 3.5: EMP and Natural Log of the Nominal Exchange Rate



APPENDIX A

ADDITIONAL ROBUSTNESS CHECKS FOR INVESTMENT EPISODES DETERMINANTS

This appendix presents additional results for the estimation of the determinants of sustained investment surges episodes, using different models from the limited dependent variable family. Tables A.1 and A.2 present alternative models. The first column shows the standard results from a Logit model, without estimating the average marginal effects for comparison purposes.[1] As in all Logit models, the coefficients represent the log of the odds ratios. The odds ratios represent the ratio of the likelihood of the "positive" outcome over the "negative" outcome. In our case, the likelihood that episode dummy is equal to one, over the likelihood that the episode dummy is equal to zero. For example a coefficient of 1.2 means that the positive outcome is 20 per cent more likely than the negative outcome (when the independent variable is increased by one unit), while a coefficient of 0.8 means that the negative outcome is 20 per cent less likely. Tables A.1 and A.2 present the log of the odds ratio, so the negative coefficients indicate an odd ratio lower than 1, and thus an increase in the independent variable lowers the likelihood of an episode, while ratios bigger than 1 associated with positive coefficients, increase it.[2]

The second and third column implements the Conditional Logit model. Conditional Logit models are useful to analyze how the characteristics of the different choices affect

[1]Unfortunately, there is no easy way to estimate the average marginal effect for a set of models that I will present soon, so I choose to stick with the "raw" estimations.

[2]In other words, the coefficients should be raised to the power of e to be interpreted as odd-ratios.

the likelihood of the individuals to pick among them. I group countries according to some common characteristic: countries that experienced an episode in the past (column 2) and anywhere in the sample (column 3). This accounts for the fact that countries that experience episodes may have some features that make them more likely to experience another episode in the future.

The fourth and fifth columns introduce the Re-Logit and the Firth Logit models. These two models account for the presence of rare events by penalizing the standard estimations. In our sample the number of observations associated with an episode taking place is relatively small compared to the number of observations where no episode takes place, and the ratio got worse and worse as we include additional covariates with limited coverage. I present results for a first specification that includes the covariates with a broad coverage, and the last specification, which cut the number of observations by about one sixth of the original sample of around 6,200.

The purpose of tables A.1 and A.2 is to search for unexpected changes in the coefficient. It is good to see that the results do not depend on the type of model adopted. Notice that the signs, the statistically significance and the size of the effects is more less similar in different models. We can verify that most of the variables that were consistently important in our baseline specification remain important using alternative models, except perhaps for inflation (but it was close to being not significant in the last specification of the baseline results).

While very useful, the previous results do not properly account for the fact that countries that had an episode may differ from countries that do not have them. As I first check, I implement a set of Multinomial Probit models, with a dependent variable that is exactly the same as the original episode dummy, except that it takes the value of 2 instead of 1 when the country had an episode in the past. Unlike the standard Probit models, where a country can have an episode or not, here a country can have an episode, can have an episode given that it had one in the past, or it simply can have no episode. The purpose of this exercise is once again to detect drastic changes in the coefficients among different models from the limited dependent variable family.

Tables A.3 and A.4 show the average marginal effects for the occurrence of a first episode and the occurrence of a non-first episode. Consider the table for first episodes. Most of the time the coefficients associated with undervaluation and lagged per capita growth are significant, but the size of the effect of growth is reduced substantially. Human capital is still significant but the effect is smaller. The main difference is that now the capital flow variables change sign. But notice that this is effect seems to be driven by FDI flows. The external factors are no longer significant, and trade openness is statistically significant and has a negative coefficient suggesting that more open countries are less likely to experience an episode.[3] To summarize, using a Multinomial Probit models does not lead to a drastic change in our main results.

A Nested Logit model is another popular choice that allows for a richer structure by modeling choice using a decision tree. In the multinomial model the error terms could be correlated if similar choices are related. A Nested Logit model can correct this. For my present purposes, I may want to specify a model with two branches. The first branch of the tree may include whether a country had an episode in the past or not, and a second branch whether a country has an episode today or not. But unfortunately, this is approach is not possible because I do not have choice specific variables by branch. Instead, I rely on models that does not need observables that determine branch choice. Tables A.5 and A.6 display the

[3] It is also interesting to take a look at the table that presents the results for non-first episodes. Now only a couple of variables seems to matter, including trade openness, capital account openness and terms of trade. Human capital changes it sign, while net capital flows seems to be the only variable that remains. The lagged capital stock per capital, lagged growth and undervaluation are not always significant and their sign change, in particular when we added additional covariates. Perhaps the low number of cases where our episode dummy is equal to 2 is driving these results.

results when I use models from the family of Generalized Linear Latent and Mixed Models (GLLAMM); they impose hierarchy and structure without variables that define choice at each part of the tree.

Table A.5 show the different specification of a linear model that considers that countries that had an episode in the past are part of different branch than countries that never had an episode episode before. Table A.6 put all the countries that had an episode anywhere in the sample in one branch, and the rest on the other one. Notice this second branch is "degenerate", as there is nothing to choose there. But it still make sense to check whether the results are robust. We can see that all the variables have the same sign and the same statistical significance. Although the size of effects do change by significant amounts, the differences are reasonable. For example the size of effect of undervaluation in column one in table A.6 is about two thirds of the original effect, but the number looks plausible (it is 0.022 vs. 0.29).

Table A.1: Robustness Logits II

Episode Dummy	(1) Logit	(2) Cond. Logit	(3) Cond. Logit	(4) Relogit	(5) Firth Logit
Underval81	0.377***	0.400***	0.264**	0.264**	0.375***
	(0.116)	(0.119)	(0.115)	(0.115)	(0.116)
Lag_Growth	7.708***	7.268***	6.810***	6.810***	7.685***
	(0.797)	(0.810)	(0.825)	(0.825)	(0.797)
Lag_KL	-0.272***	-0.342***	-0.201***	-0.201***	-0.272***
	(0.036)	(0.038)	(0.039)	(0.039)	(0.035)
Observations	6,230	6,230	3,860	3,860	6,230

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.2: Robustness Logits III

Episode Dummy	(1) Logit	(2) Cond. Logit	(3) Cond. Logit	(4) Relogit	(5) Firth Logit
Underval81	1.034**	0.866**	0.882**	0.882**	0.874**
	(0.415)	(0.368)	(0.377)	(0.377)	(0.384)
Lag_Growth	8.913**	8.787**	7.809**	7.809**	8.889**
	(3.714)	(3.727)	(3.742)	(3.742)	(3.572)
Lag_KL	-2.176***	-2.112***	-1.951***	-1.951***	-2.114***
	(0.415)	(0.420)	(0.416)	(0.416)	(0.402)
Fiscal	0.335	0.285	0.161	0.161	0.339
	(0.288)	(0.290)	(0.292)	(0.292)	(0.281)
Inflation	-1.442	-1.506	-1.247	-1.247	0.010
	(1.101)	(1.089)	(1.027)	(1.027)	(0.016)
XR_Stability	-0.725	-0.839*	-0.564	-0.564	-0.598
	(0.472)	(0.476)	(0.475)	(0.475)	(0.458)
Crisis_5y	-0.798***	-0.815***	-0.743**	-0.743**	-0.867***
	(0.286)	(0.290)	(0.291)	(0.291)	(0.274)
Rents	-0.017	-0.016	-0.016	-0.016	-0.015
	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)
Trade	-0.373	-0.742	-0.566	-0.566	-0.205
	(0.433)	(0.465)	(0.454)	(0.454)	(0.413)
KA_open	-0.099	-0.077	-0.058	-0.058	-0.083
	(0.101)	(0.100)	(0.099)	(0.099)	(0.099)
FDI_Inflows	-0.055	-0.026	-0.025	-0.025	-0.057
	(0.064)	(0.067)	(0.068)	(0.068)	(0.064)
Port_Inflows	-0.087***	-0.081***	-0.073***	-0.073***	-0.081***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.024)
Reserves	0.086	0.075	0.076	0.076	0.082
	(0.054)	(0.054)	(0.053)	(0.053)	(0.053)
TOT	-0.637	-0.593	-0.656	-0.656	-0.616
	(0.831)	(0.821)	(0.819)	(0.819)	(0.788)
FFend	-0.171***	-0.182***	-0.196***	-0.196***	-0.171***
	(0.050)	(0.050)	(0.051)	(0.051)	(0.048)
Global_Uncertainty	-0.073**	-0.070**	-0.076**	-0.076**	-0.068**
	(0.033)	(0.033)	(0.033)	(0.033)	(0.032)
Human_Capital	1.891**	2.191**	1.968**	1.968**	1.937**
	(0.898)	(0.883)	(0.906)	(0.906)	(0.882)
Capita_GDP	1.335***	1.217***	1.157***	1.157***	1.216***
	(0.439)	(0.430)	(0.433)	(0.433)	(0.416)
Durable	-0.015**	-0.018**	-0.019***	-0.019***	-0.013*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Observations	1,029	1,029	787	787	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.3: Multinomial Probit, Average Marginal Effect Case 1#

Episode Dummy	(1) Mprobit	(2) Mprobit	(3) Mprobit	(4) Mprobit	(5) Mprobit
Underval81	0.010**	0.014**	0.043***	0.031**	0.035***
	(0.005)	(0.007)	(0.014)	(0.014)	(0.014)
Lag_Growth	0.186***	0.320***	0.203**	0.187**	0.199**
	(0.049)	(0.061)	(0.082)	(0.081)	(0.082)
Lag_KL	-0.010***	-0.011***	0.003	-0.015*	-0.013*
	(0.002)	(0.002)	(0.004)	(0.009)	(0.007)
Fiscal		0.015**	-0.006	0.007	0.006
		(0.006)	(0.006)	(0.005)	(0.005)
Inflation		-0.008	-0.001	-0.017	-0.020*
		(0.011)	(0.007)	(0.012)	(0.011)
XR_Stability		0.000	-0.007	-0.012	-0.016
		(0.009)	(0.010)	(0.009)	(0.010)
Crisis_5y			-0.016*	-0.019*	-0.022**
			(0.009)	(0.010)	(0.011)
Rents			0.000*	0.000*	0.000
			(0.000)	(0.000)	(0.000)
Trade			-0.032**	-0.062***	-0.066***
			(0.013)	(0.021)	(0.022)
KA_open			-0.002	-0.001	-0.001
			(0.003)	(0.002)	(0.002)
NET_Inflows			0.002***	0.001	
			(0.001)	(0.001)	
FDI_Inflows					0.002**
					(0.001)
Port_Inflows					-0.001
					(0.001)
Reserves					-0.001
					(0.001)
TOT			0.017	-0.003	-0.001
			(0.024)	(0.023)	(0.024)
FFend			-0.004**	-0.002	-0.001
			(0.002)	(0.001)	(0.001)
Global_Uncertainty			0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)
Human_Capital				0.037**	0.033**
				(0.014)	(0.015)
Capita_GDP				0.017	0.016
				(0.011)	(0.010)
Durable				-0.000*	-0.000*
				(0.000)	(0.000)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# 0 Denotes no episode, 1 First Episode, 2 Episode + Episode in the Past

Table A.4: Multinomial Probit, Average Marginal Effect Case 2#

Episode Dummy	(1) Mprobit	(2) Mprobit	(3) Mprobit	(4) Mprobit	(5) Mprobit
Underval81	-0.017	-0.014	-0.004	0.001	-0.003
	(0.015)	(0.024)	(0.033)	(0.036)	(0.036)
Lag_Growth	0.523***	0.666***	-0.138	0.296	0.158
	(0.116)	(0.189)	(0.335)	(0.334)	(0.356)
Lag_KL	0.031***	-0.024***	-0.066***	0.021	0.018
	(0.004)	(0.007)	(0.015)	(0.039)	(0.039)
Fiscal		0.026	0.072**	0.068**	0.068**
		(0.017)	(0.028)	(0.028)	(0.029)
Inflation		0.005	-0.005	0.004	0.007
		(0.006)	(0.005)	(0.008)	(0.008)
XR_Stability		-0.066**	0.072	0.038	0.036
		(0.028)	(0.047)	(0.047)	(0.047)
Crisis_5y			-0.002	0.020	0.027
			(0.031)	(0.031)	(0.032)
Rents			0.001	-0.001	-0.000
			(0.001)	(0.001)	(0.001)
Trade			0.302***	0.366***	0.359***
			(0.037)	(0.040)	(0.043)
KA_open			-0.034***	-0.020*	-0.021*
			(0.010)	(0.011)	(0.011)
NET_Inflows			-0.010***	-0.009***	
			(0.003)	(0.003)	
FDI_Inflows					-0.009
					(0.006)
Port_Inflows					-0.003
					(0.002)
Reserves					0.016**
					(0.007)
TOT			-0.163**	-0.157**	-0.158**
			(0.065)	(0.066)	(0.067)
FFend			0.009*	0.002	0.001
			(0.005)	(0.005)	(0.005)
Global_Uncertainty			-0.004	-0.002	-0.002
			(0.003)	(0.003)	(0.003)
Human_Capital				-0.552***	-0.543***
				(0.088)	(0.090)
Capita_GDP				-0.024	-0.021
				(0.044)	(0.044)
Durable				-0.000	-0.000
				(0.001)	(0.001)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# 0 Denotes no episode, 1 First Episode, 2 Episode + Episode in the Past

Table A.5: GLLAMM Models 1

Episode Dummy	(1) GLLAMM	(2) GLLAMM	(3) GLLAMM	(4) GLLAMM	(5) GLLAMM
Underval81	0.032***	0.040***	0.077***	0.066***	0.064***
	(0.008)	(0.013)	(0.023)	(0.024)	(0.024)
Lag_Growth	0.473***	0.795***	0.678***	0.509**	0.500**
	(0.052)	(0.095)	(0.217)	(0.217)	(0.227)
Lag_KL	-0.022***	-0.033***	-0.060***	-0.125***	-0.125***
	(0.003)	(0.004)	(0.010)	(0.025)	(0.025)
Fiscal		0.021**	-0.010	0.013	0.012
		(0.009)	(0.018)	(0.019)	(0.019)
Inflation		-0.000	0.001	-0.000	0.000
		(0.001)	(0.002)	(0.002)	(0.002)
XR_Stability		0.010	-0.016	-0.017	-0.019
		(0.015)	(0.031)	(0.030)	(0.030)
Crisis_5y			-0.063***	-0.065***	-0.063***
			(0.019)	(0.019)	(0.020)
Rents			0.002**	-0.000	-0.000
			(0.001)	(0.001)	(0.001)
Trade			-0.020	-0.035	-0.038
			(0.022)	(0.026)	(0.027)
KA_open			0.003	-0.002	-0.003
			(0.007)	(0.008)	(0.008)
NET_Inflows			-0.002	-0.006***	
			(0.002)	(0.002)	
FDI_Inflows					-0.004
					(0.004)
Port_Inflows					-0.005***
					(0.002)
Reserves					0.005
					(0.004)
TOT			-0.052	0.004	0.002
			(0.042)	(0.043)	(0.043)
FFend			-0.016***	-0.011***	-0.012***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.005**	-0.005**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.136**	0.140**
				(0.064)	(0.064)
Capita_GDP				0.071**	0.073***
				(0.028)	(0.028)
Durable				-0.000	-0.000
				(0.000)	(0.000)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.6: GLLAMM Models 2

Episode Dummy	(1) GLLAMM	(2) GLLAMM	(3) GLLAMM	(4) GLLAMM	(5) GLLAMM
Underval81	0.022***	0.026**	0.070***	0.060**	0.058**
	(0.008)	(0.013)	(0.023)	(0.024)	(0.024)
Lag_Growth	0.441***	0.767***	0.660***	0.491**	0.486**
	(0.051)	(0.094)	(0.216)	(0.216)	(0.227)
Lag_KL	-0.012***	-0.025***	-0.055***	-0.124***	-0.125***
	(0.003)	(0.004)	(0.010)	(0.025)	(0.025)
Fiscal		0.022**	-0.012	0.008	0.008
		(0.009)	(0.018)	(0.019)	(0.019)
Inflation		-0.000	0.001	0.000	0.000
		(0.001)	(0.002)	(0.002)	(0.002)
XR_Stability		0.009	-0.013	-0.012	-0.013
		(0.015)	(0.030)	(0.030)	(0.030)
Crisis_5y			-0.061***	-0.063***	-0.061***
			(0.019)	(0.019)	(0.019)
Rents			0.002**	-0.000	-0.001
			(0.001)	(0.001)	(0.001)
Trade			-0.020	-0.030	-0.030
			(0.022)	(0.024)	(0.026)
KA_open			0.005	-0.000	-0.002
			(0.007)	(0.008)	(0.008)
NET_Inflows			-0.001	-0.006***	
			(0.002)	(0.002)	
FDI_Inflows					-0.004
					(0.004)
Port_Inflows					-0.005***
					(0.002)
Reserves					0.005
					(0.004)
TOT			-0.056	-0.000	-0.004
			(0.042)	(0.043)	(0.043)
FFend			-0.016***	-0.012***	-0.012***
			(0.003)	(0.003)	(0.003)
Global_Uncertainty			-0.005**	-0.005**	-0.005**
			(0.002)	(0.002)	(0.002)
Human_Capital				0.136**	0.135**
				(0.062)	(0.063)
Capita_GDP				0.076***	0.078***
				(0.028)	(0.028)
Durable				-0.000	-0.001
				(0.000)	(0.000)
Observations	6,230	3,298	1,084	1,041	1,029

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX B

GMM ESTIMATIONS USING THE INFLATION GAP

This Appendix includes the additional GMM estimations for the third paper, section 4. Here I reproduce the tables 3.8, 3.9, 3.10, and 3.11. But instead of the change in the rate of inflation, here I show the results using the difference between observed inflation and the target inflation. Because the Central Bank use a band for the target inflation, rather than a single number, I choose to use the mean. Thus, if the Central Bank has a target inflation between 2% and 4%, I set the target to 3%.

Tables B.1, B.2, B.3, and B.4 include the results. It is comforting to notice that the main lesson holds. In all the countries, with the sole exception of Chile, depreciations seems to trigger a sale of foreign exchange reserves, while appreciation matter very little: either the sign of the coefficient is wrong, as in Colombia in Peru, or the results are not significant and the coefficient is smaller in absolute size (see table B.4). Interest rate changes do not seem to be clearly related to exchange rate changes.

It is worth to notice that the coefficient associated with inflation gap often has the wrong sign (it is negative but it should be positive), and its size is small, and always much smaller than the coefficient associated with exchange rate changes (see table B.1). Although the problem could be the precise definition of the inflation gap, this may also imply that Latin-American Central Banks pay much more attention to exchange rates than to inflation, at least in a month by month basis. This is clearly inconsistent with the usual description of the way Inflation Targeting works.

Table B.1: GMM Estimation of Interest Rate Reaction Functions

Δ ln(Rate)	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.0061***	0.0057***	-0.0054*	0.0033*	0.0077***
	(0.0038)	(0.0033)	(0.0029)	(0.0015)	(0.0020)
Inflationgap (t-1)	0.0019**	-0.0003*	0.0006	-0.0077**	-0.0057***
	(0.0009)	(0.0013)	(0.0004)	(0.0030)	(0.0020)
Outputgap (t-1)	0.0009	0.0029**	0.0002	0.0011***	0.0028***
	(0.0008)	(0.0013)	(0.0002)	(0.0004)	(0.0008)
Δln(XR) (t-1)	0.1532*	0.4318**	0.0399**	0.0342	0.2350
	(0.0794)	(0.1938)	(0.0193)	(0.0299)	(0.2342)
Observations	183	169	70	78	116
Hansen's J χ p-value	0.4024	0.6186	0.9867	0.9923	0.3175

Instruments: Lags 2/12 of Output-gap, Inflation-gap,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table B.2: GMM Estimation of Reserve Accumulation Reaction Functions

Δ ln(Reserves)	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.0161***	0.0056***	0.0108***	0.0194***	0.01667***
	(0.0037)	(0.0019)	(0.0025)	(0.0014)	(0.0017)
Inflationgap (t-1)	-0.0018**	0.0016**	-0.0005	-0.0074***	-0.0043***
	(0.0008)	(0.0008)	(0.0006)	(0.0010)	(0.0011)
Outputgap (t-1)	0.0002	0.0022***	0.0003**	0.0009***	0.0013***
	(0.0007)	(0.0006)	(0.0001)	(0.0002)	(0.0004)
Δln(XR) (t-1)	-0. 1606**	-0.1588***	-0.2322***	-0.0364	-0.5139***
	(0.0666)	(0.0842)	(0.0375)	(0.0270)	(0.1533)
Observations	179	169	70	74	116
Hansen's J χ p-value	0.2410	0.6849	0.4230	0.5787	0.7475

Instruments: Lags 2/12 of Output-gap, Inflation-gap,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table B.3: GMM Estimation of Interest Rate Reaction Functions

Δ ln(Rate)	Brazil	Chile	Colombia	Mexico	Peru
Constant	-0.0070*	0.0151*	-0.0076**	0.0038***	0.0018
	(0.0040)	(0.0080)	(0.0034)	(0.0014)	(0.0025)
Inflationgap (t-1)	0.0017*	0.0005	0.0005	-0.0057***	-0.0066***
	(0.0010)	(0.0014)	(0.0003)	(0.0020)	(0.0020)
Outputgap (t-1)	0.0008	0.0022	0.0003**	0.0007***	0.0028***
	(0.0009)	(0.0013)	(0.002)	(0.0003)	(0.0007)
Appreciation (t-1)	0.0792	0.7536*	-0.1472**	0.1406	-0.6188**
	(0.1355)	(0.4119)	(0.2526)	(0.0855)	(0.3087)
Depreciation (t-1)	0.1916*	-0.0778	0.1403	-0.0252*	0.6756
	(0.1039)	(0.3001)	(0.0660)	(0.0134)	(0.3843)
Observations	183	149	70	78	116
Hansen's J χ p-value	0.3675	0.6242	0.9756	0.9947	0.7043

Instruments: Lags 2/12 of Output-gap, Inflation-gap,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

Table B.4: GMM Estimation of Reserve Accumulation Reaction Functions

Δ ln (Reserves)	Brazil	Chile	Colombia	Mexico	Peru
Constant	0.0220***	0.0019	0.0088***	0.0208***	0.0174***
	(0.0046)	(0.0046)	(0.0028)	(0.0016)	(0.0024)
Inflationgap (t-1)	-0.0017**	0.0015	-0.0002	-0.0073***	-0.0042***
	(0.0008)	(0.0009)	(0.0006)	(0.0011)	(0.0011)
Outputgap (t-1)	0.0002	0.0024***	0.0004***	0.0009***	0.0013***
	(0.0007)	(0.0007)	(0.0002)	(0.0002)	(0.0004)
Appreciation (t-1)	0.1352	0.0311	-0.2610**	0.0405	-0.4568**
	(0.1452)	(0.1637)	(0.1326)	(0.0625)	(0.2258)
Depreciation (t-1)	-0.2219***	0.3439	-0.1491***	-0.0799***	-0.5811**
	(0.0701)	(0.2174)	(0.0496)	(0.0424)	(0.2423)
Observations	179	169	70	74	116
Hansen's J χ p-value	0.2360	0.7017	0.3981	0.5119	0.7287

Instruments: Lags 2/12 of Output-gap, Inflation-gap,
Domestic and Federal Funds Rates (in logs)
Standard error in parentheses (Newey-West "HAC" Covariance Matrix)
*** p<0.01, ** p<0.05, * p<0.1

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