The Real Consequences of Countercyclical Capital Controls*

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November 10, 2015

Abstract

Using a macroeconomic and a microeconomic approach, we analyze the effects of capital controls on real variables in Brazil, the most preeminent case of controls being imposed countercyclically. We find that capital controls have a significant negative impact on investment. The macro analysis uses a synthetic control method and finds that investment could have been approximately 20% higher if controls had not been put in place. The micro analysis uses a panel data approach and finds that the controls reduced the investment to assets ratio by as much as 40%, with some of its effects mitigated by the extension of subsidized credit by the government through the development bank. These results indicate that the renewed support for controls since the Great Financial Crisis should be more cautiously evaluated as it might harm the potential growth rate of Emerging Economies for a long-lasting period.

*We are grateful to Ricardo Reis, Martin Uribe, Stephanie Schmitt-Grohe and Jose Scheinkman for constant guidance and support. We would also like to thank participants of the Economic Fluctuations Colloquium at Columbia University for helpful comments and suggestions. All errors are our own.

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1 Introduction

Since the onset of the Latin American crisis of the late 1990s, there has been a renewed support for the use of capital controls in periods of capital bonanza. Even the IMF, formerly known to support capital account liberalization, has recently emphasized that controls on capital inflows should be considered as part of the Emerging Economies policy toolkit (Ostry, Ghosh, Chamon and Qureshi, 2011). However, most of the papers that conclude that the imposition of taxes in capital inflows might be optimal find small welfare gains and do not explicitly consider capital accumulation decisions (see for example Bianchi, 2011).

The primary goal of our paper is to empirically evaluate the effects of capital controls on fixed investment using both macro and micro data. We evaluate the effects of several capital controls measures implemented by the Brazilian Government since 2009. We focus on Brazil because it is the most prominent case of countercyclical capital controls.[1] Moreover, financial markets in Brazil are liquid, well developed, and open to foreign capital flows, leading to a clearer connection between the controls and the real economy.

To formally study the effects of these measures, we first follow the methodology of Abadie and Gardeazabal (2003). We use a combination of other countries with similar characteristics to Brazil to construct a synthetic control country. The control country is calibrated to match Brazilian macroeconomic data *before* the imposition of controls. With that in hand, we can then construct a counterfactual that will be compared to the actual data to evaluate the impact of the measures on real activity.[2] We find that capital controls had negative effects on both investment and consumption in Brazil, with the

1. Fernandez, Rebucci and Uribe (2015) examine the behavior of capital controls in a large number of countries over the period 1995-2011 and find they are remarkably acyclical and that the Brazilian case is an unusual one, as on average countries did not did not appeal to capital control measures to counteract the capital inflows on the pre-great-contraction period.

2. Jinjarak, Noy and Zheng (2013) use the same methodology to evaluate the effects of Brazilian Capital Controls throughout 2008-11 but they focus solely on the impact on equity flows and on the exchange rate in the short-run. Carrasco, De Mello and Duarte (2014) also use this methodology applied to Brazilian data but they focus on the period between 2003-12 to evaluate the performance of the Brazilian economy among different dimensions.

former being 20% higher, and the latter being 13% higher in the synthetic country. We found no significant real effects on exports and imports.

To confirm these results at a microlevel and identify the types of firms more affected by the controls, we then use the Worldscope database on almost 300 Brazilian firms. We take a reduced form approach to see what the effects of capital controls on investment were at the firm level. We supplement the data available on Worldscope with data from the Brazilian Development Bank (BNDES) to check the degree to which different firms took advantage of subsidized loans from the BNDES to counteract this credit supply shock. We also use export data to evaluate whether firms that export more benefited from the imposition of capital controls in any particular way. What we find, robust to a host of different specifications, is that investment over assets unambiguously declined by as much as 40% after the imposition of capital controls. Further we find that firms that had access to cheaper credit from the BNDES were able to offset that decline almost completely.

We are additionally able to use the results from the first section as a novel control. We would like to run the regressions on the micro data while controlling for macroeconomic shocks or circumstances that would have impacted Brazil apart from capital controls. In fact, we can do exactly that by using the synthetic levels of investment as calculated by the synthetic control method. This captures any patterns in investment that would have affected all commodity producing/exporting nations that did not impose any controls during this period.

Separating the sample into classes, we find that the results are not sensitive to the size of the firm: in percentage terms, it appears that firms were relatively equally affected. If we then split the sample into groups based on how much firms export, we find that firms that export more were relatively unaffected by the capital controls - their investment did not decline significantly, nor did they BNDES loans help them significantly. However, firms that did not export very much were significantly affected by both. This points to the capital controls having a very targeted goal: to support exporters, potentially at the expense of other firms. Brazil, at the time, was concerned with a rapidly appreciating

exchange rate, which would have hurt exports - by imposing controls, Brazil avoided this problem, but the resultant investment drop was big enough to lead to an overall contraction. Moreover, helping exporters did not lead to higher export volumes as we can see from the results in the macro section.

The combination of these analyses, with aggregate macro and disaggregated micro data, lead us to conclude that the capital control policies enacted by Brazil did not have uniformly positive effects. There may have been some benefits in stabilizing the exchange rate and price level, which has been measured in other works. However, our work is, as far as we know, one of the few to examine the effects of such controls on real variables such as consumption and investment, and we find that the effects are strongly negative, and asymmetric. This should call for a reexamination of such policies, where modelling accounts not only for the price effects but also the investment effects to gauge the overall welfare impact of such policies.

Related Literature. This paper is related to a recent theoretical literature that advocates that controls on capital flows and, more broadly, macroprudential measures might be desirable in some contexts (Ostry et al. (2011), Bianchi (2011), Korinek (2011), Schmitt-Grohe and Uribe (2015), Farhi and Werning (2012), Costinot, Lorenzoni and Werning (2014) and many others) to curb what are called 'excessive' capital flows. This literature is based on the notion that there are externalities associated with external borrowing because individual market participants do not internalize their contribution to aggregate financial instability and 'overborrowing' in a foreign currency might arise. Thus prudential capital controls - tightening of restrictions on net capital inflows during booms and their relaxation during recessions - might be desirable to induce private agents to internalize this externality, and improve total welfare. This is not a new idea, as it goes back to Tobin's (1978) seminal paper. However, most of this literature abstracts from the effects on investment and its impact on welfare. Our paper tries to fill this gap by giving an estimate of the potential effects on investment that might help to complete an

evaluation of its welfare effects.

It is also related to papers that analyze the effectiveness of capital controls. Magud, Reinhart and Rogoff (2011) provides a thorough survey of this literature and finds that capital controls on inflows seem to make monetary policy more independent, alter the composition of capital flows, and reduce real exchange rate pressures. Klein (2012) differentiates among episodic and long-standing capital controls and finds that only the latter have some effect on growth of certain financial variables and with GDP growth. However, he also points out that these differences seem to arise from the fact that countries with long-standing controls on capital inflows are also poorer than the other countries in the sample. Andreasen, Schindler and Valenzuela (2015) study the effects of capital controls on corporate bond spreads and find that restrictions on capital inflows produce a substantial and economically meaningful increase on them, which supports our results regarding real investment. Finally, Forbes (2007) finds that the Chilean capital controls during the 90's increased financial constraints, especially for smaller traded firms. Our paper contributes to this strand of the literature by focusing on real variables and finds that there were significant real effects of controls, which is at odds with most of the previous literature.

Finally, there are some other papers that also study the particular case of Brazil after the Global Financial Crisis. Chamon and Garcia (2015) document that the capital controls measures in Brazil had some success in segmenting Brazilian and global financial markets, but they do not find significant effects in the exchange rate. Jinjarak et al. (2013) also employ a synthetic control methodology but they focus mainly on the effects on capital inflows and were not able to find any significant effect. Finally, Alfaro, Chari and Kanczuk (2014) examine the effects of these measures on firm-level stock returns and real investment and find a significant drop in cumulative abnormal returns for Brazilian firms following capital control announcements, with large firms and largest exporting firms appearing to be less affected. They do not find any statistically significant change in investment for the whole sample but, when they split the sample, they find that there was

a significant fall in investment for small and non-exporting firms while exporting firms saw a statistically significant rise in their investment rates. Although they also focus on firm-level investment, they employ an event-study methodology which do not control for changes in investment opportunities or the huge increase in provision of subsidized credit. Our contribution is to show that, even controlling for all these facts there still was a significant decline in firm investment after the imposition of controls.

Layout. The rest of the paper is organized as follows. Section 2 provides a quick view of capital controls measures in Brazil to contextualize this work. Section 3 describes the macroeconomic approach and its results. Section 4 describes the microeconomic approach and its results. Section 5 concludes.

2 A Look at the Brazilian Case

Brazil has a long history of capital controls measures. In the 1990s, a wave of current account liberalization started. Minella and Goldfajn (2007) state that

> The liberalization was a gradual process of establishing new rules on capital inflows and outflows. The result of the liberalization process was (a) reduction or elimination of taxes on foreign capital financial transactions and of minimum maturity requirements on loans; (b) elimination of quantitative restrictions on investments by nonresidents in financial and capital markets securities issued either domestically or abroad; (c) permission for residents to issue securities abroad, including debt, without prior approval by the Central Bank; (d) more freedom for residents to invest in FDI and portfolio abroad; and finally (e) the introduction of currency convertibility, initially through the mechanism of international transfers in Reais, whereby residents could transfer their resources abroad through the use of nonresident accounts.

This period of a more open capital account came to an end in 2008 due to massive foreign inflows. After some short-lived controls in the beginning of 2008, the Brazilian Government imposed a long list of measures beginning in October 2009 due to the unprecedented measures of unconventional monetary policy taken by advanced economies policy makers after the Global Financial Crisis, which were labeled later by Brazilian President Rousseff as a "monetary tsunami that have led to a currency war and have introduced new and perverse forms of protectionism in the world". These measures are the focus of this paper and are described in detail in Table 1.[3]

Date	Capital Control Measures
10/19/09	2% tax on portfolio inflows (equity & fixed income)
11/18/09	1.5% tax on the conversion of ADRs into local equities
10/04/10	Tax on fixed income inflows raised to 4% tax
10/18/10	Tax on fixed income inflows raised to 6% tax
01/06/11	Unremunerated reserve requirement on bank FX positions > US$ 3 billions
03/28/11	6% entry tax on foreign loans with maturity below 1 year
04/06/11	6% entry tax on foreign loans with maturity below 2 years
07/08/11	Unremunerated reserve requirement on bank FX positions > US$ 1 billion
07/26/11	1% tax on long notional Brazilian Real derivatives positions
12/01/11	Elimination of tax on portfolio equity inflows
02/29/12	6% entry tax on foreign loans with maturity below 3 years
03/01/12	Restrictions on anticipation of exporter payments for up to 1 year
03/09/12	6% entry tax on foreign loans with maturity below 5 years
03/15/12	Tax on derivatives set to zero for hedging by exporters
06/13/12	6% entry tax on foreign loans restricted to maturities below 2 years
12/04/12	Anticipation of exporter payments for up to 5 years are allowed
12/05/12	6% entry tax on foreign loans restricted to maturities below 1 year
06/04/13	Elimination of tax on fixed income flows

Source: Adapted from Chamon and Garcia (2015).

Table 1: Capital Controls Measures in Brazil - 2009-2012

As noted by Chamon and Garcia (2015), these measures were successful in segmenting the Brazilian and global financial markets. Figure 1 shows the spread between onshore and offshore dollar rates. The spreads had been relatively small, around 1%, but had a huge increase after the October 2010 measures, coming back to previous levels only

3. We did not start our analysis in 2008 because the measures at that time were in place for a very brief period due to the bankruptcy of Lehman Brothers. Moreover, it would be hard to disentangle the effects of the controls from those of the Global Financial Crisis.

after the loosening measures of early 2012. Moreover, as we can see in figure 2, after the October 2010 measures portfolio inflows also declined sharply while foreign direct investments actually increased and other investments were not affected.[4]

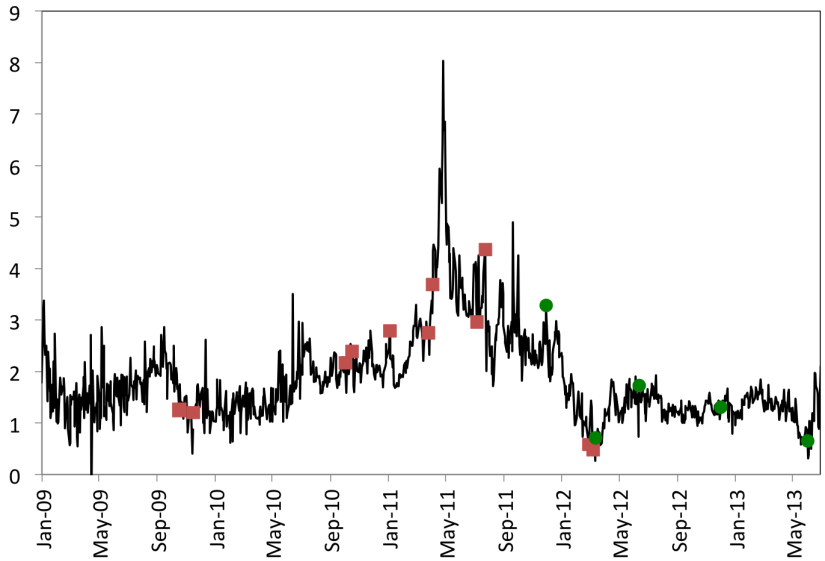

Figure 1: 90-Day Cupom Cambial (Spread Between Onshore and Offshore Dollar Rates - %)

Note: Red squares are a tightening in capital controls and green circles are a loosening in capital controls. Source: Bloomberg.

There seems also to exist a close relation between the capital controls measures and a strong slowdown in GDP growth and investment (see figures 3 and 4). The slowdown occurred both in capital goods production and, to a lesser extent, in capital goods imports, which might indicate that the effect of controls were more pronounced in the financing of capital goods purchases and not only on the financing of imports themselves (see figure 5).

Given all this preliminary evidence, we proceed in the next sections to evaluate more formally the relationship between the capital controls measures in Brazil and the real economy.

4. The increase in foreign direct investments might be related to some relabeling of flows to circumvent the controls but the Brazilian Central Bank denies that.

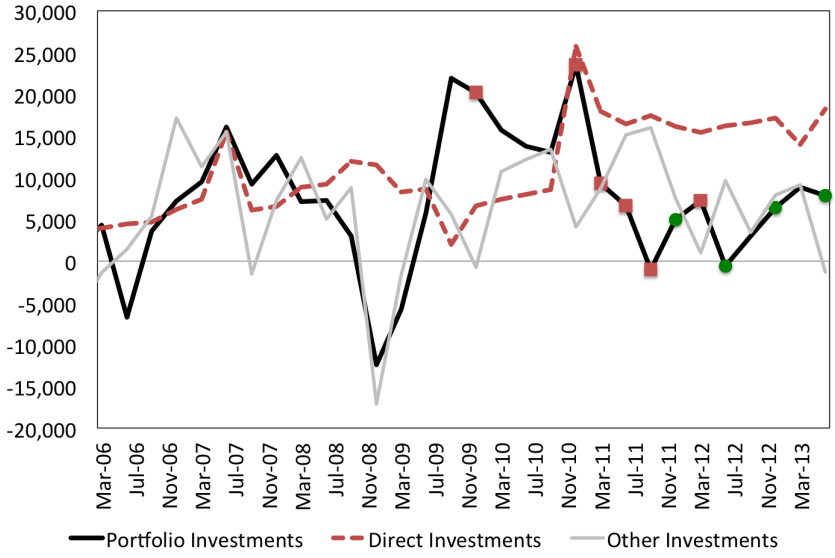

Figure 2: Brazil - Foreign Net Inflows (Seasonally Adjusted)

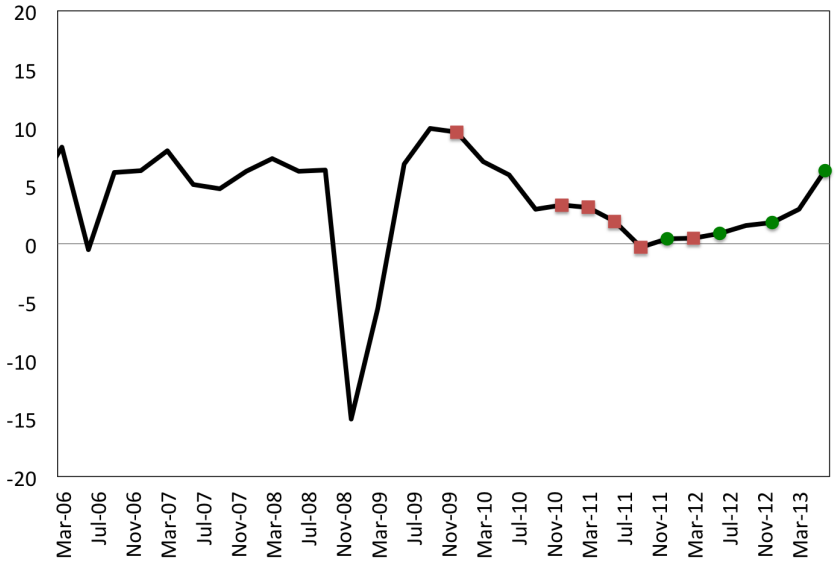

Figure 3: Brazil - GDP (Annualized Quarterly Change)

3 Macroeconomic Approach

3.1 Empirical Strategy

Looking at figures 3-5, it seems evident that Brazil's imposition of capital controls stunted growth just as it was rebounding from the 2008 crisis. In this section, we formally analyze

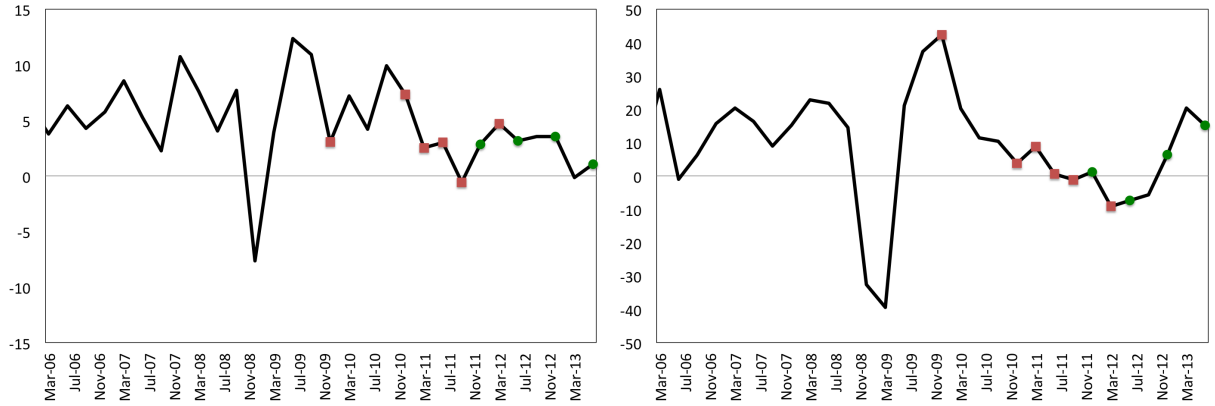

Figure 4: Brazil - Private Consumption and Fixed Investment (Annualized Quarterly Change)

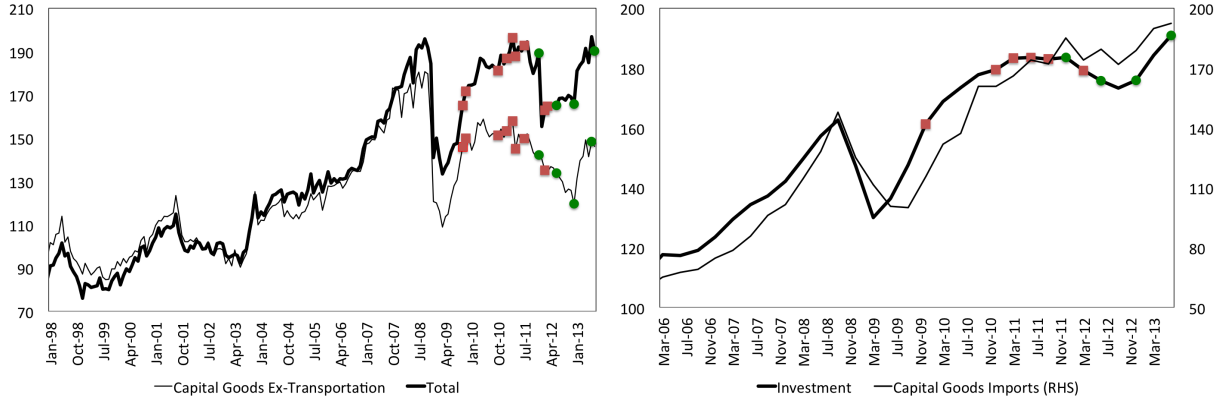

Figure 5: Brazil - Capital Goods Production/Capital Goods Imports and Fixed Investment (Annualized Quarterly Change)

the connection between these measures and the real economy. To facilitate this, we try to answer the question - what would have happened to Brazil's real macroeconomic aggregates had capital controls *not* been introduced? Brazil is a unique economy, but not so much so that we cannot learn from other countries which are subject to similar shocks.

We approach the issue by comparing the economic events in Brazil to a weighted average of countries that are comparable to Brazil. The general methodology is taken from Abadie and Gardeazabal (2003). By weighting other countries to match the macroeconomic characteristics of Brazil, we will achieve what we term a synthetic Brazil that did not impose capital controls. The difference in investment paths upon Brazil's institution of capital controls will be the real effect of capital controls.

More formally, let N be the number of countries in our sample and $W = (w_1, ..., w_N)'$ be a vector of nonnegative weights such that $\sum w_j = 1$, where w_j represents the weight of country j in the synthetic country. Our objective is to construct a counterfactual for the desired variable, which would be given by $Y_1^* = Y_0 W^*$. To do that, we will consider M many macroeconomic factors, to which we will try to match our weighted synthetic Brazil. These factors are pre-treatment[5] average data such as the real interest rate, GDP, foreign direct investment, and others. Let us call X_0 the $N \times M$ matrix that houses all of the macroeconomic data for all of the countries in our sample before the imposition of controls i.e., the vectors of pretreatment characteristics for untreated countries. Further let us call X_1 the $1 \times M$ vector of the macroeconomic variables for Brazil i.e., the vector of pretreatment characteristics for the treated country. Finally let V be a diagonal matrix with non-negative components whose elements reflect the relative importance of each characteristic. Then $W = \{w_1, ..., w_N\}$ is selected to minimize the following expression:

$$W^*(V) = arg \min_{w \epsilon W} \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)}$$

The choice of V could be subjective but we try to do it optimally following Abadie and Gardeazabal (2003). Let Y_1 be the vector of time-series for the objective variable in Brazil before the imposition of controls i.e., the vector of pretreatment time-series for the treated country, and Y_0 be the vector of the same time series for the other countries in the same period. To choose V optimally, we minimize the MSE for the pre-treatment period [6]:

$$V^* = arg \min_{v \epsilon V} \sqrt{(Y_1 - Y_0 W^*(V))' (Y_1 - Y_0 W^*(V))}$$

5. Pre-treatment means before the imposition of capital controls in our case.

6. Alternatively, we could choose other weighting matrices such as one that gives the same weight for all countries.

3.2 Country Selection and Sample Period

For our sample, we must choose countries that have similar characteristics to the Brazilian economy. Thus, the sample must include both Latin American countries and other commodities producers, which arguably might be subject to the same shocks that Brazil suffered after the Global Financial Crises. We also include the USA as the crises was originated there but, as we will see later, its inclusion is not relevant as it gets zero weights for all variables hereby analyzed. This leaves us with a sample of 10 countries: Argentina, Chile, Ecuador, Mexico, Peru, Uruguay, Australia, Canada, New Zealand and USA.

For the sample period, to minimize the possible effects of confounding factors and to have the same amount of data before and after the controls, we restrict our attention to the 15 quarter before and after the controls: 2006:1 to 2013:2.

3.3 The Effects on Real Investment

We begin our analysis by evaluating the effects of capital controls on real fixed investment. First, we must decide which characteristics to include as our target pre-treatment moments. We choose the following characteristics: GDP per capita, real GDP growth, investment to GDP ratio, the share of capital goods imports in total imports, current account to GDP ratio and FDI to GDP ratio. The first two characteristics are important to get a synthetic counterpart with the same level of economic development, as it is well documented that poorer countries tend to invest more than richer ones. The investment to GDP ratio controls for the level of investment before the treatment. The share of capital goods imports controls for the reliance of the country in foreign capital goods. It is a well known fact that developing countries rely more on imported capital goods than developed economies and thus it is important to take this characteristic into consideration. The current account to GDP ratio and the FDI to GDP ratio measure the reliance on external savings to fund investments and consequently are also important characteristics to be considered. Finally, we also consider the change in the commodity price export index as there is some evidence that the behavior of these economies are closely related

to it.[7]

The countries with nonzero weights are Uruguay (58.6%), Argentina (30.6%), Peru (5.7%) and Ecuador (5.2%). The results are shown in table 2 and figure 6. As we can see, the synthetic Brazil is able to match the pre-treatment characteristics of Brazil and the investment time series. Moreover, the level of investment in synthetic Brazil is significantly higher at the end of the period, with a gap of around 18%.

Real Fixed Investment	Brazil	Synthetic Brazil
GDP per capita (PPP)	9236	11034
Real GDP growth	4.2	5.2
Investment (% of GDP)	20.6	20.6
Capital Goods Imports (% of total)	37.3	32.5
Current Account (% of GDP)	-0.3	-0.3
FDI (% of GDP)	1.1	4.6
Commodity Exports Price (Average % change)	2.7	1.8

Table 2: Pre-Capital Controls Imposition Characteristics - 2006:1-2009:3

To check the significance of our results, we run what is called a placebo test, applying the methodology described before to all the untreated countries. As we can see in figure 7, the effect in Brazil is significantly different than what we get for other countries, specially after the October 2010 measures, which is coherent with the evidence in foreign cost of capital shown in section 2.

Finally, we also verify the robustness of our results by excluding from the original sample the two countries with the biggest weights, separately. As we can see in figure 8, the results are note very sensitive to the exclusion of these countries.

7. We construct real commodity export prices for each country following a methodology similar to Deaton and Miller (1996). The methodology is composed by 5 steps: (i) we find the equivalence between SITC level 4 groups and the IMF commodities database (composed by 51 commodities); (ii) we calculate for each country the value of each primary commodity exports using the UN COMTRADE database, which provides annual trade data for SITC level 4 groups, and take the average; (iii) we calculate the weights for each commodity by dividing its average value of exports for each commodity by the average total value of primary commodity exports; (iv) we use the weights to compute a geometric weighted-average of (US-dollar based) monthly nominal commodity export prices; and (v) we calculate the real commodity price index by dividing the nominal price index by the U.S. import price of manufactured articles from industrialized countries.

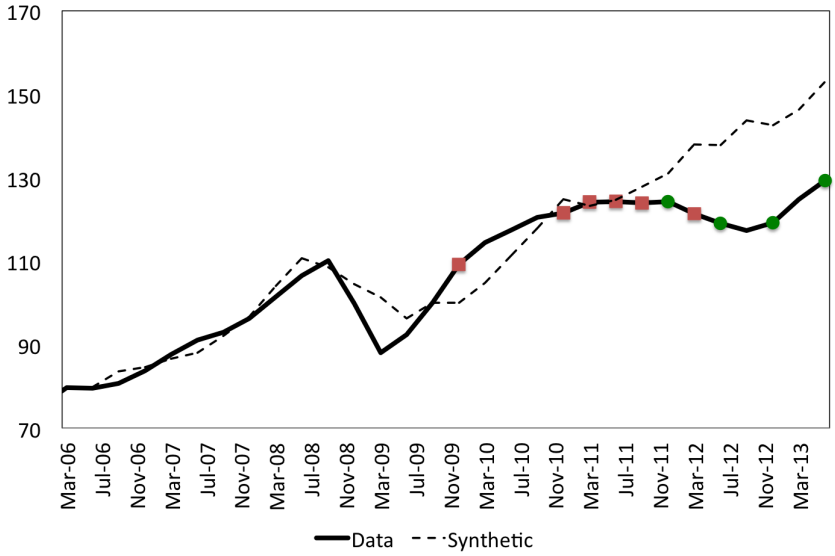

Figure 6: Real Fixed Investment - Brazil vs Synthetic Brazil

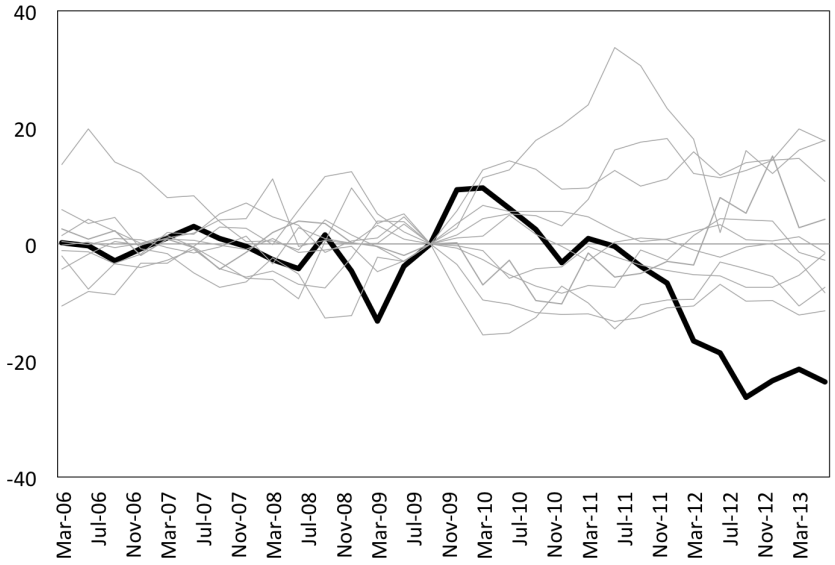

Figure 7: Real Fixed Investment - Placebo Gaps

Note: The thick black line represents the gap between real and synthetic data data for Brazil while the light gray lines represent the gap for all other countries in the sample.

3.4 The Effects on Real Consumption

We now repeat the exercise to consumption, choosing as characteristics GDP per capita, real GDP growth, consumption to GDP ratio, inflation, share of consumption goods

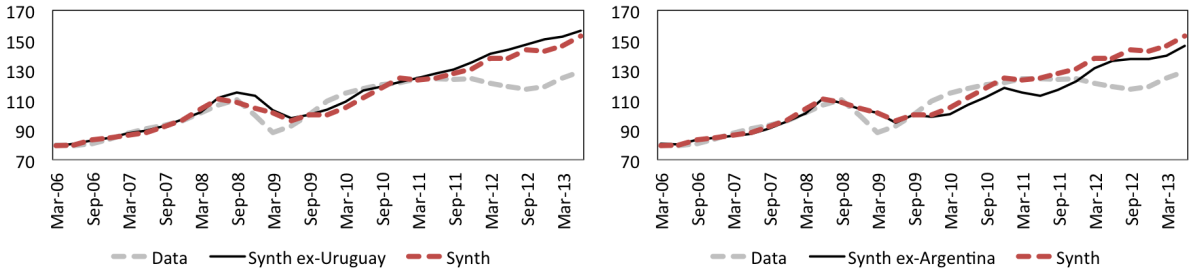

Figure 8: Real Fixed Investment - Brazil vs Synthetic Alternatives

imports to total imports and investment to GDP ratio. Again, the first two characteristics are important to get a synthetic counterpart with the same level of economic development as poorer countries usually have a different profile of consumption than richer countries. The former are more tilted towards goods while the latter toward services. Inflation is known to be an important determinant of consumption expenditures in the short run. The consumption to GDP ratio controls for the level of consumption before the treatment. We also include investment to GDP ratio to have an economy with similar spending profile. The share of consumption goods imports controls for the reliance of the country in foreign consumption goods. Finally, we target the change in the commodity price export index as there is some evidence that the behavior of these economies are closely related to it.

The countries with nonzero weights are now Peru (70.4%), Uruguay (19.9%) and Argentina (9.7%).The results can be seen in table 3 and figure 9. As we can see, the synthetic Brazil is able to match most of the pre-treatment characteristics of Brazil and the consumption time series. Again, the level of consumption in synthetic Brazil is higher at the end of the period, but now the gap is somewhat smaller, around 12%.

We run again the placebo test, applying the methodology described before to all the untreated countries. As we can see in figure 10, again the effect in Brazil is different than what we get for other countries, specially after 2011. However, we now have one of the placebos closer to the Brazilian gap, which might indicate less significant results.

We exclude again from the original samples the two countries with the biggest weights, separately, to verify the robustness of our results. As we can see in figure 11, the results

Real Private Consumption	Brazil	Synthetic Brazil
GDP per capita (PPP)	9236	8665
Real GDP growth	4.2	6.3
Inflation	4.6	4.6
Consumption (% of GDP)	70.2	64.2
Investment (% of GDP)	20.6	21.8
Consumption Goods Imports (% of total)	12.3	17.0
Commodity Exports Price (Average % change)	2.7	2.7

Table 3: Pre-Capital Controls Imposition Characteristics - 2006:1-2009:3

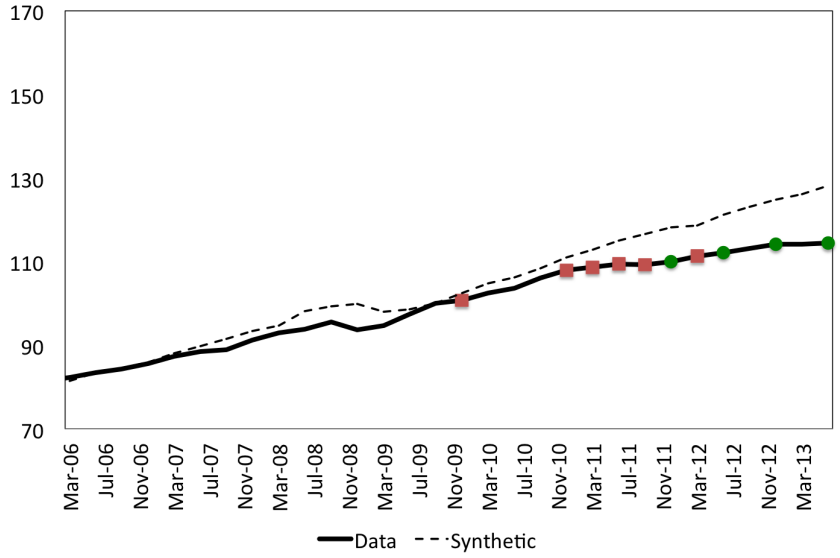

Figure 9: Real Private Consumption - Brazil vs Synthetic Brazil

are somewhat sensitive to the exclusion of Peru, but the level of synthetic consumption is even higher than before, which would indicate a stronger effect of controls on consumption.

3.5 The Effects on Real External Variables

Finally, we evaluate what the effects of capital controls were in the external real sector, repeating the exercise for exports and imports. We choose as characteristics GDP per capita, real GDP growth, investment to GDP ratio, consumption to GDP ratio and shares of consumption and intermediate goods exports or imports for each case. The first two characteristics controls for the level of economic development for the same reasons we had

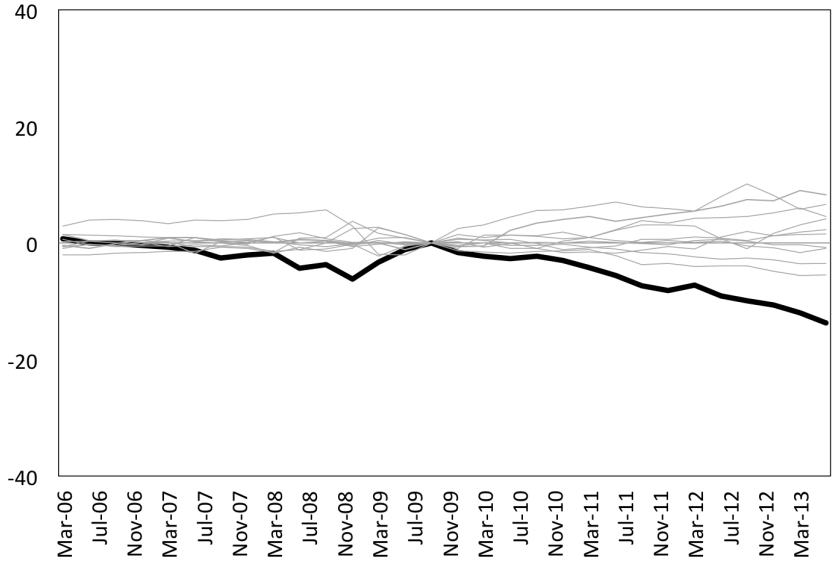

Figure 10: Real Private Consumption - Placebo Gaps

Note: The thick black line represents the gap between real and synthetic data data for Brazil while the light gray lines represent the gap for all other countries in the sample.

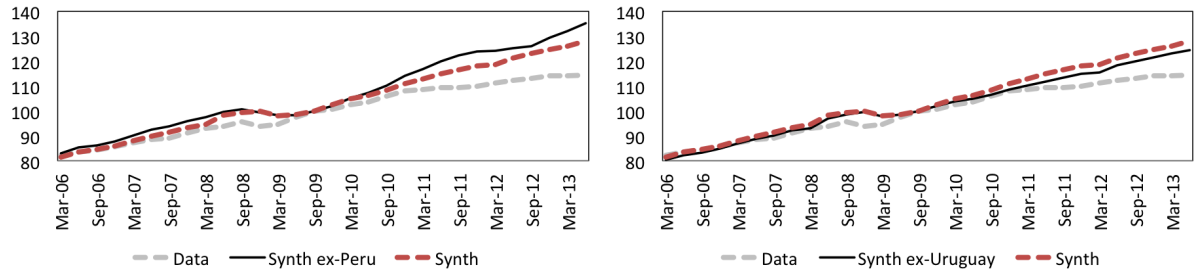

Figure 11: Real Private Consumption - Brazil vs Synthetic Alternatives

for investment and consumption. The investment and consumption to GDP ratios are used to have an economy with similar spending profiles. The shares are important to get a synthetic country with the same exports and imports profile. Finally, we also control for the change in the commodity price export index as there is some evidence that the behavior of these economies and specially its external sector is closely related to it.

The countries with nonzero weights for exports are Mexico (45.1%), Argentina (32.1%) and Chile (22.9%) and for imports are Chile (50.6%), Peru (22.6%), Mexico (15.6%) and Uruguay (11.3%). The results are shown in tables 4 and 5 and figure 12. As we can see,

the synthetic Brazil is able again to match well most of the pre-treatment characteristics of Brazil and the exports and imports time series. However, the results now are much weaker. In fact, as we can see in figure 13, running the placebo test lead us to conclude that the effect in Brazil for the external sector is not much different than what we get for other countries, which indicates that there weren't significant effects from the capital controls.

Exports Volume	Brazil	Synthetic Brazil
GDP per capita (PPP)	9236	12892
Real GDP growth	4.2	2.9
Investment (% of GDP)	20.6	22.9
Consumption (% of GDP)	70.2	61.9
Consumption Goods Exports (% of total)	28.5	26.1
Intermediate Goods Exports (% of total)	47.9	48.0
Commodity Exports Price (Average % change)	2.7	2.5

Table 4: Pre-Capital Controls Imposition Characteristics - 2006:1-2009:3

Imports Volume	Brazil	Synthetic Brazil
GDP per capita (PPP)	9236	12859
Real GDP growth	4.2	4.4
Investment (% of GDP)	20.6	21.4
Consumption (% of GDP)	70.2	61.3
Consumption Goods Imports (% of total)	12.3	16.0
Intermediate Goods Imports (% of total)	50.4	47.2
Commodity Exports Price (Average % change)	2.7	2.3

Table 5: Pre-Capital Controls Imposition Characteristics - 2006:1-2009:3

We also verify the robustness of our results again by excluding from the original samples the countries with the biggest weights, separately. As we can see in figure 14 and 15, the results are somewhat sensitive to the exclusion of Argentina for exports but they are still within the range where we would conclude that there was no significant effect of the controls on them.

This section shows that capital controls had negative effects on both investment and consumption in Brazil, with stronger and more significant effects in the former, and no significant effects on external real variables. These results might be important to evaluate

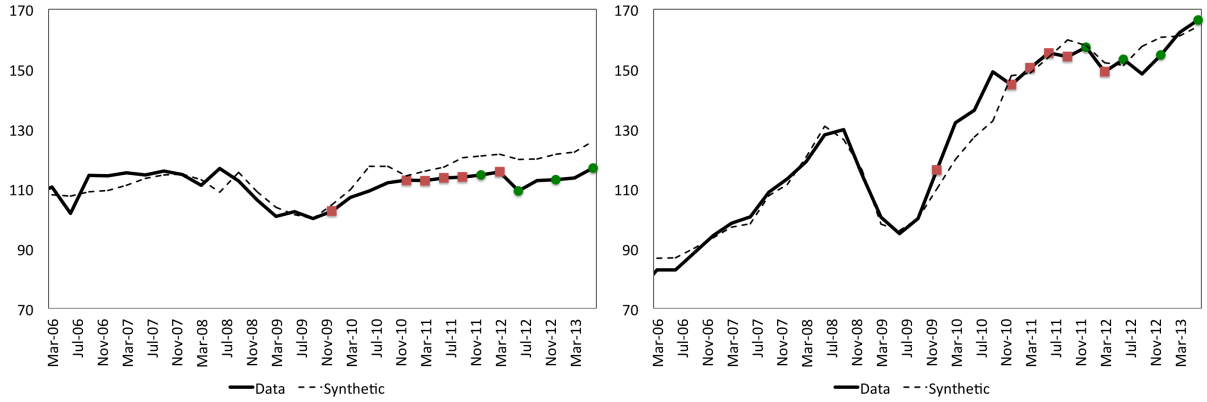

Figure 12: Real Exports and Imports - Brazil vs Synthetic Brazil

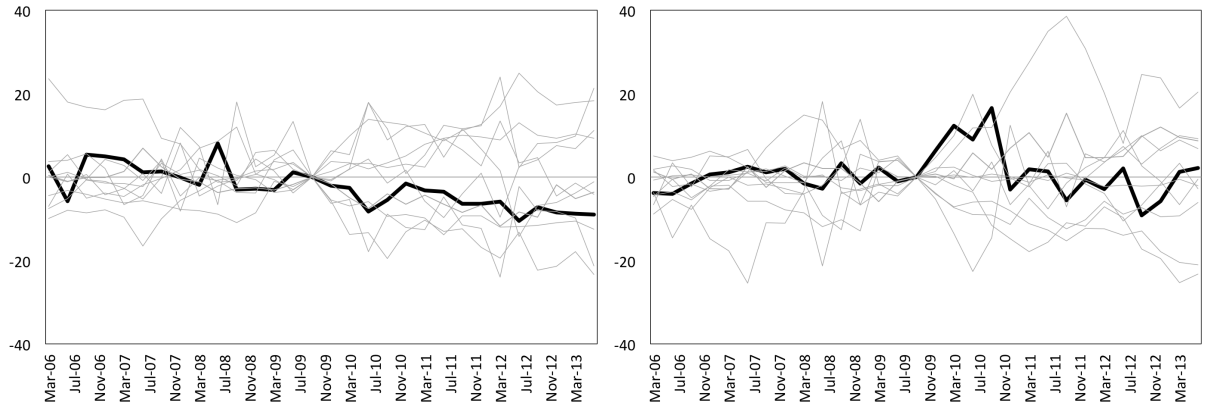

Figure 13: Real Exports and Imports - Placebo Gaps

Note: The thick black line represents the gap between real and synthetic data data for Brazil while the light gray lines represent the gap for all other countries in the sample.

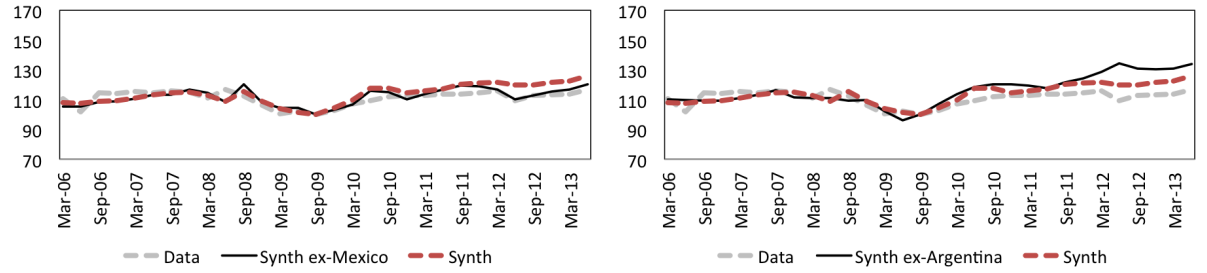

Figure 14: Real Exports - Brazil vs Synthetic Alternatives

the welfare impacts of capital controls, which gained renewed support since the Global Financial Crisis. We will now use microeconomic data to check whether we get similar conclusions using firm level data and identify the types of firms that were more affected

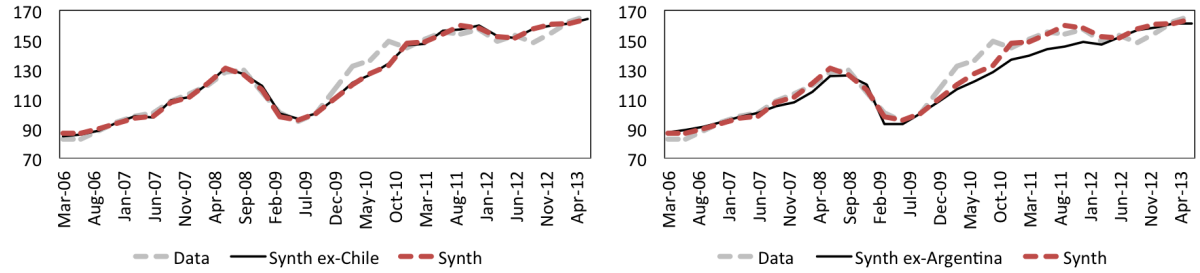

Figure 15: Real Imports - Brazil vs Synthetic Alternatives

by the imposition of controls.

4 Microeconomic Approach

4.1 Empirical Strategy

There are many potential models that we could derive here to generate estimating equations, but that is not the objective of this work. Our objective is to provide a quantification of the impact of capital controls, rather than a micro foundation. Our main estimating equation is:

$$Inv_{it} = \beta_1 Inv_{it-1} + \beta_2 \text{After} + \beta_3 \text{After*BNDES}_{it} + \beta_4 \text{Control Variables}_{it} + \eta_i + \lambda_t + \epsilon_{it}$$

Inv_t is investment over total assets at time t. After is an indicator variable that is one since 2010 and 0 before. After*BNDES is one for every year after 2009 that an individual firm received a BNDES (Brazilian Development Bank) loan, and is zero everywhere else.[8] We have different control variables for firms future investment opportunities (proxies for the marginal product of capital) - the two we will show here are cash-flow over total assets, and Tobin's q. Our specification is similar to Duchin, Ozbas, and Sensoy (2010). All variables will be fully described, with summary statistics, in the Data section below.

8. Loans from the BNDES expanded dramatically after the Global Financial Crisis, going from an average of R$46 billions before it to as high as R$190 billions in 2013. This strong policy action might have mitigated the effects of capital control measures on investment and thus we find that it is crucial to control for that.

We are positing a story that capital controls had the real effect of constricting investment. We would initially expect $\beta_1 > 0$, given the strong documented importance of lagged investment on current investment spending (see for example Gilchrist and Himmelberg (1995) and Eberky, Rebelo and Vincent (2012)). Additionally, given our story we would expect $\beta_2 < 0$, that is, that investment after the imposition of controls would be significantly lower than before. However, if the reason for the drop in investment were a negative credit supply shock, as we assume, then we would also expect $\beta_3 > 0$ as firms who had access to subsidized credit lines were not hit as hard by the controls as firms who did not.

Clearly the main estimating equation cannot be executed using simple OLS, as there are many issues that would potentially distort the results to address[9]. We will use the Arellano-Bond method which will deal with these issues.

4.2 Data

We obtained our Micro Data from the Worldscope Database on Datastream. We include all non-financial and non-public utility firms located in Brazil that reported data between 1994 and 2014. We augment this data with information of firm-level yearly loans from the BNDES[10] as well as firm-level export data from the MDIC (Ministry of Development, Industry and Foreign Trade).[11]

Worldscope only reports publicly available data, and so the sample has the potential to be biased towards larger firms. We start the sample with 651 firms from 1994 to 2014. Our first step is to drop all financial firms and public utility firms. This was done first by

9. There is a potential for endogenous regressors, there may be fixed effects that are correlated with the explanatory variables, and there could be autocorrelation due to the lagged variable.

10. BNDES provides data for all non automatic operations, which include all loans bigger than R$10 millions and account for more than half of total BNDES disbursements. As we are focusing on publicly trade companies, the smaller size loans should not be relevant for our analysis.

11. The MDIC only provides data that tells us whether a firm falls in one of the following 6 categories: (i) No exports; (ii) exports up to US$ 1 million; (iii) exports between US$ 1 and US$ 10 million; (iv) exports between US$ 10 and US$ 50 million; (v) exports between US$ 50 and US$ 100 million; and (vi) exports more than US$ 100 million. Thus, we can only split our sample in "big exporters" and "small exporters and non-exporting firms" without being able to control for firm size.

dropping firms with the relevant SIC codes but then double checked manually. Then, to minimize the possible effects of confounding factors, we restrict our attention to the four years before and after the controls: 2006 to 2013. After that, we dropped all firms that did not report data in both 2009 and 2010 to make sure that all firms in sample reported the effects of the controls. We also manually went through the remaining firms to remove any firms who had merged, or been acquired, as this produced unrepresentative spikes in data. We ended with 265 firms.

Table 6 shows some summary statistics for the firms in our sample, over the total period, as well as the four years before and after capital controls. As is evident the level of investment dropped noticeably, as did sales, while the intensive and extensive margin of BNDES loans jumped up significantly.

Variable	Total Sample	Pre-Controls	Post-Controls
Investment/Total Assets	0.0599	0.0709	0.0490
Tobin's Q	18.45	35.65	1.24
Sales/Total Assets	0.754	0.799	0.707
Number of BNDES Firms	29	28	31
Total BNDES Size of Loans	18,371	13,193	23,548

Table 6: Summary Statistics

A description of the relevant variables taken from Worldscope (along with the descriptions from the Worldscope Datatype Definitions Guide) is listed in Table 7. We define investment as capital expenditure, and normalize all variables by total assets.

4.3 Baseline Results

The results of our baseline regressions are shown on Table 8. The first column is the main regression. The second column includes business confidence at a yearly frequency, which should help act as a similar control - the coefficient here is positive, showing that an increase in business confidence led to higher levels of investment. The third is a novel control that we adapt from the Macrodata exercise. SynthInv is the first difference of

Variable	Definition
Assets (total)	Sum of total current assets, long-term receivables, investment in unconsolidated subsidiaries, other investments, net property, plant, and equipment and other assets. Adjusted for inflation.
Capital Expenditure	Funds used to acquire fixed assets other than those associated with acquisitions. Includes, but not restricted to: Additions to property, plant and equipment; Investments in machinery and equipment.
Depreciation	Cost of a depreciable asset to the accounting periods covered during its expected useful life to a business. It is a non-cash charge for use and obsolescence of an asset.
Depletion	Cost allocation for natural resources such as oil and mineral deposits.
Amortization	Cost allocation for intangible assets such as patents and leasehold improvements, trademarks, bookplates, tools and film cost.
Net Sales	Net sales or revenues of the company.
Cash	Sum of cash and short term investments.
Cash Flow	Sum of net income and all non-cash charges or credits. It is the cash flow of the company.
Market Value	Market price-year end multiplied by common shares outstanding.

Table 7: Description of the Variables

synthetic Brazil's Investment (Investment appeared to have a trend, hence the first differencing). This variable should control for any shocks that would have affected countries similar to Brazil, and is unique to our approach to this problem. Again here, this control's coefficient is positive and significant, showing that a positive shock to investment in commodity producers (or countries similar to Brazil) increases investment within Brazil. Controlling for that we still see coefficients with the signs we would expect on After and After*BNDES. The coefficient on After is consistently negative and significant at the 1% percent level. The average size of the coefficient is right around 2 percentage points. Given that the average level of investment over assets is around 6.5%, this represents a significant decline in investment - about 30%. Additionally the coefficient on After*BNDES is consistently positive and significant at the 1-5% level. The size of the coefficient is around 1.2. This means that firms that had access to subsidized credit were able to invest more

than those that did not have access, even conditioning on the general negative trend in investment. Thus, we can infer that firms with BNDES access were cushioned against the constraints. Since the net effect of the two coefficients is still negative, it is reasonable to conclude that even those firms with the cushion may have had their investment levels drop as well. The coefficient on cash flow is also significantly positive, though perhaps not large in magnitude. Using other control variables, such as Tobin's Q or sales over total assets does not change the results significantly.

	(1)	(2)	(3)
VARIABLES	Investment	Investment	Investment
Inv_{t-1}	0.0760**	0.113***	0.0773***
	(0.0318)	(0.0319)	(0.0287)
After	-0.0139***	-0.0180***	-0.0202***
	(0.00356)	(0.00376)	(0.00410)
After*BNDES	0.0125**	0.0131**	0.0124***
	(0.00506)	(0.00550)	(0.00473)
Cashflow	0.000457***	0.000370*	0.000324*
	(0.000172)	(0.000203)	(0.000179)
busconf		0.000450**	
		(0.000188)	
synthinv			0.000271***
			(0.000102)
Constant	0.0529***	0.00423	0.0558***
	(0.00438)	(0.0189)	(0.00472)
Observations	1,384	1,384	1,384
Number of firms	243	243	243

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

Table 8: Results - Baseline

4.4 Results by Size

To break down the sample by size, we take the average value of total assets over the period selected (2006 to 2013), and divide it into groups above the median and below the median. Summary statistics are shown on table 9.

We then run the same regressions as above on the three different types of controls. The results can be seen on Table 10. Interestingly, we see that the effect after capital controls was almost twice a strong for large as for small firms. Additionally, the effect of the BNDES loans appear to have the same rough magnitude for both groups, but is far

	Small	Large
Average Size	357,498	10,060,000
Average Investment/Assets	0.045	0.072

Table 9: Summary Statistics - Breakdown by Size

more significant for larger firms.[12] One potential explanation for this is that the dry up of foreign capital would have disproportionately affected larger firms, who had more access to international capital markets. Another is that small firms generally invest a smaller amount, in terms of a fraction of their total assets. Although we cannot speak to the first hypothesis, we can provide supporting evidence for the second. In general, large firms invested almost twice as much as a fraction of their total assets. Therefore the difference in the size of the coefficients makes more qualitative sense. In general, it appears that the fall in investment over assets from before capital controls to after was in the vicinity of 30-40% for both groups - in line with the aggregate numbers. This indicates, that unlike other control episodes (notably, that documented in Forbes, 2007), there was not a significantly different effect across differently sized firms.

4.5 Results by Exporter

We will now break down the results by the exporting status of individual firms. The export data was classified by overall size of exports, broken down into ranges. These were bucketed into 6 groups (from 0 to 5) manually, and then split into two groups to be as equally numbered as possible. Therefore, even though the column headings say 'Small Exporters' and 'Large Exporters' - these may not be strictly speaking, accurate. Really the distinction is between firms that export a lot, and firms that export less. Whether or not they are net exporters or that they export a considerable share of their production is not available to us. Summary statistics are shown on table 11. Exporters that export a lot

12. This result might be related to the fact that BNDES disbursements were tilted towards larger firms after the Global Financial Crisis (see De Mello and Garcia (2012), Lazzarini et al. (2014) and Bonomo, Brito and Martins (2014) for further evidence).

VARIABLES	Small Investment	Large Investment	Small Investment	Large Investment	Small Investment	Large Investment
Inv_{t-1}	0.295	0.158**	0.244	0.118*	0.426	-0.00257
	(0.245)	(0.0655)	(0.188)	(0.0649)	(0.269)	(0.0729)
After	-0.008**	-0.0173***	-0.0122***	-0.0223***	-0.0115**	-0.0270***
	(0.00416)	(0.00602)	(0.00428)	(0.00692)	(0.00516)	(0.00696)
After*BNDES	0.0119	0.0176**	0.0129*	0.0183***	0.0107	0.0142**
	(0.00774)	(0.00757)	(0.00747)	(0.00707)	(0.00715)	(0.00611)
Cashflow	0.000263**	0.0973	0.000245	0.0842	0.000124	0.117
	(0.000129)	(0.1087)	(0.000203)	(0.0901)	(0.000135)	(0.106)
busconf			0.000656**	0.000347		
			(0.000308)	(0.000346)		
synthinv					0.000329**	0.000270**
					(0.000142)	(0.000117)
Constant	0.0282***	0.0487***	-0.0354	0.0202	0.0246*	0.0668***
	(0.0106)	(0.0109)	(0.0308)	(0.0307)	(0.0130)	(0.0130)
Observations	650	734	650	734	650	734
Number of firms	124	119	124	119	124	119

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

Table 10: Results - Breakdown by Size

are, understandably, much larger than exporters that export less. However, interestingly, although they are larger, they appear to invest slightly less than smaller exporters. This is a different pattern that what emerged in the size breakdown.

	Small Exporters	Large Exporters
Number	160	110
Average Size	2,346,970	9,396,383
Average Investment/Assets	0.0631	0.0536

Table 11: Summary Statistics - Breakdown by Size of Exports

We run again the baseline regressions for both groups. The results can be seen on Table 12. Firms that exported more were far less impacted by the capital controls - although investment declined, it declined by almost a full percentage point less than their importing counterparts. These results back the intuition that the capital controls were implemented for financial (exchange rate) reasons that would limit the harm to exporters caused by a rapidly appreciating exchange rate.

Thus we have shown, both in aggregate and broken down by size and export status, that investment over total assets dropped after the imposition of capital controls. Pretty

VARIABLES	Small Exporters Investment	Large Exporters Investment	Small Exporters Investment	Large Exporters Investment	Small Exporters Investment	Large Exporters Investment
Inv_{t-1}	0.0632*	0.763***	0.0943***	0.726***	0.0618*	0.824***
	(0.0374)	(0.161)	(0.0318)	(0.146)	(0.0345)	(0.187)
After	-0.0168***	0.00127	-0.0208***	-0.00654	-0.0229***	-0.00210
	(0.00588)	(0.00505)	(0.00590)	(0.00442)	(0.00659)	(0.00625)
After*BNDES	0.0214*	0.00450	0.0240*	0.00328	0.0216**	-0.000706
	(0.0113)	(0.00585)	(0.0135)	(0.00554)	(0.0109)	(0.00595)
Cashflow	0.000514***	0.0153	0.000328	0.0186	0.000402**	-0.0356
	(0.000174)	(0.0304)	(0.000235)	(0.0273)	(0.000177)	(0.0548)
busconf			0.000298	0.000872***		
			(0.000295)	(0.000282)		
synthinv					0.000258**	0.000367***
					(0.000124)	(0.000134)
Constant	0.0566***	0.00731**	0.0222	-0.0787**	0.0593***	0.00608
	(0.00617)	(0.00943)	(0.0293)	(0.0318)	(0.00693)	(0.0121)
Observations	775	609	775	609	775	609
Number of firms	160	112	160	112	160	112

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

Table 12: Results - Breakdown by Size of Exports

consistently, the magnitude of the drop was about 30 to 40% of its original value. Large exporters, and firms that had access to the BNDES for loans did not suffer as large of a drop off.

5 Conclusion

In this work, we have shown that investment in Brazil unambiguously declined after the imposition of capital controls in late 2009. Unconditionally, we showed with micro data investment over total assets dropped at the firm level between 30 and 40 percent. Firms of different sizes were not generally differentially affected, but larger exporters fared better than smaller exporters. Additionally, firms that had access to subsidized credit from Brazil's Development Bank (BNDES) also performed much better than those that did not. Conditionally, we showed with macro data that Brazil's total investment was roughly 20 percent lower in 2013 *than it would have been* had controls not been put in place. Moreover, although larger exporters seem to have suffered less from the controls, we do not find any significant effect on real exports after their imposition.

The support for macroprudential policies in general and particularly for prudential capital controls has increased substantially after the Global Financial Crisis. In theory, capital controls can be desirable and welfare improving if they help to avoid financial and macroeconomic instability. However, if they have a disproportionate effect on investment as our results indicate, they might also have strong and long-lasting effects on potential growth, especially in economies with low savings rate such as Brazil. These effects should be taken into account to evaluate the welfare impacts of such measures.

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