Motivations for capital controls and their effectiveness

Preliminary draft - please do not quote

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Abstract

We assess the motivations for changing capital controls and their effectiveness in a country with extensive and longstanding controls - India. We focus on the controls on foreign borrowing which can in principal be justified to be motivated by macroprudential concerns. We construct a fine-grained dataset about capital control actions on foreign borrowing in India. Using event study methodology, we assess the factors that influence these capital control actions. The main factor that motivates capital control actions is the exchange rate. Capital controls are tightened after appreciation and eased after depreciation of the exchange rate. Macroprudential concerns do not seem to be a factor shaping the use of capital controls. We use both event study and propensity score matching methodologies to assess the impact of capital controls. Event study methodology suggests no impact of capital controls on most variables evaluated, but reveals limited evidence that capital controls relieve currency pressures in the short term. However, even this limited evidence disappears once selection bias is controlled for, using propensity score matching methodology.

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Contents

1 Introduction **3**

2 The research questions in the field of capital controls **6**

3 Measurement of capital control actions (CCAs) **9**

4 The setting **11**
4.1 Capital controls in India 11
4.2 Capital controls against foreign borrowing in India 12
4.3 Foreign borrowing in India 13

5 Data and methodology **15**
5.1 The Indian CCA dataset 15
5.2 Measuring macroeconomic vs. macroprudential objectives . . . 18
5.3 Methodology: Motivations for CCAs 19
5.4 Methodology: Effectiveness of CCAs 20

6 Results: What shapes CCAs? **22**
6.1 A logit analysis 22
6.2 Event study approach 22

7 Results: Were the CCAs effective? **29**
7.1 Event study approach 30
7.2 Causal analysis using propensity score matching 32

8 Conclusion **41**

A Construction of the CCAs database: Two examples **46**

B Logit model for monthly variables **47**

C Was currency volatility the driver? **48**

D Matching for dates of CCAs **48**

E Data sources **48**

1 Introduction

The global financial crisis has re-opened the debate on the place of capital controls in the policy toolkit of emerging market economies (EMEs). The volatility of capital flows during and after the global financial crisis, and the use of capital controls in major EMEs and particularly in Brazil spawned a vigorous debate amongst policymakers on the legitimacy and usefulness of capital controls. The international policy debate on capital controls stems from the fact that while restrictions on capital flows can potentially stem volatile inflows in the country that is imposing capital controls, these controls can have global implications, going beyond the economy in which they are imposed. They can distort the global allocation of capital by diverting inflows to economies that allow freer movement of capital. They can also be used as a tool in a currency war, to reduce currency appreciation pressures. The IMF has shifted its position with a perspective that these controls are a legitimate tool, and may be imposed when a country faces a net capital inflow surge, even after taking into account multilateral considerations (IMF, 2012).

What goals could capital controls potentially pursue? The first dimension lies in macroeconomic policy. Capital controls have been held out as a mechanism for avoiding overheating pressures and exchange rate pressures associated with net capital inflow surges. Others have argued that while capital controls should not be used as a tool for macroeconomic policy, they can be useful for macroprudential policy i.e. systemic risk mitigation. There are two oft-cited examples of cases where capital controls could be useful from a macroprudential perspective. First, when excessive foreign inflows risk creating domestic imbalances that cannot be directly addressed through domestic prudential regulation (for example loan-to-value ratios or capital buffers at financial institutions) as the flows are not directly intermediated through the domestic financial system. In this case, controls on cross-border transactions may be useful. A second instance where capital controls may be useful relates to foreign or foreign currency borrowing in emerging market economies (EMEs). For EMEs, an extensive literature has shown that excessive foreign currency denominated borrowing and foreign currency exposure can generate sub-optimal outcomes from a systemic risk perspective (Goldstein and Turner, 2004; Eichengreen et al., 2007). Given the evidence linking external debt, especially in foreign currency, to financial fragility, capital controls, particularly on foreign borrowing can be justified as a tool for macroprudential management: they allow the authorities to influence the level of short term foreign or foreign currency borrowing, high levels of which have been associated with past EME crises.

The IMF staff position (Ostry et al., 2010) is that capital controls can legitimately be used in the pursuit of both macroprudential as well as macroeconomic management, as measures of the last resort. While the IMF has held out this possibility, it has not articulated a full strategy through which controls could be used, which requires four elements of knowledge: (a) Precise definitions of proposed interventions; (b) Proposed rules governing conditions under which these precise actions should be taken; (c) Demonstration of effectiveness in achieving desired outcomes and (d) Demonstration that the costs are outweighed by the benefits. A significant downstream literature has addressed itself to these four questions.

In this paper, we address the first three of the four questions. We construct a precise vocabulary in classifying all capital control actions (CCAs) on foreign borrowing. We compile a definitive database about these capital control actions. We obtain evidence about the conditions under which policy makers used capital control actions, distinguishing carefully between exchange rate and macroprudential objectives. Finally, we obtain evidence about the consequences of these actions.

Our focus on India is guided by the literature on capital controls of the 1980s and 1990s, and recent work such as Klein (2012). This literature has suggested that once a country achieves an open capital account, episodic introduction of controls is not useful. Hence, if capital controls are to be used as a tool for policy, this has to be done in a context of a comprehensive administrative system of capital controls, where the government has the ability to interfere in all cross-border transactions.

At present, there are only two large economies that have a comprehensive administrative system of capital controls: China and India. Every kind of cross-border transaction is controlled, and *de jure* capital account integration as measured by the Chinn and Ito (2008) measure is very low. The empirical evidence drawn from these countries may produce insights on the four questions of this field: What kinds of interventions have been used? When have they been used? Have they yielded results? Do the benefits outweigh the costs?

The measurement of capital control actions is a challenging task. It is extremely difficult to capture the various kinds of capital controls in a simple measure that can be used for empirical analysis. The mainstream cross-country literature has relied on crude indices of capital controls, (say) annual readings of the Chinn-Ito measure. A novel strategy adopted in the recent literature consists of closely examining capital control *actions*. In contrast with the older literature, it is useful to study individual capital control ac-

tions (CCAs), to observe their precise dates, and to precisely classify the nature of the interventions.

Forbes et al. (2013) constructs a database of capital control actions drawing mainly on the International Monetary Fund (IMF) Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) data, for 60 countries, for the 2009-2011 period. They use a novel research design where propensity score matching is used to obtain a matched partner for each intervention. This permits causal identification of the impact of capital control actions. They find that most widely used capital control actions are not effective in accomplishing their stated aims.

While this constitutes better measurement of capital controls, the IMF AREAER data is a coarse measure of capital control actions. A key innovation towards better measurement of capital control actions was the dataset constructed by Pasricha (2012), which utilises AREAER, central bank websites, and news sources, to identify capital control actions in 22 emerging economies, and counts actions separately for eight broad categories of capital transactions (for example, foreign borrowing, FDI, portfolio investments etc) and within these categories, for type of measure (quantitative, price-based or monitoring measures). This reveals a much larger number of capital control actions when compared with events reported in the AREAER, and permits better classification of actions which can then reveal their consequences.

In this paper, we take the next step forward: measuring capital control actions using a legal team that reads every legal instrument associated with the capital control action. On average, our lawyers spent three man-hours per legal instrument, and constructed a fine-grained dataset about capital control actions. This yields a definitive dataset, with a careful classification of the various aspects of regulations (eg: controls on minimum maturity of loans, controls on eligible borrowers, interest rate ceiling etc). We undertake this for one country (India), analysing capital control actions on one category of transaction: foreign borrowing only. India is a good laboratory for this work, as it is the only large country apart from China which has a comprehensive administrative system of capital controls where every possible cross-border activity is regulated. Foreign borrowing is brought under focus as it is critically connected with questions of systemic risk.

Our dataset, which covers the period from January 2004 to September 2013 and contains 75 capital control actions, permits the exploration of many questions in the field. The first finding concerns the factors that influence the use of capital controls on foreign borrowing. The main factor that seems to be at work is the exchange rate. Capital controls are tightened after

appreciations and eased after depreciations. Measures of systemic risk do not seem to be a factor shaping the use of capital controls.

What was the impact of these actions? We explore the impact of these actions using event studies. There is a strong selection process at work: capital control actions are likely to take place when faced with certain circumstances. Hence, we draw on recent developments in propensity score matching, to match the *date* on which a capital control action was applied against a similar *date* with no capital control action. This permits causal identification of the impact of the capital control action. Our results show no impact of the capital control actions in any dimension evaluated. We also analyse some sub-categories of controls, in the hope that certain kinds of restrictions would be more effective than others, but find no effect in all subsets studied.

The remainder of this paper is organised as follows. Section 2 identifies the four major questions that are now of interest in this literature, reviews recent developments in the literature to address these questions and places in context our contributions to the literature. Section 3 describes recent developments in measurement of capital control actions. Section 4 describes the Indian system of capital controls, with an emphasis on capital controls against foreign borrowing, and documents the construction of the novel dataset about Indian capital control actions on foreign borrowing. Section 5 describes the data and methodologies used in the paper. Section 6 identifies the factors that shape the use of capital control actions. Section 7 measures the impact of these actions. Section 8 concludes.

2 The research questions in the field of capital controls

If capital controls were to graduate from a heterodox idea and become a mainstream tool that is used in well structured regulatory processes with the rule of law, a precise statement of the proposed intervention is required, along with precise specification of the conditions under which the restriction would kick in. The coercive power of the State is located within a framework of objectives, minimal coercive power and accountability mechanisms. A cost-benefit analysis would need to take place, to demonstrate that the proposed intervention is the best. These stages of analysis are required in the regulation-making process, by law, in many countries. Hence, in the present state of the debate, there are four unsolved questions of importance:

1. *The need for precise definitions and a shared vocabulary.* A very wide array of impediments to cross-border transactions are all covered by the broad term 'capital controls'. For capital controls to become part of the policy toolkit, there is a need to arrive at precisely articulated interventions, and a shared vocabulary, through which these interventions can be discussed, enacted and evaluated.

   The literature on capital controls of the 1980s and 1990s, and recent work such as Klein (2012), emphasises that episodic introduction of controls is not useful. Hence, if capital controls are to be used, this has to be done in a context of a comprehensive administrative system of capital controls, where the government has the ability to interfere in all cross-border transactions. The full array of restrictions needs to be specified, categorised and analysed. As mentioned in the previous section, a recent wave of literature has started this process (Pasricha, 2012; Hutchison et al., 2012; Forbes et al., 2013)). We go further in this direction by constructing a fine-grained dataset of capital control actions that separately classifies every aspect of regulation related to foreign borrowing in India.

2. *What do EME policy makers actually do, in their use of capital controls?* Do EME policy makers use capital controls in order to achieve exchange rate objectives, or are they used to pursue systemic risk objectives? Factually assessing the motivations for past EME capital controls actions can help inform the debate on capital controls, and the resulting international consensus on the rules of governance for their use. If it can be discerned in the data that emerging markets infact have been using capital controls to target systemic risk, this bolsters the legitimacy of the EME case for continued use of these instruments. On the other hand, if the data suggests that capital control actions have been used for currency manipulation, this would underscore the need for further international discussions on the rules of the game to address multilateral concerns.

   The recent debate has almost entirely focussed on what emerging economies should do, and evidence of what motivates their actions is a nascent area of research. Pasricha (2012) uses data on capital control actions on a broad range of international capital transactions for 18 EMEs over the period 2004-2010 and finds that the use of capital control actions follow trends in net capital inflows - measures to reduce net capital inflows were at their peak in 2010 and 2007, when net capital inflows to EMEs were at their peak. The paper also finds that the broad majority of capital control actions were not "prudential-type measures", i.e. were not directly targeted to address build-up of financial risk. Aizenman and Pasricha (2013) focus only on capital control actions with respect to controls on outflows by residents and find that these were also motivated by net capital inflow pressures. Fratzscher (2012) uses the measures of de-jure levels of capital controls (Chinn-Ito and

Schindler indices) to assess macroprudential vs. exchange rate objectives and finds that exchange rate and overheating objectives primarily drove capital control actions in a broad sample of countries. Our paper provides a systematic evaluation, through an event study, of macroprudential vs macroeconomic objectives using detailed data on a type of instrument - controls on foreign borrowing - that in principal would be well-suited to address systemic risk concerns.

3. *What capital controls are useful under what conditions?* An understanding is required of the conditions under which different kinds of capital controls are appropriate, which can then be translated into precise rules for financial regulators. This requires empirical evidence about the impact of capital controls upon macroeconomic outcomes and vulnerabilities to the financial system.

   Ostry et al. (2012) show a statistically strong association between financial sector-specific capital controls and lower foreign exchange borrowing. Empirical analysis by Ostry et al. (2010) suggests that countries with controls on debt flows fared better during the recent global financial crisis. However, empirical analysis by Blundell-Wignall and Roulet (2013) qualifies these results and finds that while certain kinds of restrictions on inflows (particularly debt liabilities) were most useful in good times, lower controls on bonds and on FDI inflows were associated with better growth outcomes during the recent global financial crisis period. Our dataset allows us to capture precisely the nature of and dates of each of the capital control actions, so that their impact on different macroeconomic and financial variables can be isolated in an event study setting.

4. *Weighing costs against benefits.* Cost-benefit analyses are required, which juxtapose the insights of previous decades, about the microeconomic and political economy problems associated with capital controls, against the putative gains.

   A wide body of research on capital controls focused on microeconomic distortions has highlighted consequences such as reduction in diversification opportunities for firms and households and hence enhanced risk exposure; increased cost of financing and competitive disadvantage for domestic firms that do not have direct access to capital markets (Edwards and Ostry, 1992; Edwards, 1999; Forbes, 2005, 2004). Further, the operation of a complex system of capital controls is like any other complex intervention by the government: it is vulnerable to problems of political economy with lobbying by special interest groups. Establishing the rule of law and sound governance is particularly hard in the field of capital controls, as it is hard to demonstrate that a minimal intervention is being undertaken in response to an identifiable market failure.

Even if a country was willing to accept these microeconomic distortions, the evidence is mixed on the extent to which capital controls are able to deliver on the objectives of macroeconomic policy. While capital controls seem to be able to change the composition of flows toward more long-term debt, it is not clear to what extent this represents a mislabelling of flows (Magud et al., 2011; Carvalho and Garcia, 2008). Once the economy has sophisticated firms, the restrictions imposed by any one capital control are bypassed to a substantial extent through financial engineering and misinvoicing. On the other hand, Patnaik and Shah (2012) find that the Indian capital controls were not an effective tool of macroeconomic policy. Cost-benefit analysis is a key mechanism for improving the quality of work in the regulation-making process in finance, and much remains to be done, when it comes to capital controls. We do not undertake a cost-benefit analysis in this paper.

3 Measurement of capital control actions (CCAs)

An assessment of the motivations for and effectiveness of capital controls is complicated by the challenges involved in the measurement of capital control actions. It is extremely difficult to capture the various kinds of capital controls in a simple measure that can be used for empirical analysis.

The mainstream cross-country literature has relied on crude indices of capital controls. Existing measures of *de jure* capital account openness like the Chinn and Ito (2008) [1] and the Schindler (2009) indices [2] measure the level of capital controls using the summary classifications table published by the IMF in the AREAER.[3] While these measures are easily compiled and helpful in cross-country comparisons, they do not capture the complexity of capital controls particularly when a complex administrative system of capital controls is in place.

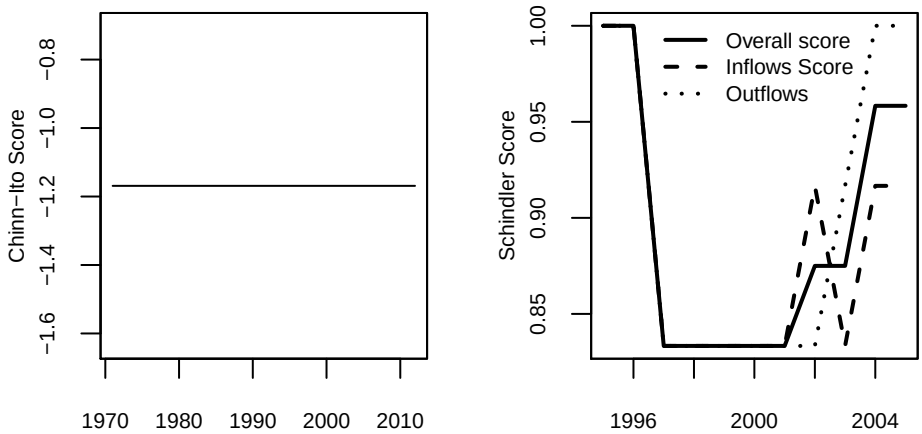
As Figure 1 shows, Chinn and Ito (2008) measure does not detect any change in India's level of openness for the entire time-series for India from 1970. The problem with measures based on AREAER classification table is that they only

[1]The Chinn-Ito measure ranges from -1.83 to 2.53, with -1.83 being a closed capital account economy and 2.53 being a open economy

[2]The Schindler measure ranges from 1 to 0, with 1 being a closed capital account economy and 0 being a open economy

[3]The IMF has been reporting on exchange arrangements and restrictions from 1950 onwards and provides a description of the foreign exchange arrangements, exchange and trade systems, and capital controls of all IMF member countries. The AREAER has provided a summary of capital controls for a wide cross section of countries since 1967.

Figure 1 De-jure measures of capital account openness: India



(a) Chinn-Ito measure (b) Schindler measure

detect a move towards capital account openness when an entire sub-category of controls is dismantled. In cases of countries like India, the process of capital account liberalisation has gone from complete prohibitions to complex bureaucratic procedures. The process has generally moved towards greater capital account openness, but without dismantling the structure of controls. This allows the authorities to retain their ability to reverse past liberalisations. These complexities are hard to capture in summary measures like Chinn and Ito (2008) and Schindler (2009). Another constraint of these databases lies in the frequency: They report one value every year. This hinders the use of high frequency data in analysing the impact of changes in capital controls.

A key innovation of the recent literature lies in shifting focus from the *level* of capital account openness to individual capital control *actions*. It may be hard to quantify the extent of restrictions present at a point in time. But it is more feasible to unambiguously identify the date of a CCA, and to place it within a classification system. This permits the analysis of *changes* in the system of capital controls, using high frequency data, and high quality measurement of each capital control actions.

This strategy is used by Forbes et al. (2013), which is primarily based on the IMF AREAER, supplemented with news sources. This paper covers 60 countries for a short window of time (2009-2011). As an example, this dataset contains 7 actions – 5 easing and 2 tightening – for India.

Pasricha (2012) constructs a fine-grained database of CCAs in 22 emerging markets for the period 2004-2010. This also uses data from AREAER, but extends it by obtaining information from websites of central banks and other regulators, news sources, and other research papers. Further to increase comparability among actions, capital control changes announced on the same date are broken down by the categories of transactions they affect (eg: portfolio flows, FDI etc), and the type of change (quantitative, monitoring or price-based) and each is counted as a separate action. As an example, for the 2009-2011 period, this dataset (extended in Hutchison et al. (2012)) contains 27 actions relating to inflow controls for India, out of which 9 relate to foreign borrowing restrictions.

In this paper, we take the next step forward in constructing a high quality dataset about CCAs. The classification system tracks changes in each aspect of regulations on foreign borrowing. For example, changes in quantitative limits on foreign borrowing are counted independently of changes in permissible end-uses of the funds borrowed, even if announced on the same date. A team of lawyers obtained all legal instruments through which CCAs were taken, and expended three man-hours of time per instrument on average. This yields a definitive dataset about capital control actions, and a sound classification system for these actions. As an example, for capital controls against foreign borrowing only, for the 2009-2011 period, this dataset contains 14 actions.

4 The setting

4.1 Capital controls in India

Capital controls were introduced in India by the British colonial authorities, as a temporary wartime measure, in 1942. They gradually evolved into a comprehensive system of restrictions on cross-border capital mobility with the Foreign Exchange Regulations Act (FERA), 1973, which criminalised violations. At the time, current account integration was also highly restricted. The conditions associated with a 1991 IMF program required decontrol of the current account and the capital account. The current account has become open, and violations of capital controls are no longer criminal offences.

All capital account transactions are prohibited unless explicitly permitted. The permissions are expressed through a set of legal instruments issued by the central bank, RBI, and the Ministry of Finance. Restrictions differ by the

type of investor, the asset class, the recipient of foreign capital, the end-use that the recipient firm puts foreign capital to, etc.

There are three areas where there are no quantitative restrictions (QRs): inbound FDI, outbound FDI, and foreign investment in the equity market. In all other areas, QRs are in place, through which the RBI specifies caps upon cross-border activities. As an example, there is a cap upon the aggregate ownership by all foreign investors, put together, of rupee-denominated debt. Similarly, there is a cap upon the amount of capital that can be taken out of the country per year by one resident.

There is no unified manual or legal document that shows all the capital account restrictions that are in place. A collection of all legal instruments that make up the capital controls system may add up to 1 million words. No one person is likely to comprehensively know all capital controls law. Sinha (2010) is a useful description of the capital controls prevalent in 2010.

4.2 Capital controls against foreign borrowing in India

Foreign borrowing with maturity of less than three years is termed short-dated borrowing. Short-dated borrowing is prohibited except if it is trade credit. Trade credit can have maturity of above three years also.

The remainder – foreign borrowing of maturity greater than three years which is not trade credit – is termed 'external commercial borrowing' (ECB). ECB has, in turn, been broken into two sub-mechanisms. Some classes of firms are permitted to borrow under certain conditions through an "automatic" window. When these tests are not satisfied, firm have to apply for "approval" from RBI.

The regulations are extremely detailed involving prices (e.g. rules about the highest interest rate that can be paid), quantities (e.g. caps on the magnitude that can be borrowed and the maturity), industrial policy (firms in certain industries are allowed to borrow, others are prohibited), etc. Table 1 shows 18 categories of rules, and the treatment of these rules under the automatic and approval route of ECB and under trade credit.

These restrictions are quite unlike those seen in other EMEs which have substantially scaled back capital controls as part of the modernisation of their economies. For example, successive AREAERS suggest that Chile had no restrictions on credit from non-residents to residents after 2000. There were certain registration requirements and withholding tax on interest on

Table 1 Regulatory sub-classes for ECBs and trade credits

Major Category	**ECB**		**Trade Credits**
Description of control	Automatic Route	Approval Route	Automatic Route
Eligibility criteria to borrow	Eligible Borrowers	Eligible Borrowers	
Controls on eligible lenders	Recognised Lenders	Recognised Lenders	
Quantitative caps and Maturity Restrictions	Amount and Maturity	Amount and Maturity	Amount and Maturity
Price ceiling	All-in-cost ceilings	All-in-cost ceilings	All-in-cost ceilings
Permitted activities with foreign exchange	End-use	End-use	
Special route for spectrum auctions	Payment for Spectrum Allocation	3G Spectrum Allocation	
Un-permitted activities with foreign exchange	End-uses not permitted	End-uses not permitted	
Guarantees by financial institutions	Guarantees	Guarantees	Guarantees
Nature of Security that can be used by borrowers	Security	Security	
Remittance of borrowed funds into India	Parking of ECB proceeds	Parking of ECB proceeds	
Early repayment of ECB's	Prepayment	Prepayment	
Additional ECB for repayment of ECB's	Refinancing of an existing ECB	Refinancing of an existing ECB	
Interest payment of ECB's	Debt Servicing	Debt Servicing	
Legal Process	Procedure	Procedure	Reporting Arrangements
Route for distressed corporate entities	Corporates Under Investigation		
Committee that decides approval route		Empowered Committee	
Special approval category		ECB for Rupee loan repayment	
Special approval category		ECB for low cost housing	

loans in Korea, but only notification requirements for large loans; in Mexico, there were no restrictions imposed except for some limits on foreign currency borrowing by banks as a percentage of their net worth and on their open foreign exchange positions; in Brazil, there were no controls other than for some time, transparent tax on short term borrowing; and in Turkey, for some part of the last decade, there were restrictions in place on foreign currency and foreign currency-linked consumer and mortgage loans.

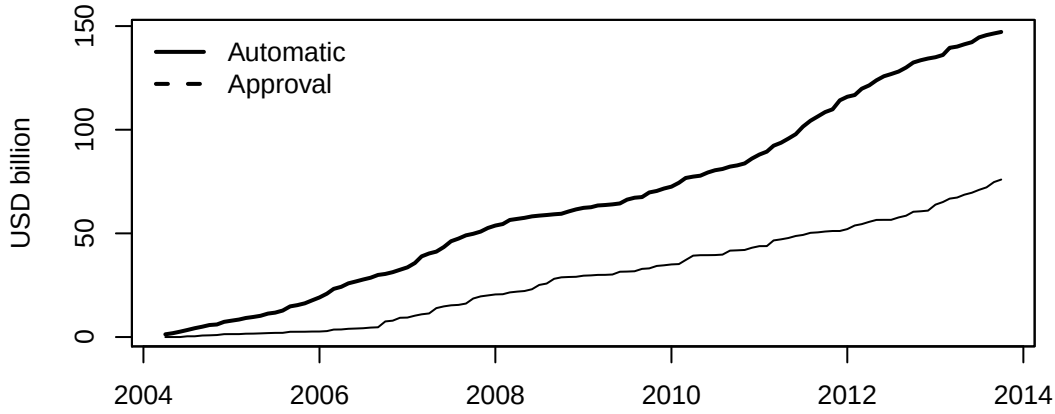
4.3 Foreign borrowing in India

Figure 2 shows the cumulative borrowing that has taken place under ECB (automatic) and ECB (approval) mechanisms over the last decade. The stock of borrowing in March 2013 was 12 times higher than that of March 1991. Expressed as a proportion to total external debt, this rose from 20.3% in March 2000 to 32.7% in March 2013.

The RBI reports the average maturity of all realised medium to long term foreign borrowing (ECB) at a monthly frequency from Jan 2004 onwards. Figure 3 shows that the average maturity period of medium to long term foreign borrowing lay largely between 4-6 years over the entire time series.

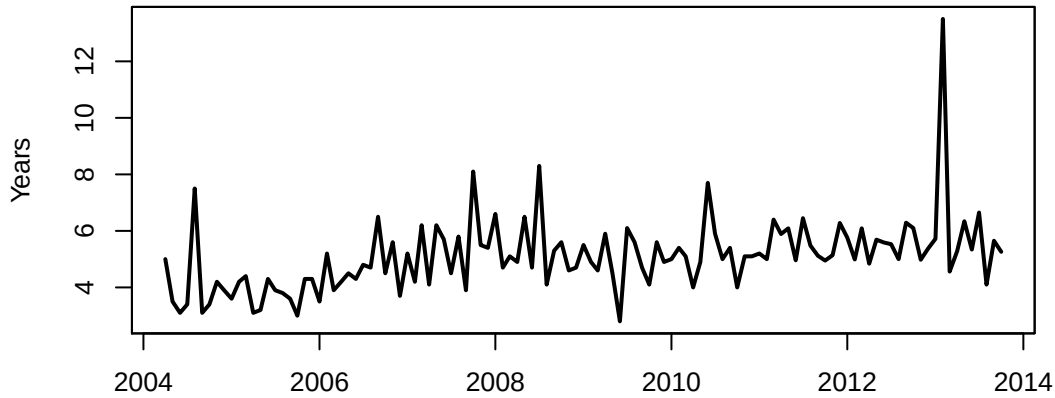
The Indian capital controls are strongly biased in favour of long-dated borrowing: Only trade credit is permitted as a mechanism for short-dated borrowing. It would, hence, be interesting to compare the outcomes of Indian foreign borrowing against the experiences of other countries. Figure 4 com-

Figure 2 Cumulative borrowing through ECB



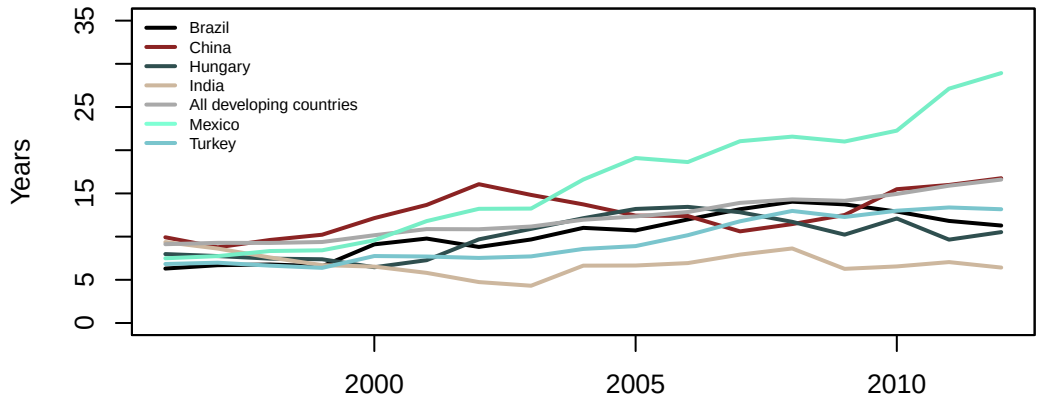
Source: RBI monthly statistics

Figure 3 Average ECB maturity period



Source: RBI monthly statistics.

Figure 4 Average maturity of new private external debt commitments: EMEs



Source: World Bank, International Debt Statistics

pares the maturity structure of new debt from a group of emerging markets that had few restrictions on foreign borrowing during this time period. The figure shows that India had a similar maturity structure as other countries in 1995. Hence, the fact that Indian borrowing had a maturity of four to six years may not have been a consequence of the capital controls system. However, over the last 20 years, many EMEs have increased the maturity of their external debt, as their financial systems developed and the demand for EME asset classes increased, but India's maturity structure has stagnated.

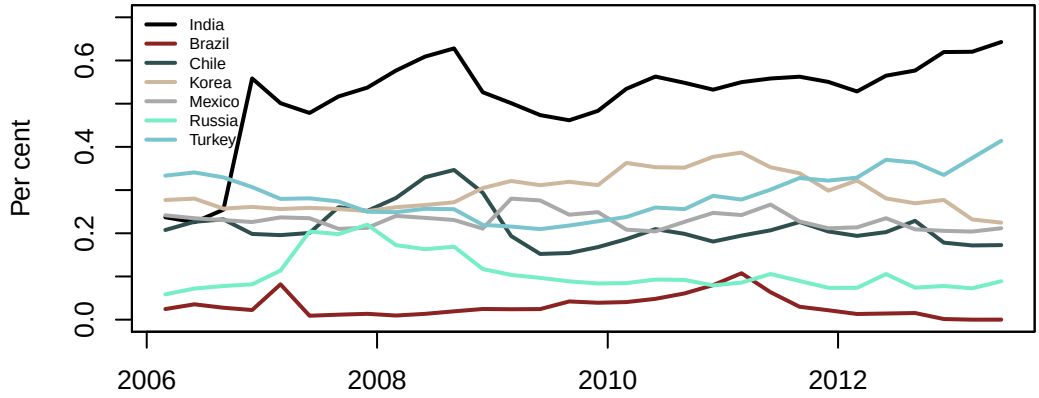
A similar anomaly is visible in Figure 5, which shows that India has the most short-dated borrowing, relative to long-dated loans, when compared with other EMs that have few restrictions on foreign borrowing.

5 Data and methodology

5.1 The Indian CCA dataset

There are roughly 100 legal instruments which add up to the full history of capital controls for ECB between January 2004 to September 2013. Our comprehensive scan of legal instruments ensures that the resulting database is the definitive enumeration of capital control actions. Even though administrative and procedural changes can have a substantial impact upon the

Figure 5 Ratio of short term to long term loans



Source: World Bank Quarterly External Debt Statistics.

ability to undertake transactions, the strategy adopted was to focus only on substantive changes.

Our approach is to count separately a change in every aspect of regulation (regulatory sub-classes in Table 1) even if one or more of these are changed on the same date. Our approach differs from related work in this field. As an example, if one RBI circular eases the eligibility criteria for firms allowed to borrow abroad as well as eases the maturity restrictions, Pasricha (2012) classifies this as one event. We classify this as two distinct actions. This makes possible the analysis of various classes of CCAs.

For our empirical analysis, we drop the dates of mixed events: dates on which easing and tightening changes were simultaneously introduced. We also drop those changes on controls in foreign borrowing that overlap with other changes in capital controls. This yields a database of unambiguous changes in capital controls on foreign borrowing with no contemporary confounding events in terms of CCAs.

Table 2 shows summary statistics of our capital controls actions database. Of a total of 75 events, 68 are easing and 7 are tightening. As this shows, the largest number of changes took place in the definition of the class of firms that were considered eligible for the automatic route or the approval route. As most of the records pertain to easing, in many elements of the analysis which follows in this paper, we analyse easing events only.

Table 3 shows the number of records in the database in each year. The most events were seen in 2012 and 2013, when many CCAs took place to ease

Table 2 Tightening and easing events

Variables	Easing	Tightening
Automatic eligible borrowers	12	1
Automatic amount and maturity	8	0
Automatic all-in-cost ceilings	1	1
Automatic end use	6	1
Automatic end use not allowed	0	1
Automatic parking	0	1
Automatic prepayment	3	0
Approval eligible borrowers	17	0
Approval amount maturity	4	0
Approval all-in-cost ceilings	2	1
Approval end use	9	0
Approval parking	0	1
Approval prepayment	1	0
Trade-credit amount maturity	2	0
Trade-credit all-in-cost ceilings	3	0
Total	68	7

Table 3 Year-wise CCAs

Year	Easing events	Tightening events
2003	0	1
2004	2	0
2005	6	0
2006	2	0
2007	1	6
2008	8	0
2009	0	0
2010	8	0
2011	6	0
2012	20	0
2013	15	0

controls. However, most tightening events took place in 2007, when the net capital inflows to India were surging.

5.2 Measuring macroeconomic vs. macroprudential objectives

We use the CCA database to address two questions: first, are the CCAs imposed in response to macroeconomic management concerns or macroprudential management? Second, what impact did the CCAs have on macroeconomic and financial variables?

In order to address these questions, we need to distinguish between variables that represent macroeconomic management objectives from those that represent macroprudential objectives. A joint report by the BIS, FSB and IMF (BIS et al., 2011) carefully distinguishes macroeconomic objectives from macroprudential objectives. In their analysis, a target exchange rate or a target level of exchange rate volatility is not seen as an objective of macroprudential policy.[4] In this paper, we follow the BIS-IMF-FSB approach and distinguish between macroeconomic objectives (exchange rate pressures) and macroprudential objectives.

We use four outcome variables to assess exchange rate objectives:

1. INR/USD returns: This variable is the daily percentage change in spot exchange rate of the Indian rupee (INR) against the US dollar.

2. Frankel-Wei residual: Consider the exchange rate regression Haldane and Hall (1991) that has gained prominence after Frankel and Wei (1994). An independent currency, such as the Swiss Franc (CHF), is chosen as an arbitrary 'numeraire', and the regression model is:

$$d\log\left(\frac{\text{INR}}{\text{CHF}}\right) = \beta_1 + \beta_2 d\log\left(\frac{\text{USD}}{\text{CHF}}\right) + \beta_3 d\log\left(\frac{\text{JPY}}{\text{CHF}}\right) + \beta_4 d\log\left(\frac{\text{DEM}}{\text{CHF}}\right) + \epsilon$$

   The ϵ of this regression can be interpreted as the India-specific component of fluctuations of the INR/USD exchange rate.

[4] However, in the remaining literature, the distinction between macroeconomic and macroprudential objectives is not so clear. Blanchard (2013) suggests a much more complex approach where monetary policy, exchange rate intervention, macroprudential measures and capital controls are all used to manage the exchange rate, and this is justified in order to prevent large exchange rate changes which are thought to cause disruptions in the real economy and in financial markets.

3. Exchange market pressure: This variable is the Felman and Patnaik (2013) measure of exchange market pressure expressed in terms of per cent change in exchange rate at a monthly frequency. It indicates how much the exchange rate would have moved if the central bank did not intervene in the foreign exchange market or change the interest rates. Positive (negative) values indicate a pressure to depreciate (appreciate).

4. Real effective exchange rate: This variable is the weighted average of nominal exchange rates adjusted for relative price differential between the domestic and foreign countries.

To assess macroprudential objectives, we use the following variables:

1. Foreign borrowing: This is the month-on-month growth in foreign borrowing under the automatic and approval route.

2. Private bank credit growth: This is the month-on-month percentage growth of non-food credit extended by the banking sector. In order to avoid the confounding effects of the highly volatile inflation time-series, credit growth is re-expressed in real terms.

3. Stock price returns: This is the daily percentage change in the S&P CNX Nifty closing prices.

4. Gross capital inflow surge: This is the quarter-on-quarter growth in gross flows on the financial account of Balance of Payments.

5. M3 growth: This is the month-on-month growth in money supply.

5.3 Methodology: Motivations for CCAs

We approach the question of what motivates use of CCAs in two ways. The first approach involves using both sets of outcome variables (measuring exchange rate and macroprudential objectives) in a logit model explaining easings of controls.[5] If only exchange rate variables are significant and of the right signs, we may infer that the exchange rate motivations are predominant. The logits are done at a weekly frequency and 3 lags of each of the outcome variables are used.[6] The weekly frequency puts a constraint on the outcome variables we may use in the logits.[7] For exchange rate objective,

[5] There were too few tightenings in sample for a robust logit analysis.

[6] The results are not sensitive to the choice of lag.

[7] In Appendix B, we also provide results for logits at a monthly frequency. The results are unchanged.

Table 4 Event Study for Capital Controls Motivation: Expected Trends

Variable	**Trend prior to:**	
Exchange Rate Objective	Easing	Tightening
INR/USD Returns	Depreciation	Appreciation
Frankel-Wei Residual	Depreciation	Appreciation
Exchange Market Pressure	Depreciation	Appreciation
REER	Depreciation	Appreciation
Macroprudential Objective	Easing	Tightening
Foreign Borrowing (ECB)	Slowing	Increasing
Bank Credit Growth	Slowing	Increasing
Gross Inflows	Slowing	Increasing
Stock Price Growth	Slowing	Increasing

we use two specifications. In the first specification we use the spot returns and in the second specification we use the predicted part and the residual from the exchange rate regression used in Frankel and Wei (1994). To proxy concerns about build-up of financial imbalances, we use growth in M3 and the stock market (Nifty) returns.

The second approach to address the question of motivations for CCAs involves using an event study. The event study looks for statistically significant trends in each of the outcome variables, in the period leading up to the event date which is the date of the CCA. If the CCAs are used as a tool of exchange rate policy, then foreign borrowing is restricted when there is pressure to appreciate, and vice versa. On the other hand, a macroprudential regulator would tighten controls on foreign borrowing in response to evidence of excessive foreign borrowing, excessive currency mis-matches or asset price bubbles. The testable hypotheses for each of our outcome variables are summarised in Table 4.

For the event study, mean adjustment is used in all cases, where the time-series of percentage changes in a time-series is de-meaned. Bootstrap inference for event studies as implemented in Anand et al. (2014) is utilised.

5.4 Methodology: Effectiveness of CCAs

To study effectiveness of capital controls we use two methodologies. First, we conduct event studies starting from the event date, i.e. the date of a CCA. The event studies are done separately on easing and tightening events, with all events included in the sample. Table 5 presents the testable hypothesis with respect to each of the outcome variables under the assumption that

Table 5 Event Study for Capital Controls Effectiveness: Expected Trends

Variables	**Expected Impact of:**	
Exchange Rate Objective	Easing	Tightening
INR/USD Returns	Appreciation	Depreciation
Frankel-Wei Residual	Appreciation	Depreciation
Exchange Market Pressure	Appreciation	Depreciation
REER	Appreciation	Depreciation
Macroprudential Objective	Easing	Tightening
Foreign Borrowing (ECB)	Increase	Decrease
Bank Credit Growth	Increase	Decrease
Gross Inflows	Increase	Decrease
Stock Prices	Increase	Decrease

capital controls were effective.

While an event study with all CCA changes allows us to identify changes in series after a CCA, it does not allow us to make causal inference. The RBI utilises a certain selectivity process which determines when a CCA is employed. In order to isolate the treatment effect of CCAs on outcome variables, we use propensity score matching methodology to identify time periods that had similar characteristics as those prior to the date of the CCA but where no CCA was employed (control group). We then compare the outcomes in the weeks after CCA between the treatment and control groups.

The conventional use of propensity score matching is located around units of observation such as a firm or a household, where a selection process has identified some units for a treatment. A logit regression is utilised to characterise the selection process. Units with a proximate value of the propensity are similar to the treated units, but were not treated. This strategy can be extended to identifying *time periods* as controls (Moura et al., 2013; Aggarwal and Thomas, 2013). The explanatory variables used in the logit model are: exchange rate changes, credit growth, money supply growth and returns on Nifty.

There are 33 weeks in which 68 easing measures are observed. We delete weeks in which there was both tightening and easing. We force a minimum window of ± 4 weeks around treatment dates to ensure that treatment and control dates do not overlap. We introduce a caliper to achieve common support and get 22 matched pairs. We then do an event study using only these matched pairs.

The subsequent sections describe our results.

6 Results: What shapes CCAs?

Both logit and event study analysis indicate a predominance of exchange rate motivations for undertaking CCAs.

6.1 A logit analysis

When we use both exchange rate and other financial variables together in a logit regression to assess which of the variables are associated with a higher probability of easing of inflow controls, we find that only exchange rate variables are statistically significant. Table 6 shows the results of logit models which explain a dummy variable which is 1 in weeks in which an easing CCA is present. Model 1 uses the raw INR/USD exchange rate. The only regressors that are significant are the INR/USD exchange rate with a lag of 1 week and 3 weeks. In both cases, depreciation predicts easing. Model 2 shifts from the raw INR/USD returns to two components: the predicted part and the residual from the exchange rate regression used in Frankel and Wei (1994). At the same two lags (1 and 3), the residual of the exchange rate is statistically significant.

Appendix shows the results of logit model with variables at monthly frequency. Here we include monthly foreign borrowing flows as one of the explanatory variable. Again, the only regressor that is significant is the INR/USD exchange rate.

This evidence suggests that RBI eases CCAs on foreign borrowing when faced with currency depreciation. There is no evidence of responding to credit growth, stock market returns or broad money growth.

6.2 Event study approach

Our next step in the analysis is to conduct a series of event studies. This permits careful analysis of one time-series of interest at a time, in the period leading up to the event date which is the date of the CCA.

Exchange Rate Objectives

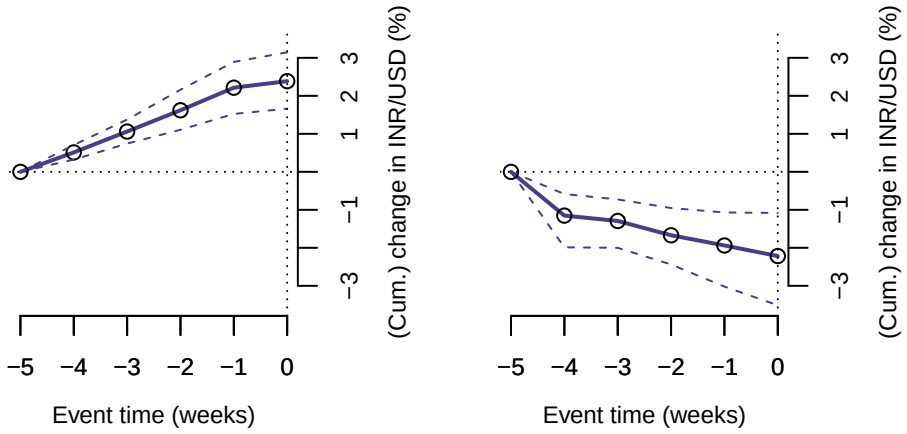
The mean-adjusted time-series of the USD-INR exchange rate prior to the CCA date is shown in Figure 6. The left pane (Figure 6(a)) shows the average movement of the USD-INR in the five weeks prior to the date on which an

Table 6 Logit on easing of controls on foreign borrowing

	Model 1	Model 2
(Intercept)	-3.52^*	-3.32^*
	(0.29)	(0.27)
INR returns$_{t-1}$	0.60^*	
	(0.27)	
Bank credit growth$_{t-1}$	-0.38	-0.37
	(0.37)	(0.38)
M3 growth$_{t-1}$	-0.31	0.13
	(0.54)	(0.51)
Nifty returns$_{t-1}$	-0.05	-0.05
	(0.07)	(0.07)
INR returns$_{t-2}$	0.30	
	(0.25)	
Bank credit growth$_{t-2}$	-0.02	-0.03
	(0.33)	(0.31)
M3 growth$_{t-2}$	-0.09	0.15
	(0.48)	(0.46)
Nifty returns$_{t-2}$	0.02	-0.03
	(0.07)	(0.08)
INR returns$_{t-3}$	1.21^*	
	(0.29)	
Bank credit growth$_{t-3}$	0.05	0.09
	(0.30)	(0.32)
M3 growth$_{t-3}$	-0.02	-0.23
	(0.44)	(0.48)
Nifty returns$_{t-3}$	0.11	0.06
	(0.07)	(0.08)
FW predicted$_{t-1}$		0.13
		(0.20)
FW residuals$_{t-1}$		0.65^*
		(0.28)
FW predicted$_{t-2}$		-0.08
		(0.19)
FW residuals$_{t-2}$		0.29
		(0.30)
FW predicted$_{t-3}$		0.01
		(0.19)
FW residuals$_{t-3}$		0.63^*
		(0.31)
N	535	508
AIC	209.15	203.13
BIC	431.83	473.88
$\log L$	-52.58	-37.57

Standard errors in parentheses
* indicates significance at $p < 0.05$

Figure 6 USD-INR fluctuations prior to dates of CCAs



(a) USD-INR exchange rate movements prior to 68 easing events

(b) USD-INR exchange rate movements prior to 7 tightening dates

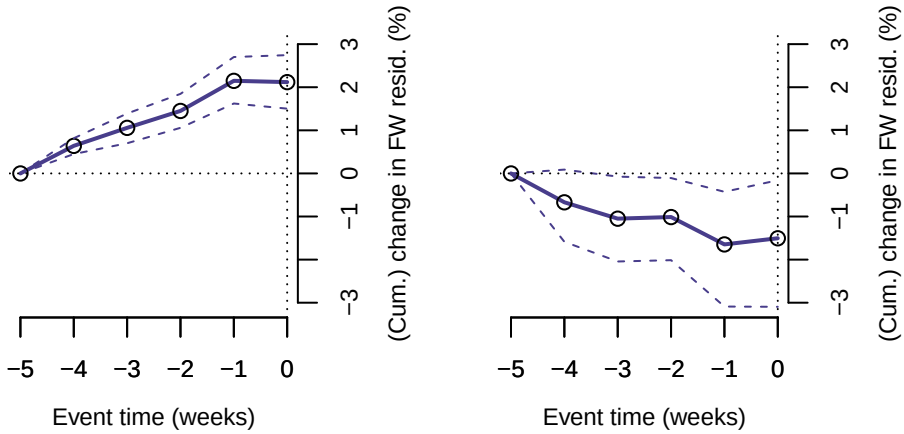
easing is announced. On average, an exchange rate depreciation of 3% over five weeks precedes the easing date. The null hypothesis of no-change can be rejected at a 95% level of significance. The right pane (Figure 6(b)) applies the same analysis to tightening dates. The dataset here is weaker in that we observe only 7 dates, which gives a wider 95% confidence interval. On average, an exchange rate appreciation of 2% over five weeks precedes the tightening date. Here also, the null hypothesis of no-change can be rejected at a 95% level of significance. This suggests the use of CCAs as a tool for exchange rate policy, and is consistent with the logit model of Table 6.

The other 3 measures of exchange rate objective yield similar results (Figures 7 to 9. In all cases, there is a significant appreciation trend for the Indian Rupee prior to tightening of inflow controls, and in all but one case, a significant depreciation trend prior to easing of inflow controls. Only for the REER, measured at a monthly frequency, the depreciation trend prior to easing of inflow controls is not statistically significant at 95% level of significance. On the whole, we interpret these results as strong evidence of exchange rate motivation for capital control actions.

Macroprudential Objectives

If RBI is concerned about the build-up of systemic risk, then there may be a CCA response to private bank credit growth, foreign borrowing (ECB), capital flows and stock prices to lean against the wind.The event study results

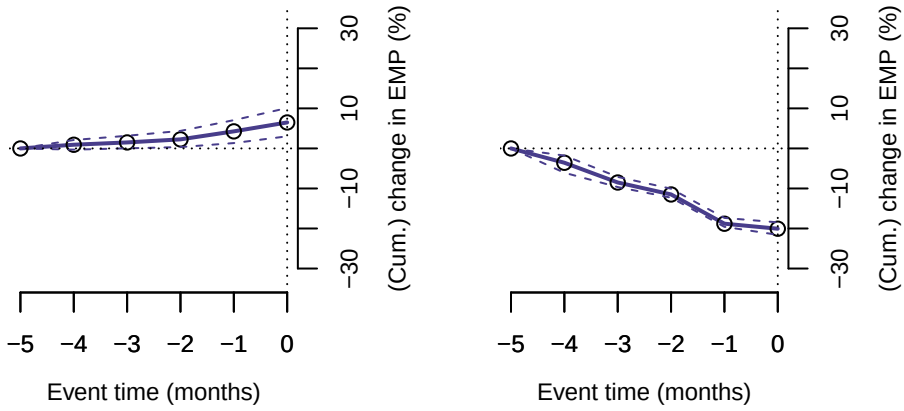
Figure 7 FW residual fluctuations prior to dates of CCAs



(a) FW residual movements prior to 68 easing events

(b) FW residual movements prior to 7 tightening dates

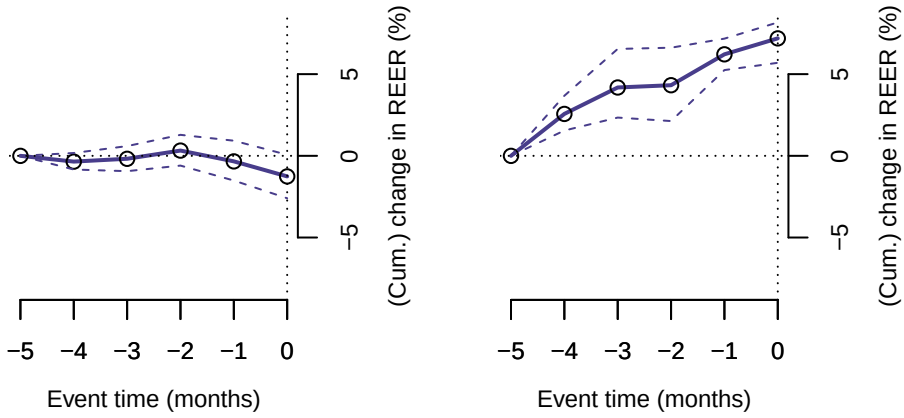
Figure 8 Fluctuations in EMP prior to dates of CCAs



(a) Movements in EMP prior to 62 easing events

(b) Movements in EMP prior to 7 tightening dates

Figure 9 REER fluctuations prior to dates of CCAs



(a) Real effective exchange rate movements prior to 62 easing events

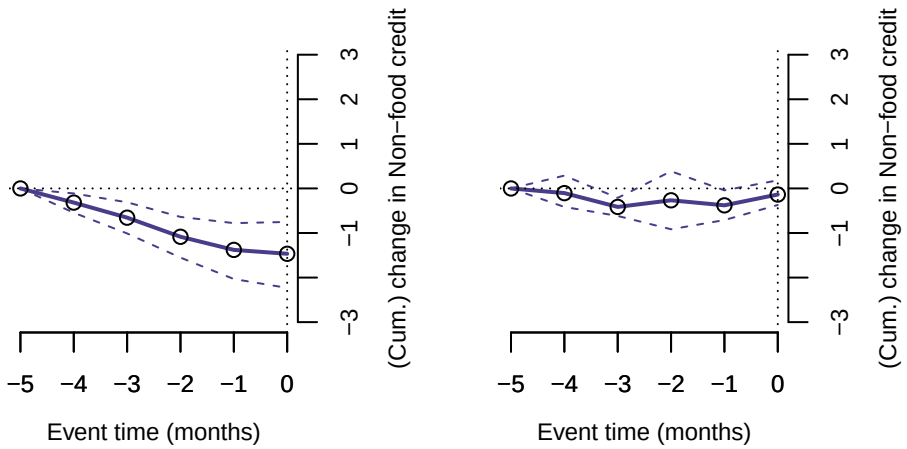
(b) Real effective exchange rate movements prior to 7 tightening events

for each of these series are presented in Figures 10 to 13. The Table 7 puts the event study evidence together and limits the horizon to 2 months for monthly variables and to 2 quarters for quarterly variables . Given that the administrative infrastructure for the controls is well established, and that these actions take place quite frequently, we think that the actual lag between the emergence of trends in outcome variables and the policy response would not be 5 quarters, but less.

In contrast with the results on exchange rate objectives, the evidence in support of macroprudential objectives is more mixed. As far as easing of CCAs are concerned, there are no statistically significant trends in 3 out of the four variables in the periods leading up to easing of inflow controls. The fourth variable, bank credit growth, has a slowing trend prior to easing. On the tightening side, there is evidence of increasing foreign borrowing and gross inflows prior to tightening of controls in the full horizons considered (Figures 11 and 12), but in the last 2 months prior to tightening, the foreign borrowing is slowing or flat. Further, there is no evidence of increasing stock prices or bank credit growth prior to tightening of controls.

We interpret these results as suggesting one-sided and weak evidence of macroprudential concerns driving capital control actions, unlike the unambiguous evidence for exchange rate objectives. This conclusion becomes clearer when looking at Table 7, which puts the results for all the variables together.

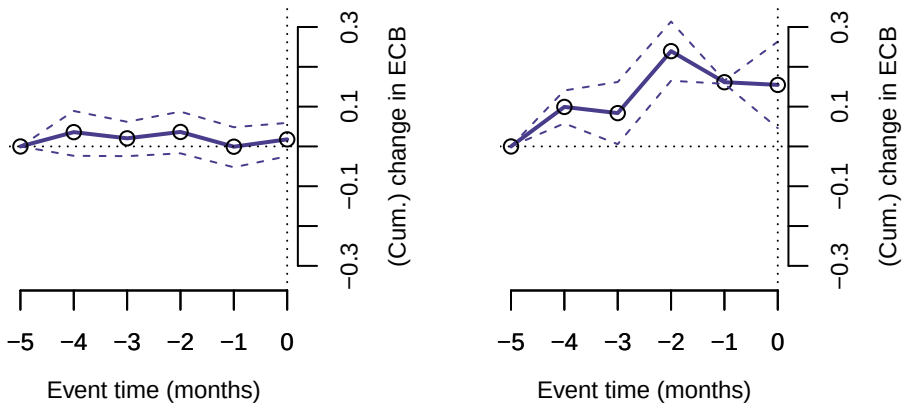
Figure 10 Fluctuations in bank credit growth prior to dates of CCAs



(a) Movements in bank credit growth prior to 62 easing events

(b) Movements in bank credit growth prior to 7 tightening events

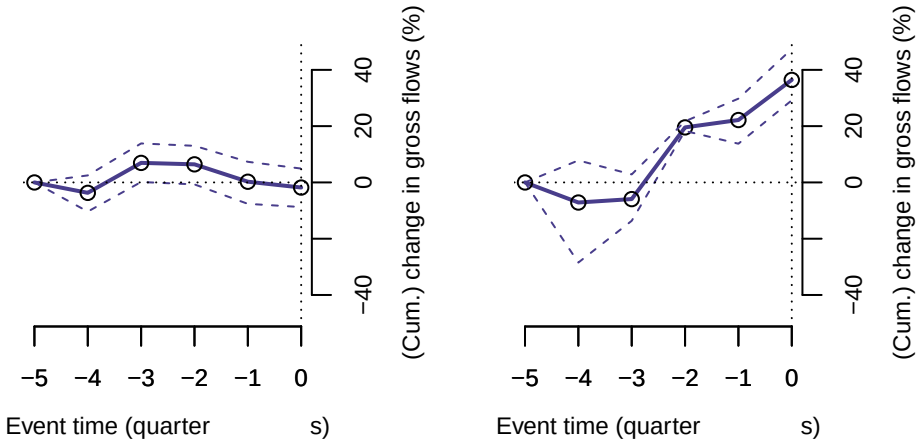
Figure 11 Fluctuations in foreign borrowings prior to dates of CCAs



(a) Movements in foreign borrowing prior to 62 easing events

(b) Movements in foreign borrowing prior to 7 tightening events

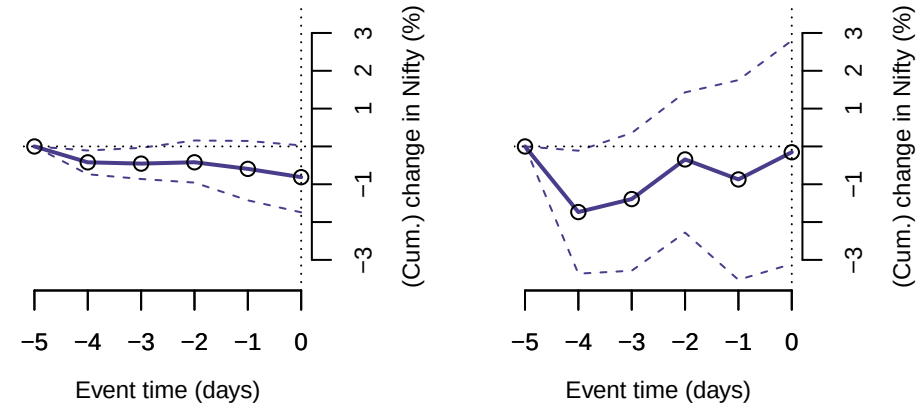
Figure 12 Fluctuations in capital flows prior to dates of CCAs



(a) Movements in capital flows prior to 50 easing events

(b) Movements in capital flows prior to 7 tightening events

Figure 13 Fluctuations in stock prices prior to dates of CCAs



(a) Movements in stock prices prior to 68 easing events

(b) Movements in stock prices prior to 7 tightening events

Table 7 Event Study for Capital Controls Motivation: Summary Table

Variable	**Trend prior to:**	
Exchange Rate Objective	Easing	Tightening
INR/USD Returns	Depreciation	Appreciation
Frankel-Wei Residual	Depreciation	Appreciation
Exchange Market Pressure	Depreciation	Appreciation
REER	Depreciation	Appreciation
Macroprudential Objective	Easing	Tightening
Foreign Borrowing (ECB)	No Trend	No Trend
Bank Credit Growth	Slowing	No Trend
Gross Inflows	No Trend	Increasing
Stock Prices	No Trend	No Trend

Notes: The table summarizes the statistically significant trends (95%) over 5 days, 5 weeks, 5 months or 5 quarters prior to event, depending on the frequency of the variable. The daily variable is stock prices, weekly variables are INR/USD returns and Frankel-Wei Residuals, Foreign borrowing is a monthly variable and the quarterly variable is gross capital inflows.

To summarise, the logit model and the event studies evidence shows a clear role for exchange rate policy in explaining RBI's use of CCAs. The evidence is less conclusive for variables that may capture macroprudential objectives - these variables are not significant in logit regressions. Further, there are no clear patterns in foreign borrowing or stock price returns prior to changes in controls. There is evidence that easing of controls follow periods of slowing bank credit growth but the reverse is not true prior to tightenings. There is evidence of tightening of capital controls in gross inflow surges, but reverse is not true prior to easings, and moreover, the foreign borrowing itself is slowing in the 2 months prior to the change. Putting these together, it is hard to conclude that RBI is using CCAs as a tool for systemic risk reduction, rather than a tool of exchange rate policy.

7 Results: Were the CCAs effective?

The event study on effectiveness reveals mixed results on the impact on exchange rate. There is no impact on the exchange market pressure, i.e. the pre-event trend continues unabated post event, for both easing and tightening events. Tightening of CCAs are able to stem appreciation of the spot exchange rate and Frankel-Wei residual. There are some results on the easing side, where the depreciation trends observed prior to easing are halted, for

spot exchange rate and Frankel-Wei residual. However, since spot exchange rate depreciation is arrested but exchange market pressure continues to suggest depreciation post-easing, the halt in spot exchange rate depreciation may simply reflect higher use of foreign exchange reserves post event, rather than an impact of the event itself. These considerations lead us to interpret these results as suggesting little effectiveness of capital controls.

On the macroprudential outcome variables, further, tightening of inflow controls are followed by a decline in foreign borrowing. However, overall capital inflows do not decline following tightening rather, see a strong growth. This suggests either that the desired outcome of change in relative composition of inflows towards less riskier forms did materialise, or more likely, a mislabelling of flows took place as a means to evade tighter controls.

While the event study suggests some significant trends in the periods after tightening of controls, we do not know if these trends reflect the impact of controls per se, or may have also materialised even if capital controls had not been changed when they were. To isolate the impact of capital controls, we do a causal analysis, using matched pairs of events, where each pre-event window was matched with another where the initial conditions were similar, but the event (capital control change) did not take place. This analysis does not reveal any independent impact of easing of controls on any of the outcome variables tested.

7.1 Event study approach

The event study on effectiveness reveals mixed results on the impact on exchange rate (Table 8 and Figures 14, 15, 16, 17). On the easing side, for 3 outcome variables - INR/USD returns, Frankel-Wei residual and REER - the post-event mean is no different from the mean at the event date.[8] Putting this result in the context of results from the previous section, which showed a steady depreciation trend prior to easing, one could infer that CCAs are able to halt the slide in the exchange rate. However, there is no impact on the exchange market pressure, i.e. the pre-event trend continues unabated post event, for both easing and tightening events. This suggests that the halt in spot exchange rate depreciation may simply reflect higher use of foreign

[8]The results on the insignificant difference in mean returns of the spot exchange rate post-event are not driven by higher volatility of exchange rate post-event. See Appendix C.

exchange reserves post event, rather than an impact of the event itself. [9]

On the tightening side, a similar story holds. The exchange market pressure continues to show appreciation pressures even after tightening of capital controls, while the INR/USD returns, REER and Frankel-Wei residual suggest a halt in the pre-event trend of appreciation post event (Figures 14, 15, 16, 17). This again suggests a role for foreign exchange reserve accumulation in contributing to the steming of nominal exchange rate pressures. All together, the results are ambiguous and we do not view these as suggesting a clear benefit in terms of exchange rate management, from the use of capital controls.

For the variables representing macroprudential objectives, the evidence for effectiveness of capital controls is also thin (Figures 18 to 22). Easing of controls does not have any impact on foreign borrowing (which increases at month 1 after event but falls back thereafter), gross inflows or growth of bank credit (which continues to decline). Stock prices, however, show a small increase after easing of controls, suggesting the possibility of a positive confidence effect. To explore this confidence effect further we do an event study on the foreign institutional investor (FII) inflows into equity markets and find that these increase in the days after the easing of controls (Figure 22).

Tightening of capital controls is associated with a significant decline in foreign borrowing in the 5 months after tightening events. Further, tightening of capital controls has no impact on bank credit growth. The two results together may suggest a decline in riskiness of overall credit growth with foreign currency borrowing replaced by domestic currency borrowing. However, gross inflows continue to increase over this period (2 quarters). While these trends are consistent with the desired outcome of change in relative composition of inflows towards less riskier forms, they could also be due to a mis-labelling of flows as a means to evade tighter controls. There are very few tightening events in sample, and we do not obtain parallel results with the easing of controls (which are more numerous), which have no impact on each of these series. For these reasons, we view the evidence in favour of capital controls mitigating macroprudential concerns as being scant.

To summarise, the event study reveals that post-event, the outcome variables on the whole do not show trends that one would expect if capital controls were

[9] This conclusion has been verified through an event study on foreign exchange reserves. Prior to easings, foreign exchange reserves were declining and they continued to decline post-easing. The reverse held for tightening events.

Table 8 Event Study for Capital Controls Effectiveness: Summary Table

Variable	**Trend after:**	
Exchange Rate Objective	Easing	Tightening
INR/USD Returns	Halt depreciation	Halt appreciation
Frankel-Wei Residual	Halt depreciation	Halt appreciation
Exchange Market Pressure	Continued Depreciation	Continued Appreciation
REER	No Trend (No Impact)	Halt appreciation
Macroprudential Objective	Easing	Tightening
Foreign Borrowing (ECB)	No Trend	Decline
Gross Inflows	No Trend	Continued Increase
Bank Credit Growth	No Trend	No Trend
Stock Prices	Small increase	No Trend

Notes: The table summarizes the statistically significant trends (95%) over 5 days, 5 weeks, 5 months or 5 quarters after the event, depending on the frequency of the variable. Daily variable: stock prices; Weekly: INR/USD returns, Frankel-Wei Residuals; Monthly: Foreign borrowing; Quarterly: Gross capital inflows.

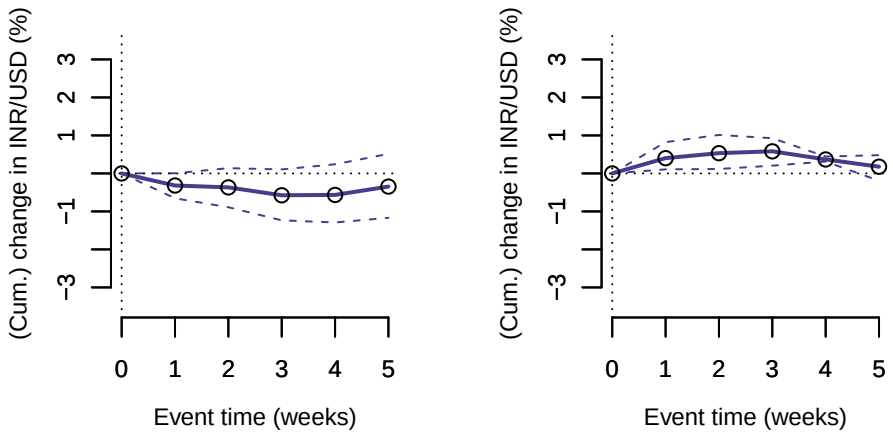
effective. There is some evidence of a stemming of depreciation pressures on the currency post-easing, stemming of appreciation pressures post tightening and of slowing of foreign currency borrowing post-tightening. However, to be confident that these results reflect causal impact of capital controls, we need to take the next step, of using a control group of periods that were similar to the pre-event periods but where the treatment (capital control action) was not applied. The next section presents the results of this analysis.

7.2 Causal analysis using propensity score matching

The results of section 6 show that the RBI utilises a certain selectivity process which determines when a CCA is employed. The time-periods prior to the week of a CCA have certain characteristics. We utilise propensity score matching to identify similar time-periods, where no CCA was employed. This gives a control time period. The explanatory variables used in the logit model are: exchange rate changes, credit growth, money supply growth and returns on Nifty.

While only a small set of explanatory variables were used in the logit model, match balance is achieved for a broad set of time-series variables, as shown in Table 9. In this table, the null of equality of distributions is always rejected before matching and is broadly not rejected after matching. This suggests that we have succeeded in finding a set of 22 control weeks where macroeconomic conditions were much like the 22 treatment weeks. Figure 23

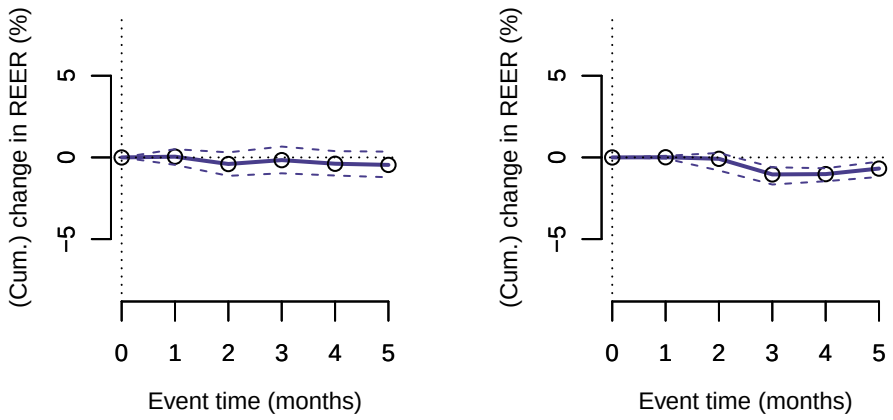
Figure 14 USD-INR fluctuations after the dates of CCAs



(a) USD-INR exchange rate movements after 68 easing events

(b) USD-INR exchange rate movement after 7 tightening events

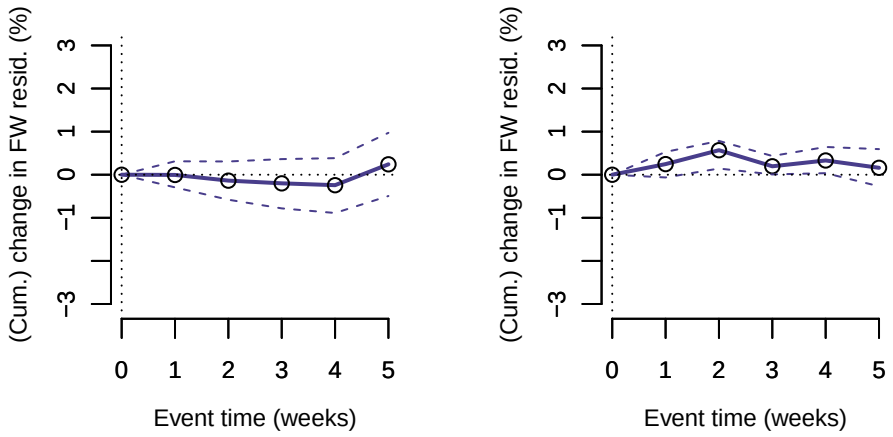
Figure 15 REER fluctuations after the dates of CCAs



(a) Real effective exchange rate movements after 62 easing events

(b) Real effective exchange rate movements after 7 tightening events

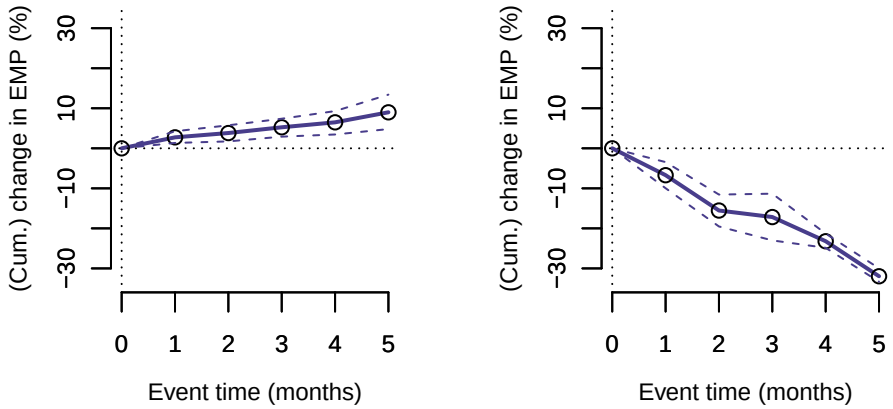
Figure 16 FW residual fluctuations after the dates of CCAs



(a) FW residual movements after 68 easing events

(b) FW residual movements after 7 tightening events

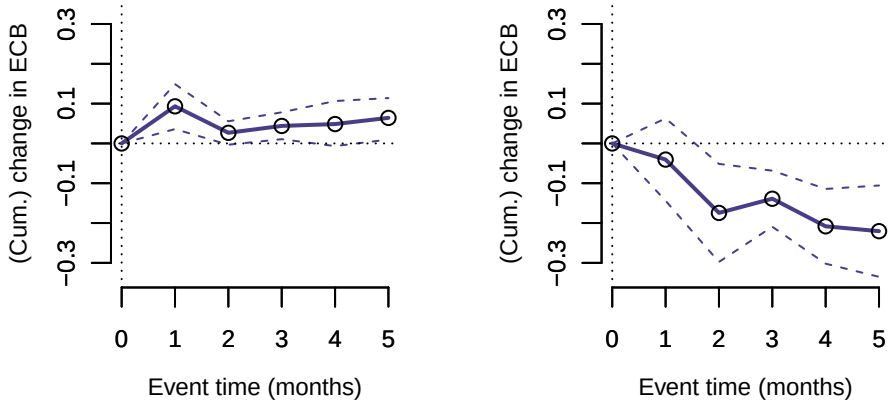
Figure 17 Movements in exchange market pressure after the dates of CCAs



(a) EMP movements after 62 easing events

(b) EMP movements after 7 tightening events

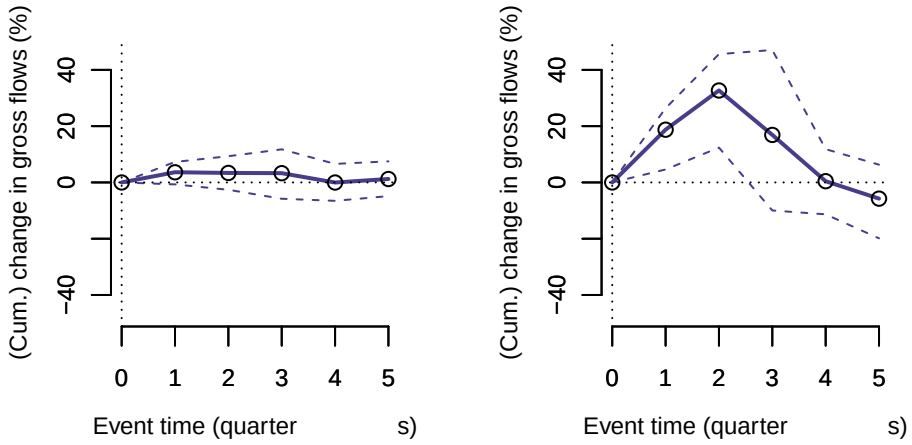
Figure 18 Fluctuations in foreign borrowings after the dates of CCAs



(a) Movements in foreign borrowing after 62 easing events

(b) Movements in foreign borrowing after 7 tightening events

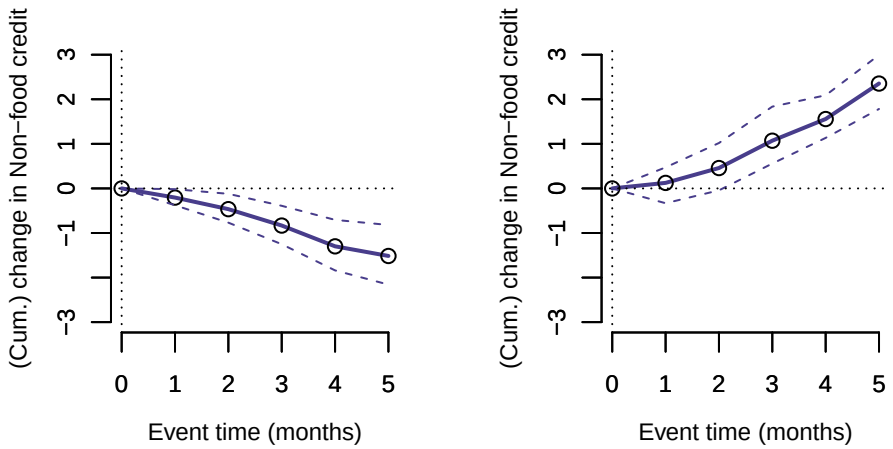
Figure 19 Fluctuations in overall capital flows after the dates of CCAs



(a) Movements in overall capital flows after 50 easing events

(b) Movements in overall capital flows after 7 tightening events

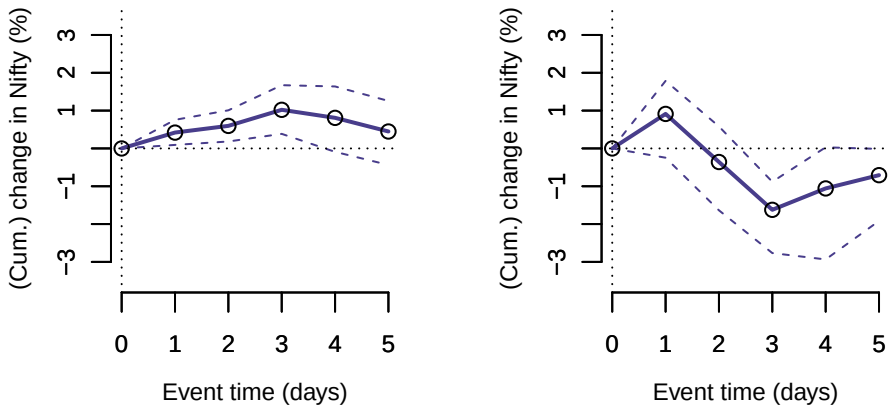
Figure 20 Fluctuations in bank credit growth after the dates of CCAs



(a) Movements in bank credit growth after 62 easing events

(b) Movements in bank credit growth after 7 tightening events

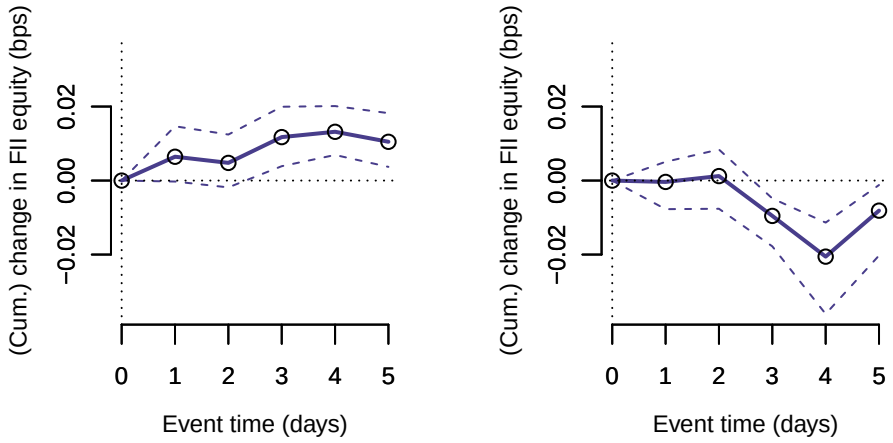
Figure 21 Fluctuations in stock prices after the dates of CCAs



(a) Movements in stock prices after 68 easing events

(b) Movements in stock prices after 7 tightening events

Figure 22 Fluctuations in foreign capital flows into the equity market after the dates of CCAs



(a) Movements in foreign equity inflows after 68 easing events

(b) Movements in foreign capital flows after 7 tightening events

Figure 23 CDF of the propensity score before and after matching

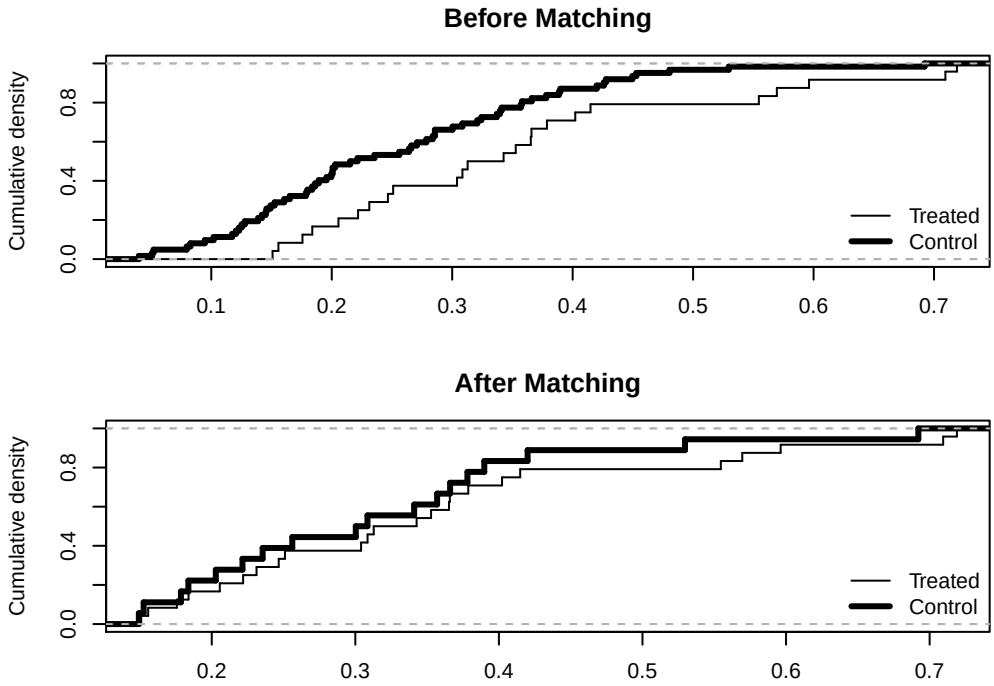
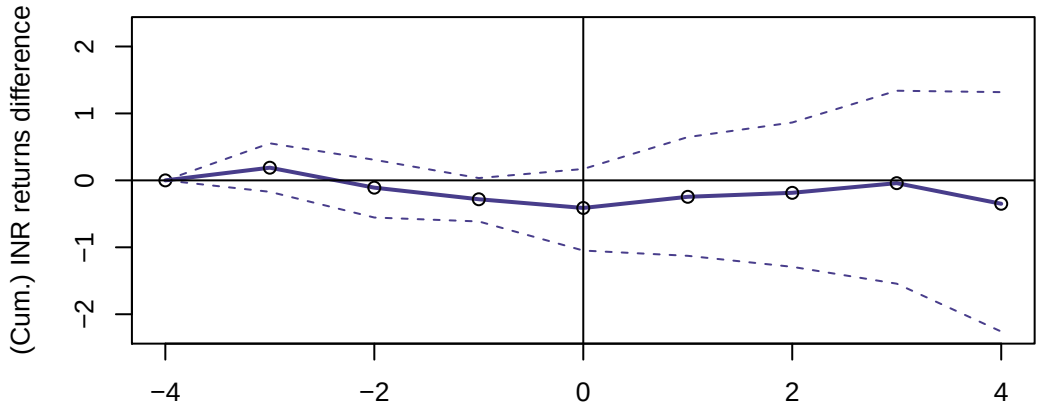


Table 9 Kolmogorov-Smirnov Test

The table shows the Kolmogorov-Smirnov Test statistic of a broad set of variables for the treated and control group before and after matching. The values in brackets are p-values.

	Before Matching	After Matching
Propensity score	0.47	0.05
	(0)	(1)
INR-USD Returns$_t - 1$	0.33	0.18
	(0.01)	(0.87)
Credit Growth$_{t-1}$	0.11	0.14
	(0.87)	(0.99)
M3 Growth$_{t-1}$	0.11	0.14
	(0.87)	(0.99)
Nifty Return$_{t-1}$	0.28	0.14
	(0.03)	(0.99)
FW Predicted$_{t-1}$	0.09	0.27
	(0.97)	(0.39)
FW residual$_{t-1}$	0.33	0.27
	(0.01)	(0.39)
Net Foreign Inflow$_{t-1}$	0.35	0.26
	(0.01)	(0.49)
INR-USD Returns$_{t-2}$	0.32	0.27
	(0.01)	(0.39)
Credit Growth$_{t-2}$	0.05	0.14
	(1)	(0.99)
M3 Growth$_{t-2}$	0.13	0.14
	(0.7)	(0.99)
Nifty Return$_{t-2}$	0.22	0.14
	(0.13)	(0.99)
FW Predicted$_{t-2}$	0.24	0.36
	(0.1)	(0.11)
FW residual$_{t-2}$	0.3	0.23
	(0.02)	(0.63)
Net Foreign Inflow$_{t-2}$	0.16	0.39
	(0.68)	(0.11)
INR-USD Returns$_{t-3}$	0.45	0.18
	(0)	(0.87)
Credit Growth$_{t-3}$	0.11	0.18
	(0.89)	(0.86)
M3 Growth$_{t-3}$	0.07	0.14
	(1)	(0.99)
Nifty Return$_{t-3}$	0.29	0.45
	(0.02)	(0.02)
FW Predicted$_{t-3}$	0.17	0.32
	(0.5)	(0.18)
FW residual$_{t-3}$	0.34	0.21
	(0.01)	(0.68)
Net Foreign Inflow$_{t-3}$	0.12	0.21
	(0.92)	(0.74)

Figure 24 Causal impact of CCA upon the INR/USD returns



shows that the cumulative distribution of the propensity is highly unequal before matching, but after the matching, the two distributions are alike. This persuades us that there is match balance.

Using this matched sample of 22 weeks with a CCA and 22 weeks with no CCA, we conduct an event study about returns on the INR/USD exchange rate. This result is shown in Figure 24. The difference in returns between each pair is averaged and cumulated. We know, from Figure 6, that rupee depreciation took place in the weeks prior to a CCA. As the control weeks are similar, rupee depreciation took place in the weeks prior to the event date with the controls also. Hence, we see no significant movement prior to the event date in the event study.

Turning to the period after the event date, we see no statistically significant impact as there is no difference between the treatment week and the control week.

Table 10 applies such causal analysis to multiple outcome measures. Whether we look at the residual of the Frankel-Wei regression, or net foreign inflows, or the stock market index, or credit growth: there is no statistically significant impact.

Table 10 Causal analysis of various outcome variables

For the 22 matched pairs obtained, we calculate the difference for the treated and control week for a broad set of variables, at a horizon of 1, 2, 3 and 4 weeks after the event. Using simple ordinary least square regression and robust regression, we do not reject the null of equality of means at all horizons.

Net FII inflow

	OLS	Robust
1	0.07 (0.09)	0.07 (0.1)
2	0.08 (0.1)	0.08 (0.11)
3	0.06 (0.12)	0.06 (0.13)
4	0.06 (0.15)	0.06 (0.15)

Nifty

	OLS	Robust
1	-1.11 (2.11)	-0.96 (2.13)
2	-3.27 (2.49)	-1.71 (2.28)
3	-4.56 (2.89)	-2.76 (2.31)
4	-3.14 (3.09)	-1.71 (2.83)

Credit growth

	OLS	Robust
1	-0.28 (0.4)	-0.24 (0.43)
2	-0.43 (0.41)	-0.39 (0.42)
3	-0.49 (0.53)	-0.6 (0.53)
4	-0.28 (0.6)	-0.07 (0.58)

FW residual

	OLS	Robust
1	0.12 (0.54)	0.19 (0.58)
2	-0.04 (0.67)	0.12 (0.61)
3	0.04 (0.81)	0.39 (0.89)
4	-0.23 (1.01)	0.35 (1.13)

Square of INR-USD returns

	OLS	Robust
1	0.44 (1.36)	0.32 (0.99)
2	0.91 (1.53)	0.4 (0.93)
3	1.81 (1.89)	0.45 (1)
4	2.2 (1.98)	1.04 (2.11)

8 Conclusion

There is fresh interest in re-assessing the potential role for capital controls as a tool for macroeconomic or macroprudential policy. In well structured financial regulatory regimes, under the rule of law, regulations that restrict capital account transactions will need to be precisely stated and will need to be backed by cost-benefit analysis.

Of particular importance are comprehensive administrative systems that cover all kinds of capital account transactions, as the evidence shows that the episodic use of capital controls in an otherwise open capital account has low effectiveness. Within the broad range of restrictions, there is particular interest in restricting foreign borrowing, given the potential implications for systemic risk.

Four important unanswered questions can be identified. First, what do EME policy makers actually do in their use of capital controls? Second, how can we arrive at a precise vocabulary and classification system for capital controls, through which empirical evidence can be built up using datasets across the world? Third, what is the causal impact of various kinds of CCAs? Finally, how can the costs and the benefits of capital controls be measured?

In this paper, we study one large country, India, which is a rare exponent of a comprehensive administrative system of capital controls, of the kind that is advocated in some of the recent proposals to resurrect capital controls. We focus on one class of restrictions – on foreign borrowing – which could be important from the viewpoint of systemic risk.

Building on the recent work of Pasricha (2012); Forbes et al. (2013), we analyse individual CCAs, rather than the low frequency measures of capital account openness which have dominated the traditional literature. We improve upon existing work by undertaking thorough legal analysis of every CCA, thus yielding precise observation of actions and categorisation of these actions. Using three man hours of lawyer time per capital control action, we arrive at a new dataset of 75 CCAs.

This analysis leads to a detailed classification system of the capital control actions in India. If capital controls are to be further researched on a global scale, a standardised classification system of this nature will be required that span multiple countries, through which the analysis of this paper can take place on a multi-country scale.

Our analysis yields two main results. First, the Indian authorities seem to

employ CCAs primarily in response to exchange rate movements. In particular, they seem to respond to the country-specific component of exchange rate movements.

The second result is about the impact of these capital control actions. The treatment effect is analysed in two ways. Event studies are a natural strategy. In addition, we address selectivity through propensity score matching, where dates with CCAs are matched against dates with no CCAs but a similar macroeconomic setting. Both kinds of analysis show that there is no robust impact of the CCAs. This result is consistent with the previous literature on Indian capital controls such as Patnaik and Shah (2012).

This analysis is consistent with the mainstream capital controls literature from the 1980s and 1990s. The Indian authorities are utilising CCAs to pursue exchange rate policy and not systemic risk reduction, and their actions are ambiguous in influencing either the exchange rate or other outcomes. These results suggest that India's extremely complex capital controls system yields little results in return for problems of bureaucratic overhead, political economy and violations of the rule of law.

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A Construction of the CCAs database: Two examples

In this appendix, we present two examples of our methodology of translating CCAs into a consistent database for evaluating effectiveness of controls.

1. On 21st May 2007, an RBI circular (`http://rbi.org.in/scripts/NotificationUser.aspx?Id=3544&Mode=0`) reduced the spread on all-in-cost ceilings to 150 basis points for 3-5 years and to 250 basis points for more than 5 year maturity. The reduced spread was also announced for borrowers under the approval route. End-use requirements governing external borrowings were tightened: ECB proceeds could no longer be used for investing in real estate, including integrated townships.

   From this circular we get three tightening events:

   (a) The all in cost ceilings were reduced for the eligible borrowers under the automatic route.

   (b) The all in cost ceilings were reduced for the eligible borrowers under the approval route.

   (c) The end use restrictions were tightened.

   For this date we get 3 records in the CCAs database, and all three are tightening. Pasricha (2012) classifies these three events introduced on a single day as *two* tightening events: it clubs the twoprice based measures (cost ceiling changes) as one event and categorises the end use restrictions as a quantitative event . These changes may have differential impact on the different types of borrowers (firms under approval and automatic routes). Hence, for the purpose of assessing impact of controls, they merit independent counting as three tightening events.

2. On 29th May 2008, an RBI circular (`http://rbi.org.in/scripts/NotificationUser.aspx?Id=4200&Mode=0`) eased capital controls in three directions:

   (a) The restrictions on all-in-cost ceilings were eased to 200 basis points from 150 basis points for 3-5 year maturity and from 250 to 350 basis points over 6 month LIBOR for above 5 year maturity.

   (b) Borrowers that were infrastructure firms were permitted to borrow through ECB with a limit of USD 100 million, for the purpose of rupee expenditure, for permissible end-uses, under the Approval Route.

   (c) For other borrowers, the existing limit of USD 20 million for Rupee expenditure for permissible end-uses under the Approval Route was enhanced to USD 50 million.

For this date we get 3 records in the capital controls actions database, and all three are easing. This circular cannot be read independently. The nature of change introduced in the above circular is different from the previous example. In this circular, several of the previous tightening events were reversed. This requires tracking all the previous circulars where the tightening of controls were introduced to get an idea of the sequential liberalisation of tightening measures.

From this circular we get three easing events related to the following aspects of ECB regulation:

(a) Easing of all in cost ceilings.

(b) Easing of restrictions on eligible borrowers under the approval route.

(c) Easing of restrictions on permissible amount.

Pasricha (2012) counts the cost ceilings as one event and clubs the other two quantitative changes as one event. In our classification system, these are viewed as three distinct easing events, as the nature of changes introduced through this circular are different and may have differential impact for different borrowers. In this way we do a careful reading of each of the 97 circulars and track changes related to all aspects of ECB regulation. This approach sheds light on the minutest details of changes in capital controls. As an example, while Forbes et al. (2013) identifies 5 events directed towards easing, our approach (that focusses on controls on one category of international capital transactions i.e. external borrowing) is able to identify 14 easing events in the period 2009-2011. The number is likely to go up if we extend this approach to tracking capital controls on all categories of international transactions.

B Logit model for monthly variables

Table 11 Monthly logit model

	Estimate
Intercept	-0.6977 (0.409)
INR-USD Returns$_{t-1}$	0.2943 (0.1404) *
ECB$_{t-1}$	-0.0027 (0.0037)
Credit Growth$_{t-1}$	-0.3725 (0.2947)
Nifty Return$_{t-1}$	0.0034 (0.0376)
M3 Growth$_{t-1}$	-0.3328 (0.2746)

C Was currency volatility the driver?

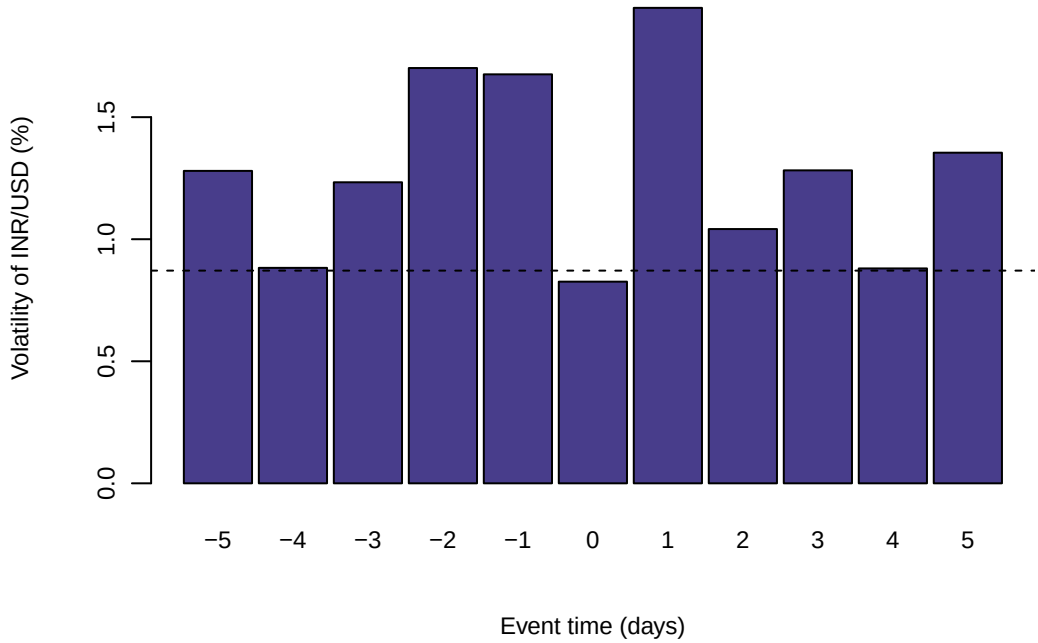
D Matching for dates of CCAs

We show the list of weeks with CCAs and the matched week with no CCA that was identified using propensity score matching.

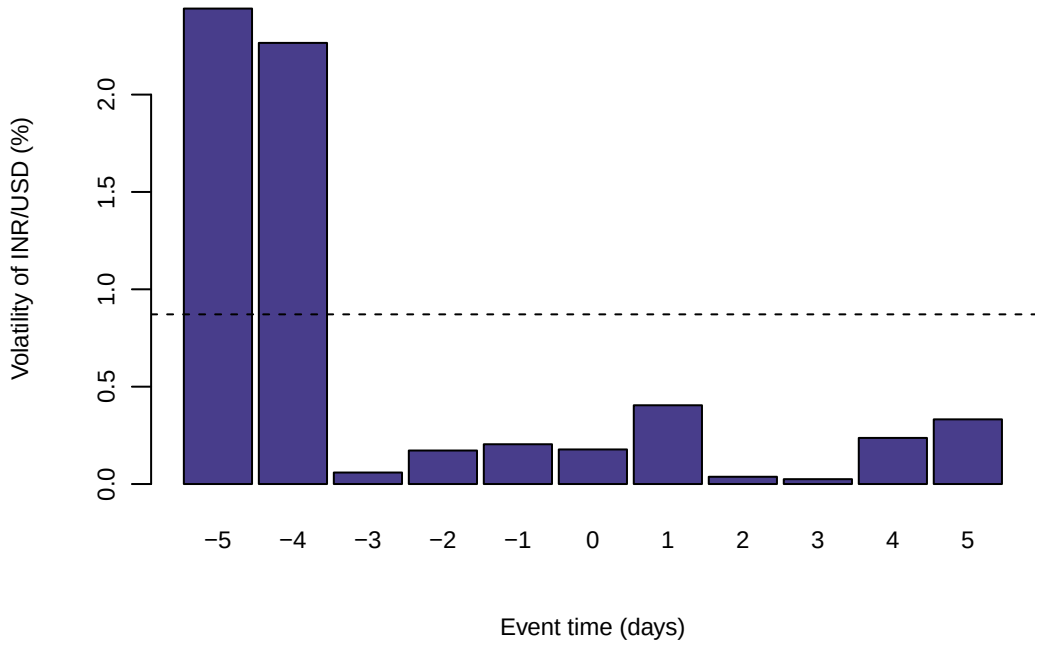
Treated	Control
2004-02-06	2011-04-29
2005-04-29	2006-09-01
2005-08-05	2007-06-08
2006-12-08	2003-09-19
2008-10-31	2009-03-13
2010-01-29	2011-02-18
2010-03-05	2013-05-24
2010-05-14	2009-03-06
2010-07-23	2009-01-16
2010-08-13	2009-05-15
2011-12-23	2006-04-21
2012-01-06	2009-01-23
2012-03-02	2008-02-15
2012-04-20	2012-06-29
2012-04-27	2010-11-26
2012-09-14	2003-01-10
2012-11-09	2010-12-10
2012-11-30	2009-09-04
2012-12-14	2006-04-14
2012-12-21	2005-09-16
2013-01-11	2013-03-29
2013-07-12	2009-07-03

E Data sources

Figure 25 Movements in currency volatility after the dates of CCAs

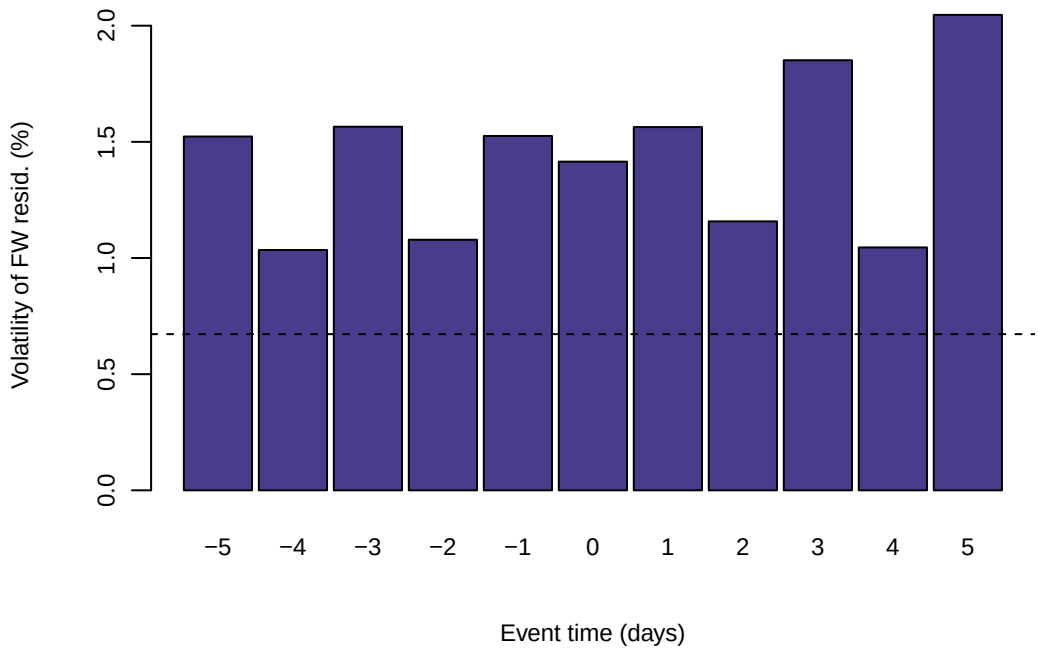


(a) Movements in currency volatility after 68 easing events

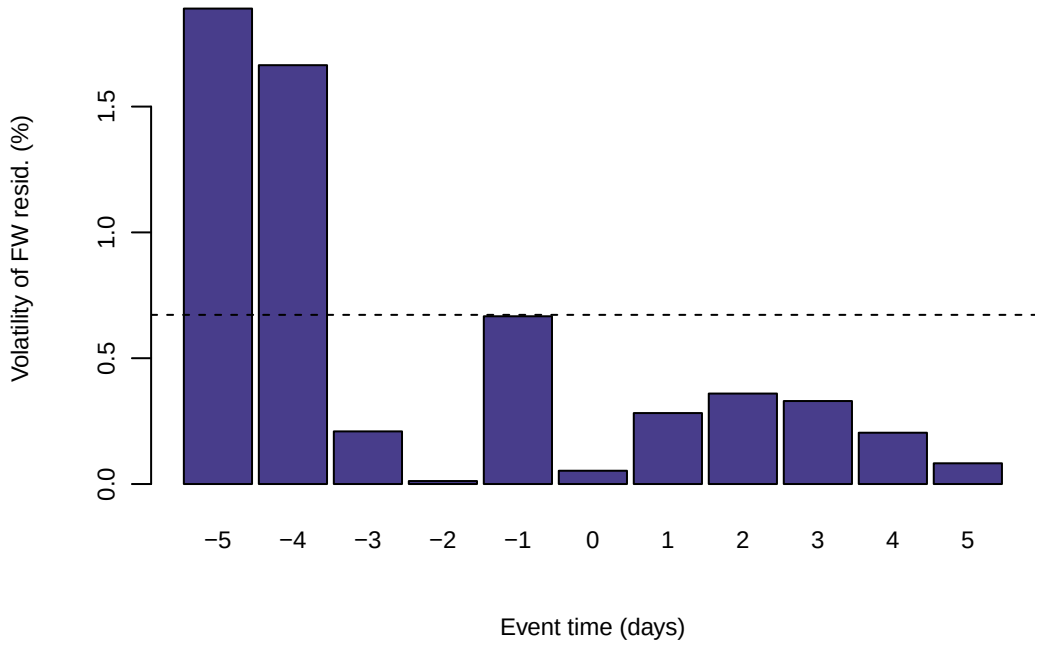


(b) Movements in currency volatility after 7 tightening events

Figure 26 Movements in FW residuals volatility after the dates of CCAs



(a) Movements in FW residual volatility after 68 easing events



(b) Movements in FW residuals after 7 tightening events

Table 12 Data sources

Variables	Sources
Rupee-dollar exchange rate	Reserve Bank of India (RBI)
Frankel-Wei residuals	India specific component of fluctuations in INR/USD exchange rate based on Frankel and Wei (1994) methodology.
Exchange market pressure	Felman and Patnaik (2013) measure expressed in terms of percent change in exchange rate at a monthly frequency.
Real effective exchange rate	Bank for International Settlements (BIS)
Foreign borrowing	Reserve Bank of India (RBI)
Private bank credit growth	Reserve Bank of India (RBI)
Stock price returns	National Stock Exchange (NSE)
Gross capital flows	Reserve Bank of India (RBI)
Money supply (M3)	Reserve Bank of India (RBI)