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Keywords: Capital account openness, Financial integration, Covered interest parity, Capital controls, Foreign exchange market.

JEL Code: G15, F30, F31, F32

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1 Introduction

In the last three decades, the magnitude of cross-border capital flows has gone up by leaps and bounds as most emerging market economies (EMEs) actively took steps to systematically dismantle their capital controls and open up their economies to foreign investments. Yet from time to time these EMEs keep experimenting with capital control policies to satisfy myriad objectives such as, limiting exchange rate appreciation or preventing a sharp depreciation, increasing monetary policy independence, reducing inflation, dealing with volatility in financial markets and so on (Forbes et al., 2015).

This makes it harder to assess how open or closed a country's capital account truly is. In other words, what has been the *de-facto* outcome of the *de-jure* capital control actions taken by countries over time in response to global financial flows? Assessing a country's financial integration with the rest of the world using indices constructed out of de-jure capital controls often requires subjective judgements. This underscores the importance of relying on reduced form de-facto measures which reflect the net impact of capital control changes.

In this paper we attempt to measure the changes over time in the capital account openness of a large and important emerging economy, India, using a de-facto price based measure. India is a good case study to analyse capital account liberalisation, given that it continues to be prime exponent of a comprehensive capital controls system. It is perhaps the only country in the world, other than China, that till date has in place a complex and elaborate framework of capital controls. The Indian authorities keep changing their capital control policies on a fairly regular basis. This also implies that measuring the extent of India's financial integration with the global economy is far from a straightforward exercise. Unlike many other EMEs, one cannot characterise India's capital account as either open or closed at any given point of time. Rather the extent of India's financial integration has to be deciphered on a continuous basis from available data.

Understanding how open a country's capital account is also has important policy implications in the context of the Impossible Trilemma, a fundamental tenet of open economy macroeconomics. The Trilemma faced by all open economies is that no country can pursue independent monetary policy, stable exchange rates and capital account liberalisation at the same time. The extent of trade-off between domestic monetary policy autonomy and using currency policy to stabilise the exchange rate critically hinges on the extent of the country's integration with the international financial markets.

We measure India's capital account openness using deviations from the Covered Interest Parity (CIP). The deviations from the CIP measure the degree of cross-border market segmentation caused by capital controls (Ma et al., 2004; Frankel, 1992). It is computed as the spread between the onshore interest rates and the offshore-market implied interest rate. A substantial onshore-offshore yield gap would indicate effective segnmentation of the onshore and offshore markets via the capital controls (Ma et al., 2004), while a negligible or a narrow gap between the two will indicate close to perfect capital mobility in the absence of capital controls.[1]

In our paper, we measure the CIP deviations using the offshore non-deliverable forward (NDF) rate for the USDINR and the onshore spot rate to deduce the trend of capital account openness in India for more than a twenty year period spanning August 1999 to January 2021.[2] In particular, we study the difference between the NDF implied yield and the onshore interest rate. The NDF market is free of capital controls which makes it a good candidate for capturing

[1]The interpretation of the onshore / offshore interest spread assumes that both the onshore and offshore markets are highly liquid. It also assumes zero or negligible country and credit risk ((Ma et al., 2004)).

[2]There exist both onshore and offshore markets for trading in the Indian Rupee. The dominant segment of the offshore market is the non-deliverable forward (NDF) market.

the market implied interest rates, especially when the NDF market in the home-currency is liquid.[3] The NDF implied yield captures the net covered rate of return that would be available to foreign participants on Indian financial instruments had there been no restrictions on the capital account.

Deviations from CIP can change over time depending upon, among other factors, the gradual changes brought about in capital control actions. The advantage of such a measure is that it captures all kinds of complexities in capital account related restrictions as reflected in the prices and is also a dynamic measure which evolves in keeping with the degree of financial integration. For a country such as India whose capital account is never fully open or entirely closed but instead the restrictions on foreign capital entry or exit undergo periodic and frequent changes, CIP deviations would accurately reflect the changes over time in the extent of economy's financial integration.

During the time period of our study, India has witnessed several changes in its policy on capital account liberalisation, with some measures directed towards relaxation of certain controls, while others intended to further tighten the restrictions.[4] The changing nature of the policy on capital controls will reflect in the widening and narrowing of the CIP deviations from one period to another. To identify changes in the policy stance, we estimate structural breaks in the CIP deviations. We connect the resultant sub-periods with the documented changes in the capital control actions to identify if the corresponding sub-period reflects the general phase of tightening or easing of capital controls.

CIP is a pure arbitrage condition. Greater financial liberalisation means more arbitrage between markets. In the ideal world of perfect capital mobility, and zero transactions costs, the CIP condition will hold, else riskless profitable arbitrage opportunities will arise. However, in the presence of real-world frictions such as liquidity costs in the form of bid-ask spreads, capital market imperfections such as capital controls, differential tax treatments etc there would be 'neutral bands' or 'no-arbitrage bands' around the theoretical parity condition, within which profitable arbitrage is not possible (Balke and Wohar, 1998).

Outside the bands, the deviations will be arbitraged away as agents exploit the profit opportunities. However, inside the bands, the CIP deviations will persist. These non-linear dynamics of CIP deviations outside and within the bands have been modeled in the literature using the threshold autoregression (TAR) model (Balke and Wohar, 1998; Balke and Fomby, 1997; Peel and Taylor, 2002). In this paper, we use the Self-Exciting Threshold Autoregressive model (SETAR) to estimate the no-arbitrage bands on CIP deviations. The SETAR model allows the estimation of the upper and lower boundaries of the "no-arbitrage" bands (provided that the series follows a non-linear behaviour), and the speed of convergence outside the band. The size of the no-arbitrage band, and the speed of adjustment are interpreted as (inverse) measures of the level of financial integration of markets (Juhl et al., 2006; Levy Yeyati et al., 2009).

Our study is similar to Hutchison et al. (2012a) who examine the effectiveness of international capital controls in India by analysing the daily return differentials between the onshore Rupee market and the NDF market. They argue that the de-jure and de-facto capital openness in India have varied over the 1998-2011 period but a general trend of liberalization is clearly evident. While their study ended in 2011 we extend the time period to 2019 to study the more recent developments. This enables us to capture a period in recent years when the CIP deviations are almost down to zero implying near perfect capital account liberalisation. It also helps us analyse the differences in the evolution of India's capital account openness in the pre and post 2008 periods.

[3]The USDINR has one of the largest NDF market as detailed in Section 3.

[4]We describe some of these events in Section 7.1.

In the aftermath of the Global Financial Crisis of 2008, many changes were implemented in India with regard to the capital control actions. With respect to the foreign portfolio investment alone,Pandey et al. (2019b) show that India has seen atleast five to six CCAs every year. This hints at the elaborate framework of CCAs that is in place in India. They also find that a greater extent of easing of capital controls took place in the post-2008 period. This necessitates the need to analyse capital account openness in India in the more recent years. To the best of our knowledge, no study has documented whether increased relaxations of legal restrictions has indeed translated into greater capital account liberalisation in India in the post 2008 period.

Moreover, while Hutchison et al. (2012a) divide their sample period into exogeneously motivated sub-periods based on their constructed dataset of capital control actions, we let the data uncover the gradual evolution of capital account openness through multiple sub-periods using the structural break tests. We then connect each of these sub-periods with the corresponding changes in capital controls as documented in the existing studies to build a comprehensive and coherent narrative about capital account liberalisation in India over the past two decades.

Our study is also related to Ma and McCauley (2013) who compare the evolution of India and China's capital account openness based on eight de-facto measures for the period 2000-2012. They find India to be more financially open than China on six out of the eight measures.

We find that over the period from 1999 to 2020, the average CIP deviation is -1.14 and the median is -0.66. The negative deviation broadly implies that the elaborate and complex system of capital controls that continues to be in place prevents capital outflows more than it prevents capital inflows. We also find that the CIP deviations have diminished considerably in the past decade and the no-arbitrage bands have also narrowed. This implies that India's capital account has become more open over time.

Our analysis indicates large variability in the magnitude and the direction of the CIP deviations during our sample period. We find large and persistent deviations in the CIP, especially in the first half of our sample period. These deviations start reducing considerably in the period post financial crisis, and more so in the period from 2015 onwards. Our structural break tests enable us to identify the sub-periods reflecting differential patterns of the CIP deviations.

The increasing capital account openness also reflect in the width of the no-arbitrage bands estimated using the SETAR model. Overtime, we observe that the size of the bands have narrowed down considerably, which indicate a greater de facto capital account openess. The speed of convergence to the no-arbitrage bands has also come down, indicating arbitrage trades occurring more rapidly in the presence of large CIP deviations.

Our findings are critical for policy making especially in the context of monetary policy. If arbitage between the domestic and foreign markets is perfect i.e. Indian financial markets are fully integrated with the global markets, then according to the CIP condition, the domestic interest rate equals the sum of foreign interest rate and expected currency depreciation. If the Indian Rupee is pegged to the foreign currency, then the expected depreciation component becomes zero which means domestic interest rates cannot deviate from foreign interest rates. This implies that the central bank can either set the domestic interest rate and let the Rupee float, or it can peg the exchange rate and give up control over the interest rate, which is the classic Impossible Trilemma implication.

If however the arbitrage is imperfect and the Indian capital account is not fully open, then the central bank can target both the exchange rate and the interest rate but this choice will prove to be costly. Intervention in the foreign exchange market to target the exchange rate, will increase the domestic money supply thereby fueling inflation. This means that currency intervention would need to be sterilised by selling government bonds but that in turn imposes an interest burden on the government which worsens its fiscal position.

Our study indicates that if indeed India's capital account has become more open over time which is what we find, implying that there would be greater inflows of capital in response to any increase in the domestic interest rate by the central bank, then the central bank has much less room now to target the exchange rate. This becomes even more relevant in the current context given that the Indian central bank now has an inflation targeting mandate and hence, must respond to inflationary risks by raising the interest rate. In other words, increasing capital account openness along with increased monetary policy autonomy that is required to successfully pursue an inflation target, reduces the policy space available to the central bank to stabilise currency fluctuations. Hence the results of our paper are critical for monetary policy formulation.

The rest of the paper is structured as follows. In the next section, we provide a brief background of India's capital account liberalisation process over the past several years. In Section 3 we discuss the growth of the NDF market for the Indian Rupee. In Section 4 we describe the problems with the de-jure measures of capital account openness. We present the calculation of the CIP deviation using the NDF implied yield in Section 5 and analyse structural breaks in the CIP deviation in Section 6. In Section 7 we estimate the no-arbitrage bands and present the results of the SETAR model and finally end with concluding remarks in Section 8.

2 India's capital account liberalisation

India adopted liberalisation reforms in the early 1990s prior to which it was primarily a closed economy especially with regard to its capital account transactions. This was part of a broader agenda of reforms initiated after the balance of payments crisis of 1991. On the external front, the reforms included dismantling of trade restrictions, move towards current account convertibility, a market oriented exchange rate regime and a gradual opening up of the capital account. While liberalising the capital account, the approach adopted was a calibrated one.

With the Latin American debt crisis of the early 1980s and the Asian financial crisis of 1997 fresh in mind, India prioritised certain kinds of flows and agents in the liberalisation process. In particular, India favoured non debt flows such as foreign direct investment (FDI) and portfolio investment flows over debt flows (Sengupta and Gupta, 2015; Mohan and Kapur, 2009). Currently, barring a few sectors, FDI is universally allowed. Portfolio equity flows have also witnessed significant liberalisation. In contrast, debt flows are subject to numerous restrictions including borrowers and lenders having to satisfy eligibility conditions, minimum maturity period, ceilings on interest rate spread and end-use restrictions.

While authorities have been gradually relaxing the legal restrictions that govern foreign investment flows, from time to time new restrictions have also been imposed on the foreign investors. As a result, despite the adoption of liberalisation reforms in 1990s, even today in India there exists a comprehensive and complex legal and regulatory framework of capital controls and an extensive array of restrictions on capital account transactions.[5] In an extensive study, Pandey et al. (2016) find that the capital controls system in India contains innumerable rules tailored to the asset class, investor type, recipient type, transaction magnitude etc. In other words, the capital account liberalisation that has been underway in India over the last couple of decades can be viewed as a continuous process.

Two recent studies present detailed datasets on de-jure capital control actions (CCAs) taken by the Indian authorities since early 2000s.[6] These datasets have been hand-constructed by

[5] See for example, Pandey et al. (2019a), Sengupta and Gupta (2015), Hutchison et al. (2012b), and Shah and Patnaik (2008) among others, for a brief description of India's capital controls regime.

[6] For the purposes of our study we take into account the capital control actions applicable to foreign portfolio investment (FPI) in equity, debt and derivatives markets and do not consider those with respect to foreign direct

studying the legal instruments issued by the authorities and they provide a comprehensive description of the changes that have taken place in CCAs in India over the last couple of decades. The fine-grained dataset constructed by Pandey et al. (2016) throw light on the CCAs pertaining to external commercial borrowing (ECB) by Indian firms. They classify each CCA into 'easing' vs. 'tightening'. Their database has 76 unambiguous CCAs about firms' foreign borrowing between January 2004 and September 2013. Of these, they find that 68 are easing actions whereas 8 are tightening.

As per the Pandey et al. (2016) database, the highest number of CCAs occurred in 2012 and 2013, towards the end of their sample period. Majority of these were aimed at easing restrictions on Indian firms. Most tightenings took place in the year 2007 in response to a surge in capital inflows. This shows that in recent years, the Indian authorities have been easing the capital controls and permitting more and more firms to borrow from abroad.

In another study, Pandey et al. (2019b) construct a database that quantifies the legal regulations applicable to foreign portfolio investors interested in investing in the Indian financial markets. Over a period of 18 years from January, 2000 to December, 2018, their dataset records a total of 151 CCAs. This implies that the rules governing foreign access to the Indian capital markets are, on average, revised *nine* times a year. The dataset covers various asset classes such as debt, equity, derivatives etc. The highest share of rule changes (42%) pertain to debt securities (both government and corporate debt), which saw a number of easing actions.

In their dataset, 2018 saw the maximum number of CCAs and the years 2000, and 2005 saw the least number of such events. They also classify the CCAs into easing and tightening events. FPI easing events denote events that have the effect of relaxation of existing controls or any action that makes it easier for foreign investors to invest in the host country. Conversely, FPI tightening events denote events that have the effect of increasing the capital controls or any actions that make it harder for foreign investors to invest in the host country.

Like the previous study on ECB, Pandey et al. (2019b) find that for the full period of the dataset, the easing events are substantially higher in number at 99, compared to the tightening events which were 27 in number. For all the years, except 2003 and 2006, the number of easing events is higher than the number of tightening events. The maximum number of FPI easing events took place in 2018 (14 in number) followed by 2008 (11), 2013 (10) and 2012 (9). The maximum number of FPI tightening events also took place in 2018 (9) followed by 2008 (4).

These two datasets combined together imply that in recent years, particularly since the Global Financial Crisis of 2008, there has been a steady relaxation of capital controls by Indian authorities on foreign investment flows. A number of changes in CCAs were also announced in 2019 and 2020, as outlined in Table 1.[7]

Further, in 2019 a committee appointed by the RBI suggested several measures to curb the rising influence of the offshore INR markets and to improve the ease of access to the onshore markets (Thorat (2016)). These included among other things, an extension of trading hours to make it easier for foreign investors to trade, permission to users to undertake over the counter currency derivative transactions upto USD 100 million without underlying exposure and alignment of tax treatment with global standards.

investment (FDI). This is because changes in FDI related restrictions are likely to impact de-facto openness with an even longer lag given the nature of these investments. This is also consistent with the strategy adopted in Hutchison et al. (2012b). We also use CCAs and capital controls interchangably.

[7] In 1995, the equities and corporate debt markets regulator SEBI (Securities and Exchanges Board of India) released regulations for foreign institutional investment. The regulations provided a limited scope for investment in debt securities. The regulation mandated that not less than 70% of the aggregate of all investments made by FIIs should be in equity and equity related instruments (commonly referred to as the 70:30 route).

Subsequently several of the committee's recommendations were accepted and implemented. For instance, from January 2020 onwards, domestic banks have been permitted to offer foreign exchange prices to users at all times to avoid hindrances posed by time zone differences. Exchanges in India's International Financial Services Centre (IFSC) called Gujarat International Finance Tec (GIFT) City were permitted to offer INR derivative contracts with settlement in foreign currency. Starting June 1, 2020, domestic banks were also permitted by the RBI to participate in NDF markets.[8] However, most of these relaxations occurred in the late-end of our study period, and thus the effect of these is not reflected in our analysis.

3 The Rupee NDF market

Due to the periodic and frequent imposition of capital account restrictions by the Indian authorities, international participants engaged in cross-border transactions are unable to obtain easy access to the onshore currency market to either hedge their exposures to the Indian Rupee (INR) or to speculate on the currency movements.[9] As a result, over the years an offshore non-deliverable forward (NDF) market has developed. The existence of NDF markets enables investors to carry out foreign exchange related transactions outside the regulatory framework of the onshore markets (Ma et al., 2004; McCauley et al., 2014). By virtue of being located in financial centres outside India for example, participants in this market can escape the stringent capital account restrictions of India and yet take a speculative position on the expected changes in say the USDINR exchange rate. They are also able to hedge their exposures to the INR by accessing these non-deliverable forward contracts.

As described in Guru (2009), an NDF is similar to a regular forward foreign exchange contract. The main difference is that an NDF does not involve a physical settlement of the contract and exchange of currencies. The underlying premise is that the NDF contracts are traded on currencies that are not deliverable offshore.

The Rupee NDF market is largely a USD settled market on the USD-INR rate. The NDF contracts in Rupee are bilaterally settled and are traded in over the counter (OTC) market at various offshore locations such as Singapore, HongKong, London, Dubai and New York.[10] Trading volumes are concentrated in the markets with highest trading time overlap. As a result, Singapore has emerged as the largest market trading USD-INR offshore. INR is also the most actively traded NDF in the London market along with South Korean Won.

According to the Bank of International Settlements triennial survey, 2019, the global turnover of emerging economy currencies increased by almost 60 percent in the last three years and their global share went up from 15 percent in 2013 to 23 percent in 2019. A major driver of this increase in share was the INR which experienced a near doubling of trading during this period.

Alongside the size of India's open economy, the INR NDF market has also grown substantially in size over the years. It has emerged as the second largest NDF market globally in terms of average daily turnover and is almost thrice as large as the onshore deliverable forward market. India accounts for about 18.2 percent of the global trade in NDFs (Thorat (2016)). The average daily turnover in the global NDF market in 2019 was about USD 259 billion and the INR along

[8] In May 2020, two IFSC exchanges launched INR derivative contracts according to Reserve Bank of India Bulletin, "Onshoring the Offshore", 2020. The share of INR derivatives at these exchanges however remains small accounting for only 2 percent of the total exchange traded INR derivatives turnover globally. The average daily turnover by domestic Indian banks in the non-deliverable derivatives contracts (forwards and options) was around USD 1.1 billion as of August 2020.

[9] According to the BIS triennial survey (2019), over-the-counter trades in the Indian rupee accounts for 1.7 percent of the total global forex turnover, compared with 1.1 percent in the 2016 survey.

[10] see, Reserve Bank of India Bulletin, "Onshoring the Offshore", 2020.

with South Korean Won, Brazilian Real and Taiwan New Dollar accounted for as much as 70 percent of the total NDF turnover.

The average daily volume for INR outright forwards stood at USD 62.72 billion in April 2019 compared with USD 29.91 billion in spot market trades. Within this category, NDFs accounted for a significant share of the increase in trading between 2016 and 2019. The INR NDF market now accounts for roughly 82 percent of the total outright forwards in USD-INR in 2019 as against 74.3 percent in 2016. The NDF volumes for the USD-INR currency pair reported a staggering three-fold increase, from around USD 16.4 billion in 2016 to USD 50 billion in 2019.

The offshore Rupee market is not only large it is also mostly unregulated. Volumes in the NDF market have recorded a dramatic rise over the years across multiple offshore centres due to multiple factors including favourable tax laws, ease of access owing to absence of any stringent regulations, market-making by large, global banks as well as participation by large hedge funds (Patel and Xia (2019)). NDF contracts with one-month or less maturity are typically the most liquid in the offshore INR market accounting for close to 70 percent of the total trades.[11]

4 *De-jure* vs. *De-facto* measures

There are two ways to measure capital account openness of a country: de-jure measures and de-facto measures. De-jure measures are constructed from the legal restrictions by collecting data on changes in regulations. Some of the relatively older cross-country de-jure measures are the the Chinn-Ito index (Chinn and Ito (2008)) or the index constructed by Schindler (2009). These measures use the detailed capital controls published in the summary classifications table by the International Monetary Fund in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

Some of the more recent measures include the one in Forbes et al. (2015) who construct a dataset that tracks increases and decreases in controls on capital inflows, controls on capital outflows, and macro-prudential measures at a weekly frequency for 60 countries from 2009 through 2011. Likewise, Pasricha et al. (2018) construct a high frequency dataset on capital controls of 16 emerging market economies from 2001 to 2012. They count the policy changes separately, decomposing them into several categories.

Specifically for India, Pandey et al. (2016) construct a de-jure dataset of restrictions pertaining to foreign borrowing by Indian firms. In a more recent study Pandey et al. (2019b) quantify the legal regulations applicable to foreign portfolio investors interested in investing in the Indian financial markets, over the period from 2000 to 2018. The dataset constructed by them discerns information from legal instruments to identify whether the instrument tightens or eases capital controls on investment by foreign institutions in different asset classes such as debt, equity and derivatives.

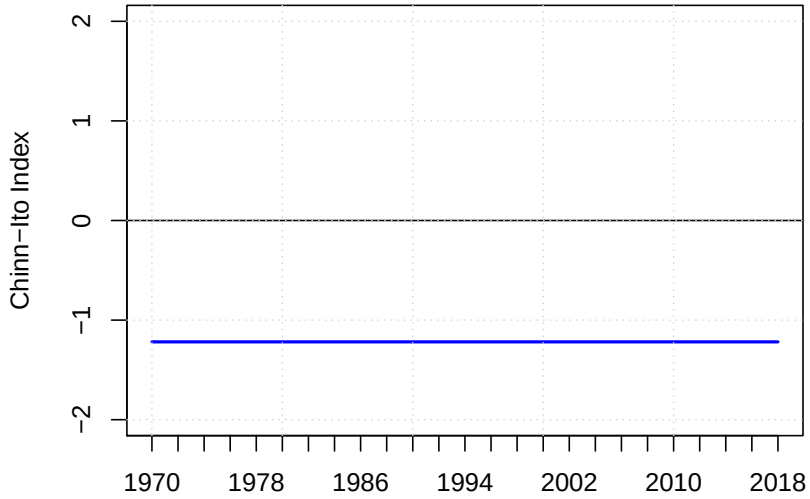
There are three problems with using these de-jure measures to capture capital account openness. First, de-jure is not the same as de-facto. There always exist loopholes in any regulation. Hence, while many legal restrictions maybe in place, investors may find loopholes in them and be able to bring in more capital than what the de-jure measures would imply. Alternatively, it may well be the case that even when de-jure measures show that the capital account has been opened up, in reality foreign capital flows may not have changed much because the country in question may not be an attractive investment destination perhaps due to weaknesses in its macroeconomic fundamentals or because of other impediments to foreign investment such as cumbersome tax laws etc. These will not get captured by de-jure measures of capital openness.

[11] see, Reserve Bank of India Bulletin, "Onshoring the Offshore", 2020.

In these circumstances, de-facto measures of capital account openness help to get a better understanding of how open a country's capital account truly is.

Second, majority of the de-jure indices, especially those constructed on a yearly basis, fail to capture the intricacies of capital controls for specific countries owing to their low frequency. This problem becomes even more acute for a country like India, where it is possible that within a span of a year, many rules and regulations are changed by the authorities in order to alter the capital account openness. In such a situation these de-jure measures would not convey an appropriate picture because the value of the indices typically do not change a lot over time. For instance the well-known Chinn-Ito index which is often used in the literature as a benchmark index for measuring capital account openness fails to adequately capture the gradual relaxation of controls implemented in India since the mid 1990s; instead the index continues to assign the same score unless all restrictions are removed. This would erroneously imply for example that India has not experienced any capital account liberalisation at all since 1970 (see Figure 1).

Figure 1 Chinn Ito Index of capital account openness: India



Finally, even the de-jure measures built using higher frequency data tend to ignore the quality or the nature of the restrictions which is albeit harder to quantify. This may result in treating all the de-jure changes equally and assigning an incorrect score to capital account openness. For example, it is possible that within a year, a country relaxes 5 controls and imposes 3 new ones. On balance just by taking into account the quantity of restrictions it may seem that capital account of this country opened up more in that year. However, it could very well be that the new restrictions imposed were major ones with a broadbased impact whereas the controls that were eased were not as critical, implying that in effect, capital account may have become more closed than before. These nuances which are important to consider when quantifying the extent of financial integration of a country may not be captured properly by the existing de-jure measures.

These problems get addressed to a large extent when the de-facto measures are used. There are two categories of de-facto measures of capital account openness: quantity based and price-based. Quantity based measures use data on the gross or net flows of capital. In our paper, we focus on the price-based measure, that is, the deviations from the covered interest parity (CIP).

Unlike the quantity based measures, deviations from the CIP is a market-based measure which shows the reduced form outcome of capital account liberalisation. Hence it is arguably a more precise measure (Ma and McCauley, 2007). In a later section, we also show data on the gross

capital flows to give an idea of how these have changed over time alongside changes in the CIP deviation in the case of India.

Interest rate parity forms the bedrock assumption of international finance in some sense, and CIP remains the benchmark for detecting departures from perfect capital mobility. As described by Frankel (1992), the condition that covered interest differential should be zero in the event of perfect international capital mobility is an 'unalloyed criterion' for measuring the degree of financial market integration across national boundaries.

5 Onshore-Offshore yield

The covered interest parity condition says that the domestic interest rate must equal the sum of foreign interest rate and the expected depreciation of the currency, otherwise arbitrage opportunities will arise. Expected depreciation is typically measured using the difference between the currency forward and currency spot rates. If there is a difference between the domestic and foreign interest rates then investors can participate in the forward or in the spot market to arbitrage these differences. CIP works through this arbitrage concept. If however there exist capital controls then this arbitrage condition breaks down.

More specifically, under CIP, the forward exchange rate (F) of the home currency (in our case, the INR), in the absence of capital controls, is linked by arbitrage to its spot rate (S) and the interest rate differential between the home currency (r) and the US dollar (i^{USD}) as given by:

$$F = S(1+r)/(1+i^{USD}) \tag{1}$$

When capital controls are binding, non-residents may not have full access to the domestic or onshore financial markets. In these circumstances, existence of a liquid non-deliverable forward (NDF) market offering relatively unrestricted access to the foreign participants helps. In that case the CIP equation becomes:

$$F_N = S(1+r)/(1+i^{USD}) \tag{2}$$

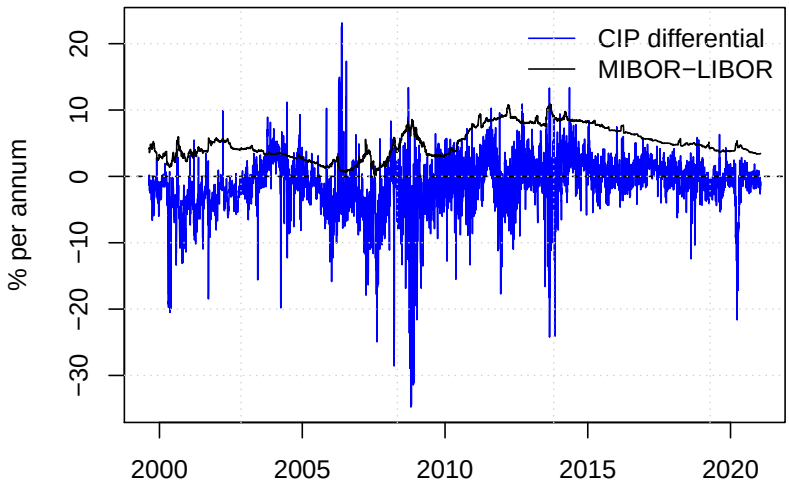
where F_N stands for non-deliverable forwards or NDFs. From Equation 2, we can obtain the NDF implied interest rate Misra and Behera (2006) as follows:

$$r = \frac{F_N}{S}(1+i_{USD}) - 1 \tag{3}$$

where S is the spot exchange rate of the US dollar in terms of the Indian Rupee, F_N is the NDF rate of a certain maturity, and i_{USD} is the interest rate on dollar deposits of the corresponding maturity. The deviation of the domestic interest rate from the NDF implied domestic yield is a measure of the CIP deviation and hence of financial integration. The greater the magnitude of the deviation, the lower the capital account openness of the home country. We use the London Interbank Offer rate (LIBOR) and the Mumbai Interbank Offer Rate (MIBOR) as the domestic onshore and foreign interest rates, respectively. We focus on 1-month maturity NDF rate given that most of the liquidity in the NDF market is in the 1-month maturity contracts as described in Section 3. Accordingly we use the 1-month MIBOR and LIBOR rates as well.

We access daily data on NDF contracts and the spot rate from Thomson Reuters Eikon database, and obtain data on 1-month LIBOR rates on dollar deposits from the Federal Reserve Board. We obtain the MIBOR rate on Rupee deposits of same maturity from the Reserve Bank of

Figure 2 1 month CIP deviations and India-US Interest rate differentials



India's Database of Indian Economy. Our data spans a period of more than 20 years, from August 1999 to January 2021.[12]

When the markets are well integrated, the deviations should ideally be zero. A zero-spread suggests the absence of effective capital controls, or the absence of arbitrage pressure or both. A non-zero spread suggests the possibility of arbitrage opportunities. However, not all non-zero deviations translate into arbitrage opportunities due to the presence of transactions costs and other factors such as imperfect capital mobility. Therefore the need to estimate arbitrage bands which we discuss in detail in section 7.

Figure 2 presents the annualized CIP deviations for our sample period along with the 1-month differential between the MIBOR and LIBOR rates. We observe significant variability in the magnitude, and the direction of the CIP deviations during our sample period. The CIP deviations between 1999 and 2010 ranged between $\pm$ 10%, with outliers around the time of the 2008 Global Financial Crisis. While there have been periods of widening deviations during the last 20 years, over time the size of the CIP deviations has reduced, especially in the recent years.

Table 2 presents summary statistics of the CIP deviation and of the interest differential between India and the US. The mean CIP deviation for the full sample period is -1.14%, while the median is -0.66%. The negative mean broadly reflects an asymmetry in the violations from the CIP condition, indicating that the net effect of capital controls is more binding on capital outflows. The average differential between onshore and foreign interest rates during the sample period is 5%, reaching the highest level of close to 11%. The median is around 4.6%. This reflects a pretty large differential between the interest rates on the Indian Rupee and the USD denominated rates. These return differentials show up in the CIP deviations, especially in the wide-ranging variations across the sample period.

The average and the median values for the full sample mask these variations in the CIP deviations. While the initial part of the sample period from 1999-2002 was characterised with mostly negative CIP deviations (implying the onshore rate to be lower than the implied offshore rate), we see that the deviations become positive in the period between 2003 to 2005. In the later years, especially around the GFC, we find significantly large negative deviations.

[12]Since both MIBOR and LIBOR are annualized, we first de-annualize the two interest rates, compute the NDF implied interest rate, r, and then re-annualize it by multiplying by 12. We then compare the implied domestic yield with the MIBOR rate to capture the extent of CIP deviations.

Post 2010, we observe that the CIP deviations fluctuate within the positive and the negative territory, up until 2013 around which, once again we start seeing CIP deviations showing large positive bias. This implies that while some periods witnessed more capital inflow pressures, others experienced capital outflow pressures and arbitrage opportunities may or may not have been exploited depending on the extent of effective capital controls and transaction costs.

In the period post 2014, we observe a considerable reduction in the size of the deviations from the CIP. These observed differences also reflect the gradual policy shifts in the capital controls by the Indian regulator. To uncover the complex process of financial liberalisation followed over the last two decades, we therefore also study the sub-periods.

While one can exogenously identify the sub-periods of substantial variations based on capital control changes (as in Hutchison et al. (2012a)), this approach introduces subjectivity in the determination of break dates for these periods. We instead let the data identify the sub-periods based on the structural break test (Bai and Perron, 1998), and then trace the policy changes, capital control measures and macroeconomic developments for the identified sub-periods.

6 Structural breaks in CIP deviation

The methodology for determining structural breaks endogenously is well-established in the literature.[13] Given a standard linear regression model, the test checks for parameter instability in the model in sub-periods. The approach relies on estimating the breakpoints obtained by minimizing the residual sum of squares in each sub-period. The null hypothesis is that there is no structural break, against the alternative that there are unknown number of breaks. In our analysis, the null of no structural break is rejected in favor of the alternative.

The test requires two inputs: a) the minimum number of observations in one regime ('h') and b) whether the break is expected in levels or trend? A look at the deviations reveals that the breaks are likely to be in levels, not in trend. We estimate the optimal number of structural breaks by allowing various levels of h: 10%, 12%, 15% and 20%. We find that the sub-periods with five structural breaks with $h = 12\%$ overlap with the subperiods at all other levels of h. We therefore use these five breaks (which give us six sub-periods) for the analysis.

Figure 3 superimposes the breakpoints on the CIP deviations graph, and Table 3 provides the summary statistics for each of the sub-periods along with the corresponding dates.

If we look at the average CIP deviations before and after the Global Financial Crisis (2008-09) we find that in the pre-GFC period, the average CIP deviation was -2.58 and it goes down to -0.03 in the post-GFC period. In other words, India's capital account has become significantly more open in the last decade compared to what it was in the first half of our sample period. This is also evident from Figure 3 which shows that over time the CIP deviation has become smaller, and more tightly distributed around zero.

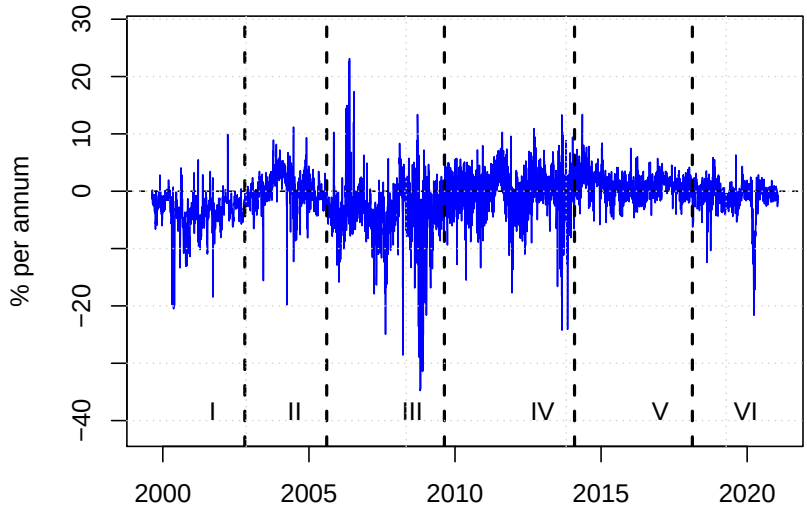
6.1 CIP deviations, capital controls and macro conditions

In this section we analyse each of the six sub-periods in greater detail. Specifically we discuss the kind of capital control actions, and macroeconomic conditions that these sub-periods were associated with, in order to throw some more light on the nature of the CIP deviations that we have estimated.

August 1999 - October 2002
As shown in Table 4 the first sub-period was characterised by a moderate GDP growth rate of 5.32%. Consumer price index inflation was reasonably low at 3.95% but the short-term interest

[13] See for example, (Andrews, 1993; Bai, 1994; Bai and Perron, 1998, 2003; Zeileis et al., 2003, 2010).

Figure 3 Daily CIP deviations from 1999 to 2021



rate proxied by the 91day TBill rate was quite high at 7.76% while the policy repo rate was 8.5%. The current account registered a small surplus on average during this period, 0.08 percentage of GDP. The interest rate differential was positive.

The average CIP deviation during this period was -3.73 (table 3) implying that interest parity did not hold and there were significant barriers to capital account transactions. The existing data on de-jure capital control actions (CCAs) shows that during this period the number of easing events exceeded the number of tightening events (table 1). Yet the relatively high deviation from interest parity could be because in early 2000s, India's capital account was still a reasonably closed one. The liberalisations initiated in early to mid 1990s were not yet substantial or would have become effective with a long lag given that this entailed a big change in the status quo. In fact any meaningful change in capital account liberalisation took place only from early 2003 onwards as explained in Hutchison et al. (2012a), confirming that there was a deep legacy impact.

As shown in Zeileis et al. (2010), this was also a period when the INR was relatively tightly pegged to the USD. This shows up in the low volatility (1.94) of the nominal exchange rate in table 4.

October 2002 - August 2005
During this period,the average GDP growth rate increased dramatically to 7.25% consistent with the remarkable 'boom' experienced by the Indian economy in the 2000s. Inflation was controlled at 3.82% and interest rate had come down to 4.91%. The favourable macroeconomic factors along with the steady process of capital account liberalisation that had been going on since the mid 1990s, encouraged significant capital inflows into the Indian financial markets. The interest rate differential came down from the previous period.

The policymakers imposed some additional restrictions on foreign investment inflows while relaxing some existing controls both on inflows and outflows. The overall attempt seemed to be to stem the surge of capital inflows which were triggered by India's improving growth prospects. The average CIP deviation during this period turned positive and went down to 0.25 implying greater integration of India's financial markets with the rest of the world. This shows that inflows continued despite the imposition of additional controls. The current account remained in surplus mode (0.25% of GDP). Greater exchange rate fluctuations were also allowed. This was thus a period of high growth rate, stable inflation and low interest rates.

August 2005 - August 2009
This period, which also included the 2008 Global Financial Crisis. witnessed the highest average CIP deviation in the last 20 years implying that India's capital account liberalisation process was impeded during this time in a relative sense. While the authorities continued relaxing some controls, most notably on foreign portfolio investment flows, they also imposed several new restrictions on Indian firms' external commercial borrowings.

The volatility of the CIP deviations was also the highest during this period as shown in table 3. A look at the de-jure data presented in Pandey et al. (2016) shows that the highest number of capital account restrictions on Indian firms' foreign borrowing was in the year 2007. Likewise Pandey et al. (2019b) find that the second highest number of capital controls imposed on foreign portfolio investment by the Indian authorities was in the year 2008.

During this time the current account recorded a deficit of 1.87% of GDP. The exchange rate moved away from the USD peg to a basket peg involving several currencies with greater flexibility as reflected in the increase in currency volatility (6.27) in table 4. This was also the time when CPI inflation began inching upwards and so did the short term interest rates, while GDP growth continued to be high at 8.14%. The interest rate differential continued to decline during this period.

August 2009 - February 2014
The period after the Global Financial Crisis of 2008 was marked by a dramatic increase in CPI inflation. At 10.41%, average inflation in this sub-period was the highest in last 20 years. The repo rate was increased to 7% and monetary policy contraction by the RBI raised the 91day TBill rate to 7.39%. GDP growth started slowing down and current account deficit widened to 3.4% of GDP. The average interest rate differential was the highest in this period reflecting the fact that the India's central bank was tightening monetary policy in response to rising inflation whereas the US Fed had lowered the interest rates to zero in response to the Global Financial Crisis.

The other notable development of this period was the increase in currency volatility. The RBI substantially reduced its interventions in the foreign exchange markets as a result of which the INR-USD became almost a freely floating exchange rate. This would be the only sub-period in our sample where we observe this a relatively volatility of the currency (8.27).

In terms of capital control actions, while the number of tightening events exceeded the number of easing events during this period, the average CIP deviation was down to 0.02, the lowest in our sample period, implying that India's capital account had opened up again after a temporary interruption in the preceding years. This could be because majority of the controls were imposed in 2012 and particularly in 2013 (in context of the Taper Tantrum episode of May 2013) and these restrictions had a lagged impact on the CIP deviation. The consequences of these tightening actions therefore show up in the next sub-period when CIP deviation goes up again.

February 2014 - February 2018
By this time CPI inflation had been controlled. This period also coincided with India's adoption of Inflation Targeting as a monetary policy framework. The interest rates continued to be high even though inflation had started coming down from the high levels of the post-2008 period. The interest rate differential came down from the previous high of 7.38% but remained high at 6.84%.

Currency volatility went down as the RBI returned its focus to stabilising currency fluctuations. CIP deviation went up even though this period was characterised by a significant amount of easing of capital control actions. As mentioned earlier, this could reflect the lagged impact of controls imposed in the previous sub-period.

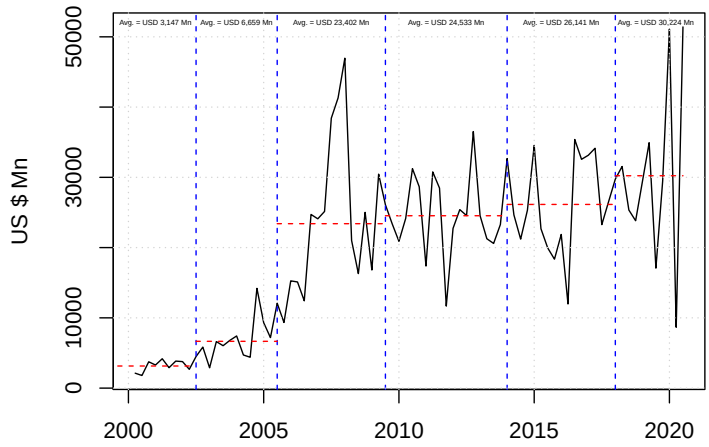
February 2018 - January 2021
In the final sub-period of our sample, we find that average CIP deviation was down to -0.94, implying continued liberalisation of the capital account and reduction of barriers on foreign investments. The volatility of the CIP deviations was among the lowest during this period. This period also coincides with the onset of a prolonged economic slowdown triggered by the Covid19 pandemic which is reflected in the decline in GDP growth rate to 0.87%. The interest differential also came down further.

While currency volatility went up compared to the preceding period, inflation remained more or less the same and short term interest rates were at their lowest level in the last 20 years.

As mentioned earlier, if we look at the years pre and post 2008 i.e. before and after the effects of the Global Financial Crisis started getting felt worldwide, it is clear that the CIP deviation in the post-2008 period has been substantially lower than in the pre-2008 period. The narrowing of the CIP deviation in recent years fits well with the de-jure data on capital control actions as described in Pandey et al. (2019b). They find a large number of capital control relaxations announced by the Indian authorities in 2017 and 2018. In fact 2018 witnessed the maximum number of easing events since 2000. This hints at the possibility that capital control relaxations in recent years may have indeed resulted in greater financial integration of the Indian economy.

This is also reflected in the de-facto quantity-based measure of capital account openness as shown in figure 4 which plots the absolute values of gross capital flows in and out of Indian economy during our sample period. There was a sharp increase in the average value of gross capital flows from 2005 onwards followed by a steady increase over the next one decade or so. The last sub-period witnessed a moderate jump in the average value of gross flows which is also consistent with our finding of narrowing CIP deviation during this time.

Figure 4 Gross capital flows (absolute values): India



It is worth noting in this context that the narrowing of the average CIP deviation over time, especially from 2008 onwards raises questions about the effectiveness of the capital controls regularly imposed or tightened by the policy makers to reduce inflows or restrict outflows over the years. The de-jure data on CCAs shows that in general authorities have been much more active in changing capital controls in the post-2008 period. Between FPI and ECB controls, while the pre-2008 period saw 32 tightening and 44 easing episodes, the post-2008 period (2008 included) registered as many as 64 tightening and 62 easing episodes.

6.2 Comparison with other EMs

It might be useful to get a sense of how India's average CIP deviations over the last couple of decades and hence de-facto capital account openness compare with other emerging economies. For this purpose, we calculate the CIP deviations for South Korea and China using data on their 1-month NDF contracts and the differential between their respective interbank offer rates and the LIBOR. We selected EMEs which have a sizeable NDF market, and amongst these we could find continuous data for only China and South Korea. We plot their CIP deviations and the interest rate differentials in figure 5 for South Korea and figure 6 for China.

Figure 5 South Korea: 1 month CIP deviations and Interest rate differentials with US

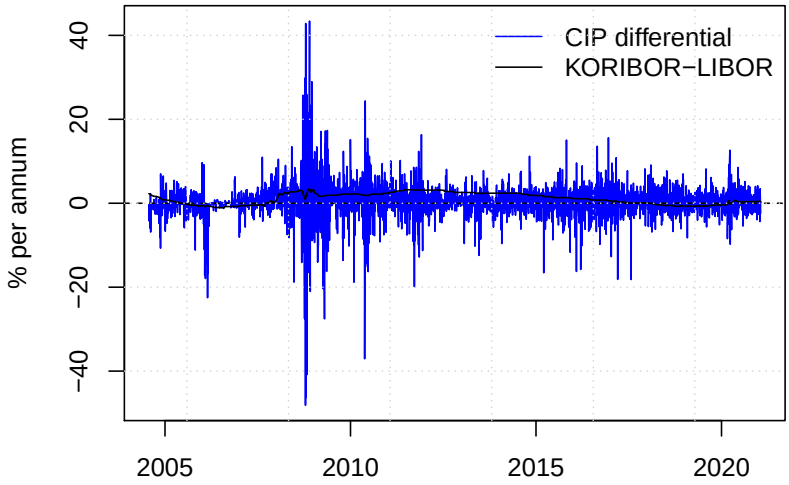
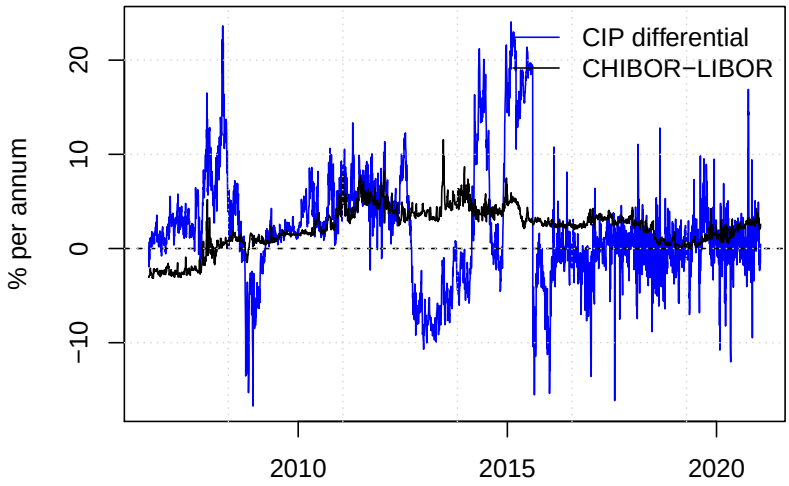


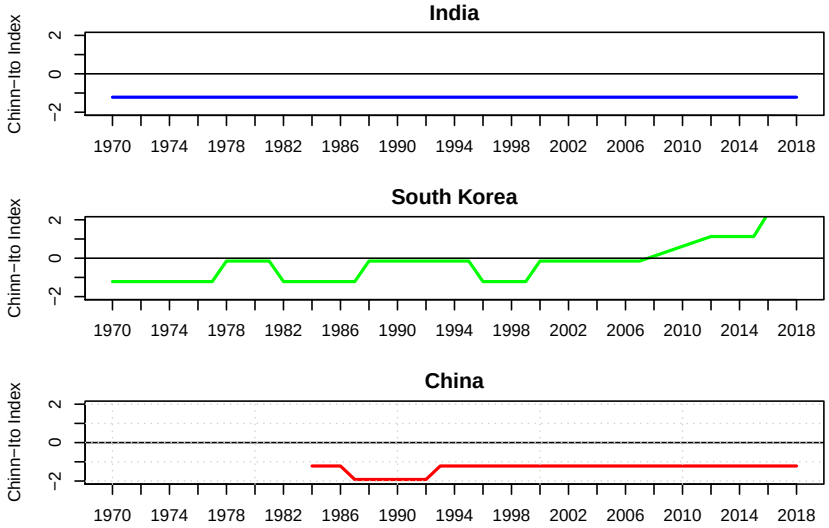
Figure 6 China: 1 month CIP deviations and Interest rate differentials with US



We find that barring the Global Financial Crisis period of 2008-09, the overall CIP deviation in South Korea more or less fluctuates close to the zero value over the period from 2005 to 2020, and is relatively smaller compared to India. This implies that in a de-facto sense South Korea's capital account is more open than that of India. This reflects the substantial reduction in capital account restrictions that Korea implemented from 2005 onwards, mainly driven by liberalisation of regulations governing capital flows in bond and equity markets (Sengupta and Gupta (2018)). The variations in CIP deviations over the sample period are also less compared

to India. However the picture is quite different when we look at China's CIP deviation. The volatility in China's CIP deviation is substantially more than that of India though on average the deviations seem to range from +10% to -10% similar to India.

Figure 7 Chinn Ito Index of Openness: India, South Korea, China



We also look at one de-jure measure of openness for these two countries and compare them with India's in figure 7. We plot the Chinn-Ito index for the full period for which data is available for all 3 countries. We find that for India and China the average values of the index are -1.2 and -1.3 respectively, implying that both these countries have closed capital accounts with no change over time in the degree of openness as can also be seen from the graph. This reiterates the point made earlier that such de-jure indices ignore the continuous process of liberalisation that might be underway in a country. In contrast the average value of the index for South Korea is -0.2. To the extent that higher value of the index represent greater financial integration, South Korea has a more open capital account compared to China and India when measured by this index. Clearly we get a much more nuanced view of capital account liberalisation when we study the CIP deviations as compared to a de-jure measure.

7 No-arbitrage bands estimation

The presence of transactions costs and capital controls result in the formation of bands around the CIP deviations within which arbitrage will not be possible (Hutchison et al. (2012a)). However, outside of these bands (or threshold values), arbitrage profit opportunities will emerge. In the presence of a liquid foreign exchange market, the force of arbitrage would bring back the deviations within the no-arbitrage boundaries. The threshold values and thus the width of the bands, as well as the speed of reversion to the no-arbitrage bands depend upon capital controls restrictions, transactions costs as well as institutional factors such as the size and liquidity of the spot and forward currency markets (Juhl et al., 2006; Levy Yeyati et al., 2009).

We hypothesise that with the gradual relaxation in the capital controls, the width of the no-arbitrage bands, as well as the speed of mean reversion would reduce. To estimate the no arbitrage bands, we use the self exciting threshold autoregressive (SETAR) model.[14] The SETAR model is a piecewise linear model where different autoregressive processes are estimated

[14]The SETAR model is a special, and the most simplest case of a non-linear threshold autoregressive (TAR) model (Tong (1990)) in which the regime-switching thresholds depend on the lagged values of the autoregressive model itself.

depending on the state of the variable at time $t-1$. The autoregressive coefficients take different values depending on whether the previous value of the variable is above or below a certain threshold value, thus exhibiting regime switching dynamics. The SETAR model nests the linear AR model when all autoregressive coefficients are same across all regimes (Hutchison et al., 2012b).

We estimate a SETAR model that allows two thresholds in the CIP deviations. The upper and lower thresholds divide the series into three regimes. The model is given as:[15]

$$\begin{aligned}
\delta_t &= \alpha\delta_{t-1} + \epsilon_t && \text{if } \kappa_l < \delta_{t-1} < \kappa_u \\
\delta_t &= \kappa_l(1-\rho_l) + \rho_l\delta_{t-1} + \epsilon_t && \text{if } \delta_{t-1} \leq \kappa_l \\
\delta_t &= \kappa_u(1-\rho_u) + \rho_u\delta_{t-1} + \epsilon_t && \text{if } \delta_{t-1} \geq \kappa_u
\end{aligned}$$

where, δ_t is the time series of interest, in our case, CIP deviations, $\epsilon_t \sim N(0, \sigma^2)$, and κ_l and κ_u denotes the lower and upper thresholds respectively. The difference between the κ_l and κ_u form the no-arbitrage band. When δ_{t-1} lies within the band dictated by κ_l and κ_u, δ_t follows an autoregressive process with mean zero. However, when δ_{t-1} lies outside of the band, δ_t follows a different auoregressive process with a different mean (Peel and Taylor, 2002; Juhl et al., 2006; Martens et al., 1998) and revert to being within the band. Inside the bands, the series may follow a random walk, indicating the absence of profitable arbitrage opportunities.

The thresholds (κ_l and κ_u) are not known and estimated by a sequential grid search method in the time series as suggested by Hansen (2000). In this method, a single threshold is first determined based on the value that minimizes the residual sum of squares using concentrated least squares. Once the first threshold is determined, conditional on that threshold, a grid search is again conducted to determine the second threshold.

Note that the number of thresholds may not necessarily be two. It may be one, or the series may even not be non-linear in nature. For each sub-period obtained from the structural break tests (section 6), we test for non-linearity and the number of thresholds using the Hansen (1996) likelihood ratio test. Based on the results of the test, we estimate the thresholds (or not in case the series is linear) to obtain the no-arbitrage bands for each sub-period as specified in Model 4. We discuss the results in the next subsection.

7.1 SETAR estimation results

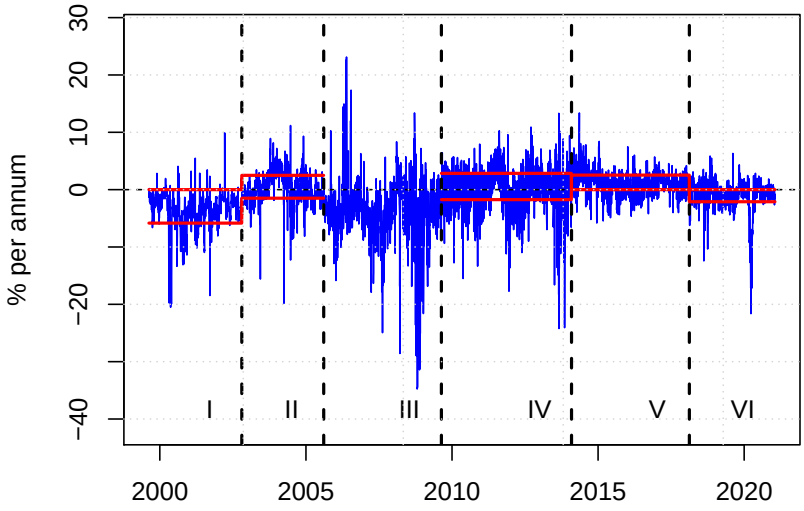
Table 5 reports the SETAR estimates for the six subperiods identified in Section 6. The table shows the beginning and end dates of each sub period, the selected model (linear or two-regime or three-regime based on the Hansen test results), the estimated coefficients with the lagged δ_t term, and the number of observations. In the three-regime model, the lower (negative) threshold serves as the lower boundary, while the higher (positive) threshold serves as the upper boundary of the no-arbitrage bands. In the two-regime model, the zero point is interpreted as the implicit second boundary. When the series is in the outer regime, the speed of convergence (or reversion to the no-arbitrage bands) is measured by the estimated AR(1) coefficient. Lower the magnitude of the AR(1) coefficient, higher is the speed of reversion to the no-arbitrage bands, indicating strong force of arbitrage.

The test for the number of thresholds (versus the null of linearity) indicates three 2-regime TAR model (Sub-period 1, 5 and 6), two 3-regimes TAR model (Sub-period 2 and 4), and one linear

[15] This model is similar to the band-TAR model of Balke and Fomby (1997) and Peel and Taylor (2002). The main difference is that the band-TAR model assumed symmetric arbitrage bands on both sides, while this model allows for asymmertic arbitrage bands.

model in sub-period 3. Figure 8 plots the CIP deviations along with the estimated thresholds for each sub-period.

Figure 8 SETAR model estimation results on 1-month CIP deviations with estimated boundaries



The table indicates that the size of the no-arbitrage bands varies across the sub-periods.[16] In the first sub-period, August 1999 to October 2002, the effect of stricter controls (despite gradual easing) manifests itself in the form of wider no-arbitrage bands within which no profitable arbitrage could be undertaken despite the large magnitude of CIP deviations. The upper threshold is set to zero, since the first boundary comes out to be very close to zero. The width of the bands is the difference between zero and the lower threshold, which returns 5.84 percentage points. The speed of reversion to no-arbitrage bands as measured by the AR(1) coefficient is also low, indicating slower arbitrage and therefore, market segmentation during this period.

In the second period, the width declines relative to the first period, but still continues to be large at 3.98 percentage points, with the speed of reversion to the no-arbitrage bands being 0.35 in the lower regime, and 0.06 in the upper regime. The lower coefficient in the upper regime indicates that the capital controls were less binding on the inflows during this period.

The third period which coincides with the financial crisis saw large CIP deviations. In this regime, the test results do not reject the null of linearity, indicating that the entire series follows a stationary AR process in this sub-period, with no-estimated boundaries for the upper and / or lower threshold, implying that the bands lie outside the range of the observed CIP deviations. The absence of arbitrage bands here indicates little or no pressure for arbitrage trades. This widening is in line with the further tightening of capital account restrictions on foreign portfolio investment as well as external commercial borrowings and also imposition of controls on capital outflows, in the later part of the sub-period in the aftermath of the 2008 crisis.

The fourth sub-period saw a mix of relaxations and controls. However, as discussed in Section , the period saw more number of tightening events than the easing events. It is also noteworthy, that on the negative side, the size of the bands is much closer to zero (1.74), than on the positive side (2.84). This indicates the presence of stricter controls on the inflows. The speed of reversion to no-arbitrage bands is similar to the speed observed in the second sub-period for

[16]It is computed as the difference between the positive and negative / upper or lower threshold.

the lower threshold, but the speed of reversion is slower in the upper regime. The width of the no-arbitrage bands turns out to be 4.58 percentage point in this sub-period.

In contrast to the first three sub-periods, the last two sub-periods show relatively narrow no-arbitrage bands (2.53 and 2.11 percentage points respectively) indicating that the net controls were relatively weak during these periods. This is in line with the de-jure measures which indicate that capital account restrictions were progressively relaxed in the last two sub-periods, and there were more easing episodes realtive to the tightening episodes (Table 1).

Overall, our results indicate a gradual opening of the capital account, based on the narrowing arbitrage bands during the period of the analysis.

8 Conclusion

Interest parity and arbitrage are age-old concepts in financial economics. In a day and age when a plethora of both de-jure and de-facto measures of a country's capital account openness have been used in the literature without there being any consensus as to which measure is better, a relatively under-utilised measure is a price-based one that uses deviations from the Covered Interest Parity.

In our paper we study the changes in the capital account openness over time of the Indian economy using the CIP deviations and no-arbitrage band estimation. India offers a great case study to analyse CIP deviations, because it has an elaborate system of capital controls in place and the authorities keep altering the rules on a regular basis thereby changing the underlying conditions for arbitrageurs.

Our analysis reveals that over a 20-year period, India has achieved a substantial amount of financial liberalisation and on average CIP deviation has been quite small in size but there have been periods of wide deviations from the interest rate parity. Most notably, in recent years, India seems to have become significantly more financially integrated with the global markets, as demonstrated by smaller CIP deviations and narrowing arbitrage bands.

Our finding has important policy implications for India in context of the trade-offs presented by the Impossible Trilemma. With a narrower band, the linkage among currency and money markets is necessarily tighter. Changes in one price or rate are more likely to be transmitted quickly and more predictably into other prices guided by CIP. As an inflation targeting country since 2016, India needs greater monetary policy autonomy. Greater capital account openness over time implies that there is limited room for stabilising currency fluctuations without triggering macroeconomic distortions in the domestic economy.

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Table 1 Brief overview of capital controls on foreign portfolio investment in India, 2000-2020, continued

2000	Enactment of Foreign Exchange Management Act (FEMA), bringing Foreign Institutional Investment under the regulatory purview of RBI.
1995-2004	FPI investment in debt securities was subject to a limit of USD 1 billion. Separate limits of investment were prescribed via the 70:30 route and the 100% debt route. USD 100 million was permitted under the 70:30 route and USD 900 billion was permitted under the 100% debt route.
2003	Relaxation of rules governing External Commercial Borrowing (ECB) by Indian firms.
2004	The overall FPI limit in debt securities was increased from USD 1 billion to USD 1.75 billion. In December, 2004 a separate limit of USD 500 million was announced for investment in corporate bonds. Since then, separate limits are announced for Government bonds and corporate bonds. In the subsequent years there has been a gradual increase in the quantitative limits for FPI investment in government and corporate bonds.
2008	No more demarcation of FPI investments in debt securities under the 70:30 and 100% route. Sharp increase in limits for FPI investment in government and corporate bonds.
2013	The separate sub-limits of FPI investment in Government debt-Old and Government debt-Long were merged into a single limit of USD 25 billion, eventually raised to USD 30 billion. The separate sub-limits of FPI investment in corporate debt were merged into a single limit of USD 51 billion.
2014	FPIs allowed to invest in exchange traded currency derivatives.
2015	RBI prohibited FPIs from investing in: (a) G-secs with a maturity period of less than three years, and (b) liquid and money market market mutual funds. FPI investment in rupee denominated debt securities moved from quantitative restrictions to percentage based limits. Aggregate FPI investment in any G-sec issuance was capped at 20% of the outstanding stock of that issuance. RBI allowed Indian firms eligible to raise ECB to issue rupee denominated bonds within the overarching ECB policy.
2018	RBI withdrew the restriction on investment in G-secs with a minimum residual maturity of 3 years. RBI re-allocated the sub-limits for investment among general FPIs and "long-term FPIs". The existing condition with respect to FPI investment in G-secs with less than 1 year maturity was relaxed, and the investment cap was increased to 30% of the total investment of the FPI in that category. For corporate bonds, the framework moved from quantitative limits to percentage based limits.
2019	A new route for FPI investment, referred to as the "Voluntary Retention Route" (VRR), was announced. Under this route, FPIs were allowed to invest in G-secs of all maturities subject to conditions such as minimum investment size, lock-in period, etc. RBI announced a "Fully Accessible Route" (FAR) that gives unlimited access to FPIs but only to a select set of G-Secs, specified by the RBI from time to time. The existing condition that no FPI shall have an exposure of more than 20% of its corporate bond portfolio to a single corporate (including exposure to entities related to the corporate) was withdrawn.
2020	Short-term investment limit applicable to FPIs investing in G-Secs and corporate bonds was increased from 20% to 30% of the total investment. FPI investments in debt instruments issued by Asset Reconstruction Companies and by an entity under the Corporate Insolvency Resolution Process as per the resolution plan approved by the National Company Law Tribunal under the Insolvency and Bankruptcy Code, 2016 would be exempted from the short term investment limits.

Table 2 Summary statistics of CIP deviations and MIBOR-LIBOR differential

	CIP deviation (%)	MIBOR-LIBOR differential (%)
Minimum	-34.77	-0.03
Q1	-2.93	3.37
Median	-0.66	4.57
Mean	-1.14	5.00
Q3	1.28	6.93
Maximum	23.13	10.92
SD	4.17	2.32
% of -ve obs.	58.95	-
# of obs.	5,584	5,584

Table 3 Summary statistics of sub-periods of CIP deviations

Sub-period	Start date	End date	Number of obs.	Median CIP dev.	Mean CIP dev.	SD	MIBOR-LIBOR mean
I	1999-08-18	2002-10-22	829	-3.10	-3.73	3.24	3.94
II	2002-10-22	2005-08-11	732	0.25	0.25	2.97	3.25
III	2005-08-11	2009-08-21	1046	-3.34	-3.79	5.53	3.12
IV	2009-08-21	2014-02-03	1161	0.35	0.02	3.96	7.38
V	2014-02-03	2018-02-15	1052	1.18	1.12	2.03	6.84
VI	2018-02-15	2021-01-20	763	-0.46	-0.94	2.76	4.27

Table 4 Macroeconomic developments in the sub-periods of 1-month CIP deviations

Sub-period	Start date	End date	CIP mean	GDP growth	Inflation	Interest rate	Currency volatility
I	1999-08-18	2002-10-22	-3.73	5.32	3.95	7.76	1.94
II	2002-10-22	2005-08-11	0.25	7.25	3.82	4.91	3.29
III	2005-08-11	2009-08-21	-3.79	8.14	7.25	6.35	6.27
IV	2009-08-21	2014-02-02	0.02	7.03	10.41	7.39	8.27
V	2014-02-03	2018-02-15	1.12	7.40	4.83	7.15	4.85
VI	2018-02-15	2021-01-20	-0.94	0.87	4.75	5.24	5.37

GDP growth is the year on year growth rate in real GDP. We use the 2004-05 base year series till 2013-14 and the 2011-12 base year series after that. Inflation refers to year on year CPI inflation. Interest rate is the 91-day treasury bill rate which encompasses the monetary policy stance of the RBI. Currency volatility is the annualised volatility of the INR-USD nominal exchange rate.

Sub-period	Start date	End date	Lower threshold	Upper threshold	% of obs.			AR(1) coefficient			AIC	MAPE	Obs.
					Low	Medium	Upper	Low	Medium	High			
I	1999-08-18	2002-10-22	-5.84		0.17		0.82	0.66		-0.35	1203.21	1.55	830
II	2002-10-22	2005-08-11	-1.49	2.50	0.25	0.53	0.22	0.35	0.69	0.06	1206.00	1.84	733
III	2005-08-11	2009-08-21	-	-		0.50					6256.75		1047
IV	2009-08-21	2014-02-03	-1.74	2.84	0.25	0.54	0.21	0.34	0.09	0.12	2970.76	2.49	1162
V	2014-02-03	2018-02-15	2.53		0.80		0.20	0.30		0.22	1327.58	2.78	1053
VI	2018-02-15	2021-01-20	-2.11	-	0.17		0.83	0.93		-0.04	1006.45	2.12	764

Table 5: SETAR model on 1-month CIP deviations: Estimation results