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Original Paper

Real Effective Exchange Rates and Foreign Direct Investment Inflows: Empirical Evidence from India's Sub-National Economies

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Abstract

This paper investigates the impact of real effective exchange rates (REER), both in terms of levels and volatility, on foreign direct investment (FDI) inflows for a panel of 35 Indian sub-national economies over the period 2000-2013. In light of the asymmetric distribution of FDI inflows within India, we focus on examining the nexus between FDI inflows at the sub-national level and India's competitiveness captured by REER. Our empirical analysis reveals that movements in REER have a significant and negative impact on FDI inflows, while REER volatility is found to be inducing FDI. Our results are suggestive that FDI inflows into India are largely domestic market oriented in nature.

Purpose: *In light of the asymmetric distribution of FDI inflows within India, we focus on examining the nexus between foreign direct investment (FDI) inflows at the sub-national level and India's competitiveness captured by real effective exchange rates (REER). This paper investigates the impact of REER, both in terms of levels and volatility, on FDI inflows to 35 Indian sub-national economies over the period 2000-2013.*

Research Methodology: *To examine the impact of REER on FDI inflows, we compile a panel dataset for 35 sub-national economies covering the time period 2000 to 2013. We employ panel fixed effects*

models to explore our relationship of interest between REER and FDI, controlling for other characteristics specific to a sub-national economy.

Findings: *Our empirical analysis reveals that movements in REER have a significant and negative impact on FDI inflows, while REER volatility is found to be inducing FDI. Our results are suggestive that FDI inflows into India are largely domestic market-oriented in nature.*

Originality/Value: *Considering that India's FDI inflows exhibit significant concentration patterns among selected regions, we exploit this heterogeneity at the sub-national level to empirically understand the determinants of FDI, with a particular focus on cost competitiveness as captured by REER. The extant literature has not explicitly focused on testing the impact of REER both in terms of its levels and volatility on FDI inflows to India at the sub-national level, especially not at the sub-national level. While admittedly the exchange rate varies only at the national level, the value-addition comes from understanding its interaction with state-varying macroeconomic indicators.*

Keywords

Foreign Direct Investment, Sub-national economies, Real Effective Exchange Rate, India

JEL Classification: F21, F31, C33, O53

1. Introduction and Motivation

Foreign Direct Investment (FDI) inflows to developing economies play a significant role in supplementing domestic capital, technology and skills thus accelerating economic growth in a country (Note 1). Moreover, FDI inflows enable recipient countries to integrate into regional value chains, thereby facilitating exports (Note 2).

Recent studies that investigated the nexus between economic growth and FDI inflows to India have found a positive relationship between the two variables (Thangamuthu & Karthikeyan, 2015; Pal, 2016; Abubakar & Bala, 2016). Among various emerging and developing economies, India has evolved as a significant recipient of global FDI inflows over the last 15 years or so. With the gradual but systematic dismantling of trade and investment barriers, the country has experienced significant FDI inflows since the early 2000. Figure 1 shows, in absolute terms, in the early years of the decade beginning 2000, FDI inflows were hovering around US$ 5 to US$ 7 billion. The real turnaround appears to have occurred between 2005 and 2008 when FDI inflows increased from about US$ 10 billion to a peak of over US$ 40 billion in 2008 just before the global financial crisis (GFC) struck. Despite a sharp deceleration in FDI inflows between 2008 and 2012 there appears to be a modest recovery since then. FDI inflows have clearly not reached the pre-GFC peaks although they stood at US$ 35 billion in 2014 (Figure 1).

Figure 1 also highlights the share of India's FDI as a percent of world FDI and India's Gross Domestic Product (GDP). After declining sharply in the post GFC period India's FDI as a share of world FDI and India's GDP started increasing after 2012 and stood at over 2.5 and 1.5 percent respectively in 2014. These facts largely reflect the increasing prominence of India's FDI.

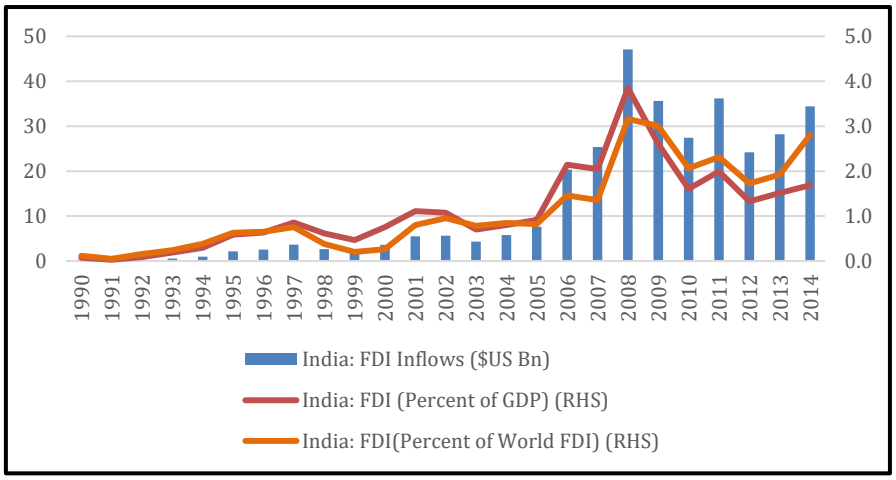

Figure 1. FDI Inflows to India (US$ Billion) and as a Percent of GDP and World FDI, 1990-2014

Source: Reserve Bank of India and World Bank.

There is a well-established academic literature that points to a large number of factors that determine FDI inflows especially into emerging and developing economies (See Blonigen, 2005 for a comprehensive review of this literature). Studies such as Sahoo (2012) and Sahiti et al. (2018) have identified market size, labour cost, trade openness, infrastructure, economic reforms and labour quality as determining factors for FDI inflows. One of the many determinants on FDI relates to the movement of exchange rates both in terms of level and volatility. At a very basic level, when an economy experiences a depreciation of its currency for example, viz. the value of its currency declines relative to another currency or a basket of currencies, it potentially improves the attractiveness of that country as a destination for FDI inflows as the country gains a "locational advantage" as a result of a possible reduction in its wages and costs of production, ceteris paribus (Froot & Stein, 1991; Klein & Rosengren, 1994; Goldberg, 2009). Although there are various other confounding factors such as future expectations of exchange rates that matter in order to empirically determine the extent to which exchange rate movements affect FDI inflows, the broader point to note is that cost competitiveness remains one of the crucial determining variables affecting FDI inflows.

Popovici and Calin (2015) in their study examine the impact of enhancing competitiveness on FDI inflows for Central and Eastern European countries. Their findings reveal that FDI inflows can be increased by improving competitiveness variables. For most emerging and developing economies like India, remaining cost competitive has become a pre-requisite to continue being an attractive destination for global FDI inflows. In light of this background, this paper examines the impact of cost competitiveness, broadly proxied by Real Effective Exchange Rates (REER) on FDI inflows in India. While there is some literature to date that studies the relationship between exchange rates and FDI in the context of India, most of the literature investigates this relationship at the aggregate level.

Considering that India's FDI inflows exhibit significant concentration patterns among selected regions, we exploit this heterogeneity at the sub-national level to empirically understand the determinants of

FDI, with a particular focus on cost competitiveness as captured by REER. Further, consistent with the related literature that points to varying levels of competitiveness (Note 3) and governance structures observed in India, undertaking an empirical analysis at the sub-national level is warranted.

The remainder of the paper is structured as follows. Section 2 will provide an overview of the FDI trends and patterns in India at the sub-national level. Section 3 will discuss the theoretical and empirical literature on determinants of FDI, specifically focusing on the nexus between exchange rates and FDI. Section 4 will outline the empirical model employed in the paper, along with details on the data sources and definitions. Section 5 with furnish the empirical results as well as the robustness checks, while Section 6 summarizes the paper highlighting some policy implications.

2. Trends and Patterns in FDI Inflows to Sub-national Economies of India

Figure 2 shows the regional breakdown of the top five major contributors to India's FDI inflows at the national level. We observe, on average, over the period of 2001 to 2013 five out of 17 regions (as classified by the Reserve Bank of India (RBI)) (Note 4) received almost 60 percent of India's total FDI inflows.

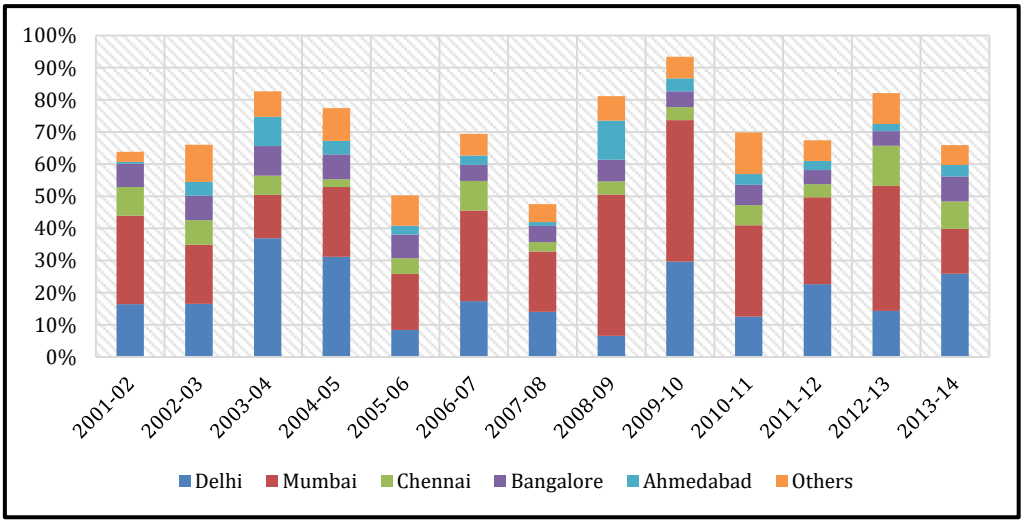

Figure 2. Top 5 Regional FDI Contribution to India's FDI (Percent)

Source: Authors based on Reserve Bank of India data.

Among these five regions, the lion's share is represented by the Mumbai region comprising the sub-national economies of Maharashtra, Dadra & Nagar Haveli and Daman & Diu, which has continued to be the largest recipient of FDI inflows to India, closely trailed by the Delhi Region represented by New Delhi as well as a part of the sub-national economies of Uttar Pradesh and Haryana (known as the National Capital Region). On average, between 2001 and 2013, over a quarter of India's overall FDI inflows has flown into the Mumbai region (26 per cent), followed by the Delhi region (19 per cent), implying that the sub-national economies in these two regions receive about 45 percent of the

nation's overall FDI.

Other regions such as the Southern region represented by Bangalore and Chennai (covering the sub-national economies of Karnataka, Tamil Nadu and Puducherry), received an average share of 12 percent during this period. The region of Ahmedabad consisting of Gujarat was the fifth largest receipt of FDI inflows to India accounting for about an average of 4 percent of India's FDI from 2001 to 2013. These trends provide some indicative evidence of large-scale clustering of FDI into the combination of Mumbai, Delhi, Bangalore, and Chennai regions, with the remainder being split across the rest of the country.

Further, it is worth noting that the average contribution of these four regions during the pre and post-GFC periods reveals that the shares have been fairly consistent for all regions except for Mumbai region, which seems to have experienced a notable jump in this share after the GFC from 21 per cent to 33 per cent (Figure 2).

Figure 3 breaks down the regional FDI inflows further at the sub-national level (Note 5), as a percent of India's FDI. The results are largely consistent with the regional trends. We find that 31 percent of India's FDI inflows are destined to Delhi and Maharashtra. The other five sub-national economies Gujarat, Karnataka, Tamil Nadu and Andhra Pradesh contribute receive around 15 percent of India's FDI inflows. Thus, the top seven sub-national economies out of 36 sub-national economies of India contribute to over 45 percent of India's FDI. In 2013 we see that Delhi and Maharashtra have traded places, with Delhi attracting the highest level of FDI out of the seven top recipients of FDI inflows to India.

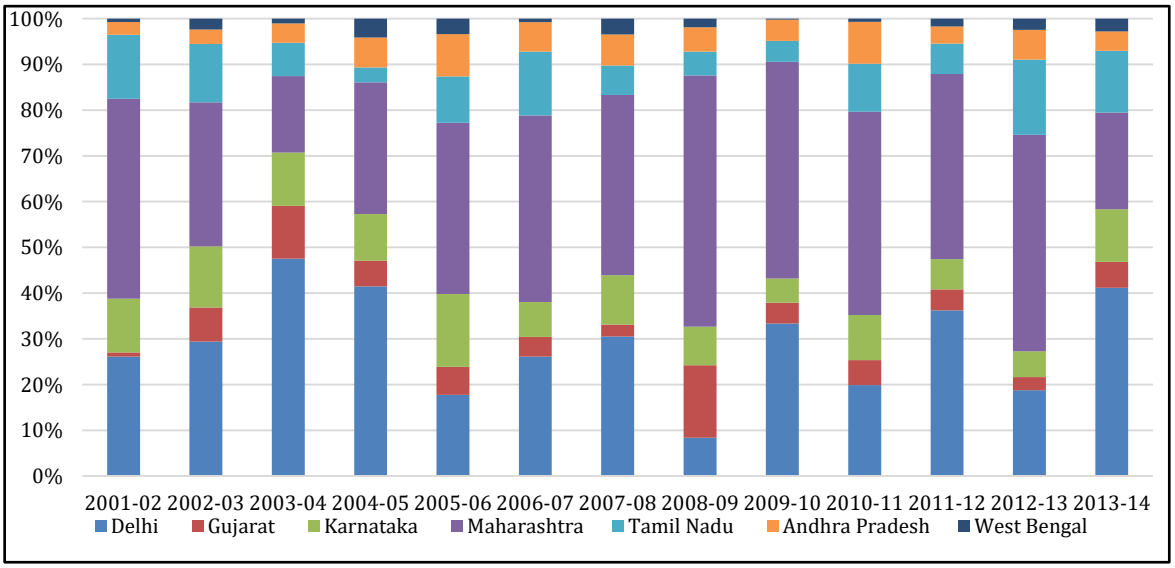

Figure 3. Top 7 Recipients of India's FDI by Sub-National Economy: US$ Billion (Real 2000 Prices)

Note. Andhra Pradesh covers newly formed Andhra Pradesh and Telangana.

Source: Authors.

To put this in perspective, we consider the magnitude of FDI inflows to these sub-national economies as a proportion of their respective Gross State Domestic Product (GSDP) between 2001 and 2013 while comparing it to the national average. Interestingly, FDI inflows as a share of GSDP in Maharashtra have registered a decrease from close to 2 per cent in 2001 to around 1.3 per cent in 2013, positioning Maharashtra's share of FDI at par with the national average (Figure 4).

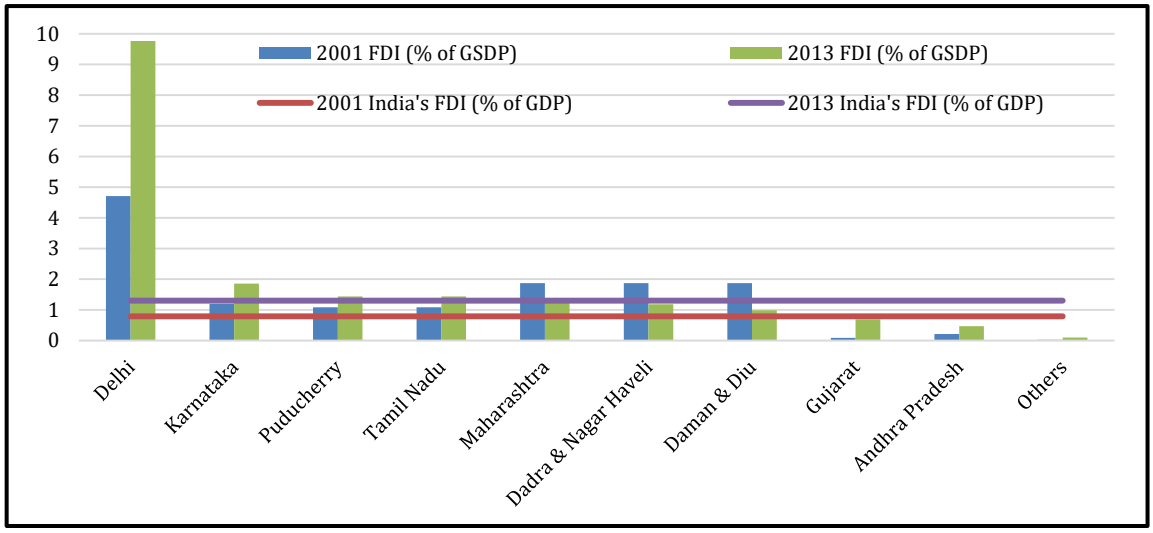

Figure 4. FDI (Percent of GSDP) of Top 7 Indian Sub-national Economies

Source: Authors.

In the relatively bigger sub-national economies (in terms of GSDP) such as Delhi, Karnataka, and Tamil Nadu, the share of FDI as a proportion of their output has more than doubled during the corresponding period. Evidently, Delhi has shown the largest increase in the FDI as a share of GSDP, representing an increase from 4.7 per cent in 2001 to 9.7 per cent in 2013. However, the main surprises came from Gujarat, Chhattisgarh and Madhya Pradesh. In Gujarat, FDI inflows as a proportion of GSDP, increased from about 0.1 per cent in 2001 to 0.7 per cent in 2013 this translates to an approximate increase of 7 times.

To sum up, our discussion on the trends and patterns of FDI inflows to India at the sub-national makes it apparent that FDI inflows to India are highly skewed towards selected regions. This warrants the need of examining FDI patterns at a disaggregated level. In Section 3, we offer a discussion of the theoretical and empirical literature examining the impact of exchange rates on FDI before proceeding with our empirical analysis.

3. Literature Review

The following discussion proceeds in two parts. The first part provides an overview of the theoretical and empirical literature addressing the nexus between exchange rate movements and FDI inflows. The second part of the section focuses specifically on the relevant literature for India.

3.1 Overview of Literature

How do movements in REER, both in terms of their levels and volatility, affect FDI inflows? The theoretical and empirical literature seems ambiguous at best. However, notwithstanding the ambiguity, the literature points to some directions as to what to expect from the nexus between exchange rate movements both in terms of their levels and volatility and FDI inflows.

The literature posits that the exchange rate effects operate broadly through the valuation channel which can affect FDI inflows through three specific ways. A positive relationship between host country's currency depreciation and its FDI inflows can come about in three specific ways through the valuation channel (Froot & Stein, 1991; Goldberg & Klein, 1998; Blonigen, 1997). The first is through wealth effects. When there is depreciation of the host country's currency, it makes its assets cheaper and can in turn encourage FDI inflows (Chakrabarti & Scholnick, 2002). The second is what can be termed as the demand effects. When there is depreciation of the host country's currency, it makes it less attractive to repatriate profits to the home country which in turn leads to higher reinvestment of retained earnings in the host country. Hence a positive effect of depreciation is observed as it triggers more inflows of FDI (Goldberg & Klein, 1997).

The third effect relates to cost competitiveness. There is a subtle difference observed in the literature with respect to the cost competitiveness effects of exchange rate movements on FDI inflows, which to a large extent depend on the nature of FDI inflows. In other words, if FDI inflows are export-promoting (vertical) in nature, then a REER depreciation induces FDI as firms using the host country as an export platform experience lowering of export costs; similarly, if FDI is domestic-market oriented/commodity seeking (horizontal), REER depreciation induces FDI because of wealth effects. However, the caveat is that if the country is part of a supply chain and has low-value-add, changes in REER levels might not have a significant effect although REER volatility might do so.

While the above effects hold in general, there are some important caveats regarding exchange rate expectations which can actually confound the positive impacts of a host country depreciation. If there are strong expectations of sustained and further depreciation in the host country's currency, it can hold back further FDI to that country. Further, expectations of depreciation of the host country's currency can also reduce repatriation of retained earnings. Finally, if further depreciation in the host country's currency is expected in future then based on Uncovered Interest Parity (UIP), the interest rates in that country will go up, and therefore cost of credit will go up, therefore reducing FDI into that country.

Besides the influence of REER levels on FDI, volatility of REER matters too for FDI and there is a large strand of both theoretical and empirical literature that examine this relationship. At the risk of simplifying a complex strand of literature, there are two possible conflicting effects that the literature points to when examining the impact of exchange rate volatility on FDI inflows. Higher REER volatility can induce FDI inflows into a country if FDI is export substituting in nature. This implies that an increase in REER volatility between the firms' home country and the host country could motivate the firm to serve the host country through a local production facility rather than exports, which to a

reasonable degree will insulate it against the risk of uncertainties imposed by exchange rate volatility. Empirically, some notable papers such as Cushman (1988), Stokman and Vlar (1996), De MÈnil (1999), Pain and Welsum (2003) find a significantly positive relationship between REER volatility and FDI inflows in the host country.

On the other hand, a body of literature also suggests that higher exchange rate volatility can deter firms from moving to the host country because of risk aversion reasons. To be sure, a firm planning to undertake an investment in a country that is prone to greater exchange rate fluctuations might imply a riskier stream of profits. This coupled with the sunk costs involved in the investment activity would encourage the firm to place on hold its investment rather than undertake it (See for instance the discussion in Goldberg (2009) and Foad (2005)). In other words, as summarised by Goldberg (2009), considering that exchange rate volatility introduces additional risks to the return on a firm's investment, the expected values of its investment projects are reduced which deters FDI accordingly. This hypothesis is also supported empirically by studies such as Darby et al. (1999), Byrne and Davis (2003), Benassy-Quere et al. (2001).

Similar to the case of movements of REER (in levels), one of the key points to be noted from the related literature is that the relationship between REER volatility and FDI inflows depends on the nature of FDI inflows. If FDI is horizontal or domestic-market oriented in nature, an increase in REER volatility could induce FDI because costs of exporting becomes high which leads firms to serve the domestic market by establishing a base in the host country. The intuition, as alluded to earlier, is that the firm attempts to establish an early base in the country in order to avoid dealing with exchange rate risks since they already know that they are going to serve the specific host country market. However, if the nature of FDI is vertical or export-oriented, we expect to see a negative relationship between REER volatility and FDI, viz. an increase in REER volatility is likely to deter FDI, for risk aversion reasons elaborated earlier (Note 6).

Overall, the impact of REER both in terms of levels and volatility may have an ambiguous impact on FDI reflecting the complex nature of the relationship governing the variables of interest.

3.2 Literature on India

Unlike the vast literature on the determinants of FDI which exist for advanced economies, studies focused on selected developing countries like India are relatively scarce. A handful of studies such as Jha (2003), Singhania and Gupta (2011), Wang (2012), Dua and Garg (2015), Mukherjee (2011), Tshuchiya (2015), Jacob and Kattookaran (2019) and Sharma and Baby (2019) are relevant in the context of our discussion as they focus on the possible determinants of FDI inflows to India. While four out of these eight papers focus on general determinants of FDI inflows which do not factor in exchange rates, only two papers namely Dua and Garg (2015), Wang (2012) and Jacob and Kattookaran (2019) do so.

Dua and Garg (2015) for instance use (quarterly) aggregate FDI data from 1997Q3 to 2011Q3 to examine the empirical determinants of FDI. They find that a depreciating exchange rate attracts FDI

inflows to India. In similar vein, Wang (2012) undertakes a study to investigate the impact of REER volatility on FDI inflows to BRIC (Brazil, Russia, India and China) countries using yearly data from 1994 to 2012. The paper finds a negative relationship between exchange rate volatility and FDI in the long-run for India and Russia. Jacob and Kattookaran (2019) employs the auto regressive distributed lag (ARDL) model to determine the impact of nominal exchange rate on India's FDI inflows using monthly data from April 1995 to March 2018. The findings of their study reveal that exchange rate volatile has a negative and significant impact on FDI flows to India both in short and long run.

Although studies such as Singhania and Gupta (2011) use yearly data from 1991 to 2008 to test the determinants of FDI inflows, they do not account for the role of exchange rates. Other papers such as Jha (2003) are primarily qualitative in nature focusing on measuring the importance of variables such as the country's projected image and attitude towards FDI, the domestic investment policy, quality of infrastructure etc. in understanding the drivers of FDI inflows into India. Whereas papers such as Misra and Verma (2019) use FDI as one of the determinants to study the factors driving India's exchange rate.

A small but growing set of studies have departed from the aggregate focus on India as a whole and factored in the regional inequality in distribution of FDI inflows into India. Mukherjee (2011) for example focuses on the regional inequality in the FDI flows to India and finds a positive association of FDI inflows to a particular region with the region's market size, agglomeration effects and size of its manufacturing and services base. A similar conclusion has been drawn by Tsuchiya (2015), who performs a region and sector wise analysis of India's FDI inflows using yearly data from 2008 to 2013.

Clearly, to the best of our knowledge, the extant literature has not explicitly focused on testing the impact of REER both in terms of its levels and volatility on FDI inflows to India at the sub-national level, exploiting the variation using disaggregated data. While admittedly the exchange rate varies only at the national level, the value-addition comes from understanding its interaction with state-varying macroeconomic indicators.

4. Data and Empirical Model

To examine the impact of exchange rate on FDI inflows, we compile a panel dataset for 36 sub-national economies using annual data from 2000 to 2013. The dependent variable of interest captures the equity component of FDI inflows to individual sub-national economies of India. Regional FDI data, collected from Reserve Bank of India, is used to approximate state-level FDI using GSDP to assign weights. The key independent variable of interest is the annual Real Effective Exchange Rate (REER), collected at the national level from Bank of International Settlement (BIS) (Note 7).

We employ panel fixed effects models to explore our relationship of interest between REER and FDI. The basic estimating equation will be to understand the impact of REER on FDI inflows to India's sub-national economies, controlling for other characteristics specific to a sub-national economy. The baseline equation takes the form:

$$fdi_{it} = \alpha_0 + \beta_1 REER_t + \delta \mathbf{Y}_{it} + \gamma_i + \varepsilon_{it} \quad (1)$$

Where, fdi_{it} refers to FDI inflows to a sub-national economy *i* at time *t;*

$REER_t$ represents the time-varying independent variable captured by REER index;

$\boldsymbol{Y}_{it}$ represents a matrix of control variables measured at time *t* for a sub-national economy *i.*

γ_i represents a set of control variables in sub-national economy *i* capturing entity fixed effects

ε_{it} is the idiosyncratic error term.

In the equation (1), $\beta \; and \; \delta$ are the parameters to be estimated.

For our study we expect to see a positive relationship between the depreciation of the host country's currency and its FDI inflows. Our control variables are informed by the related literature (Blonigen, 2005; Dua & Garg, 2015) and encompasses a selected set of macroeconomic, institutional and financial factors. These factors are captured by variables specific to sub-national economies that could possibly determine FDI. A brief explanation on these variables and their priors are as follows:

- Gross State Domestic Product (GSDP) Per Capita: reflects the different levels of development in the states; a higher income level could imply greater consumer demand which would trigger FDI inflows into the sub-national economy. Thus, we expect to see a positive relationship between GSDP per Capita and FDI.
- Total Population: has been used as a proxy for market size; a larger market size possibly reduces per unit cost of production (economies of scale) attracting greater FDI flows. A priori, we expect to see a positive relationship between FDI and market size.
- Inflation: as measured by the Consumer Price Index (CPI) is expected to have a negative impact on FDI as high inflation would lead to increased investment risks thus making the investors reluctant to invest, in turn discouraging FDI.
- Wages and Salaries: are a measure of labour costs in the sub-national economy; higher labour costs could result in increased production costs that can in turn reduce the attractiveness of the sub-national economy to the investors.
- Student-Teacher Ratio at Secondary Educational Institutions: used as a proxy for the level of human capital development in a sub-national economy; availability of skilled and educated workers is likely to induce FDI.
- Paved Roads in Length: assesses the extent of infrastructure development in a sub-national economy; quality physical infrastructure helps reduce costs of production for firms which induces FDI. A priori, we expect to see a positive impact of improved infrastructure on FDI flows.
- Share of Bank Credit to GSDP: is used as a proxy for financial development; it captures the extent of credit creation in the sub-national economy. Higher financial sector development could reduce investment risks attracting FDI.
- Trade Openness: A priori the impact of trade openness has an ambiguous impact on FDI inflows into a particular sub-national economy as it depends on the nature of FDI; For instance, higher trade openness could deter FDI when firms prefer to export than undertake horizontal FDI. However, if one

considers the case of vertical FDI, higher trade openness may induce more FDI as firms may be encouraged to move to take advantage of the greater trade engagement of the place.

We first estimate equation (1) to capture the impact of REEER movements in levels on FDI inflows before controlling for volatility of REER to understand its impacts on FDI inflows. In the baseline model, we use a simple measure of REER volatility as calculated by the standard deviation of the monthly REER index, while we use coefficient of variation of the REER series as a robustness check.

Two primary econometric problems can potentially produce biased estimates in the specified empirical model. One is the classic issue of simultaneity bias or reverse causality which remains an unresolved issue in the decades old general exchange rate-FDI literature. The other is that of endogeneity that arises from omitted variable bias in specifying the model. Our panel data estimation can handle the concern of omitted variable bias to a reasonable extent by incorporating entity fixed effects.

It has been well established that such estimation allows us to control for unobserved entity-specific fixed characteristics that might affect the impact of REER on FDI. We expect the estimates of the fixed-effects regression to remain robust when the potential source of endogeneity arises from the correlation between the time-invariant component of the error term and the regressor of interest, for a fixed-effects model resolves this problem by excluding the unobservable time-invariant effects through a time-demeaning of the data.

Table 1 provides a matrix of correlation between all the variables used in our analysis. All the sources and detailed definitions of the variables and the summary statistics are presented in Annex tables A2 and A3.

Table 1. Correlation Matrix

	State FDI as a ratio of GSDP	**GSDP per Capita**	**Population**	**Inflation**	**Wages**	**Trade Openness**	**Student-Teacher Ratio (Secondary)**	**Paved Road Length per '000 Sq. Km**	**Bank to Credit as a percent of GSDP**	**REER**	**REER Volatility**	**Foreign Exchange Reserve (FXR)**
State FDI as a ratio of GSDP	1.00											
GSDP per Capita	0.34	1.00										
Population	-0.03	-0.35	1.00									
Inflation	0.11	0.38	0.03	1.00								
Wages	0.18	0.00	0.67	0.17	1.00							
Trade Openness	0.43	0.22	-0.15	0.09	0.27	1.00						
Student-Teacher Ratio (Secondary)	0.18	-0.20	0.35	-0.31	0.35	0.22	1.00					
Paved Road Length per '000 Sq. Km	0.44	0.50	-0.15	0.06	-0.05	0.01	0.05	1.00				
Bank to Credit as a percent of GSDP	0.50	0.51	0.14	0.21	0.22	0.07	0.11	0.82	1.00			
REER	0.06	0.24	0.02	0.48	0.09	0.05	-0.06	0.03	0.10	1.00		

REER Volatility	0.12	0.28	0.02	0.60	0.10	0.06	-0.20	0.04	0.13	0.63	1.00	
Foreign Exchange Reserve (FXR)	-0.11	-0.26	-0.02	-0.65	-0.10	-0.02	0.16	-0.04	-0.11	-0.33	-0.45	1.00

Source: Authors.

The second part of our empirical analysis is to capture the possible effects of an exchange rate expectations on FDI inflows. Specifically, we use accumulation of foreign exchange reserves and interact it with REER to capture expectations of sustained appreciation in the country's exchange rate. When a country intervenes in the foreign exchange market and builds foreign exchange reserves, thereby attempting to prevent its currency from appreciating through sustained reserve accumulation, there is a likelihood of market expectations of further appreciation in the future. This is reflected in equation (2) given below.

$$fdi_{it} = \alpha_0 + \beta_1 REER_t + \beta_2 Volatility_t + \delta \boldsymbol{Y}_{it} + \gamma_i + \beta_3 fxr_t + \beta_4 fxr_t * REER_t + e_t + \varepsilon_{it} \quad (2)$$

If reserve changes are a good proxy for sustained REER appreciation, then a priori we should observe a positive relationship between REER and FDI implying that a REER appreciation is likely to induce domestic-market oriented FDI.

5. Empirical Results

We start with our fixed effects estimation outlined in equation (1), the results of which are summarized in Table 2. We build our model by assessing the importance of several macroeconomic, institutional and financial determinants of FDI (Columns 1 to 3) before testing for the specific impact of REER and REER volatility (Columns 4 and 5).

Table 2. Empirical Results: Including Bank Credit as a percent of GSDP

Dep Var: State FDI as a Ratio of GSDP	**(1)**	**(2)**	**(3) Baseline**	**(4) REER**	**(5) REER Volatility**
GSDP per Capita	0.00570	0.00465	0.00417	0.00528	0.00386
	(0.00401)	(0.00350)	(0.00308)	(0.00362)	(0.00361)
Population	0.0662**	0.0604**	0.0476**	0.0503**	0.0455**
	(0.0286)	(0.0270)	(0.0208)	(0.0221)	(0.0212)
Inflation	-0.00704**	-0.00549**	-0.00912**	-0.00950**	-0.00902**
	(0.00295)	(0.00252)	(0.00404)	(0.00425)	(0.00415)
Wages	-0.00188	-0.00168	0.000310	0.00109	0.000924
	(0.00325)	(0.00297)	(0.00201)	(0.00206)	(0.00202)
Trade Openness	0.00325	0.00429	0.00428	0.00449	0.00411
	(0.0100)	(0.00952)	(0.00895)	(0.00891)	(0.00889)
Student-Teacher Ratio (Secondary)		0.00341*	0.00342**	0.00378**	0.00428**
		(0.00171)	(0.00168)	(0.00178)	(0.00200)

Paved Road Length per '000 Sq. Km		1.18e-06	4.96e-07	6.52e-07	5.95e-07
		(1.28e-06)	(9.38e-07)	(9.61e-07)	(9.55e-07)
Bank Credit as a percent of GSDP			0.0336*	0.0344*	0.0330*
			(0.0186)	(0.0189)	(0.0188)
REER				-0.000250*	-0.000375**
				(0.000141)	(0.000177)
REER Volatility					0.00173*
					(0.00100)
Observations	455	455	455	455	455
R-squared	0.077	0.088	0.153	0.158	0.166
Number of States	35	35	35	35	35

Note. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; State FE included.

Source: Authors.

The results offer some interesting insights. First, with regard to the key variables of interest, we find REER to be consistently statistically significant and negatively associated with FDI inflows, across all specifications. This implies that a host country's currency appreciation measured by an increase in REER deters FDI inflows in the host country.

Recall (see section 3.1) that regardless of whether FDI inflows are export-promoting (vertical) or domestic-oriented (horizontal) in nature, a REER appreciation deters FDI, with the only difference being that in the case of the latter, the channel of impact operates through wealth effects. Consistent with our discussion, our results suggest that a REER appreciation reduces FDI inflows, viz. a 10 percentage point increase in REER is associated with a reduction in FDI inflows as a share of GDP by .0025 percentage points.

It must be noted that the coefficient of REER is only weakly significant at the 10 percent level. However, when we factor in REER volatility, we find that the statistical significance of REER improves with the variable being significant at the 5 percent level, while still consistently exerting a negative impact on FDI inflows to sub-national economies.

In contrast to the results for REER movements in levels, the effect of REER volatility on FDI inflows to India is positive. That is, a 10 percentage point increase in REER (appreciation) is associated with an increase in FDI inflows to sub-national economies as a share of GDP by .0173 percentage points, which is economically quite significant.

As explained earlier in the paper, if FDI is domestic-market oriented in nature, an increase in REER volatility is likely to induce FDI as firms that have decided to serve the domestic market establish a base in the host country (in light of higher costs of exporting) to avoid dealing with exchange rate risks since they already know that they are going to serve the specific host country market.

Focusing briefly on other possible determinants of FDI, our findings largely conform to the priors stated earlier. Population consistently remains statistically significant in all specifications and carries a

positive sign implying that sub-national economies with a larger market size will attract more FDI. Higher inflation has a significant and negative impact on FDI inflows across all specifications, suggesting that sub-national economies with higher inflation tend to deter FDI, which also conforms to the priors. Other significant determinants of FDI include the positive and significant role of human capital in attracting FDI and a positive yet weak statistical significance for credit creation, proxying for the level of financial sector development in sub-national economies.

Considering the possibility that there could be reverse causality between FDI and financial sector development, we drop this variable from our regression and re-run our model with the same set of control variables used before. Table 2a summarizes the results. We can observe that while there is consistency in terms of magnitude, sign and statistical significance of most control variables, REER on its own loses its statistical significance despite being negative when we do not control for REER volatility. However, when we add in REER volatility, the results resemble the findings reported earlier in Table 2.

Table 2a. Empirical Results: Excluding Bank Credit as a percent of GSDP

Dep Var: State FDI as a Ratio of GSDP	**(1)**	**(2)**	**(3)**	**(4)**
		Baseline	**REER**	**REER Volatility**
GSDP per Capita	0.00570	0.00465	0.00546	0.00354
	(0.00401)	(0.00350)	(0.00395)	(0.00360)
Population	0.0662**	0.0604**	0.0626**	0.0555**
	(0.0286)	(0.0270)	(0.0283)	(0.0269)
Inflation	-0.00704**	-0.00549**	-0.00570**	-0.00526**
	(0.00295)	(0.00252)	(0.00266)	(0.00251)
Wages	-0.00188	-0.00168	-0.00116	-0.00126
	(0.00325)	(0.00297)	(0.00286)	(0.00284)
Trade Openness	0.00325	0.00429	0.00444	0.00394
	(0.0100)	(0.00952)	(0.00950)	(0.00952)
Student-Teacher Ratio (Secondary)		0.00341*	0.00366*	0.00434**
		(0.00171)	(0.00181)	(0.00211)
Paved Road Length per '000 Sq. Km		1.18e-06	1.31e-06	1.20e-06
		(1.28e-06)	(1.31e-06)	(1.29e-06)
REER			-0.000179	-0.000351**
			(0.000118)	(0.000172)
REER Volatility				0.00232**
				(0.00103)
Observations	455	455	455	455
R-squared	0.077	0.088	0.091	0.105
Number of States	35	35	35	35

Note. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; State FE included.

Source: Authors.

Finally, we run our augmented model to test the effects of exchange rate expectations on FDI inflows. In the augmented regression specification, as noted earlier, we introduce the changes in foreign exchange reserves as an additional control variable and also interact it with REER to capture the effect of expected exchange rate appreciation on FDI. Our main results continue to remain robust and the coefficient of the interaction term carries the appropriate positive sign though it is not statistically significant.

Table 3. Empirical Results: Augmented Model

Dep Var: State FDI as a Ratio of GSDP	(1) Baseline	(2) FXR	(3) FXR*REER
GSDP per Capita	0.00386	0.00344	0.00312
	(0.00361)	(0.00368)	(0.00363)
Population	0.0455**	0.0443**	0.0432**
	(0.0212)	(0.0213)	(0.0205)
Inflation	-0.00902**	-0.0101**	-0.00984**
	(0.00415)	(0.00413)	(0.00396)
Wages	0.000924	0.000588	0.000620
	(0.00202)	(0.00190)	(0.00191)
Trade Openness	0.00411	0.00455	0.00450
	(0.00889)	(0.00902)	(0.00902)
Student-Teacher Ratio (Secondary)	0.00428**	0.00392**	0.00393**
	(0.00200)	(0.00185)	(0.00185)
Paved Road Length per '000 Sq. Km	5.95e-07	4.70e-07	4.40e-07
	(9.55e-07)	(1.01e-06)	(1.00e-06)
Bank Credit as a percent of GSDP	0.0330*	0.0333*	0.0333*
	(0.0188)	(0.0189)	(0.0189)
REER	-0.000375**	-0.000348*	-0.000398*
	(0.000177)	(0.000172)	(0.000232)
REER Volatility	0.00173*	0.00162*	0.00156*
	(0.00100)	(0.000948)	(0.000893)
Change in FXR		-0.000743	-0.00397
		(0.000440)	(0.00515)
FXR*REER			3.38e-05
			(5.28e-05)
Observations	455	455	455
R-squared	0.166	0.171	0.172
Number of States	35	35	35

Note. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; State FE included.

Source: Authors.

5.1 Robustness Checks

We perform two kinds of robustness checks to ascertain the consistency of the findings of our baseline fixed effects estimates and that of the augmented model. The first type of robustness check is to use an alternative definition of REER volatility and the second type is to re-run our empirics using alternative series of REER.

The results using coefficient of variation as a measure of volatility is given in Table 4. The results indicate that exchange rate volatility, measured by coefficient of variation, is positively and significantly associated with FDI inflows, and has consistent signs with the baseline model. Interestingly, exchange rate is negative but becomes significant at the 10 percent level when we use coefficient of variation as a measure of volatility. Finally, the interaction term of reserves and REER remains positive and insignificant, akin to our results in Table 3.

Table 4. Robustness Check Using Coefficient of Variation as an Alternate Measure of REER Volatility

Dep Var: State FDI as a Ratio of GSDP	**(1) Baseline**	**(2) Augmented with REER**	**(3) Augmented with REER Volatility (CV)**	**(4) Augmented with FXR interaction and REER Volatility (CV)**
GSDP Per Capita	0.00465	0.00546	0.00348	0.00269
	(0.00350)	(0.00395)	(0.00361)	(0.00358)
Population	0.0604**	0.0626**	0.0553**	0.0528*
	(0.0270)	(0.0283)	(0.0269)	(0.0266)
Inflation	-0.00549**	-0.00570**	-0.00527**	-0.00585**
	(0.00252)	(0.00266)	(0.00251)	(0.00233)
Wages	-0.00168	-0.00116	-0.00126	-0.00152
	(0.00297)	(0.00286)	(0.00284)	(0.00269)
Student-Teacher Ratio (Secondary)	0.00341*	0.00366*	0.00434**	0.00403**
	(0.00171)	(0.00181)	(0.00211)	(0.00198)
Paved Road Length per '000 Sq. kms)	1.18e-06	1.31e-06	1.19e-06	1.04e-06
	(1.28e-06)	(1.31e-06)	(1.29e-06)	(1.34e-06)
Trade Openness	0.00429	0.00444	0.00393	0.00425
	(0.00952)	(0.00950)	(0.00951)	(0.00969)
REER		-0.000179	-0.000297*	-0.000345*
		(0.000118)	(0.000152)	(0.000204)
REER Volatility (Coefficient of Variation)			0.221**	0.201**

			(0.0986)	(0.0878)
Change in Foreign Exchange Reserves (FXR) (Percent)				-0.00512
				(0.00459)
FXR*REER				4.67e-05
				(4.68e-05)
Observations	455	455	455	455
R-squared	0.088	0.091	0.105	0.110

Note. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; State FE included.

Source: Authors.

For the second type of robustness check, we consider an alternative REER series. We would like to check if our baseline results are sensitive to this choice of REER series, which are computed for different sets of countries and use different weights. For instance, the REER series from Bruegel is computed for 138 trading partners while the series from Reserve Bank of India (RBI) is calculated for both 36 currencies as well as 5 currencies. Figure 5 depicts the trends in the different REER series available. While we can observe that the REER series from Bank for International Settlements (BIS) (which we use for our baseline) and St. Louis Federal Reserve Bank Database (FRED) overlap with each other with almost negligible differences, there are divergences in the REER series between the other series. However, all the series seem to converge post 2009. The correlations between the changes in different REER series as shown in Table 5 also suggest that most series are highly correlated. Some are perfectly correlated like BIS and FRED, while some like Bruegel and BIS are highly correlated but not complete (0.87).

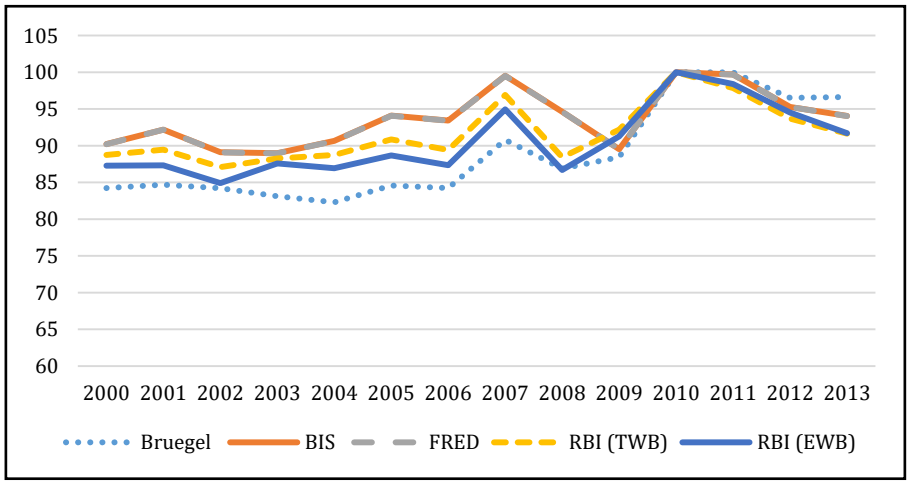

Figure 5. REER Series

Source: Authors.

Table 5. REER Percentage Change Correlation

Bruegel and BIS	Bruegel and RBI (TWB)	Bruegel and RBI (EWB)	Bruegel and FRED	BIS and RBI (TWB)	BIS and RBI (EWB)	BIS and FRED	RBI (TWB) and RBI (EWB)	FRED and RBI (TWB)	FRED and RBI (EWB)
0.87	**0.88**	**0.87**	**0.87**	**0.76**	**0.72**	**1.00**	**0.99**	**0.76**	**0.72**

Source: Authors.

In light of the above, we re-estimate our model using Bruegel REER series. Table 6 shows that exchange rate volatility continues to be positive and significant at 5 percent level even when we use an alternative REER series. REER is negative but insignificant, consistent with our main findings in Table 3. Finally, it is worth noting that the signs and significance levels of the control variables such as population, inflation, and student-teacher ratio also concur with our main findings.

Table 6. Robustness Check Using Alternative REER Series

Dep Var: State FDI as a Ratio of GSDP	**(1) Baseline**	**(2) Augmented with REER**	**(3) Augmented with REER Volatility (SD)**	**(4) Augmented with FXR interaction and REER Volatility (SD)**
GSDP Per Capita	0.00465	0.00460	0.00321	0.00283
	(0.00350)	(0.00348)	(0.00304)	(0.00354)
Population	0.0604**	0.0597**	0.0539**	0.0532*
	(0.0270)	(0.0271)	(0.0250)	(0.0268)
Inflation	-0.00549**	-0.00446*	-0.00564*	-0.00832**
	(0.00252)	(0.00245)	(0.00279)	(0.00343)
Wages	-0.00168	-0.00132	-0.00187	-0.00260
	(0.00297)	(0.00310)	(0.00318)	(0.00301)
Student-Teacher Ratio (Secondary)	0.00341*	0.00359*	0.00467**	0.00437**
	(0.00171)	(0.00181)	(0.00222)	(0.00212)
Paved Road Length per '000 Sq. Kms)	1.18e-06	1.23e-06	9.98e-07	8.12e-07
	(1.28e-06)	(1.26e-06)	(1.23e-06)	(1.34e-06)
Trade Openness	0.00429	0.00416	0.00405	0.00470
	(0.00952)	(0.00951)	(0.00950)	(0.00966)
Bruegel REER		-9.15e-05	-9.47e-05	-1.32e-05
		(8.74e-05)	(8.85e-05)	(8.22e-05)
Bruegel REER Volatility			0.00232**	0.00275**
			(0.00104)	(0.00120)
Change in Foreign Exchange Reserves (FXR) (Percent)				0.00195

				(0.00580)
FXR* Bruegel REER				-3.46e-05
				(6.50e-05)
Observations	455	455	455	455
R-squared	0.088	0.089	0.105	0.115

Note. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; State FE included.

Source: Authors.

The findings from both the robustness checks, using an alternative volatility measure and REER series, corroborates the main findings of this paper thus validating the robustness of our model. We undertake additional robustness checks (Note 8) using Bruegel REER series with an alternative measure of volatility (coefficient of variation) and using alternative REER RBI (TWB) and RBI (EWB) series.

Table 7 summarizes the comparative results of the robustness checks, wherein REER volatility remains positive and significant for all regression specifications. REER remains negative and insignificant, consistent with our main finding, for all specification except in column (2a) where we use coefficient of variation as a measure of volatility for Bruegel REER series. Finally, the interaction term of reserves and REER remains insignificant for all specification and is positive in column (1, 3 and 4). Broadly, we can say that results maintain a strong consistency both in signs and significance of the variables under consideration.

Table 7. Summary of Robustness Checks

REER Series / Variable	(1) BIS using Coefficient of Variation	(2) Bruegel REER using Standard Deviation	(2a) Bruegel REER using Coefficient of Variation	(3) RBI Trade Weighted REER using Standard Deviation	(4) RBI Export Weighted REER using Standard Deviation
REER	Negative & Significant	Negative & Insignificant	Positive & Insignificant	Negative & Insignificant	Negative & Insignificant
REER Volatility	Positive & Significant	Positive & Significant	Positive & Significant	Positive & Significant	Positive & Significant
Interaction Term (FXR*REER)	Positive & Insignificant	Negative & Insignificant	Negative & Insignificant	Positive & Insignificant	Positive & Insignificant

Source: Authors.

6. Conclusions

In this paper, we have estimated the impact of REER both in terms of levels and volatility on FDI inflows to India's sub-national economies. Using annual data from 2000 to 2013, we constructed a panel dataset for 36 sub-national economies of India. Our empirical results show that a REER

appreciation (levels) deters FDI inflows, though increased REER volatility appears to induce FDI inflows. The empirical results are robust in general for different model specifications determining the impact of REER index on FDI flows. Given that most studies on the impact of REER levels and volatility on FDI inflows have been at the aggregate (national) level, our paper makes an important contribution to the existing literature by undertaking this analysis at the sub-national level for India.

Our findings are suggestive of FDI inflows to India being relatively more domestic-oriented in nature since the impact of movement in REER (levels) on FDI inflows is found to be weakly significant. Therefore, as India positions itself as a platform for more export-oriented FDI, policymakers need to be more concerned about exchange rate competitiveness and managing REER appreciation.

Furthermore, the analysis suggests that maintaining cost competitiveness through an exchange rate regime centred on inflation targeting, supported by disciplined fiscal policy is likely to be more durable than attempting to manage the currency per se. Managing REER (levels) can generate both positive and negative externalities for States – with greater move towards decentralization. Thence, if REER is not managed well at the national level, it can nullify or negate the developmental progress made by states on various fronts.

The use of national level REER to evaluate its impact on the FDI inflows at the sub-national level may be viewed as a limitation of our study. However, building a sub-national level REER series is beyond the scope of our study. Yan et al. (2016) have constructed provincial-level REER indices to study the effect of REER on regional economic growth in China. It would be interesting to construct a similar state-level index for India for our future research on the impact of REER on FDI inflows to India.

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Notes

Note 1. Among the early works see Barro (1997); Borensztein et al. (1998); Mencinger (2003); Alfaro et al. (2004); Razin (2004); Carkovic and Levine (2005); Bosworth and Collins (1999); and Mody and Murshid (2005); For more recent assessments, see Herzer (2012) and Iamsiraroj (2016).

Note 2. See for instance, Athukorala and Hill (1998), Hobday (2002), Ng and Yeats (1999) for some of the early literature on this phenomenon of FDI and production fragmentation. Also see Ganges and Van Assche (2010) for a relatively recent discussion.

Note 3. For an example, see the discussion on competitiveness of India's sub-national economies in Tan et al. (2015).

Note 4. RBI releases FDI data based on 17 regional offices. Each regional office covers the FDI inflows into a specific number of states. For a complete list of RBI's regional offices and states covered refer to Annexure 1. In this paper, we refer to RBI's regional offices as regions and states and federal

territories are referred as sub-national economies.

Note 5. While a state-level FDI data is not available, it can be approximated from the regional-level data. To that end, we use Gross State Domestic Product (GSDP) in current prices as weights for disaggregating regional level FDI inflows to the corresponding state-level inflows and subsequently deflate it by the average of Consumer Price Index (for Industrial and Rural Labourers) to convert to constant prices at 2000 prices. As an illustration, take the case of the Patna region which covers two states, namely- Bihar and Jharkhand. We weight the FDI inflows to the Patna region on the basis of the GSDP of these two states. So in order to find Bihar's FDI we approximate the weight by dividing Bihar's GSDP by the sum of Bihar and Jharkhand's GSDP. We then multiply this weight by Patna region's FDI to break it down to state-level in this case Bihar's FDI.

Note 6. The caveat to bear in mind is that if the country part of a supply chain, firms have low value-added implying that they will be especially sensitive to volatility because margins are thin.

Note 7. For definitions and sources refer to Annexure Table A2. Other REER series are used as robustness checks, as discussed later in the paper.

Note 8. Tables for additional robustness checks will be made available upon request.

Annexure

Table A1: RBI's Regional Office

RBI's Regional Office	**States Covered**
Ahmedabad	Gujarat
Bangalore	Karnataka
Bhopal	Madhya Pradesh, Chhattisgarh
Bhubaneshwar	Odisha
Chandigarh	Chandigarh, Punjab, Haryana, Himachal Pradesh
Chennai	Tamil Nadu, Puducherry
Guwahati	Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura
Hyderabad	Andhra Pradesh
Jaipur	Rajasthan
Jammu	Jammu & Kashmir
Kanpur	Uttar Pradesh, Uttarakhand
Kochi	Kerala, Lakshadweep
Kolkata	West Bengal, Sikkim, Andaman and Nicobar Islands
Mumbai	Maharashtra, Dadra & Nagar Haveli, Daman & Diu
New Delhi	Delhi, Part of UP and Haryana
Panaji	Goa
Patna	Bihar, Jharkhand

Source: Reserve Bank of India.

Table A2. Data Sources and Definitions

Variable	Unit	Abbreviation	Sources
REER (+/-)	Index	Monthly Average	BIS
REER Volatility (SD) (+/-)	Monthly Standard Deviation	Monthly Standard Deviation	BIS
Gross State Domestic Product per Capita (+)	Rupees Real Prices (Base Year 2000)	Gross State Domestic Product per Capita is Gross State Domestic Product divided by population.	GDP: http://mospi.nic.in/Mospi_New/site/inner.aspx?status=3&menu_id=82 Population: www.indiastat.com Inflation: CPI(RL and IW):Ministry of Labour Bureau (Archive)
Population (+)	10,000 persons	Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.	www.indiastat.com
Inflation (Average of Rural and Industrial Labourers) (-)	Index	Consumer price index is used to indicate the change in prices against a reference period of a basket of goods and services purchased by households. Based on the purpose of the CPI, different basket of goods and services can be selected.	CPI(RL and IW):Ministry of Labour Bureau (Archive)
Student-Teacher Ratio (Secondary) (+)	Ratio	The average number of students per teacher in Secondary Educational Institutions in a given year.	www.indiastat.com
Paved Road Length (+)	(Kms per '000 Sq. kms)	Paved Roads/Geographical Area	CMIE, States of India
Bank Credit (as a percentage of GSDP) (+)	10 Million Rupees, Real Prices (Base Year 2000)	The bank credit in Schedule Commercial Banks, comprising term loans, cash credit, overdrafts and bills purchased and discounted. Average GDP deflators calculated using the CPI (Rural Labourers) and CPI (Industrial Workers) indicators 1.1.08 & 1.1.09 respectively are used to calculate the real values of credit for each state. Year 1999-2000 has been used as a base for this calculation	Statistical Tables Relating to Banks in India Reserve Bank of India. http://rbidocs.rbi.org.in
Wages and Salaries (-)	10 Million Rupees, Real Prices (Base	The sum of wages and salaries, employers' contribution as provident fund and other funds	Annual Survey of Industries

	Year 2000)	and workmen and staff welfare expenses. Average GDP deflators calculated using the CPI (Rural Labourers) and CPI (Industrial Workers) indicators 1.1.08 & 1.1.09 respectively are used to calculate the real value of wages and salaries for each state. Year 1999-2000 has been used as a base for this calculation	
Foreign Exchange Reserves (+/-)	Average of Monthly % Change(%)	Total reserves Minus Gold	International Financial Statistics

Source: Authors.

Table A3. Summary Statistics

Variable	**Mean**	**Between Std. Dev.**	**Within Std. Dev.**	**Min**	**Max**	**Observations**	**Number of Sub-national Economies**
Ln State FDI	3.26	2.90	1.19	-1.81	8.99	436	35
State FDI as a Ratio of GSDP	0.01	0.01	0.01	0.00	0.17	490	35
Ln GSDP Per Capita	10.26	0.47	0.25	8.69	11.80	455	35
Ln Population	6.72	2.14	0.08	1.81	9.94	490	35
Inflation	1.52	0.06	0.46	0.97	2.75	490	35
Ln Wages	6.29	2.13	0.40	0.08	9.91	490	35
Ln Student-Teacher Ratio (Secondary)	3.24	0.30	0.30	1.79	4.38	490	35
Paved Road Length per ‘000 Sq. kms)	2432.56	4293.35	503.79	8.78	21574.51	490	35
Bank Credit as a % of GSDP	0.30	0.34	0.11	0.03	2.16	490	35
Trade to GSDP	0.12	0.16	0.09	0.00	0.89	490	35
REER	93.67	0.00	3.76	88.98	100.00	490	35
REER Volatility	2.08	0.00	0.74	1.21	3.43	490	35
Change in Foreign Exchange Reserve (FXR) (%)	1.32	0.00	1.37	-0.53	3.83	490	35

Source: Authors.