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Impact of exchange rate volatility on investment: Evidence from India

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Abstract

This paper studies the impact of real exchange rate volatility on firm level investment using data on Indian manufacturing firms. Real exchange rate volatility is found to have a negative impact on firm level investment spending. The impact is non-linear in the level of exchange rate volatility and depends upon the size of firm's mark-up and its trade exposure. Foreign equity ownership reduces the negative impact of exchange rate volatility significantly but the same cannot be said about access to domestic equity finance.

JEL Classification: F1, F4

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I. Introduction

Exchange rate is the single most important price affecting all external transactions in an open economy. Exchange rate movements can affect an economy through a number of channels such as the cost of imported inputs relative to other factors of production, price of exports relative to foreign competitors or the cost of external borrowing, etc. One particular aspect of exchange rate movements that has been of concern for policy makers and academics alike is their volatility. This paper uses a well-documented dataset on Indian firms to study the impact of exchange rate volatility on firm's investment. Results indicate that exchange rate volatility has a negative impact on firm level investment and this effect is both economically and statistically significant. There is evidence of non-linearity in the impact of exchange rate volatility on investment. The impact also depends upon the size of firm's mark-up and its trade exposure. Finally, foreign equity ownership is found to significantly mitigate the adverse impact of exchange rate volatility on firm level investment.

India presents an interesting case for examining the role of exchange rate volatility both because of its dynamic growth experience over the last two decades and also because of its unique approach to financial integration in the face of rapid globalization and trade openness. India's overall management of capital flows can be characterized by its calibrated and gradualist approach towards capital account liberalization. In line with that, the RBI has followed a managed floating exchange rate regime to balance the competing objectives of exchange rate stability, low inflation and domestic growth (see Hutchison et al. (2012)). Studies examining the impact of exchange rate volatility on Indian firms are, however, very few. In that respect this paper fills an important gap in the existing literature by looking at the impact of exchange rate volatility on firm level investment spending in India.

Key contributions of this paper are threefold: a.) Using firm level information to capture the role of firm heterogeneity in determining their response to exchange rate volatility. b.) Highlighting the presence of non-linearity in the impact of exchange rate volatility. c.) Examining the impact of access to foreign and domestic equity finance on firm's response to exchange rate volatility.

The paper is organized as follows: section 2 gives a brief review of the literature while section 3 presents the empirical model. Section 4 describes the dataset and the variables used in the empirical analysis and section 5 presents the results. Section 6 concludes.

II. Literature Review:

Exchange rate volatility can affect investment through multiple channels and in theory, the sign of this relationship is ambiguous and depends on the underlying assumptions (Aiginger, 1987; Caballero and Pindyck, 1996; Dixit and Pindyck, 1994; the collection of articles in Aizenman and Pinto, 2005). For a perfectly competitive firm with a constant returns to scale production technology and capital as the only fixed factor of production, marginal profitability is a convex

function of output prices implying that the expected marginal revenue productivity of capital rises with an increase in price uncertainty. Higher uncertainty should, therefore, increase the desired level of capital stock and hence investment for a risk neutral investor (Hartman, 1972; Abel, 1983). Introducing asymmetric adjustment costs of investment (larger for downward than for upward investment) in the model makes firms reluctant to invest due to the risk of getting stuck with too much capital if events turn unfavorable. Thus firms invest only if the difference between expected profitability and the cost of capital exceed a certain threshold. In such a situation, higher uncertainty can lead to inaction – and hence depresses aggregate investment as investors try to avoid the irreversible mistake of investing in the wrong activity (Bernanke, 1983). As shown by Caballero (1991) and Abel and Eberly (1994), however, asymmetric adjustment cost is not enough to ensure a negative correlation between investment and exchange rate volatility which requires that the marginal product of capital be a decreasing function of the capital stock.

The "real options" approach to investment, pioneered by McDonald and Siegel (1986), Dixit (1989), Pindyck (1988), Dixit and Pindyck (1994), etc. looks at investment decision as an "option" to invest, which must be exercised optimally. Firms, according to this approach, are faced with the choice between "investing now" versus "not investing now and investing later instead". Once an irreversible investment is made, the possibility of investing later on, when better information is available, has been lost thus adding to the cost of investment. Again, as shown by papers like Darby et al. (1999) and Sarkar (2000), the notion of a negative uncertainty – investment relationship is not always correct. Under certain conditions, an increase in uncertainty can actually increase the probability of investing and thereby have a positive impact on investment.

Given the differing outcomes of various theoretical models, studies have tried to examine the impact of real exchange rate uncertainty on aggregate investment empirically. Goldberg (1993), Darby et al. (1999), Pindyck and Solimano (1993), Serven and Solimano (1993), Bleaney (1996), Ghura and Grennes (1993), Bleaney and Greenaway (2001) etc. are some examples of this approach. Empirical evidence on the negative impact of exchange rate volatility on investment is, however, also mixed. Thus, while Ghura and Grennes (1993) and Bleaney and Greenaway (2001) find a negative impact of exchange rate volatility on investment; Serven (2003) find that the negative impact of volatility on investment matters only when it exceeds a threshold level and it matters more for economies that are more open & less financially developed. Goldberg (1993) finds an unstable relationship between investment and exchange rate volatility using industry level data for the US – positive in some periods and negative in others while Bleaney (1996) finds neither linear nor non-linear effects of exchange rate volatility on investment using data for 41 developing countries.

Recent studies have tried to use firm level data to untangle the relationship between investment and exchange rate volatility. However, these studies are few and far between and, barring a few exceptions (e.g. Kandilov et al., 2011), focus on publicly listed firms from developed countries. Further, no existing study, to the best of our knowledge, takes in to account non-linearity in the impact of exchange rate volatility on firms. A careful analysis of the relationship between

exchange rate volatility and growth taking in to account firm heterogeneity, industry structure and role of financial access is therefore much called for.

III. Empirical Model

The baseline empirical specification used in the paper is based on the model of profit maximizing imperfectly competitive firm presented in Kandilov et al. (2011). The firm uses domestic and foreign variable inputs to produce a single good that is sold in domestic and foreign market. The firm decides on the amount of inputs used, amount of output produced and the level of investment at the beginning of the period t before the realization of exchange rate volatility. Time-to-build lag implies that the new capital resulting from investment becomes available the following period. Firm has to pay a cost for adjusting its capital stock resulting in a loss of some fraction of investment.

Solving for the first order conditions of the firm's profit maximization problem and linearizing the Euler equation resulting from it gives the following investment equation:

$$\frac{I_{it}}{K_{it-1}} = E_t\left[\phi_0 + \phi_1\beta_t + \phi_2\frac{I_{it+1}}{K_{it}} + \phi_3\frac{S_{it+1}}{K_{it}} + \phi_4\frac{Z_{it+1}}{K_{it}} + \phi_5\frac{S^*_{i\,t+1}}{K_{it}} - \phi_6\frac{Z^*_{i\,t+1}}{K_{it}} + \phi_7\mu_{t+1} + \phi_8\sigma^2_{t+1}\right] \quad (1)$$

where S_{it+1} is the value of the total sales, $S^*_{i\,t+1}$ is the value of exports, Z_{it+1} is total costs, and $Z^*_{i\,t+1}$ is the cost of imported inputs. I_{it+1} is the level of investment and K_{it} is the firm's stock of capital. β is the discount factor from period t to period t+1. Equation (1) shows that for the profit maximizing firm, investment depends on the discount factor, future investment, and expected total and foreign sales, expected total costs and imported input costs, as well as expected mean and variance (volatility) of exchange rate.

Following Kandilov et al., this paper uses a reduced equation based on Eq. (1) to estimate the impact of exchange rate volatility on investment. The baseline specification focusing on the impact of exchange rate volatility on investment is given by:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1\frac{I_{it-1}}{K_{ijt-2}} + \alpha_2\frac{S_{ijt}}{K_{ijt-1}} + \alpha_3\frac{S_{i\,jt-1}}{K_{ijt-2}} + \alpha_4\frac{C_{ijt}}{K_{ijt-1}} + \alpha_5\frac{C_{i\,jt-1}}{K_{ijt-2}} + \alpha_6\Delta e_{jt} + \alpha_7 ev_{jt} + \nu_i + \eta_t + \varepsilon_{ijt} \quad (2)$$

where $\frac{I_{ijt}}{K_{ijt-1}}$ is the investment rate for firm 'i' in industry 'j' in year 't', $\frac{S_{ijt}}{K_{ijt-1}}$ and $\frac{C_{ijt}}{K_{ijt-1}}$ are the firm's total sales and cash flows, respectively normalized by its capital stock. The term Δe_{jt} is the annual difference in the logarithm of the real exchange rate for industry *j* and ev_{jt} denotes the exchange rate volatility measure for that industry. Higher sales indicate higher profitability and are therefore expected to increase firm's investment. Similarly, in the presence of capital

market imperfections cash flow can be an important determinant of investment by firms (see Fazzari et al. (1988)). Lagged values of sales and cash flow are included to allow for serial correlation in these variables. At the same time, lagged value of investment is included in the model to take in to account any autocorrelation that might arise due to adjustment costs. A full set of year dummies and industry specific trends are included to capture aggregate economy-wide and industry specific fluctuations.

Next the baseline model (2) is augmented in two important ways. First, following Campa and Goldberg (1995) I check how the impact of exchange rate volatility on investment varies with firm's mark-up by including an interaction term between mark-up and exchange rate volatility. Second, to capture the role of firm's external sector exposure in determining the impact of exchange rate volatility on investment, I augment the baseline model with export and import exposure dummies. This gives us the following specification:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{it-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{S_{i\,jt-1}}{K_{ijt-2}} + \alpha_4 \frac{C_{ijt}}{K_{ijt-1}} + \alpha_5 \frac{C_{i\,jt-1}}{K_{ijt-2}} + \alpha_6 \Delta e_{jt} + \alpha_7 ev_{jt} + \alpha_8 \chi_i^{exp} * ev_{jt} + \alpha_9 \chi_i^{imp} * ev_{jt} + \nu_i + \eta_t + \varepsilon_{ijt} \qquad (3)$$

where χ_i^{exp} and χ_i^{imp} are the dummies for firm's export and import exposure (defined in detail below) respectively.

Using the "real options" approach to investment decisions Sarkar (2000) shows that the impact of uncertainty on investment is non-linear. Serven (2003), using data on 61 developing countries for the period 1970 to 1995, provides evidence for the presence of non-linearity in the relationship between investment and real exchange rate uncertainty. To test for the non-linear effect of real exchange rate uncertainty on firm level investment I estimate the following model:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{it-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{S_{i\,jt-1}}{K_{ijt-2}} + \alpha_4 \frac{C_{ijt}}{K_{ijt-1}} + \alpha_5 \frac{C_{i\,jt-1}}{K_{ijt-2}} + \alpha_6 \Delta e_{jt} + \alpha_7 \lambda_j^{25} * ev_{jt} + \alpha_8 \lambda_j^{50} * ev_{jt} + \alpha_9 \lambda_j^{75} * ev_{jt} + \alpha_{10} \lambda_j^{90} * ev_{jt} + \alpha_{11} \lambda_j^{95} * ev_{jt} + \nu_i + \eta_t + \varepsilon_{ijt} \qquad (4)$$

where

$$\lambda_j^{25} \leq 25th\ percentile$$
$$25th\ percentile < \lambda_j^{50} < 50th\ percentile$$
$$50th\ percentile < \lambda_j^{75} < 75th\ percentile$$
$$75th\ percentile < \lambda_j^{90} < 90th\ percentile$$
$$90th\ percentile < \lambda_j^{95} < 95th\ percentile$$

Results confirm the presence of non-linearity in the impact of exchange rate volatility on investment.

Finally, to check whether foreign equity ownership mitigates the negative impact of exchange rate volatility on investment, the last specification includes an interaction term between exchange rate volatility and foreign equity ownership dummy (defined below). This gives us the following equation:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{it-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{S_{i\,jt-1}}{K_{ijt-2}} + \alpha_4 \frac{C_{ijt}}{K_{ijt-1}} + \alpha_5 \frac{C_{i\,jt-1}}{K_{ijt-2}} + \alpha_6 \Delta e_{jt} + \alpha_7 ev_{jt} + \alpha_8 \delta_i^{Foreign} * ev_{jt} + \alpha_9 \delta_i^{Foreign} + \nu_i + \eta_t + \varepsilon_{ijt} \quad (4)$$

Foreign equity ownership is found to mitigate the negative effects of exchange rate volatility on firm's investment significantly. The same cannot be said about access to the domestic equity market though. This last result is in line with the findings of studies like Demir (2013).

With lagged dependent variable in the equation, standard estimators are rendered inconsistent due to correlation between unobserved panel level effects and the lag of the dependent variable. We therefore use the two- step system GMM estimator suggested by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998)[1] to estimate equations 1 to 4.

IV. Data

The firm level dataset consists of information on over 800 manufacturing firms regarding cash flows, sales, total assets, exports and imports apart from other things. The data is obtained from the CMIE - PROWESS database and cover fifteen year period from 2000 to 2016. The data covers twenty three manufacturing industries classified according to the two digit NIC code[2].

Firm level investment is proxied by cash outflow on account of purchase of fixed assets while the capital stock is proxied by the firm's stock of Net fixed assets. Cash flow is calculated as the firm's after-tax operating profit plus depreciation. The average investment rate over the entire period is 0.5 percent while average sales as a percentage of capital stock over the same period is about 24 percent. Roughly 36 percent of the firms in our sample are exporters while 32 percent of the firms are importers. Export exposure dummy for firm 'i', χ_i^{exp}, is set equal to one if the average share of export to sales for the firm is greater than zero and zero otherwise. Import exposure dummy for firm 'i', χ_i^{imp}, is similarly set equal to one if the average share of import to total cost for the firm is greater than zero and zero otherwise

There is significant heterogeneity across firms in terms of their market power as captured by the average firm level mark-up defined as: $\psi_i = \frac{value\ of\ sales_i + \Delta inventories_i}{payroll_i + cost\ of\ materials_i}$. Higher market power can allow firms to better absorb the effects of exchange rate volatility by adjusting their profit margins. The baseline model is therefore augmented with an interaction term between

[1] The system GMM estimator is itself based on the difference GMM estimator suggested by Arellano and Bond (1991)
[2] Appendix gives the details of industrial classification

exchange rate volatility and average firm level mark-up. The average firm-level mark-up over this entire period is 2.72 but with a sample variation of roughly 34 percent.

The other important factor likely to affect firm's ability to deal with volatility is access to domestic and foreign equity markets. Several studies have shown the ameliorating impact of foreign equity ownership on firms under uncertainty (see, for e.g., Desai et al. ,2008; Demir, 2013; Caglayan et al., 2014) About 11 percent of the firms in our sample are foreign owned (have more than 10 percent foreign equity ownership) and 81% are publicly listed. Given that the sample contains information on both publicly traded and non-traded private firms apart from the information on foreign equity ownership, we can explore if exchange rate uncertainty affects firms differently depending on firms' access to domestic or foreign equity capital. Table 1 presents some descriptive statistics of our dataset.

One shortcoming of the dataset is that it only includes the surviving firms and does not provide information on firms that exit from the sample due to exchange rate uncertainty. This survivorship, however, would bias our estimations against observing any significant effects of exchange rate uncertainty as the sample includes only the most successful firms, which must have developed the means to survive such negative shocks.

Prior to estimating our models we apply a number of sample selection criteria. First, we include only private firms with no public sector ownership. Secondly, we only keep firms with at least five consecutive years of data. Finally, due to multiple sources of information, a few firms had discrepancies in their reported export earnings and total sales figures. We drop those firms from our sample. This leaves us with a total of 855 firms.

Real Exchange Rate Uncertainty

To carry out our analysis, we need a proxy that captures the volatility of the exchange rate series. In the literature, different methodologies are used to construct measures of exchange rate uncertainty, although there is still no consensus on which one is the most appropriate (Clark et al., 2004). Our benchmark measure of exchange rate uncertainty is based on the GARCH (1, 1) model applied to log of monthly bilateral real exchange rate (we use real instead of nominal exchange rate since theoretically profits are affected by both nominal exchange rates and prices of traded goods). We estimate the GARCH (1,1) process using monthly data on bilateral real exchange rates from 1999 to 2016 (the bilateral real exchange rate series is calculated using the nominal exchange rate and CPI data from the IMF's *International Financial Statistics Database*). I estimate an EGARCH (1, 1) process separately for every year from 2005 to 2016 using monthly data on real exchange rates from the previous six years. As in Clark et al. (2004), I use the last estimated conditional standard deviation as the approximation of the conditional volatility. For example, the conditional volatility for the year 2005 is the estimated conditional standard deviation for December 2004 in the EGARCH (1,1) model using data from January 1999 to December 2004.

To test the robustness of the key results I use an alternative measure of real exchange rate volatility based on the annual standard deviation of the first difference of the logarithm of the monthly real exchange rate. For each year, the average of this monthly standard deviation from the previous six years is used as a proxy for exchange rate uncertainty. The two measures are highly correlated in practice.

To obtain the industry specific measures, bilateral volatility measures are combined using the partner's trade share are weights. For example, exchange rate volatility ev_{jt} for industry j in year t is defined as:

$$ev_{jt} = \sum_k Trade\ Share_{jk} * ev^c_{kt}, \quad (5)$$

where $Trade\ Share_{jk}$ is $\frac{1}{T}\sum_t \frac{M_{jkt}+X_{jkt}}{\sum_k M_{jkt}+X_{jkt}}$, M_{jkt} denotes imports from country k to India in industry j, in year t and X_{jkt} denotes exports from India to country k in industry j, in year t. Finally, ev^c_{kt} is the conditional exchange rate volatility in year t between Indian rupee and country k's currency. Data on industry-level exports and imports is obtained from UN COMTRADE database. I consider India's 26 largest trading partners, each with a trade share of at least 1 percent. Table 2 presents the export and import shares of the twenty largest trading partners, with US, China, UAE and Germany at the top of the list. This group of partners captures more that 75% of India's total trade. The trade shares are fixed over time — they are averaged (within an industry) across the sample time period. Hence, variation in ev_{jt} over time comes only from changes in exchange rate volatility and not from fluctuations in partners' trade shares.

Table 3 presents industry-wise average (over the entire sample period) of the two measures along with the change in these measures from the beginning of the period in 2005 to the end in 2016. One can see significant variation across industries in terms of the average value and more importantly the change in the exchange rate volatility.

The industry exchange rate is computed using formula (4) by replacing exchange rate volatility ev^c_{kt} with the level of real exchange rate in year t between Indian rupee and country k's currency, e^c_{kt}.

V. Results

5.1 Main Results

Table 4 presents the results from our benchmark specification (1). The first column presents the results from the benchmark specification using the GARCH measure of exchange rate volatility. The estimates reveal a large, negative and significant impact of exchange rate volatility on investment. The estimated coefficient of -0.163 implies that a one percent increase in conditional volatility, $\left(ev^{GARCH}_{jt}\right)$, leads to a 0.91% decrease in investment. Alternatively, a one standard deviation decrease in conditional volatility increases investment by 19.5 %.

Consistent with our findings using the GARCH measure, the coefficient on (ev_{jt}^{sd}) in column (2) is negative and statistically significant and implies that a one percent increase in unconditional volatility leads to a 1.1% decline in investment.

Among the firm specific determinants of investment, as expected, lagged investment has a positive and significant impact on current investment in both columns (1) and (2). The coefficients on current and lagged sales are positive and negative respectively and both are statistically significant. This indicates the expected positive impact of sales growth on investment. The coefficients on current as well as lagged cash flow are positive but only the latter is statistically significant. The positive impact of cash flow on investment reflects the importance of internal funds for investment.

In addition to the year dummies, used to account for any aggregate economy wide shocks common to all industries, the model also includes interaction terms between industry dummies and the time trend to capture industry specific shocks. Both the year dummies and the interaction terms between industry dummies and time trend are jointly significant according to the F-test for joint significance.

Hansen test for over-identifying restrictions fails to reject the validity of the instrument sets in both the specifications (the p-values are 0.213 and 0.218 respectively in column (1) & (2)). Further, use of alternative lags as instruments does not appear to change the key results significantly. Tests for serial correlation applied to the residuals in the first difference equations show that we can reject the null hypothesis of no first-order serial correlation but we cannot reject the null-hypothesis of no second order serial correlation.

5.2 The role of mark-up and trade exposure

Firm level mark-up is an important determinant of the impact of exchange rate volatility on investment. As discussed above, firms with higher level of mark-up are likely to be better able to absorb the impact of exchange rate volatility on profits and therefore have investment that is less sensitive to exchange rate uncertainty. To check whether firms with higher market power experience smaller negative impact of exchange rate volatility the baseline model is augmented to include an interaction term between exchange rate volatility and the average firm level mark-up, ψ_i . Table 5 presents the results from this exercise. The interaction term between exchange rate volatility and mark-up has a positive coefficient in column (1) indicating that the impact of exchange rate volatility is smaller for firms with higher mark-up. The coefficient is, however, insignificant.

To check whether this is due to the presence of possible non-linearity an additional interaction term between exchange rate volatility and squared mark-up is added to the model. Both the linear and the squared terms are economically and statistically significant indicating that the magnitude of the negative impact of exchange rate volatility declines with mark-up faster at lower levels of mark-up. The magnitude of the impact of exchange rate volatility in investment is more than 13 percent higher for a firm with a mark-up that is two standard deviations below

the average mark-up while it is less than 12 percent smaller for a firm with mark-up that is two standard deviation above the average. The elasticity of investment with respect to exchange rate volatility is 1.3 times higher for firms with mark-up that is two standard deviation below the average as compared to the firms with mark-up that is two standard deviation above average.

Just like mark-up, firm's trade exposure can also determine the impact of exchange rate uncertainty on investment. Higher export exposure can mitigate the impact of exchange rate volatility while higher import exposure can aggravate it. To check this I define dummies for export and import exposure and include their interaction with the exchange rate volatility in the model. Dummy for export exposure (χ_{it}^{exp}) takes a value of zero if the average share of export in total sales for firm *i* is equal to zero and one otherwise. Similarly, the dummy for import exposure (χ_{it}^{imp}) takes a value of zero if the share of imports in total cost is equal to zero and one otherwise. Table 6 presents the results from this model. As expected, the coefficient on the interaction term between export dummy and exchange rate volatility is positive while that on the interaction term between import dummy and exchange volatility is negative. Both are, however, statistically insignificant. When the two trade exposure terms are, however, interacted with the mark-up the sign of both the terms is reversed and the import exposure term becomes positive and significant. Overall the evidence for export exposure mitigating the impact of exchange rate volatility on firm's investment is week. On the other hand, higher mark-up firms using imported inputs see a smaller decline in their investment when faced with higher exchange rate volatility. This could be a reflection of higher productivity of firms using imported inputs. Equally it could imply that the firms with higher market power, which are generally larger producers, may be entering in to long-term contracts with foreign suppliers and by doing so they are able to reduce the impact of exchange rate volatility they face.

5.3 Non-linearity in the impact of volatility

As discussed in the beginning, there is theoretical as well as empirical evidence for the presence of non-linearity in the impact of uncertainty on investment. Specification 4 includes interactions of exchange rate volatility with dummies created by dividing the sample in to 5 mutually exclusive groups based on the level of exchange rate volatility as follows:

$$\lambda_j^{25} \leq 25th\ percentile$$
$$25th\ percentile < \lambda_j^{50} < 50th\ percentile$$
$$50th\ percentile < \lambda_j^{75} < 75th\ percentile$$
$$75th\ percentile < \lambda_j^{90} < 90th\ percentile$$
$$90th\ percentile < \lambda_j^{95} < 95th\ percentile$$
$$\lambda_j^{100} \geq 95th\ percentile$$

In the estimation of specification 4 we use the interaction between the exchange rate volatility and the first five dummies (the coefficients can therefore be interpreted as the impact of exchange rate volatility in that particular range relative to that in the top 5th percentile). Table

7 presents the results from this exercise. As expected, coefficients on the interaction terms are positive implying a smaller impact of exchange rate volatility relative to the top 5th percentile. For example, the impact of exchange rate volatility is 8 percent smaller in case of the lower 25th percentile of volatility when compared to the top 5th percentile.

Moreover, the size of the coefficients on the interaction term declines as the exchange rate volatility increases and, in fact, the coefficients on the last two interaction terms are statistically insignificant thereby indicating the presence of non-linearity in the relationship between exchange rate volatility and investment. The five interaction terms are jointly significant (p-value for the F-test for joint significance is 0.0016). Overall the results indicate the need to take in to account non-linearity in estimating the elasticity of investment with respect to exchange rate volatility.

5.4 Foreign equity ownership and the impact of volatility

Finally, foreign equity ownership can help mitigate the impact of exchange rate volatility on firm level investment through better access to international goods and capital markets, larger supply of internal finance through parent company and better risk management know-how, experience & productivity (Arnold and Javorcik, 2009; Desai et al., 2008; Mitton, 2006; Yasar and Paul, 2009). Higher exchange rate volatility can also cause risk-averse foreign firms to substitute foreign production for exports (Cushman, 1985; Goldberg and Kolstad, 1995). Demir (2013) uses data on publicly traded and non-traded Turkish firms to show that access to foreign equity helps mitigate the adverse impact of exchange rate volatility on firm level employment growth. Following their example, we define firms with more than 10 percent of foreign equity ownership as 'foreign' while the rest are defined as 'domestic'. Equation (4) is then estimated using Arellano-Bond GMM estimator results from which are presented in Table 8.

Column (1) gives the result from the baseline model. As expected, the interaction term between foreign equity ownership dummy and exchange rate volatility is positive and statistically significant. The impact is also economically significant. While a 1 percent increase in exchange rate volatility reduces investment by 1 percent for domestic firms it only reduces investment by 0.69 percent for 'foreign' firms. Column (2) uses a higher threshold of foreign equity ownership (25 percent) and gives similar result. In fact, now the difference in elasticity of investment with respect to exchange rate volatility is even higher with domestic firms seeing a decline in investment almost twice as high (0.96 percent) as the 'foreign' firms (0.48) for the same 1 percent increase in volatility. This indicates the presence of non-linearity in the impact of foreign equity ownership on the elasticity of investment with respect to exchange rate volatility.

The last column adds another interaction term between exchange rate volatility and a dummy for publicly listed firms $(\delta^{listing})$ which takes a value of one if the firm is listed on either the Bombay Stock Exchange or the National Stock Exchange. This interaction term captures the differential impact of exchange rate volatility on firms with access to domestic equity. The estimates show no significant impact of access to domestic equity market on the investment

elasticity of firms even though foreign equity ownership continues to remain a significant determinant of firm's investment elasticity with respect to exchange rate volatility. Overall, the results indicate that foreign equity ownership mitigates the negative impact of exchange rate volatility on investment though the same cannot be said about access to domestic equity finance.

5.5 Robustness Checks

To check whether these results are robust to alternative choice of firm level covariates I carry out several robustness checks. Firstly, the significantly better performance of foreign firms in the face of exchange rate shocks might be a reflection of their higher profitability and efficiency. To check this measures of 'profitability' and 'efficiency' are included in the model[3]. Profitability is defined as the net profits before taxes divided by the end of last period total assets[4]. Similarly, efficiency is defined as total sales divided by the total assets[5].

Columns (1) and (2) of Table 9 presents the results of these specifications. As expected, more profitable and more efficient firms do grow faster than the rest. The main results of a significantly negative impact of exchange rate volatility on investment and a significantly positive interaction effect of having access to foreign equity (which is again found to be increasing in the level of foreign participation), however, remain unchanged. Differences in productivity and efficiency alone cannot, therefore, explain the differences in the impact of exchange rate volatility on investment.

To check whether the positive interaction effect of having foreign equity is being driven by industries with no foreign firms I estimate equation (4) after excluding those industries that have no foreign firms (these are leather products, printing and furniture). Column (3) of table 8 presents the results from this exercise. The key results remain unchanged with this adjustment.

Finally, as discussed in section 5.2, trade orientation is an important determinant of the impact of exchange rate volatility on firm's investment. To check whether the beneficial impact of foreign equity ownership varies across firms with different trade exposures I divide the whole sample in to exporters, non-exporters, importers and non-importers. Equation (4) is then estimated for each of the sub-samples separately. Table 10 presents the results from this exercise. The first key result of this exercise is that firms with exposure to exports are affected much less by the volatility in exchange rate as compared to the firms with no exposure to exports. This is in line with the findings of studies such as Campa and Goldberg (1999), Kandilov et al. (2011) and Demir (2013). Secondly, the coefficient on the interaction term between foreign equity ownership and exchange rate volatility is much bigger and more significant for firms with no export exposure than those with export exposure. Similarly, the coefficient on exchange rate volatility is bigger and more significant for firms with positive

[3] Only lagged values of these measures are included in order to avoid reverse causality.
[4] We exclude the outliers by dropping the observations where the absolute value of profitability rate exceeded one.
[5] Outliers below and above the 1st and 99th percentile respectively are dropped.

import exposure as compared to the rest. Of course, as discussed in section 5.2, the volatility mitigating effect of import exposure crucially depends upon the firm level mark-up. The results still, however, indicate that foreign trade does act as a substitute for foreign equity investment in emerging markets like India.

VI. Conclusion

As emerging markets open up to international trade and capital flows, they are forced to contend with sharp movements in the value of their domestic currency. Efforts to dampen these movements in exchange rate involve significant costs (both implicit and explicit) including a potential loss in monetary policy autonomy. This paper looks at the impact of an increase in the real exchange rate volatility on firm level investment using firm level data on over 800 Indian manufacturing firms. The results indicate that exchange rate volatility affects firm level investment negatively and significantly. The relationship between investment and volatility is, however, non-linear and depends upon the firm's characteristics such as its mark-up, trade exposure and foreign equity ownership.

These results have important policy implications. Emerging markets like India have tried to protect themselves against volatile exchange rate movements by using a combination of capital controls, monetary policy adjustments and direct forex market intervention. Such measures are, however, not without their costs. In this context, encouraging both trade openness and financial openness can be useful in helping to mitigate the negative effects of exchange rate volatility on firms. Further, policy makers trying to stabilize exchange rate must take in to consideration the potential non-linearity in the impact of exchange rate volatility on investment and growth. At lower levels of volatility, the costs of trying to stabilize the exchange rate are likely to be higher than the possible benefits.

Several important questions are thrown up by these findings. For example, how and to what extent does the availability and use of financial hedging instruments alter the relationship between investment and exchange rate volatility? How does exchange rate volatility affect the structure of exports and imports and the impact of such a change on the transmission of exchange rate shocks? Finally, what are the channels through which foreign equity ownership affects investment elasticity with respect to exchange rate volatility? Further work in this direction could be very fruitful.

References

Abel, A.B., 1983,"Optimal investment under uncertainty," *The American Economic Review*, 73(1), pp.228-233.

Abel, A.B and Eberly, J., 1994,"A unified model of investment under uncertainty," *American Economic Review*, 84(5), pp. 1369-84.

Aiginger, K., 1987, "Production and decision theory under uncertainty", Blackwell, Oxford

Aizenman, J. and Pinto, B., 2005, Overview, In: Aizenman, J., Pinto, B. (Eds.), Managing economic volatility and crises: a practitioner's guide. Cambridge University Press, New York, pp. 1–44.

Arellano, M. and Bover, O., 1995,"Another look at the instrumental variable estimation of error-components models," *Journal of econometrics*, 68(1), pp.29-51.

Arnold, J.M. and Javorcik, B.S., 2009,"Gifted kids or pushy parents? Foreign direct investment and plant productivity in Indonesia," *Journal of International Economics*, 79(1), pp.42-53.

Bernanke, B.S., 1983,"Irreversibility, uncertainty, and cyclical investment," *The Quarterly Journal of Economics*, 98(1), pp.85-106.

Bleaney, M., 1996, "Macroeconomic Stability, Investment and Growth in Developing Economies," *Journal of Development Economics*, 48, pp. 461–477.

Bleaney, M. and Greenaway, D., 2001, "The impact of terms of trade and real exchange rate volatility on investment and growth in sub-Saharan Africa", *Journal of development Economics*, 65(2), pp. 491-500.

Blundell, R. and Bond, S., 1998,"Initial conditions and moment restrictions in dynamic panel data models," *Journal of econometrics*, 87(1), pp.115-143.

Caballero, R.J., 1991,"On the sign of the investment-uncertainty relationship," *The American Economic Review*, 81(1), pp.279-288.

Caballero, R.J. and Pindyck, R.S., 1996, "Uncertainty, investment and industry evolution", *International Economic Review,* 37 (3), pp.641–662.

Caglayan, M. and Demir, F., 2014,"Firm productivity, exchange rate movements, sources of finance, and export orientation," *World Development*, 54, pp.204-219.

Campa, J. M. and Goldberg, L. S, 1999," Investment, Pass-Through and Exchange Rates: A Cross-Country Comparison," *International Economic Review*, 40(2), pp.287-314.

Cushman, D.O., 1985,"Real exchange rate risk, expectations, and the level of direct investment," *The Review of Economics and Statistics*, 67(2), pp.297-308.

Clark, P., Tamirisa, N., Wei, S.J., Sadikov, A. and Zeng, L., 2004,"Exchange rate volatility and trade flows-some new evidence," *IMF Occasional Paper*, *235*.

Darby, J., Hallett, A.H., Ireland, J. and Piscitelli, L., 1999,"The impact of exchange rate uncertainty on the level of investment," *The Economic Journal*, 109(454), pp.55-67.

Demir, F., 2013, "Growth under exchange rate volatility: Does access to foreign or domestic equity markets matter?," *Journal of Development Economics*, 100(1), pp.74-88.

Desai, M.A., Foley, C.F. and Forbes, K.J., 2008,"Financial constraints and growth: Multinational and local firm responses to currency depreciations," *The Review of Financial Studies*, 21(6), pp.2857-2888.

Dixit, A., 1989,"Entry and exit decisions under uncertainty," *Journal of political Economy*, 97(3), pp.620-638.

Dixit, A. and Pindyck, R., 1994, "Investment under uncertainty", Princeton University Press, New Jersey

Fazzari, S., Hubbard, R.G. and Petersen, B.C., 1988, "Financing constraints and corporate investment", Brookings Papers on Economic Activity, 1, pp. 141–195.

Ghura, D. and Thomas J. G, 1993, "The Real Exchange Rate and Macroeconomic Performance in Sub-Saharan Africa," *Journal of Development Economics* 42, pp. 155–174.

Goldberg, L.S., 1993,"Exchange rates and investment in United States industry," *The Review of Economics and Statistics*, pp.575-588.

Goldberg, L.S and Kolstad, C., 1995,"Foreign Direct Investment, Exchange Rate Variability and Demand Uncertainty," *International Economic Review*, 36(4), pp. 855-73.

Hartman, R., 1972,"The effects of price and cost uncertainty on investment," *Journal of Economic Theory,* 5(2), pp. 258-266.

Hutchison, M., Sengupta, R. and Singh, N., 2012, "India's trilemma: financial liberalization, exchange rates and monetary policy", *The World Economy*, *35*(1), pp.3-18.

Kandilov, I.T. and Leblebicioğlu, A., 2011,"The impact of exchange rate volatility on plant-level investment: Evidence from Colombia," *Journal of Development Economics*, 94(2), pp.220-230.

McDonald, R. and Siegel, D., 1986,"The value of waiting to invest," *The Quarterly Journal of Economics*, 101(4), pp.707-727.

Mitton, T., 2006,"Stock market liberalization and operating performance at the firm level," *Journal of Financial Economics*, 81(3), pp.625-647.

Pindyck, R., 1988,"Irreversible investment, capacity choice, and the value of the firm," *American Economic Review*, 78(5), pp. 969-85.

Yaşar, M. and Paul, C.J.M., 2009,"Size and foreign ownership effects on productivity and efficiency: an analysis of Turkish motor vehicle and parts plants," *Review of Development Economics*, 13(4), pp.576-591.

Pindyck, R. and Solimano, A., 1993, "Economic instability and aggregate investment", In: Blanchard, O.J. and Fischer, S. (Eds.), NBER Macroeconomics Annual. MIT Press, Cambridge, pp. 259–302

Serven, L., 2003, "Real exchange rate uncertainty and private investment in LDCs", *The Review of Economics and Statistics*, 85 (1), pp.212–218

Serven, L. and Solimano, A. eds., 1993. *Striving for growth after adjustment: the role of capital formation*. World Bank Publications.

Table 1

Summary Statistics

Variable	Mean	St. Dev.	Min	Max
Investment Rate $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	0.005	0.013	0.00	0.47
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.24	5.38	0.00	325.67
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	-0.009	0.29	-21.3	4.99
Average Mark-up (ψ_i)	2.05	1.09	0	8.74
Δexchange rate (Δe_{jt})	0.025	0.073	-0.14	0.14
Fraction exporters	0.165	0.07	0.08	1
Fraction importers	0.14	0.07	0.06	1
Fraction Foreign	0.075	0.047	0	0.52
Average export exposure (χ_{it}^{exp})	6.19	9.6	0.00	58.9
Average Import exp. (χ_{it}^{imp})	0.95	3.12	0.00	47.3
Exchange Rate Volatility (ev_{jt}^{GARCH})	0.028	0.006	0.016	0.047
Exchange Rate Volatility $(ev_{jt}^{Std.\ Dev.})$	0.028	0.004	0.018	0.034

Table 2

Average share of exports and imports, by partner (2005-2016)

Rank	Partner	Export Share (%)	Rank	Partner	Import Share (%)
1	**USA**	13.5	**1**	**China**	22.37
2	**UAE**	7.24	**2**	**USA**	8.35
3	**China**	5.78	**3**	**Germany**	4.33
4	**UK**	4.83	**4**	**Indonesia**	3.1
5	**Germany**	3.64	**5**	**Italy**	2.94
6	**Sri Lanka**	3.1	**6**	**Korea**	2.94
7	**Singapore**	2.84	**7**	**UK**	2.94
8	**Italy**	2.72	**8**	**Malaysia**	2.79
9	**Netherland**	2.47	**9**	**Japan**	2.74
10	**Saudi Arabia**	2.46	**10**	**Bangladesh**	2.35
11	**France**	2.27	**11**	**France**	2.35
12	**Japan**	2.21	**12**	**Hong Kong**	2.18
13	**Malaysia**	2.1	**13**	**Singapore**	2.1
14	**Bangladesh**	2.05	**14**	**Netherland**	2.1
15	**Belgium**	1.81	**15**	**UAE**	1.95
16	**Korea**	1.80	**16**	**Switzerland**	1.91
17	**Hong Kong**	1.69	**17**	**Russia**	1.88
18	**Indonesia**	1.58	**18**	**Brazil**	1.74
19	**Turkey**	1.50	**19**	**Sri Lanka**	1.66
20	**Spain**	1.39	**20**	**Belgium**	1.31

Table 3

Industry real exchange rate volatility measures – sample average and change, 2005-2016

3-digit ISIC mfg. industry	(ev_{jt}^{GARCH})		$ev_{jt}^{Std.\ Dev.}$	
	Average	Change 2005-16	Average	Change 2005-16
Food	0.025	-0.004	0.03	-0.004
Beverages	0.03	0.002	0.032	-0.0004
Tobacco	0.03	0.002	0.029	0.008
Textiles	0.026	0.0002	0.028	0.006
Apparel	0.03	0.0012	0.027	0.009
Leather	0.03	0.0003	0.028	0.008
Footwear	0.03	0.0013	0.028	0.008
Wood	0.024	0.001	0.024	0.01
Paper	0.029	-0.0002	0.028	0.007
Printing	0.034	0.002	0.029	0.009
Chemicals	0.027	-0.00	0.026	0.008
Pharma	0.03	-0.00	0.029	0.007
Rubber	0.028	-0.0003	0.028	0.009
Plastic	0.027	-0.00	0.026	0.007
Non-metallic minerals	0.029	0.0002	0.028	0.006
Iron & steel	0.029	0.0003	0.028	0.009
Non-ferrous metals	0.028	0.001	0.027	0.006
Metal Products	0.027	0.0015	0.026	0.0055
Electronics, etc.	0.027	0.0003	0.026	0.0067
Machinery	0.029	0.003	0.028	0.0076
Transport equipment	0.029	0.0005	0.028	0.008
Furniture	0.037	0.0006	0.029	0.01
Gems & Jewelry	0.028	0.0004	0.029	0.008

Table 4

Investment and real exchange rate volatility estimate

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)	(2)
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.3782*** (0.0768)	0.38245*** (0.07654)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0209*** (0.0044)	0.02064*** (0.0046)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0094*** (0.0026)	-0.0094*** (0.0026)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	0.0029 (0.0272)	0.00262 (0.0264)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.1242*** (0.0464)	0.1236*** (0.0470)
Δexchange rate $\left(\Delta e_{jt}\right)$	-0.0081 (0.0073)	-0.0052 (0.0077)
Exchange Rate Volatility $\left(ev_{jt}^{GARCH}\right)$	-0.1627*** (0.0435)	
Exchange Rate Volatility $\left(ev_{jt}^{Std.\ Dev.}\right)$		-0.1935** (0.0805)
Number of Observations	5180	5180
Hansen Test (p-value)	0.230	0.256
1st order serial correlation (p-value)	0.00	0.00
2nd order serial correlation (p-value)	0.213	0.218

Table 5

Exchange rate volatility and the impact of mark-up

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)	(2)
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.3473*** (0.0894)	0.3466*** (0.0883)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0149*** (0.0044)	0.0145*** (0.0043)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0050*** (0.0017)	-0.0055*** (0.0017)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	0.0255 (0.0297)	0.0250 (0.0292)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.0458** (0.0186)	0.0454** (0.0182)
Δexchange rate $\left(e_{jt}\right)$	-0.0086 (0.0071)	0.0081 (0.0070)
Exchange Rate Volatility $\left(ev_{jt}\right)$	-0.1757*** (0.0376)	-0.1850*** (0.0378)
Exchange Rate Volatility $\left(ev_{jt}\right) *$ Mark-up(ψ_i)	0.0046 (0.0032)	0.0108** (0.0043)
Exchange Rate Volatility $\left(ev_{jt}\right) *$ Mark-up squared $\left(\psi_i^2\right)$		-0.0003** (0.0001)
Number of Observations	5111	5111
Hansen Test (p-value)	0.730	0.746
1st order serial correlation (p-value)	0.000	0.000
2nd order serial correlation (p-value)	0.178	0.177

Table 6:

Exchange rate volatility and trade exposure

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.4323*** (0.0679)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0227*** (0.005)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0104*** (0.003)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	-0.0045 (0.0274)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.1324** (0.0525)
Δexchange rate (e_{jt})	-0.0098 (0.0073)
Exchange Rate Volatility (ev_{jt})	-0.1621*** (0.0444)
Exchange Rate Volatility $(ev_{jt}) *$ Export exp. (χ_{it}^{exp})	0.0118 (0.0442)
Exchange Rate Volatility $(ev_{jt}) *$ Import exp. (χ_{it}^{imp})	-0.0425 (0.0471)
Exchange Rate Volatility $(ev_{jt}) *$ Export exp. (χ_{it}^{exp})* Mark-up(ψ_i)	-0.0017 (0.0014)
Exchange Rate Volatility $(ev_{jt}) *$ Import exp. (χ_{it}^{imp})* Mark-up(ψ_i)	0.0108** (0.0051)
Number of Observations	5180
Hansen Test (p-value)	0.482
1st order serial correlation (p-value)	0.00
2nd order serial correlation (p-value)	0.163

Table 7:

Non-linearity in the impact of exchange rate volatility

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.3761*** (0.0765)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0207*** (0.0044)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0094*** (0.0025)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	0.0071 (0.0263)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.1262*** (0.0456)
Δexchange rate (e_{jt})	-0.0085 (0.0075)
Exchange Rate Volatility (ev_{jt})*dummy for volatility less than or equal to the 25th percentile $(\delta_{25}^{voler} \leq 25th\ percentile)$	0.0808*** (0.0292)
Exchange Rate Volatility $(ev_{jt}) *$ dummy for volatility between 25th & 50th percentile $(25th\ percentile < \delta_{50}^{voler} < 50th\ percentile)$	0.0647*** (0.0226)
Exchange Rate Volatility $(ev_{jt}) *$ dummy for volatility between 50th & 75th percentile $(50th\ percentile < \delta_{75}^{voler} < 75th\ percentile)$	0.0287* (0.0152)
Exchange Rate Volatility $(ev_{jt}) *$ dummy for volatility between 75th & 90th percentile $(75th\ percentile < \delta_{90}^{voler} < 90th\ percentile)$	0.0051 (0.0107)
Exchange Rate Volatility $(ev_{jt}) *$ dummy for volatility between 90th & 95th percentile $(90th\ percentile < \delta_{95}^{voler} < 95th\ percentile)$	0.0187 (0.0113)
Number of Observations	5180
Hansen Test (p-value)	0.318
1st order serial correlation (p-value)	0.000
2nd order serial correlation (p-value)	0.227

Table 8:

Exchange rate volatility and foreign equity ownership

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)	(2)	(3)
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.3579*** (0.0903)	0.3782*** (0.0776)	0.3556*** (0.0918)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0194*** (0.0046)	0.0210*** (0.0044)	0.0194*** (0.0046)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.008*** (0.0028)	-0.0094*** (0.0026)	-0.008*** (0.0028)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	0.0129 (0.0274)	0.0029 (0.0271)	0.0124 (0.0275)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.1104*** (0.0399)	0.1237*** (0.0464)	0.1104*** (0.0399)
Δexchange rate (e_{jt})	-0.0099 (0.0064)	-0.0078 (0.0073)	-0.0097 (0.0064)
Exchange Rate Volatility (ev_{jt})	-0.176*** (0.0428)	-0.1726*** (0.0439)	-0.1263** (0.0646)
Exchange Rate Volatility (ev_{jt}) ∗Foreign Ownership Dummy $(\delta_i^{foreign} > 10)$	0.0540** (0.0273)		0.0541** (0.0272)
Exchange Rate Volatility (ev_{jt}) ∗Foreign Ownership Dummy $(\delta_i^{foreign} > 25)$		0.0860*** (0.0328)	
Foreign Ownership Dummy $(\delta_i^{foreign} > 10)$	-0.0013 (0.0008)		-0.0013 (0.0008)
Foreign Ownership Dummy $(\delta_i^{foreign} > 25)$		-0.0023** (0.0009)	
Exchange Rate Volatility (ev_{jt}) * Listing Dummy $(\delta^{listing})$			-0.0542 (0.0532)
Listing Dummy $(\delta^{listing})$			0.0012 (0.0014)
Number of Observations	5180	5180	5180
Hansen Test (p-value)	0.578	0.218	0.999
1st order serial correlation (p-value)	0.000	0.000	0.000
2nd order serial correlation (p-value)	0.206	0.213	0.210

Table 9

Robustness Checks

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1)	(2)	(3)[6]
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.3232*** (0.0819)	0.3732*** (0.0739)	0.3584*** (0.0906)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0251* (0.0138)	0.0191*** (0.0071)	0.0194*** (0.0046)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0084* (0.0046)	-0.0092*** (0.0030)	-0.0084*** (0.0028)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	-0.0892 (0.0897)	-0.0071 (0.0383)	0.0135 (0.0276)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.0822 (0.0607)	0.1255*** (0.0481)	0.1109*** (0.0399)
Δexchange rate $\left(e_{jt}\right)$	-0.0134 (0.0086)	-0.0071 (0.0074)	
Exchange Rate Volatility $\left(ev_{jt}\right)$	-0.1686** (0.0882)	-0.1572*** (0.0582)	-0.1796*** (0.0435)
Exchange Rate Volatility $\left(ev_{jt}\right)$ ∗Foreign Ownership Dummy $\left(\delta_i^{foreign} > 10\right)$	0.0839** (0.0365)	0.0604** (0.0250)	0.0533** (0.0275)
Foreign Ownership Dummy $\left(\delta_i^{foreign} > 10\right)$	-0.0029*** (0.0011)	-0.0017** (0.0007)	-0.0013 (0.0008)
Lagged Profitability	0.006*** (0.0019)		
Lagged Efficiency		0.0523*** (0.0198)	
Number of Observations	4150	5137	5150
Hansen Test (p-value)	0.291	0.275	0.999
1st order serial correlation (p-value)	0.002	0.000	0.000
2nd order serial correlation (p-value)	0.195	0.219	0.207

[6] Only industries with foreign equity presence

Table 10

Foreign equity ownership and trade exposure

Dependent Variable : $\left(\frac{I_{ijt}}{k_{ijt-1}}\right)$	(1) $(\chi_{it}^{imp} > 0)$	(2) $(\chi_{it}^{imp} = 0)$	(3) $(\chi_{it}^{exp} > 0)$	(4) $(\chi_{it}^{exp} = 0)$
Lagged Investment Rate : $\left(\frac{I_{ijt-1}}{k_{ijt-2}}\right)$	0.1418 (0.2108)	0.2023** (0.0868)	0.3284** (0.1492)	0.2090** (0.1059)
Total Sales $\left(\frac{S_{ijt}}{k_{ijt-1}}\right)$	0.0337*** (0.0121)	0.0092** (0.0039)	0.0331*** (0.0104)	0.0169*** (0.0050)
Lagged Total Sales $\left(\frac{S_{ijt-1}}{k_{ijt-2}}\right)$	-0.0123* (0.0068)	0.0021 (0.0034)	-0.0157** (0.0066)	-0.0063* (0.0033)
Cash Flow $\left(\frac{C_{ijt}}{k_{ijt-1}}\right)$	-0.0930* (0.0506)	0.0187 (0.0192)	-0.0895* (0.1134)	0.0258 (0.0281)
Lagged Cash Flow $\left(\frac{C_{ijt-1}}{k_{ijt-2}}\right)$	0.1686 (0.1035)	0.0711*** (0.0226)	0.1134 (0.0926)	0.1056* (0.0614)
Δexchange rate (e_{jt})	-0.0201 (0.0127)	-0.0056 (0.0064)	-0.0167* (0.0097)	-0.0094 (0.0081)
Exchange Rate Volatility (ev_{jt})	-0.0737 (0.0684)	-0.1580*** (0.0290)	-0.1119* (0.0652)	-0.1657*** (0.0345)
Exchange Rate Volatility (ev_{jt}) ∗Foreign Ownership Dummy $(\delta_i^{foreign} > 10)$	-0.0026 (0.0950)	0.0723*** (0.0254)	0.0193 (0.0752)	0.0731** (0.0313)
Foreign Ownership Dummy $(\delta_i^{foreign} > 10)$	-0.0002 (0.0030)	-0.0021*** (0.0007)	-0.0009 (0.0024)	-0.0023** (0.0009)
Number of Observations	1425	3755	1616	3564
Hansen Test (p-value)	0.782	0.421	0.746	0.730
1st order serial correlation (p-value)	0.113	0.007	0.023	0.00
2nd order serial correlation (p-value)	0.191	0.163	0.074	0.199