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Transmission of Real Exchange Rate to the Manufacturing Sector: Role of Financial Access

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Abstract

We explore the impact of Real Exchange Rate changes on the performance of Indian manufacturing firms over the period 2000-2012. Our empirical analysis shows that real exchange rate movements have a significant impact on Indian firms' performance but the impact varies across different firm and industry characteristics. In particular the impact depends upon the degree of market power, trade orientation, foreign ownership, access to domestic finance and industry concentration. Further, appreciation and depreciation affect firms' performance differently. Results from Panel-VAR confirm these findings. Overall, our results point towards the need for taking in to account firm and industry level heterogeneity in designing policies aimed at managing exchange rate shocks and also the role of greater financial development in currency risk management.

JEL Classifications: F1, F4

Keywords*:* *Real Exchange Rate, Manufacturing Performance, Mark up*

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I. Introduction

International economics has long been concerned with the effects of exchange rate movements on the real economy. The topic continues to attract theoretical as well as empirical researchers alike. This paper contributes to the large body of empirical literature looking at the impact real exchange rate movements on firm level performance by using a newly compiled dataset of around 1420 Indian manufacturing firms.

Exchange rate movements can affect firm performance 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. Although the impact on firm performance is only one component determining how exchange rate changes affect aggregate economic growth, it can be an important and significant determinant of the same. An important advantage of using firm level panel data is that it allows us to control for unobservable firm level effects while studying the impact of real exchange rate changes. These individual idiosyncrasies reflect important characteristics of a firm, which are likely to influence its response to exchange rate movements. Our empirical model uses time varying industry and firm characteristics to capture heterogeneity in response to exchange rate changes.

The main finding of this paper is that real exchange rate changes affect firm level performance but the impact varies across different firm and industry level characteristics. Firms with a larger share of exports in their total earnings and a smaller share of imports in their total inputs are likely to benefit more from depreciation in the real exchange rate. Similarly, firms with greater market power are less affected by changes in real exchange rate. More importantly, foreign equity ownership and access to domestic equity finance along with a higher degree of industry concentration are associated with significantly diminished impact of real exchange rate changes on firms' growth. Results from Panel Vector Auto-Regression reinforce these findings. From policy makers perspective these findings have important implications. They indicate the need to take in to account firm and industry specific characteristics while trying to study the impact of real exchange rate changes. At the same time, they point towards the role of greater foreign equity investment and better access to domestic equity finance in helping mitigate the impact of exogenous real exchange rate shocks. This, however, does not take away from the need to have a

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competitive real exchange rate and sound macroeconomic policies for encouraging robust economic growth and maintaining internal and external balance in the long run.

The Indian Case

India presents a unique case for studying the impact of exchange rate movements. Prior to the Balance of Payments crisis in 1991, Indian Rupee was pegged to a basket of currencies dominated by the US Dollar. The external payment crisis of 1991 forced the Reserve Bank of India (RBI) to implement a set of market oriented financial sector reforms and a paradigm shift from fixed to market-based exchange rate regime in March 1993.[1] Institution of Current Account convertibility in August 1994 and gradual liberalization of Capital Account along with other trade and financial liberalization measures meant a rise in total turnover in the foreign exchange market by more than 150% from USD 73.2 billion in 1996 to USD 130 billion in 2002-03 and further to USD 1100 billion in 2011-12[2]. A direct outcome of these changes has been a rise in the volatility of Indian Rupee. Figure 1 plots average annual volatility of monthly Rupee-USD log returns to illustrate this point.

In this backdrop, RBI's exchange rate management policy has aimed at maintaining orderly conditions in the foreign exchange market by eliminating lumpy demand and supply and preventing speculative attacks, without setting a specific exchange rate target. RBI has used a combination of tools including sales and purchase of currency in both the spot and the forward segments of the foreign exchange market, adjustment of domestic liquidity through the use of Bank Rate, CRR, Repo rate etc. and monetary sterilization through specialized instruments, towards this end[3]. An interesting feature of RBI's intervention during this period has been asymmetry during episodes of appreciation and depreciation.

[1] See the Special edition of RBI's *Reports on Currency and Finance*, Vol. III (2005-06) for detailed discussion on the evolution of India's foreign exchange market. (Link: http://rbidocs.rbi.org.in/rdocs/content/PDFs/89704.pdf) See Sengupta and Sengupta (2012) for a discussion on India's Capital Account Management between 1990-2011.
[2] Table A in Appendix presents the growth in the size of foreign exchange market in India over time.
[3] For instance, RBI resorted to a net purchase of 5.4 billion USD between April-August 1997 to reduce the acute upward pressure on Rupee resulting from buoyant capital inflows and sluggish import demand. Then, as Rupee weakened in the last week of August, partly in response to the East Asian financial crisis, RBI sold foreign exchange worth 978 million USD to strengthen the Rupee. Again, a surge in capital inflows starting 2004 forced RBI to purchase foreign exchange in order to ward off the upward pressure on Rupee. This time around RBI's intervention was sterilized using *Market Stabilization Scheme* bonds issued specifically for this purpose.

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Figure 2 plots Net Sales of Foreign Exchange Assets by RBI as a percentage of total turn-over in the foreign exchange market[4] along with monthly log returns on Rupee – USD exchange rate[5]. One can see that RBI has been intervening actively in the foreign exchange market during episodes of Rupee appreciation by purchasing foreign exchange while following a hands-off approach during episodes of Rupee depreciation (This has clearly been the case at least until 2009.). Underlying this asymmetry has been the notion that an appreciated Rupee would hurt exporters through a loss in cost competitiveness and by corollary, adversely affect India's growth performance. Empirical evidence on the impact of exchange rate on the performance of Indian firms is however non-existent[6i]. Present paper tries to fill this important gap in the literature. The key findings of this paper suggest that, the impact of exchange rate varies across different types of firms and industries. More importantly, while the export competitiveness channel is dominant in industries with higher degree of concentration, both export competitiveness and import cost channel operate in industries with lower degree of concentration. This indicates that an unambiguous case for a beneficial effect of exchange rate depreciation or an adverse impact of exchange rate appreciation cannot be made for firms in industries with low degree of market concentration.

The rest of the paper is organized as follows – Section 2 provides a brief review of the literature. Section 3 describes the dataset in detail. Section 4 presents the single equation GMM results while section 5 presents Panel VAR analysis. Section 6 concludes.

II. Literature Review

The question of real exchange rate devaluations and its impact on open economies is an old one. In the standard Keynesian framework, devaluation boosts income and output through its impact on aggregate demand. At the same time supply side factors suggest that by increasing the cost of imported inputs, exchange rate devaluations can cause a reduction in output. A vast body of research has made its way in to the literature under the subject heading of *contractionary devaluation*. Countries such as Mexico, where real depreciations were consistently coupled with

[4] Negative net sales implies net purchase of foreign exchange by RBI
[5] Positive return implies appreciation of Rupee.
[6] Recent paper by Cheung and Sengupta (2013) being the only exception. However their focus is exports performance of the firms and they do not focus on the role of finance.

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output contractions, and where real appreciations were associated with output expansions, have become conventional examples of the contractionary devaluation problem.

In an attempt to assess the effects of exchange rates on output, the literature has taken four different routes. The first is a factual method that compares output performance before with that after the currency devaluation and is commonly known as the 'before-after' approach. Diaz-Alejandro (1965), Cooper (1971), Krueger (1978)[ii] are some early examples of this strand of literature. Most papers in this literature do not find a significant recessionary impact of devaluations. One of the problems of this approach is that it does not take in to account problems of simultaneity and endogeneity.

The second approach, known as the *control-group* approach, compares before-after output performance in devaluing countries with output performance in a set of non-devaluing countries during the same time span. Assuming that all devaluing and control group countries face the same exogenous external factors, the difference in the output performance of these two groups should only reflect the effect of devaluations. Donovan (1981, 1982), Kamin (1988) and Edwards (1989 a, b)[iii] are some examples of this approach. While finding some evidence of an improvement in external balance, this set of papers does not find clear evidence of *contractionary devaluation*. Control group approach suffers from the problem of selection bias. Countries in the *treatment group* (non-control group) are likely to have a rather poor economic performance before the devaluation as compared to those in control group. The control group approach will exaggerate the positive impact of a program/devaluation when past poor economic performance indicates an improvement of the current conditions. The opposite will be true if past poor performance indicates subsequent deterioration.

The third set of empirical studies which is more recent uses time series and panel data techniques to capture the relationship between exchange rate and economic performance. Rogers and Wang (1995), Santaella and Vela (1996), Copelman and Werner (1996), Kamin & Rogers (1997, 2000), Bahmani & Miteza (2006)[iv] are examples of this strand of literature. Most of these studies use country level data unlike this paper which uses firm level data. Problem with aggregate data is that it hides sector specific movements in response to exchange rate changes. By using Panel VAR on firm level data, this paper significantly adds to the existing studies in this set.

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Finally, the macro-simulation methodology relies on simulations of economic models to infer the theoretical performance of output after a hypothetical devaluation takes place. Diaz-Alejandro (1963), Krugman and Taylor (1978), Barbone and Rivera-Batiz (1987)[v] are the seminal contributions in this strand of literature. While early studies in this group focus on the demand side , studies such as Bruno (1979), Gylfason and Schrnid (1983), van Wijnbergen (1986), Buffie (1986) Agenor (1991), Gylfason and Radetzki (1991), Taye (1999)[vi] look at the supply side too. Buffie (1986), for example, shows that when investment is treated as a composite good produced by combining imported and domestic inputs Marshall-Lerner condition is no longer sufficient for an expansionary devaluation outcome. Compared to all these studies we provide a more nuanced view whereby the impact of exchange rate changes is dependent on specific features of industries and firms under consideration as well as their financial structure such as foreign equity ownership and access to domestic equity markets.

This paper is also related to a large body of microeconomic literature looking at the impact of exchange rate fluctuations on firm level performance. A section of this literature looks at the impact of exchange rate changes on firm's value measured by its stock returns. Examples of this literature include Adler and Dumas (1984), Jorion (1990), Bodnar and Wong (2000), Dominguez and Tesar (2006), Parsley and Popper (2006)[vii]. Another strand of the same literature looks at the issue of pricing policies in response to currency fluctuations (for e.g. Goldeberg and Knetter (1997)[viii]). Finally a small section of this literature looks at the impact of currency fluctuations on firm level variables such as investment or employment (e.g. Goldberg (1993), Campa and Goldberg (1995, 1999), Nucci and Pozzollo (2001), Demir (2013))[ix]. While this paper is most closely related to the last strand of literature, most of the existing papers in this literature look at developed countries with little attention being paid to the emerging markets such as India. One of the reasons for this gap is the lack of good quality firm level data. In that respect our paper contributes to the existing literature by putting together a large firm level dataset for an emerging economy that can be used to answer questions regarding impact of macroeconomic variables such as exchange rates on firms.

Finally our paper is also linked to the literature on the role of financial development in economic growth. Governments the world over offer significant inducements to attract foreign investment, motivated by the expectation of spillover benefits to augment the primary benefits of a boost to

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national income from new investment. The sources and extent of these spillover benefits have been empirically examined with mixed results. However, relatively few papers have tried to explore the role of foreign capital in mitigating the costs of external shocks to firms[x7]. The finding that access to foreign and domestic equity finance is associated with smaller impact of exchange rate changes points towards an additional channel through which financial development can boost growth.

III. Data

Our primary source of data is the PROWESS database compiled by the Centre for Monitoring Indian Economy. The original database contains financial and other information on over 7,965 manufacturing firms. After taking in to account missing observations and misreported data we are left with a balanced panel of 1420 manufacturing firms over the period 2000-2012. These firms represent more than 93 percent of the total market capitalization on the Bombay Stock Exchange and cover all the major industries in the Indian economy including chemicals, textiles, food and beverages etc. Since our focus is on manufacturing firms, we only include those in our sample. The average size of asset holdings of the firms in our sample was about INR 15000 million (USD 242 million) in the year 2012 and they had an average sales of INR 15500 million (USD 250 million) and an average workforce of 2600 over the same period. Of the 1420 firms, 325 (23%) were non-exporters while 214 (15%) were non-importers[8]. The average share of exports in total sales was around 22 percent while the average share of imports in total inputs was around 28 percent in the year 2012 for all the firms in our sample.

To check how well our sample captures fluctuations in aggregate data we plot changes in sales and investment in the sample and the aggregate macroeconomic data in the figures below. Our sample manages to capture the broad trends in aggregate data reasonably well. Between 2000 and 2007 investment increased more or less continuously, except for a couple of occasions. After the 2008 Global Recession, however, investment maintained a sustained downward trend till 2012. Our sample average captures this broad trend successfully.

[7] Demir(2013) being an exception

[8] Non-exporters are firms with zero exports during the period 2000-2012. Similarly, non-importers are firm with zero imports during the same period.

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Plots of average sales growth, income growth and market capitalization present a similar picture. There is an increase in sales, income and market capitalization between 2004 and 2007 followed by a downturn in 2008 due to global financial crisis that originated in the US.

Key Characteristics

Text table 1 provides industry wise composition of our sample along with key characteristics such as sales growth and trade shares. The first column gives the total number of firms for each sector in the entire sample followed by the industry-wise average annual growth rate of sales in the second column. Chemicals constitute the largest share of our sample in terms of the number of firms followed by Food and Beverages and Textiles. Automobile is the fastest growing industry in terms of sales with an average annual growth rate of 11 percent. Leather and leather products, Paper and Computers and Electronics, on the other hand, have shown a sharp decline in sales volume over the same period. The next column lists the average size of total asset holdings by firms in each industry. Firms in the Automobile sector are the largest in terms of their asset holdings.

The last two columns give industry wise average share of exports in total sales and share of imports in total intermediate inputs in year 2012. Non-metallic mineral products have the highest share of exports and imports in our sample. Readymade garments, leather and electrical machinery are other industries with significant export shares while plastic, chemicals and computers have significant share of imported inputs. As discussed above, shares of exports and imports have an important bearing on the impact of exchange rate movement on firm's performance. A larger share of exports in total revenue implies that an increase in price competitiveness following currency depreciation is likely to boost revenues, income as well as expected future profits of the firm. Similarly, the larger is the share of imported inputs in total cost, the greater is the increase in cost of production and the decline in current and future profits due to a real depreciation. The empirical model that follows, therefore, incorporates firm specific export and import shares while studying the impact of real exchange rate movements on firms.

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Text Table 1

Industry	No. of Firms	Annual Sales Growth	Total Assets (Re millions)	Average Export Share	Average Import Share
Food and Beverages	256	0.8	2682	9.3	14
Tobacco	7	-1.9	25804	4	26
Textiles	254	-3.6	2664	17	14
Readymade Garments	27	4.4	1481	35	14
Leather and Leather products	25	-6.6	1333.9	45	20
Paper and Paper products	14	-6.1	518	8	7.6
Chemicals	477	0.9	7909	17.9	32
Plastic and Rubber products	111	-2.3	1569	11.1	34
Non-metallic mineral products	28	3.9	5496.8	54	48
Basic metals	192	4.8	12634	8.9	15.7
Fabricated metal products	89	9.1	7027	8.5	18.3
Computer and Electronics	19	-5.1	16176	9.5	39
Electrical machinery	137	-3	2034	30	31
Misc. machinery	157	3.1	5369	12	19.7
Automobiles	12	11.1	40993	6	7.3
Other transport equipment	182	5.5	7001	10	19
Furniture	35	-1.7	1768	10	33

The next section describes in detail the construction of our real exchange real exchange rate measure.

Industry Specific Real Exchange Rate

Choice of the right exchange rate measure is crucial for analyzing the relationship between exchange rate and firm level performance. At the national level, discussions of exchange rate movements often rely on aggregate trade-weighted exchange rates, such as the carefully constructed measures computed by the Reserve Bank of India or Bank of International Settlements. However, focus on national aggregates necessarily omits industry-specific distinctions concerning trade partners, market competition etc. The importance of particular countries as competitors /trading partners within an industry can differ substantially from their importance in the aggregated trade of the economy. As a consequence, aggregate trade-weighted

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indexes may be less effective than industry-specific real exchange rate indexes in capturing changes in industry competitiveness induced by movements in bilateral exchange rates[9][xi].

To address this issue we construct industry specific trade weighed indices of real exchange rates using annual data on key trading partners' trade share in each industry and bilateral exchange rates from *UNCOMTRADE* and IMF's *International Financial Statistics*. Each industry is denoted by an index *i* and each country/trade partner of that industry by an index c. The industry-specific real exchange rate indices depart from the aggregate indices in that the weights of each trading partner's bilateral exchange rate vary by industry and are equal to the share of that country in India's trade of that specific industry. In contrast, aggregate indices use the weights of each trading partner in the total international trade activity of the entire Indian economy.

Formula for trade weighed industry specific real exchange rate is given by:

$$ter_i = \sum_c \left(\frac{x_{i,c} + m_{i,c}}{\sum_c \left(x_{i,c} + m_{i,c} \right)} \right) \times rer_{i,c} \quad (1)$$

Where $x_{i,c}$ and $m_{i,c}$ are respectively exports and imports of industry *i* to country *c* and $rer_{i,c}$ is the bilateral real exchange rate between India and country *c*[10]. Consumer Price Indices are used to calculate bilateral real exchange rates as they are available for all the countries in our sample.

Figure 6 plots the 61 country aggregate trade weighted real exchange rate of INR calculated by BIS along with the average of industry specific real exchange rates calculated above. While the two series seem to follow broadly similar long-term trend there are also clear episodes of divergences between the two[11]. The average correlation coefficient between the different industry specific real exchange rate series is 0.56 indicating significant differences in industry

[9] See Campa and Goldberg (2001) and Klein et al (2003) for discussion.
[10] We use trade and exchange rate data for top 130 trading partners to calculate industry specific real exchange rate indices. An increase in *rer* implies real appreciation.
[11] Simple correlation between the two series is 0.40.

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specific exchange rates thereby justifying our use of industry specific real exchange rates. Next section elaborates our empirical methodology[12].

IV. GMM Estimates of Exchange Rate Elasticity

a) The Model

The key motivation behind our empirical analysis is to study the relationship between real exchange rate movements and firm level performance as measured by sales growth while taking into account firm and industry level heterogeneity. In particular we would like to distinguish between the export competitiveness and imported input cost channels of transmission. Towards this end we use a baseline model with lagged dependent variable along with other determinants of sales growth. This equation is augmented with changes in sector specific real exchange rates calculated above. Change in industry specific real exchange rates are multiplied with time varying import and export shares of each firm to capture the cost and revenue channels of transmission separately. Equation 2 presents our base line specification:

$$\begin{aligned}\Delta y_{t,i} &= \beta_0 + \beta_1 \Delta y_{t-1,i} + \beta_2 \alpha_{t-1,i} \Delta e_{t,k} \times mkp^{=1}_{k,t-1} + \beta_3 \eta_{t-1,i} \Delta e_{t,k} \times mkp^{=1}_{k,t-1} \\ &+ \beta_4 \alpha_{t-1,i} \Delta e_{t,k} + \beta_5 \eta_{t-1,i} \Delta e_{t,k} + \beta_6 \alpha_{t-1,i} + \beta_7 \eta_{t-1,i} + \beta_8 \Delta e_{t,k} + \beta_9 mkp^{=1}_{k,t-1} + b' Z_{t,i} + \tau_t + \upsilon_{t,i}\end{aligned} \quad (2)$$

$\Delta y_{t,i}$ is the growth rate of sales of firm i defined as the difference in log of sales. The first term $\alpha_{t-1,i} \Delta e_{t,k}$ is the product of log difference in annual real effective rate of industry k (SREER from now on), $\Delta e_{t,k}$ [13] and $\alpha_{t-1,i}$ - lagged share of imports in intermediate inputs of firm *i*. Firms with a higher share of imported inputs are likely to benefit more from real appreciation on account of lower variable cost. One therefore expects the coefficient on this term to be positive. Using similar logic, one would expect the coefficient on $\eta_{t-1,i} \Delta e_{t,k}$ - product of lagged export share and real exchange rate change - to be negative. Use of lagged import and export shares is done to avoid endogeneity bias induced by the possible correlation of these shares with exchange rate changes.

[12] Though we use industry specific exchange rates, using aggregate real effective exchange rate measure created by *BIS* leaves our results unchanged.

[13] REER index is defined so that an increase denotes appreciation of Rupee.

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Dornbusch (1987) Nucci (2001), Goldberg (1999)[xii] show that impact of exchange rate movement on firm's investment growth is inversely related to the degree of their market power. Assuming that the exchange rate changes are permanent and uncorrelated over time, they show that the impact of exchange rate changes on the marginal profitability (and hence investment growth) of firms depends upon their external trade orientation and the size of markups reflecting their market power. Following their insight we include a measure of market power in our model. Following Domowitz, Hubbard and Petersen (1986)[xiii] we define firm's markup as –

$$AMKP = \frac{\text{Sales} + \text{Change in inventories}}{\text{Payroll} + \text{Cost of materials}} \quad (3)$$

In the absence of data on marginal cost of production, the measure given in equation (3) is commonly used in empirical literature to capture firm and industry specific markups. PROWESS data set provides information on sales, inventories, worker's compensation and intermediate inputs for each firm; allowing us to calculate time varying firm specific mark ups. In order to capture the effect of market power on the relationship between firm's performance and exchange rate changes, we multiply the reciprocal of lagged mark up, mkp_{t-1}^{-1}, with the two exchange rate terms ($\alpha_{t-1,i}\Delta e_{t,k}$ & $\eta_{t-1,i}\Delta e_{t,k}$) in our baseline specification. $Z_{t,i}$ is a set of industry specific trends and size dummies while τ_t is the set of year dummies. The year dummies along with industry specific trends are used to capture time varying and sector specific shocks that might drive exchange rates and sales growth together and thereby bias our estimates.

Industrial Structure

An important determinant of firm's response to exchange rate movements is the degree of industry concentration. Industrial organization literature, with a few exceptions, has found that market concentration and industry profitability are positively correlated. This could be a result of cost effectiveness or greater market power resulting from higher concentration. In either case, firms in high concentration industries are likely to behave differently when compared to the firms in low concentration industries in the face of exchange rate shocks. Controlling for differences in trade orientation, exchange rate changes may have a smaller effect on high-concentration industries because producers in these industries are better able to absorb shocks to

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their overall profitability on account of exchange rate changes as compared to the producers in low-concentration industries. Consequently, the link between changes in real exchange rates and growth would be weaker in industries with greater market concentration. To incorporate this effect in our baseline model we divide the sample in to 'High' and 'Low' concentration industries based on the Herfindahl-Hirschman index of market concentration. Industries with an average HHI above the median are classified as 'High Concentration' industries while the rest are classified as 'Low Concentration' industries.

Text Table 2 presents industry wise average HHI for the period 2000-2012 for eighteen Indian industries in our sample. Textiles industry has the smallest industry concentration ratio while Tobacco has the largest as measured by the average HHI. The median HHI for the industries in our sample is 0.07.

Text Table 2

Industry	Average Herfindahl Index
Food and Beverages	0.017
Tobacco	0.63
Textiles	0.01
Readymade Garments	0.06
Leather and leather products	0.20
Paper and paper products	0.25
Chemicals	0.19
Plastic & Rubber products	0.03
Non-metallic mineral products	0.10
Basic Metals	0.06
Fabricated metal products	0.07
Computer and electronics	0.20
Electrical machinery	0.03
Misc. machinery	0.07
Automobiles	0.20
Other transport equipment	0.04
Furniture	0.1

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 Arellano and Bond (1991)/ Blundell and Bond (1998)[xiv] type GMM estimator to estimate equation 2. To check the robustness of our results we replace output growth with sales growth.

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b) Results

Benchmark Model

Table 1 presents the results from this exercise. The key result from our benchmark model is that while the changes in real exchange rate affect firms in the low concentration industries significantly through both the import cost and the export competitiveness channel, they affect the firms in high concentration industries only through the export competitiveness channel. This implies that policies to keep exchange rate from appreciating, while they may have a beneficial effect on the firms in high concentration industries through the export competitiveness channel, do not have an unambiguously beneficial effect on the firms in low concentration industries. To get an idea of what these estimates mean we try to estimate the elasticity of sales growth for firms in high and low concentration industries in our sample.

Table 2 presents the results from this exercise. We use average import and export shares along with average markups for different industries to calculate these elasticity measures[14]. The numbers therefore capture the response of an 'average' firm in a given industry to exchange rate appreciation. A negative sign indicates a decrease in sales growth in response to a real appreciation and vice versa. It is important to keep in mind that these elasticity measures are merely for illustrative purposes and that they do not include the impact of exchange rate change on firm growth through the balance sheet, credit and import competitiveness channel. However, since the focus of our paper is not to provide point estimates of exchange rate elasticity, we present these numbers only to highlight our main arguments. One key result from the Table is that, except for the Leather industry which has one of the highest export shares, industries with a high level of concentration have negative exchange rate elasticity indicating that a real appreciation hurts their growth through the trade channel. For low concentration industries, however, the results are mixed. While industries such as Food and Beverages and Fabricated Metal Products benefit from a real appreciation; Textiles, Readymade Garments and Automobiles get adversely affected by the same. Overall, there is no clear evidence of real appreciation adversely affecting firms across board when both export and import cost channels are taken in to account.

[14] Overall impact of any real exchange rate movement would also incorporate its effect on the firm's balance sheet and the degree of competition faced by the import competing firms.

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Foreign Ownership

Firms with access to foreign equity can deal with exchange rate shocks and market volatility more effectively thanks to their better access to international goods and capital markets, larger supply of internal finance through parent company, and better risk management, know-how, experience, and productivity (Arnold and Javorcik, 2009; Desai et al., 2008; Mitton, 2006; Yasar and Paul, 2009)[xv]. Besides, workers employed by foreign multinationals are reported to have higher skills and productivity (Almeida, 2007; Huttunen, 2007; Navaretti et al., 2003; Yasar and Paul, 2009)[xvi]. As a result, foreign firms may display lower short-run sensitivity to volatility by keeping worker turnover low to prevent the spillover of their technology and know-how to local competitors (Fosfuri et al., 2001; Hamermesh, 1993)[xvii]. Using data on around 600 Turkish firms, Demir (2013)[xviii] find, that having access to foreign, and to a lesser degree, domestic equity markets reduces the negative effects of exchange rate volatility. To check whether we can find a similar result for the Indian firms in our sample we estimate the growth equation for foreign and domestically owned firms separately. Foreign Ownership is defined by looking at the percentage of outstanding shares held by foreign investors. These include institutional as well as other investors. Firms with more than 10 percent of foreign equity holdings are classified as 'Foreign' owned for our purpose. Table 3 provides the results from this exercise. We find that irrespective of the level of industry concentration, foreign ownership is associated with a weakening of the impact of exchange rate changes on firm growth. None of the exchange rate coefficients are significant for foreign owned firms in high as well as low concentration industries. While this does not establish causality, it does indicate that a likely way in which foreign ownership can enhance growth is by lowering the level of firm volatility. To the extent that lower volatility encourages investment and productivity growth, foreign equity ownership could encourage these even without direct technological spillovers. For the "domestic" firms the results remain the same as before.

Access to Domestic Equity Finance

Publicly traded firms may respond differently to exchange rate shocks than non-traded firms on account of easier access to external finance, better risk management and better governance. At the same time, being subject to greater market pressures, listed firms might exhibit greater

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sensitivity to shocks. We therefore divide our sample in to publicly traded[15] and non-traded firms and estimate our model on the two sets separately. Table 4 presents the results from this exercise. We find that publicly traded firms in both high and low concentration industries do not exhibit a significant response to changes in exchange rates unlike the non-traded firms. Amongst the non-listed firms, those in the low concentration industries are once again impacted through the import cost as well as export competitiveness channel whereas as those in the high concentration industries are significantly affected only through the export channel.

Robustness Checks

In this section we conduct some robustness checks for our estimates. These include looking at appreciation and depreciation episodes separately and adding firm level controls such as firm level collateral and efficiency. Results from these are presented below.

Asymmetric Effects of Appreciation and Depreciation

It is possible that appreciation and depreciation of exchange rate affect the firms differently. It may happen, for example, that real depreciation of Rupee has a much stronger effect on firm's output growth through the channel of higher import costs as compared to real appreciation. This could be the case, for example, when firms are borrowing constrained. Similarly, there is evidence that exports respond differently to exchange rate appreciation and depreciation[16]. To test this hypothesis we split the sample between appreciation and depreciation episodes separately. Results from this exercise are presented in Table 5. Two key results emerge out of this exercise – i. Firms in low concentration industries are significantly affected by real depreciation but not by real appreciation. Opposite is true for the firms in high concentration industries. ii) Even after splitting the episodes of exchange rate changes between appreciation and depreciation, we find evidence for high firm industries being significantly affected through the export competitiveness channel and not through the import cost channel (during episodes of appreciation). Firms in the low concentration industries on the other hand are significantly affected through import cost as well as export competitiveness channel during episodes of real depreciation. These findings do provide some justification for Central Bank's asymmetric

[15] Publicly traded firms are those listed on the Bombay Stock Exchange.
[16] See Cheung and Sengupta (2012)

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response to episodes of exchange rate appreciation. However, as the earlier results show, the exchange rate elasticity varies across different firms depending on their trade orientation and mark up apart from other things.

Firm level controls

We include additional firm level control variables that are likely to influence sales growth to check the robustness of our results. These are i. Efficiency growth, where efficiency is measured as the ratio of firm's sales to its total assets and ii. Firm collateral measured as the ratio of its net fixed assets to its total assets. Table 6 presents the result from this exercise. Including these additional variables does not affect out main results. Efficiency growth is positively correlated with the sales growth as expected. Collateral, on the other hand, does not appear to affect sales growth significantly. Neither of these variables changes the impact of exchange rate movements on firm growth as can be seen from the coefficients on the interaction terms (both of which are statistically insignificant). Overall, our results appear fairly robust to changes in model specifications and inclusion of additional variables.

V. Panel VAR Analysis

In the last section we use a panel VAR model to study the dynamic relationship between exchange rate and firm growth. Estimating the relationship between real exchange rate and growth is fraught with the problems of endogeneity and simultaneity. To overcome these we use a five variable VAR approach applied to panel data that allows us to treat all variables as endogenous. This technique combines the traditional VAR approach, which treats all the variables in the system as endogenous, with panel-data approach, which allows for unobserved individual heterogeneity.

For the benchmark model we specify a five variable VAR model of order two as follows:

$$x_{i,t} = \Gamma_0 + \Gamma_1 \times x_{i,t-1} + f_i + \varepsilon_t \qquad (5)$$

Where $x_{i,t}$ is a five-variable vector[17]. The endogenous variables in the VAR include natural log of sector specific real exchange rate, firm level mark-up, share of imports and exports and

[17] All variables are first differenced before being used.

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natural logarithm of sales[18]. Fisher's panel unit root test suggests that all the series are stationary at one percent level of significance.

We use the `orthogonalized` impulse response functions from the above VAR for our analysis. By orthogonalizing the response we are able to identify the effect of one shock at a time, while holding other shocks constant. Since the actual variance-covariance matrix of the errors is unlikely to be diagonal, to isolate shocks to one of the VAR errors it is necessary to decompose the residuals in such a way that they become orthogonal. However, before we can do that we need to specify the `order` of variables to be used for Cholesky decomposition. Our identifying assumption is that real exchange rate changes are the most exogenous followed by changes in firm level mark-ups while changes in firm's sales are the most endogenous. Average import and export shares lie in between these two extremes. In other words, real exchange rate affects the other variables in the VAR instantaneously though it is affected by them only with a lag. Sales growth is affected by real exchange rate and imported input changes instantaneously though it affects them in turn only with a lag. This makes intuitive sense since real exchange rate changes are determined by the changes in industrywide demand and supply conditions that are likely to be beyond the control of individual firms. Further, changes in sales are likely to be slow as compared to changes in the share of imported inputs and exports as installing new capacity to increase production takes time. Similarly, mark-ups affect import, exports and sales instantaneously but are affected by them with a lag.

In applying the VAR procedure to panel data, one needs to impose the restriction that the underlying structure is the same for each cross-sectional unit. Since this constraint is likely to be violated in practice, one way to overcome the restriction on parameters is to allow for "individual heterogeneity" in the levels of the variables by introducing fixed effects, denoted by f_i in the model. Since the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean differencing procedure commonly used to eliminate fixed effects will create biased coefficients. To avoid this problem Love and Zicchino (2000)[xix] use forward mean-

[18] Domowitz, Hubbard and Petersen (DHP) (1986) methodology is used to construct annual firm level mark-up. Mark-up variable is defined as $AMKP = \frac{\text{payroll} + \text{cost of materials}}{\text{sales} + \text{change in inventories}}$ so that an increase in mark-up reflects a decline in firm's price cost margin.

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differencing, also referred to as the Helmert procedure (see Arellano and Bover 1995)[xx]. This procedure removes only the forward mean, i.e. the mean of all the future observations available for each firm-year. Since this transformation preserves the orthogonality between transformed variables and lagged regressors, lagged regressors can be used as instruments to estimate the coefficients by system GMM.

Figure 7 presents impulse response functions from this exercise[19]. As we can see, while sales growth in low concentration industries declines in response to an exchange rate appreciation it does not show any significant impact in the case of high concentration industries. Export shares, on the other hand, decline in response to real appreciation for both high and low concentration industries. Import share and markup do not respond significantly to real exchange rate shocks for both high and low concentration industries. Looking at the variance decomposition, we find that real exchange rate shocks explain a much greater variation in sales growth in the case of low concentration industries (0.12 percent) than in the case of high concentration industries (0.004 percent).

Opposite is true in the case of export share though. Export share of high concentration industries seem to show a higher sensitivity to exchange rate changes as compared to that of the low concentration industries. High concentration, in cases where it is a result of economies of scale, can lead to less volatile export revenues. On the other hand, greater competition, fostered by a larger number of firms, by encouraging innovation and productivity, can make exports more immune to exogenous shocks. In our case, the evidence from dynamic impulse responses seems to point towards the latter possibility.

In line with our GMM estimation we next divide the sample in to 'Foreign' and 'Domestically' owned firms and estimate panel VAR separately for both. Figure 8 presents the impulse responses from this exercise. In line with our GMM estimates we find that real exchange rate shocks do not have a significant impact on the sales, export share, import share and mark ups of 'foreign' firms though they do have a significant impact on sales and export share of

[19] Standard error bands are obtained using Monte Carlo simulation.

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domestically owned firms[20]. Finally, Figure 9 presents the impulse responses for publicly traded and non-traded firms. Both traded and non-traded firms show similar impulse responses, with sales and export share declining significantly in response to an exchange rate appreciation. There is, however, a much sharper, downward adjustment in mark up in case of non-traded firms than in traded firms in response to a real exchange rate shock[21]. The result becomes even stronger if we restrict ourselves to domestically owned firms. It appears that access to domestic equity market causes mark ups to become markedly less sensitive to exchange rates even though it does not make a significant difference to the relationship between growth and exchange rate. This makes intuitive sense since publicly traded firms are subjected to greater market pressures that make it more difficult for them to adjust mark ups. However, foreign ownership softens the effect exchange rates on both non-traded and publicly traded firms as can be seem from Figure 10. These results indicate that while both foreign equity ownership and access to domestic equity market significantly alter firm's response to exchange rate changes, their impact on firm performance is different.

VI. Conclusion

This paper lays out the stylized facts regarding the transmission of industry specific real exchange rate shocks to firm level performance using data on 1420 Indian manufacturing firms. Our paper finds that real exchange rate movements have a significant effect on firm's growth performance but the impact varies across different firm and industry characteristics. Trade orientation, firm level mark-ups and industry concentration are some of the features that affect firms' response to exchange rate shocks. Amongst financial factors, foreign equity ownership and access to domestic equity market are seen to play a significant role in determining firms' response to exchange rate changes. Impulse responses from Panel Vector Auto Regression reinforce these findings.

For policy makers trying to assess the impact of exchange rate movements on the real economy these results provide various important insights. Firstly, the short run impact of a real appreciation on firms is likely to be varied making it difficult to draw a straightforward link

[20] We find similar results for high and low concentration industries but we only present the latter in the paper for brevity.

[21] VAR coefficients on exchange rate in mark-up equations show the same result. We do not present them in the paper due to lack of space but they are available from the author upon request.

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between growth and real exchange rate changes. More importantly, foreign equity ownership and access to domestic equity market are seen to be associated with a significantly reduced impact of exchange rate changes. Foreign equity ownership even reduces the dynamic effects of exchange rate shocks. While we do not try to establish causality at this stage, our results do point towards a hitherto less discussed potential benefit of higher foreign equity holding and more developed domestic equity markets. Policies that encourage these are likely to be more successful and less costly in encouraging sustained and stable growth than *ad hoc* efforts to prevent real appreciation to protect exports.

As discussed by Barry Eichengreen (2009)[xxi], real exchange rate is not a policy variable directly controlled by the policy makers. Being the relative price of non-traded goods, real exchange rate is determined by the supply and demand of these goods (just like the price of any other commodity) except in the case of a planned economy. In the long run real exchange rate will tend to move towards its equilibrium value as determined by the fundamentals. However, price rigidities imply that monetary policy and other shocks could push real exchange rate away from its long-run value in the short-run there by having an impact on growth and other real variables. The impact will vary across firms depending upon their external sector exposure and market power, apart from other things. For countries relying on volatile foreign capital inflows to finance their consumption and investment needs, a careful reserve management policy along with a sound fiscal policy are necessary to balance the multiple objectives of stable growth and external sector balance in the long run. At the same time, our results suggest that encouraging the 'right' kind of capital inflows can also help in making the economy more resilient to external shocks.

One drawback of the current study is that it does not look at the role of sector specific policy variables such as tariff rates etc. in determining exchange rate elasticity. A future study with more disaggregated dataset to explore these issues would be useful. Another important line of inquiry is the impact of exchange rate on firm level employment and difference in response of firms with different levels of productivity. We aim to cover these questions in future research.

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Table [1] Benchmark Model

Dependent Variable: Sales Growth	High Concentration	Low Concentration
Sales growth $_{t-1}$	0.06 [0.1]	-0.31 [0.29]
$\alpha_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	-0.00 [0.00]	0.02*** [0.00]
$\eta_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	-0.003*** [0.00]	-0.04*** [0.00]
$\alpha_{i,t-1} \times \Delta e_{k,t}$	-0.07 [0.18]	0.05 [0.05]
$\eta_{i,t-1} \times \Delta e_{k,t}$	0.06 [0.34]	-0.06 [0.07]
$\alpha_{i,t-1}$	-0.05 [0.65]	0.08 [0.06]
$\eta_{i,t-1}$	0.04 [0.06]	-0.07 [0.1]
$\Delta e_{k,t}$	0.03 [0.05]	-0.00 [0.01]
mkp_{t-1}	0.00 [0.00]	0.00 [0.00]
No of Groups	428	1306
No. of Observations	3482	11896
Hansen's test	0.23	0.15
Arellano Bond Test, AR(1)	0.00	0.33
Arellano Bond Test, AR(2)	0.54	0.33

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Table [2] Elasticity With Respect to Real Exchange Rate

Industry	Industry Concentration	Exchange Rate Elasticity
Food and Beverages	Low	0.14
Tobacco	High	-1.5
Textiles	Low	-0.3
Readymade Garments	Low	-1.5
Leather and Leather Products	High	1.3
Paper and Paper Products	High	-0.03
Chemicals	High	-1.1
Plastic and Rubber Products	Low	1.0
Non-metallic Mineral Products	Low	-0.8
Basic Metals	Low	0.25
Fabricated Metal Products	Low	0.40
Computer and Electronics	High	-2.1
Electrical Machinery	Low	-0.4
Misc. Machinery	Low	-0.2
Automobiles	High	-0.13
Other Transport Equipment	Low	0.34
Furniture	Low	1.0

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Table 3 Foreign Equity Holdings

Dependent Variable:	High Concentration		Low Concentration	
Sales Growth	Foreign Ownership	No Foreign Ownership	Foreign Ownership	No Foreign Ownership
Sales growth $_{t-1}$	-0.73*** [0.14]	0.13 [0.11]	-0.58*** [0.21]	-0.12 [0.20]
$\alpha_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	0.27 [0.59]	-0.002 [0.00]	0.11 [0.19]	0.02*** [0.00]
$\eta_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	-0.9 [0.5]	-0.004*** [0.00]	-8.0 [5.6]	-0.04*** [0.01]
$\alpha_{i,t-1} \times \Delta e_{k,t}$	-0.73 [0.45]	-0.02 [0.2]	-0.13 [0.16]	0.06 [0.06]
$\eta_{i,t-1} \times \Delta e_{k,t}$	0.20 [0.6]	0.57 [0.35]	5.4 [3.7]	0.05 [0.08]
$\alpha_{i,t-1}$	-0.11 [0.13]	-0.06 [0.09]	0.34 [0.17]	0.03 [0.06]
$\eta_{i,t-1}$	0.05 [0.06]	-0.14 [0.11]	0.27 [0.34]	-0.35 [0.18]
$\Delta e_{k,t}$	0.03 [0.08]	-0.018 [0.06]	-0.03 [0.04]	0.00 [0.01]
$mkp_{i,t-1}$	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00*** [0.00]
Year Dummies	Yes	Yes	Yes	Yes
Industry level trends	Yes	Yes	Yes	Yes
Size Dummies	Yes	Yes	Yes	Yes
No of Groups	264	396	874	1224
No of Observations	612	2870	1962	9924
Hansen's Test (P-value)	0.55	0.50	0.52	0.72
Arellano Bond Test, AR(1)	0.26	0.00	0.51	0.04
Arellano Bond Test, AR(2)	0.27	0.34	0.00	0.78

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Table 4 Listed versus Unlisted Firms

Dependent Variable:	High Concentration		Low Concentration	
Sales Growth	Publicly Listed	Unlisted	Publicly Listed	Unlisted
Sales growth $_{t-1}$	0.33 [0.18]	0.03 [0.16]	-0.06 [0.12]	-0.37 [0.41]
$\alpha_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	-0.05 [0.28]	-0.00 [0.00]	-0.19 [0.6]	0.02*** [0.00]
$\eta_{i,t-1} \times \Delta e_{k,t} \times mkp_{t-1}^{-1}$	-1.2 [1.3]	-0.003** [0.00]	1.96 [1.9]	-0.04*** [0.00]
$\alpha_{i,t-1} \times \Delta e_{k,t}$	-0.24 [0.31]	-0.03 [0.19]	0.03 [0.3]	0.07 [0.06]
$\eta_{i,t-1} \times \Delta e_{k,t}$	0.77 [0.68]	0.38 [0.58]	-1.0 [1.1]	0.02 [0.1]
$\alpha_{i,t-1}$	-0.2 [0.15]	0.14 [0.20]	0.13 [0.09]	0.10 [0.06]
$\eta_{i,t-1}$	-0.05 [0.1]	-0.10 [0.18]	-0.13 [0.14]	0.05 [0.15]
$\Delta e_{k,t}$	0.02 [0.07]	-0.00 [0.10]	0.03 [0.02]	0.00 [0.02]
$mkp_{i,t-1}$	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00*** [0.00]
Year Dummies	Yes	Yes	Yes	Yes
Industry level trends	Yes	Yes	Yes	Yes
Size Dummies	Yes	Yes	Yes	Yes
No of Groups	194	234	479	827
No of Observations	1731	1751	4743	7153
Hansen's Test	0.42	0.55	0.36	0.40
Arellano Bond Test, AR(1)	0.00	0.04	0.00	0.57
Arellano Bond Test, AR(2)	0.39	0.42	0.86	0.44

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Table 5 Asymmetric Effect

Dependent Variable:	High Concentration		Low Concentration	
Sales Growth	Appreciation	Depreciation	Appreciation	Depreciation
Sales growth $_{t-1}$	0.34*** [0.13]	-0.05 [0.16]	-0.39 [0.3]	-0.28 [0.21]
$\alpha_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	0.00 [0.00]	-0.00 [0.00]	-0.03 [0.07]	0.02*** [0.00]
$\eta_{i,t-1} \times \Delta e_{k,t} \times mkp_{i,t-1}^{-1}$	-0.004*** [0.00]	-0.01 [0.02]	0.04 [0.07]	-0.04*** [0.00]
$\alpha_{i,t-1} \times \Delta e_{k,t}$	0.18 [0.56]	-0.26 [0.32]	0.01 [0.1]	0.02 [0.05]
$\eta_{i,t-1} \times \Delta e_{k,t}$	0.22 [0.45]	-0.09 [0.6]	-0.03 [0.1]	0.08 [0.09]
$\alpha_{i,t-1}$	-0.06 [0.14]	-0.08 [0.1]	0.12 [0.1]	0.09 [0.06]
$\eta_{i,t-1}$	-0.11 [0.12]	0.00 [0.14]	0.15 [0.24]	-0.24 [0.12]
$\Delta e_{k,t}$	-0.15 [0.12]	0.05 [0.1]	0.00 [0.0]	-0.00 [0.02]
$mkp_{i,t-1}$	0.00 [0.00]	0.00** [0.00]	0.00 [0.0]	0.00 [0.26]
Year Dummies	Yes	Yes	Yes	Yes
Industry level trends	Yes	Yes	Yes	Yes
Size Dummies	Yes	Yes	Yes	Yes
No of Groups	410	411	1279	5260
No of Observations	1705	1777	6276	1261
Hansen's Test	0.47	0.68	0.49	0.259
Arellano Bond Test, AR(1)	0.001	0.049	0.61	0.17
Arellano Bond Test, AR(2)	0.65	0.92	0.45	0.21

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Table 6 Firm Level Controls

Dependent Variable: Sales Growth	High Concentration	Low Concentration
Sales growth t-1	0.08 [0.13]	-0.18 [0.13]
$\alpha_{i,t-1} \times \Delta e_{k,t} \times mpk_{i,t-1}^{-1}$	-0.002*** [0.00]	0.02*** [0.00]
$\eta_{i,t-1} \times \Delta e_{k,t} \times mpk_{i,t-1}^{-1}$	-0.00 [0.00]	-0.035*** [0.00]
$\alpha_{i,t-1} \times \Delta e_{k,t}$	-0.1 [0.1]	0.02 [0.05]
$\eta_{i,t-1} \times \Delta e_{k,t}$	0.24 [0.31]	0.01 [0.06]
$\alpha_{i,t-1}$	0.00 [0.07]	0.04 [0.05]
$\eta_{i,t-1}$	0.00 [0.07]	-0.05 [0.1]
$\Delta e_{k,t}$	0.01 [0.05]	-0.00 [0.01]
mpk_{t-1}	0.00 [0.00]	0.00 [0.00]
Collateral i , t-1	-0.00 [0.2]	-0.14 [0.11]
Collateral i , t-1 × $\Delta e_{k,t}$	-0.01 [0.1]	0.00 [0.03]
Δ Efficiency i, t	0.55*** [0.08]	0.34*** [0.06]
Δ Efficiency i, t × $\Delta e_{k,t}$	-0.44 [0.35]	0.12 [0.09]
Year Dummies	Yes	Yes
Industry level trends	Yes	Yes
Size Dummies	Yes	Yes
No. of Groups	3481	1306
No. of Observations	428	11893
Hansen's Test	0.47	0.12
Arellano Bond Test, AR(1)	0.00	0.01
Arellano Bond Test, AR(2)	0.31	0.35

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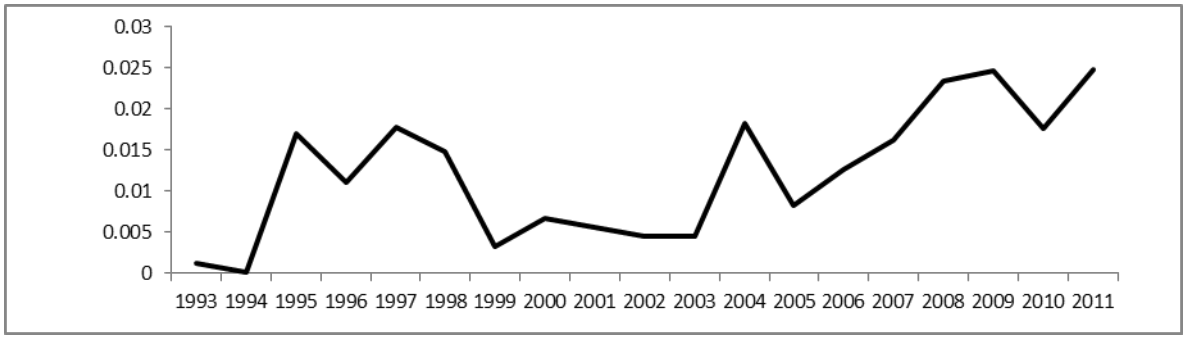
Figure 1 Average Volatility of Monthly Rupee-USD Returns



Average Volatility of Monthly Rupee-USD

Figure 2 RBI Intervention in Forex Market

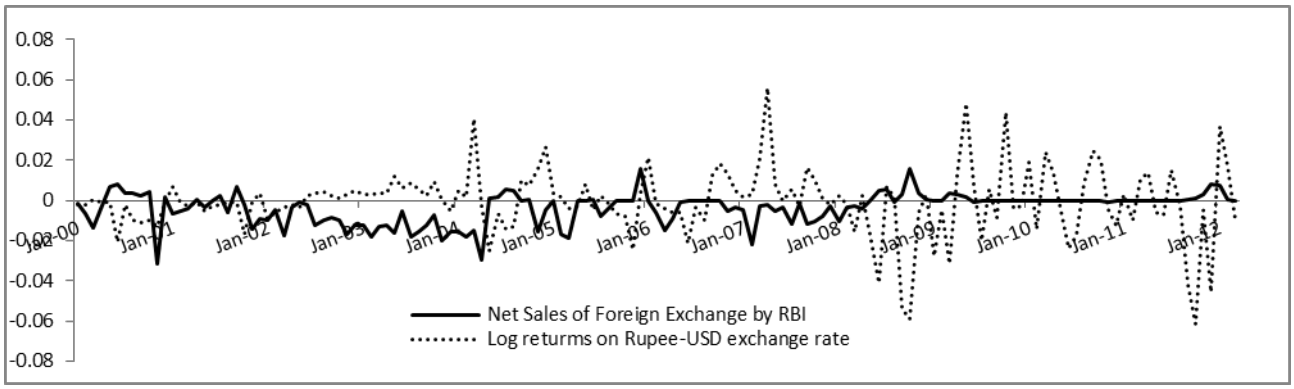


Figure 3 Sample Versus Aggregate Data

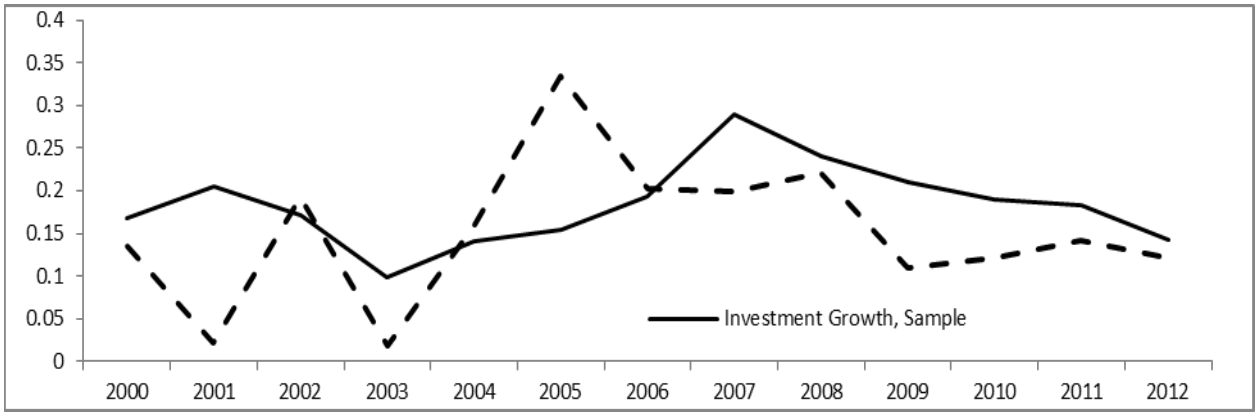


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Figure 4 Sales, Income Growth and Market Capitalization

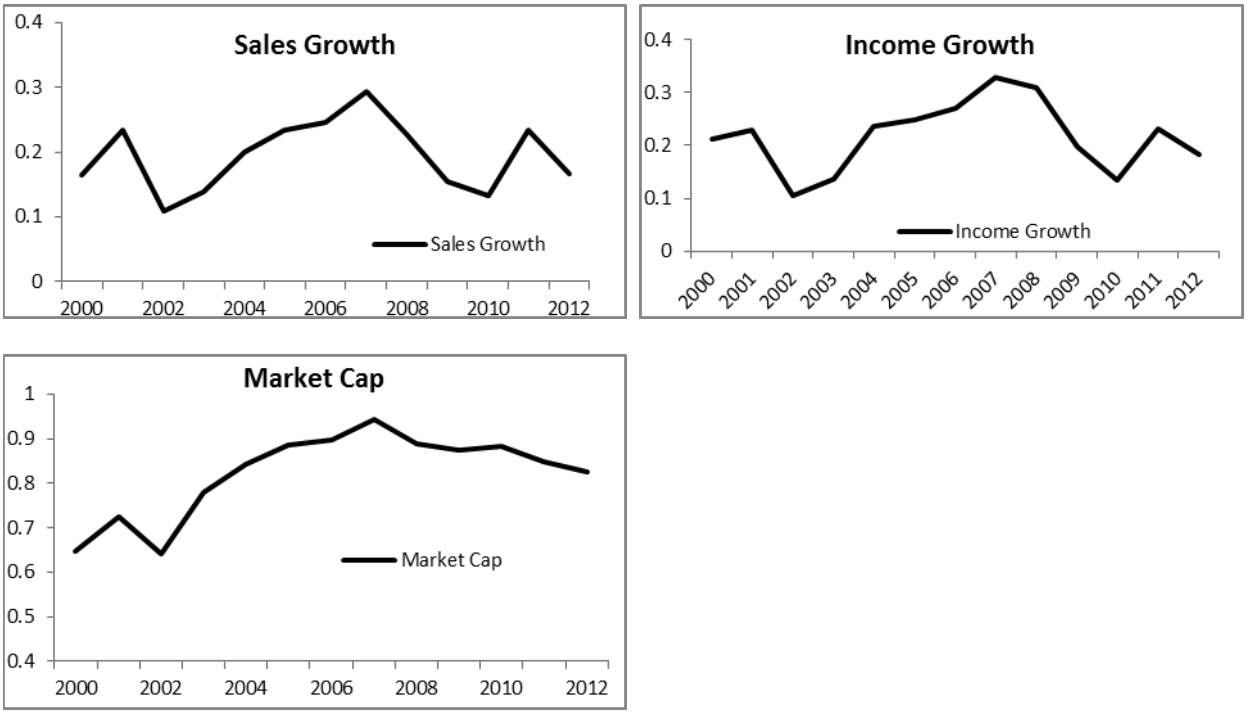

Figure 5: Aggregate and Industry Specific REER

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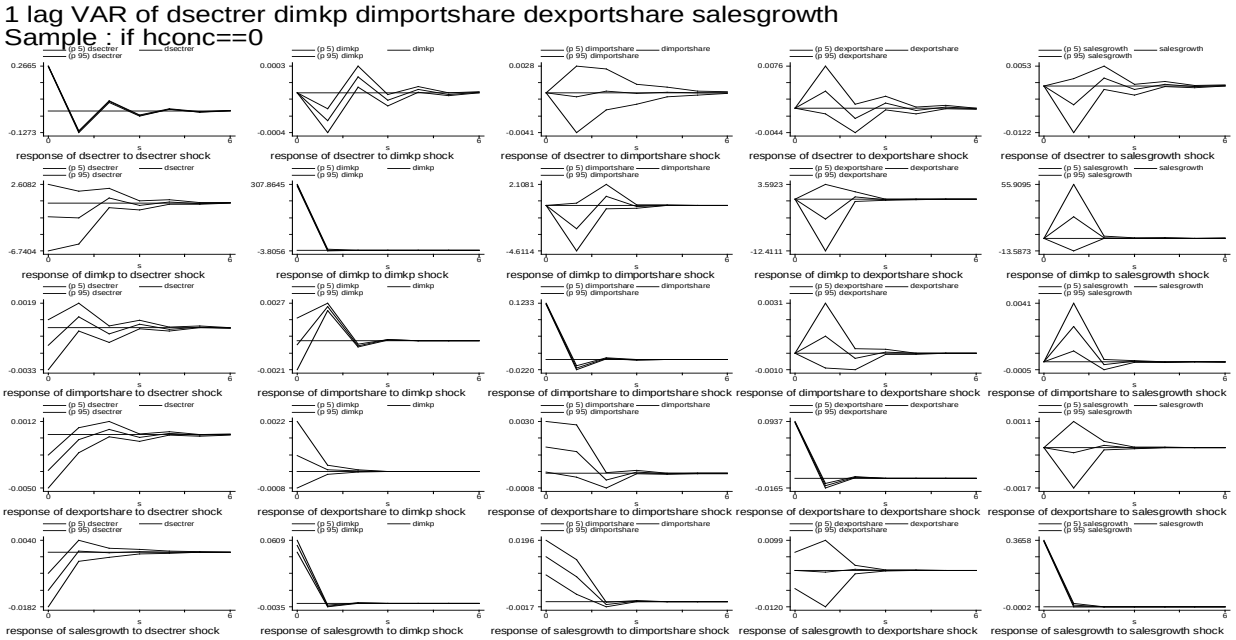
Figure 6 Impulse responses from Panel VAR

Low Concentration Industries



High Concentration Industries

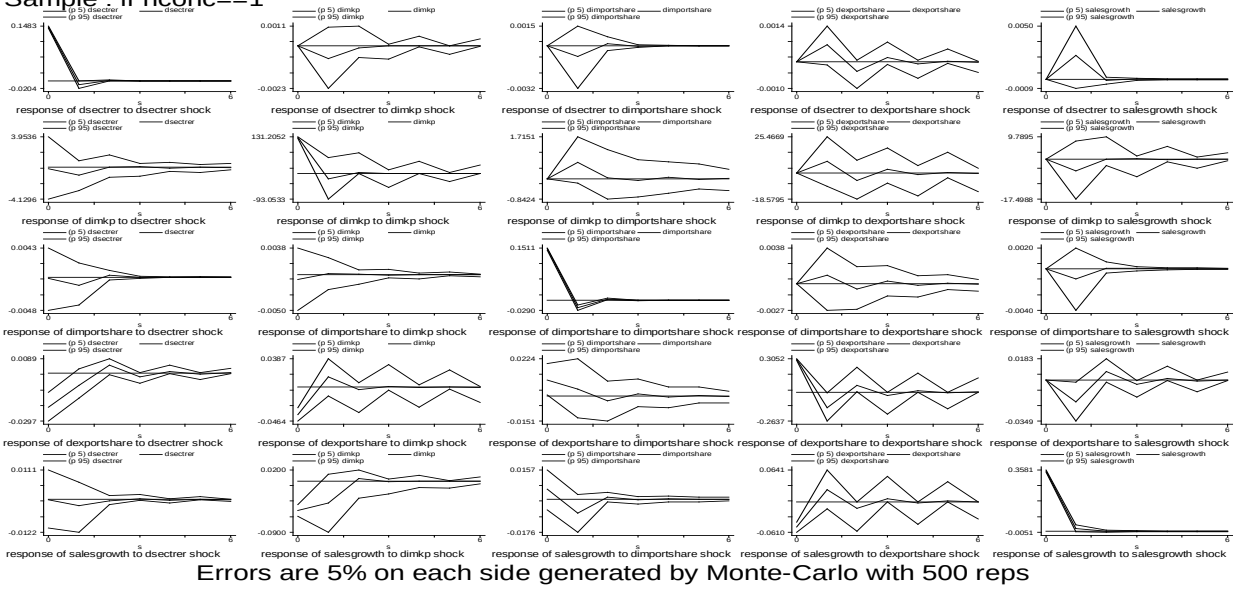


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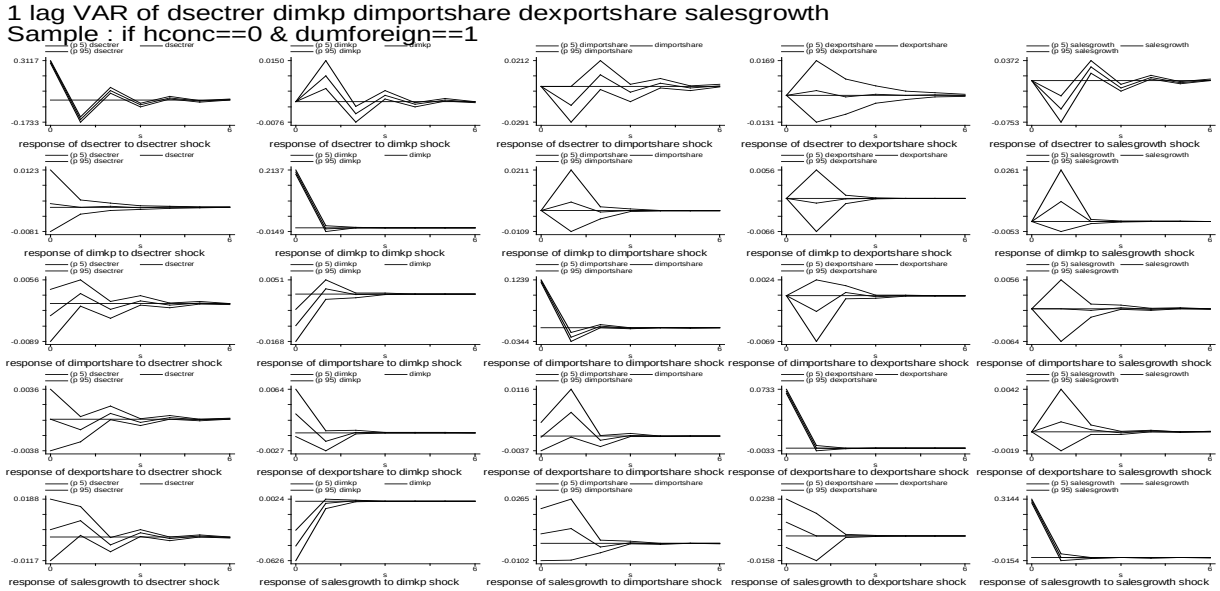
Figure 7 Impulse responses: Ownership structure

Foreign Owned Firms



Domestically Owned Firms

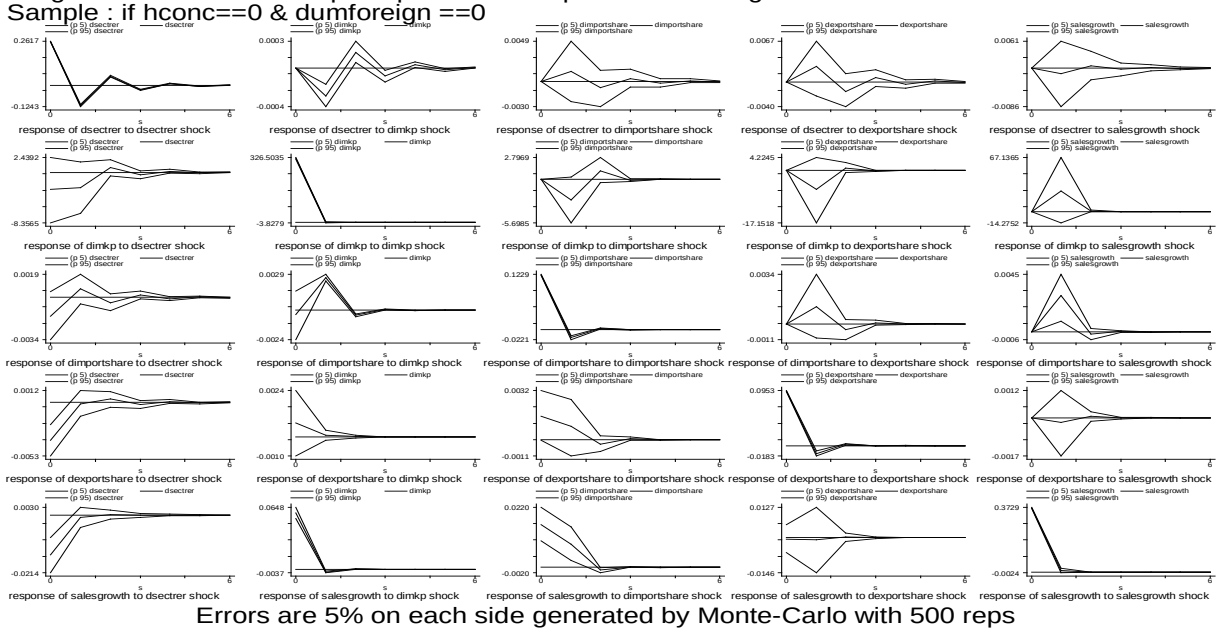


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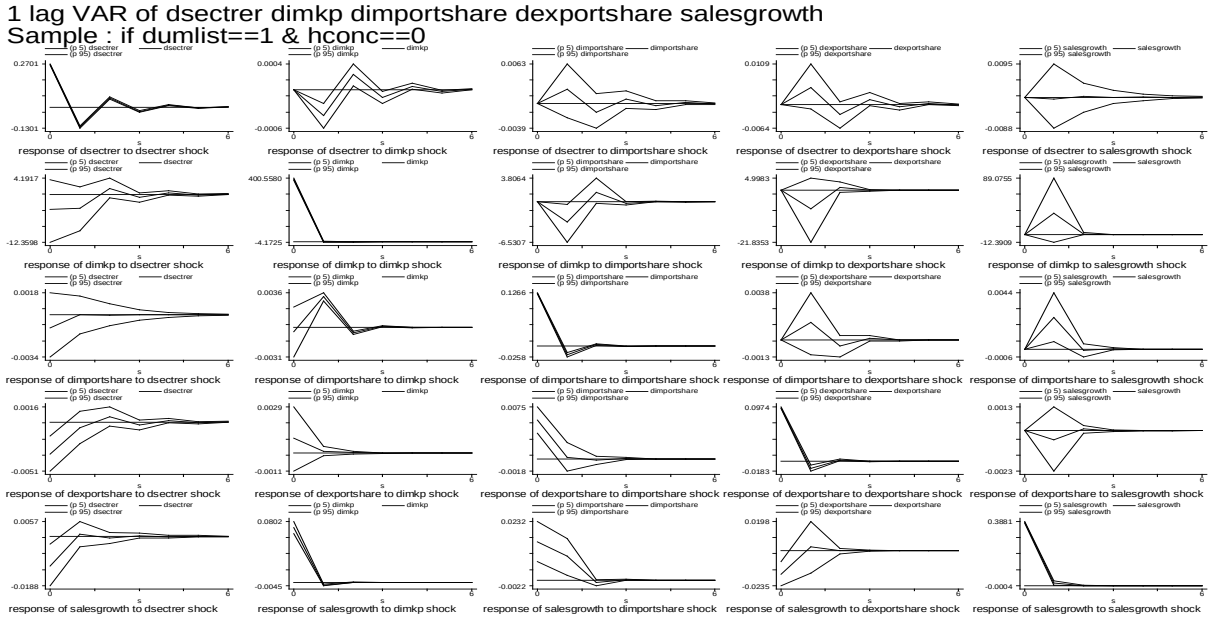
Figure 8 Impulse responses: Domestic equity access

Non-Traded Companies



Publicly Traded Companies

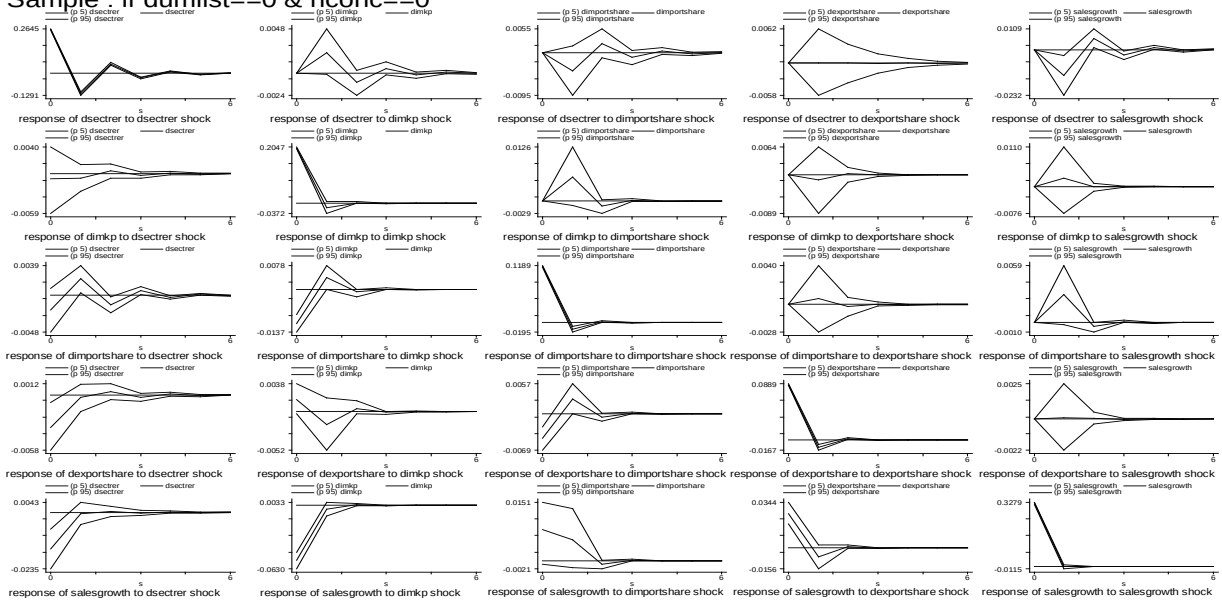


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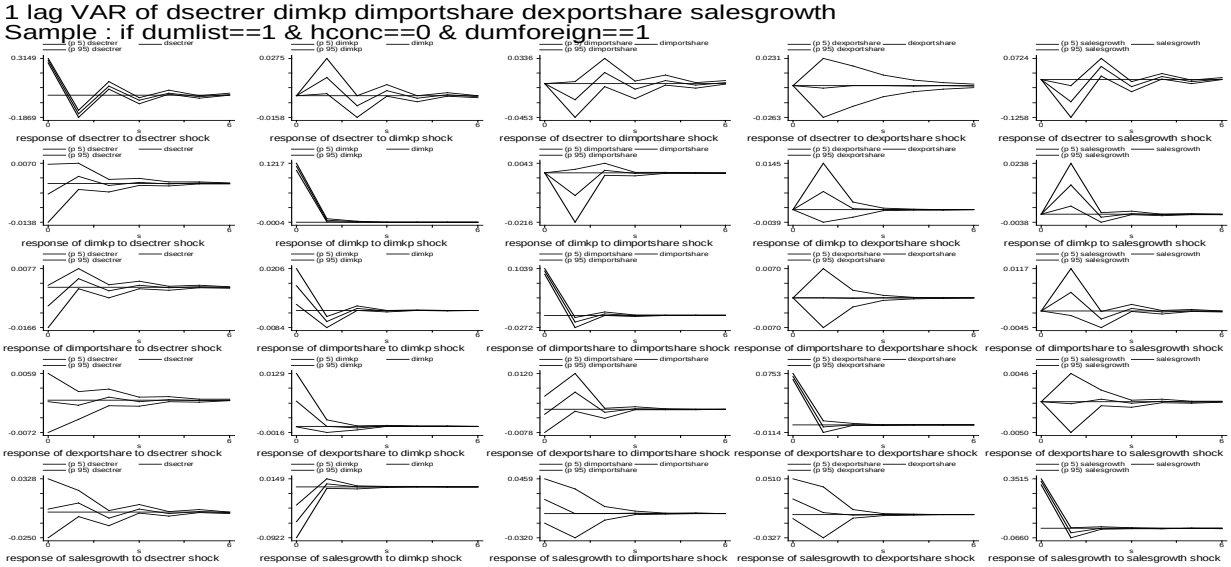
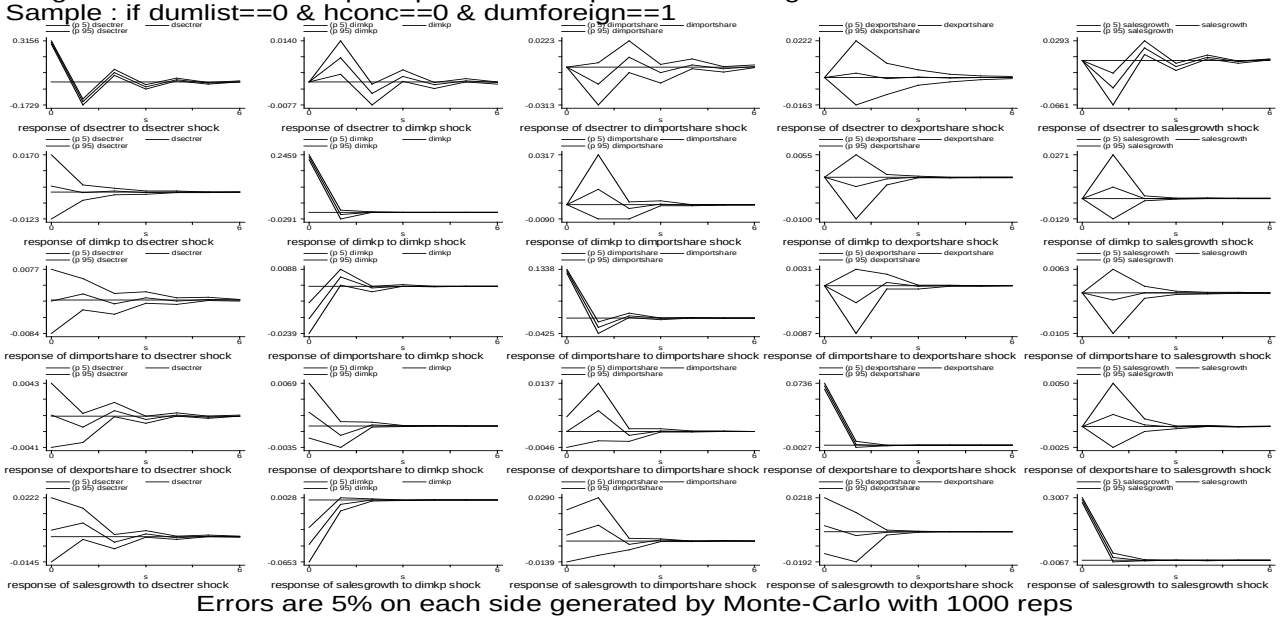
Figure 9 Traded versus Non-Traded Foreign Firms

Foreign Owned Non-traded



Foreign Owned Publicly Traded



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Appendix I

Table A

Year	Total Turnover In Foreign Exchange Market[22] (Billions of USD)	Balance of Payments Size (Billions of USD)	Foreign Currency Assets of RBI (Billions of USD)
1996	73.2	88.3	2.84
2002	130	133.5	30
2011	1175	1014	163.3

*Note: Data on Turnover in Foreign Exchange Market, Balance of Payments and Foreign Currency Assets of RBI are from RBI's *Handbook of Statistics* and *Database on Indian Economy*

[i] Cheung, Y W and Sengupta
[ii] Diaz-Alejandro (1965), Cooper (1971), Krueger (1978)
[iii] Donovan (1981, 1982), Kamin (1988) and Edwards (1989 a, b)
[iv] Rogers and Wang (1995), Santaella and Vela (1996), Copelman and Werner (1996), Kamin & Rogers (1997, 2000), Bahmani & Miteza (2006)
[v] Diaz-Alejandro (1963), Krugman and Taylor (1978), Barbone and Rivera-Batiz (1987)
[vi] Bruno (1979), Gylfason and Schrnid (1983), van Wijnbergen (1986), Buffie (1986) Agenor (1991), Gylfason and Radetzki (1991), Taye (1999
[vii] Adler and Dumas (1984), Jorion (1990), Bodnar and Wong (2000), Dominguez and Tesar (2006), Parsley and Popper (2006)
[viii] Goldeberg and Knetter (1997)
[ix] Goldberg (1993), Campa and Goldberg (1995, 1999), Nucci and Pozzollo (2001), Demir (2010)
[x] Demir (2013) being the exception
[xi] Campa and Goldberg (2001), Klein et.al. (2003)
[xii] Dornbusch (1987) Nucci (2001), Goldberg (1999)
[xiii] Domowitz, Hubbard and Petersen (1986)
[xiv] Arellano and Bond/Blundell and Bond
[xv] Arnold and Javorcik, 2009; Desai et al., 2008; Mitton, 2006; Yasar and Paul, 2009
[xvi] Almeida, 2007; Huttunen, 2007; Navaretti et al., 2003; Yasar and Paul, 2009
[xvii] Fosfuri et al., 2001; Hamermesh, 1993
[xviii] Demir (2013)
[xix] Love and Zicchino (2000)
[xx] Arellano and Bover (1995)
[xxi] Eichengreen, B. 2009

[22] Total Turnover in the foreign exchange market is defined as the sum of total sales and purchase in the foreign exchange market

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