

# Understanding foreign currency borrowing by firms

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November 17, 2014

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## **Abstract**

The Indian capital controls permit foreign currency borrowing (FCB) for firms with low credit risk, and by 2013, there was a stock of borrowing of \$132 billion. Through a combination of home bias and capital controls, FCB is the preserve of large and internationally active firms with low financing constraints. We establish a quasi-experimental design through which the causal impact of FCB upon future growth in capital, labour, exports and output is assessed. The two doublings of exchange rate flexibility in India, in 2003 and 2007, appear to have avoided moral hazard: the firms which have undertaken FCB have successfully achieved modest gains in capital stock and output.

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\*The support of the International Growth Centre and NIPFP-DEA Research Programme is gratefully acknowledged. Akhil Dua, Apoorva Gupta, Shekhar Hari Kumar and Pramod Sinha provided outstanding research assistance. The opinions expressed and remaining shortcomings are our responsibility alone.

# Contents

<b>1</b>	<b>Questions</b>	<b>3</b>
<b>2</b>	<b>Institutional setting</b>	<b>5</b>
2.1	Capital controls . . . . .	5
2.2	Hedging using currency derivatives . . . . .	7
2.3	Exchange rate regime . . . . .	7
2.4	Hypotheses . . . . .	9
<b>3</b>	<b>Data description</b>	<b>10</b>
3.1	Measurement . . . . .	10
3.2	Describing firms and their foreign borrowing . . . . .	12
<b>4</b>	<b>Which firms undertake FCB?</b>	<b>17</b>
<b>5</b>	<b>Causal impact of FCB on firm outcomes</b>	<b>19</b>
5.1	A quasi-experimental design . . . . .	19
5.2	Has match balance been achieved? . . . . .	20
5.3	Analysis of the matched dataset . . . . .	21
5.4	How do natural hedges change the outcome? . . . . .	26
5.5	Is FCB easing financing constraints? . . . . .	28
<b>6</b>	<b>Conclusion</b>	<b>28</b>

# 1 Questions

In the analysis of capital account liberalisation by emerging markets, some of the most difficult questions concern foreign currency borrowing (FCB) by firms. To the extent that FCB is unhedged, there is the risk of impaired balance sheets in the event of a large exchange rate depreciation.

Two kinds of arguments have been offered about *why* some firms may choose to hold unhedged foreign currency exposure. The first argument is grounded in moral hazard: If the government is offering to eliminate the probability of a large exchange rate depreciation, then private firms have an incentive to borrow without hedging (Kamil, 2012; Dominguez and Tesar, 2006). A second argument is grounded in a combination of financing constraints and incomplete markets, a situation termed “original sin” by Eichengreen and Hausmann (1999). Here, it is suggested that firms borrow in foreign currency as borrowing in local currency is infeasible owing to an underdeveloped credit market (Allayannis *et al.*, 2003; Demir, 2013). Even if firms *want* to hedge currency exposure, this may be hampered by underdeveloped currency derivatives markets (Eichengreen and Hausmann, 1999; Eichengreen *et al.*, 2007; Bordo *et al.*, 2010).

When a substantial set of firms possess unhedged currency exposure, this can create incentives for monetary policy to pursue exchange rate objectives (Sengupta, 2010). There can, thus, be a feedback loop where exchange rate pegging induces moral hazard and firms have unhedged FCB, and the presence of firms with unhedged FCB creates a fear of floating (Parsley and Popper, 2006).

Alongside these concerns about original sin is the possibility that borrowing in foreign currency might enable the growth of firms. Inadequate financial development may create a large set of firms who face financing constraints. If some of these firms are able to borrow abroad, and thus ease financing constraints, this can have a significant impact upon their growth.

Firms can hedge through currency derivatives markets, or firms can have natural hedges. For a firm which expects cashflows in foreign currency in the future, borrowing in foreign currency is unusually attractive as (a) It can negate the exchange rate exposure of the firm, and thus *reduce* firm exposure and (b) The cost of borrowing is low as there is no need to undertake hedging through financial markets (Mora *et al.*, 2013). In an ideal scenario, if a financially constrained exporting firm taps into FCB, this can yield a considerable impact upon the firm (Ranciere *et al.*, 2010).

In this framework, the following 4 questions are of importance:

1. What kinds of firms in EMs borrow abroad?
2. To what extent are the borrowing firms financially constrained?
3. To what extent do the borrowing firms possess natural hedges?
4. What is the causal impact of FCB, upon the borrower firms, in the years that follow the first episode of borrowing?

In terms of firm characteristics of the firms that borrow abroad, there are four elements at work:

1. The capital controls regime that is in operation may distort firm choice.
2. The traditional themes of home bias and asymmetric information are likely to be at work. Foreign capital is often able to only engage with well known and large firms.
3. FCB is particularly attractive when there are natural hedges. Firms which are active in exports and FDI may be more connected into global financial networks, and may possess natural hedges which make FCB more inviting.
4. In an underdeveloped financial system, there is the possibility of firms with good projects seeking foreign capital as a way to avoid the difficulties of borrowing within the country.

When we turn from causes to consequences, there are two groups of hypotheses. If firms are financially constrained with an underdeveloped domestic financial system, and if the information processing of foreign investors is sound, then foreign debt capital will find its way to high quality borrowers and will yield a causal impact upon the capital and output of these firms. On the other hand, there is the possibility that foreign investors suffer from home bias, and only give foreign debt to large and internationally visible firms, which are unlikely to face financial constraints (Brown *et al.*, 2014). Alternatively, foreign investors may do poor security selection, and give foreign debt to firms which have a low marginal product of capital (Patnaik and Shah, 2013).

The second group of hypotheses concerns unhedged foreign currency exposure of firms. When the government manages exchange rate volatility, this gives firms an incentive to hold currency exposure (Martinez and Werner, 2002; Patnaik and Shah, 2010). Unhedged firms are likely to suffer from balance sheet difficulties when large exchange rate movements do come about.

Through this channel, FCB can have an unhealthy impact upon the performance of borrowing firms (Aguiar, 2005; Cowan *et al.*, 2005).

The questions that this paper pursued have important implications for the sequencing in capital account liberalisation: to the extent that unhedged FCB is an important problem, this justifies capital controls that require hedging. Conversely, in countries where liberalisation of the capital account has taken place, the interplay between exchange rate inflexibility and balance sheet fragility is an important element of understanding international finance and macroeconomics. This paper contributes to this literature using firm data for India, which is an unusually good laboratory for understanding these phenomena, because of the availability of good-firm level data and its particular history of policy changes.

## 2 Institutional setting

### 2.1 Capital controls

Capital controls were introduced in India during the Second World War. For many decades, restrictions were increased. Capital controls on foreign debt began to be liberalised in the mid-1980s, with an emphasis on foreign borrowing by public sector firms. The economic reforms after the balance of payments crisis in 1991 led to opening up to private capital flows. However, India pursued a regulatory approach of placing restrictions on debt creating flows.

The phrase ‘external commercial borrowing’ (ECB) is used in India to denote foreign currency borrowing. Under the present framework, RBI regulates borrowing through the ECB route. A detailed administrative system is in place where all transactions are prohibited unless explicitly permitted, and rules specify what is done in great detail.

ECBs can be accessed under an ‘automatic’ and an ‘approval’ route. In both cases, there are numerous restrictions governing who can borrow, who can lend, the terms of the borrowing (amount and tenor), the uses to which the borrowed amount can be put (‘end use restrictions’), and the maximal interest rate that can be paid (‘all-in-cost restrictions’). The maze of rules introduces many unintentional consequences (Patnaik and Shah, 2012).

Table 1 shows the maximal interest rate that can be paid for ECB by an Indian firm. The limits are specified by maturity and modified from time to

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**Table 1** The maximal interest rate that can be paid

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Date of change	(Premium to LIBOR, bps)		
	Maturity (years)		
	3-5	5-7	> 7
31.01.2004	200	350	350
21.05.2007	150	250	250
29.05.2008	200	350	350
22.09.2008	200	350	450
22.10.2008	300	500	500
09.12.2009	300	500	500
23.11.2011	350	500	500

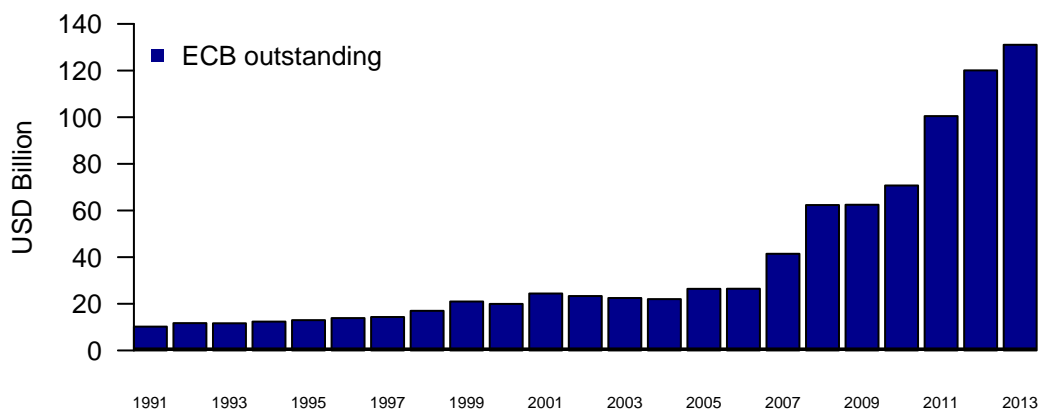
*Source: RBI*

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**Figure 1** Stock of ECB borrowing

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time by RBI in response to the objectives of currency policy. This capital control favours firms with low credit risk. Through this entire period, the maximal interest rate that can be paid is only slightly higher than the credit premium of the Indian government. This may explicitly induce effects similar to those documented in Chile by Forbes (2007), where capital controls favour large firms. Given the scarce access to FCB, there are related concerns that the firms which do FCB might merely engage in financial intermediation<sup>1</sup>, where foreign borrowing is (in turn) lent out to other firms in the country who lack access to FCB and have greater financing constraints.

Figure 1 shows the time-series of the stock of borrowing through ECB<sup>2</sup>. This

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<sup>1</sup>The RBI under the extant foreign borrowing framework does not allow utilisation of foreign currency debt proceeds for on-lending to other firms. However, given fungibility of funds, this control is hard to administer.

<sup>2</sup>The composition of India's external debt reveals that commercial borrowings constitute one of the largest components of external debt. ECB liabilities witnessed more than 12-fold increase between March 1991 to March 2013. This is also reflected in the share

shows a surge in borrowing in recent years. In this period, there are many firms which have transitioned into foreign currency borrowing (FCB) for the first time. These events are utilised in our identification strategy.

## 2.2 Hedging using currency derivatives

Currency derivatives on the USD/INR rate are traded in India and overseas. The onshore market suffers from two problems: low liquidity particularly for longer maturities, and capital controls that hamper hedging by firms (Shah, 2014).

Cash-settled USD/INR derivatives are traded overseas and have achieved significant liquidity. In the derivatives market, in 2013, it is estimated that turnover on the onshore market was \$3.14 billion a day and on the offshore market it was \$19.083 billion a day (McCauley *et al.*, 2014). Indian firms who have done outbound FDI are able to access the offshore market.

Putting these facts together, we may cautiously suggest that there is problem with incomplete markets for currency hedging, particularly for firms that have not done outbound FDI which would get around the problems of capital controls and the weak onshore market. However, given the nature of the capital controls against foreign borrowing, and the problems of home bias in international portfolio formation, it is likely that the bulk of borrowing is being done by large and well known firms, who have an FDI presence overseas. In addition, firms have a strong incentive to undertake financial engineering through which the restrictions of the capital controls are bypassed (Bruno and Shin, 2014; Shah and Patnaik, 2010). Putting these together, it is likely that incomplete markets may not hamper currency hedging.

## 2.3 Exchange rate regime

The exchange rate regime classification methodology of Zeileis *et al.* (2010) identifies two structural breaks in the Indian exchange rate regime. This is depicted in Figure 2. From 1999 to 2003, there was a pegged exchange rate with INR/USD volatility of 1.84%. This is comparable to the RMB/USD volatility of 1.39% which has prevailed from 2005 to 2014.

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of commercial borrowings in total external debt. The share has increased from 12.18% in March 1991 to 31.50% at the end of December 2013

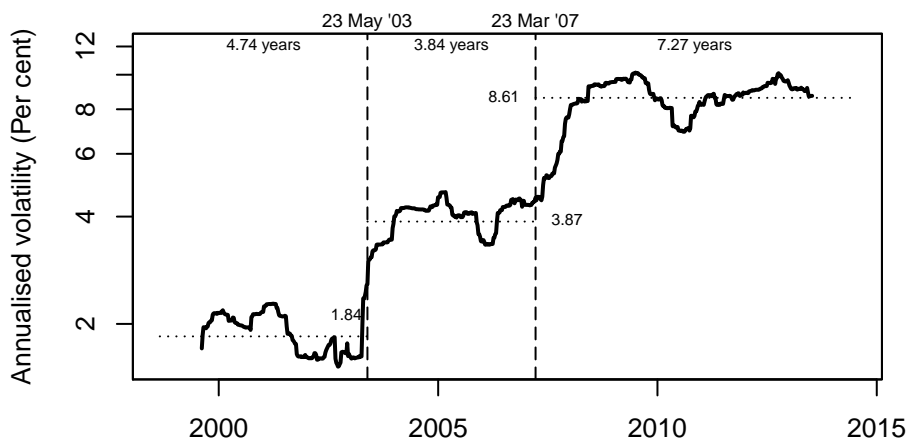
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**Figure 2** Evolution of the Indian exchange rate regime

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Each point in the graph is the annualised volatility of weekly returns on the USD/INR exchange rate, computed over a centred window of width two years. The horizontal lines are averages and the vertical lines are structural break dates.

The first period, of a *de facto* pegged exchange rate, ran for 4.74 years. A doubling of exchange rate volatility took place on 23 May 2003, and this lasted for 3.84 years. A doubling of exchange rate volatility took place on 23 March 2007, and this has been a durable framework for the following 7.27 years.





On 23 May 2003, there was a first structural break, and exchange rate volatility doubled to 3.87%. This lasted for slightly over four years, until 23 March 2007, when another doubling of exchange rate volatility took place, to 8.61%. For the most recent 7.27 years, this new regime has prevailed. While the INR/USD volatility of 8.61% is lower than that found with freely floating emerging market currencies, and the RBI continues to engage in exchange rate policy, it can be argued that the moral hazard motivation for firms to have unhedged foreign currency exposure has dropped substantially.

Figure 1 shows the aggregate time-series of foreign currency borrowing by Indian firms. The bulk of this action is found in the period after 2009, in the aftermath of the three rounds of reduction in all-cost ceilings that were effected between 2008-09 (Table 1). Over this period, exchange rate flexibility was relatively high. This suggests that moral hazard is likely to be a weak motivation in encouraging firms to undertake unhedged currency exposure.

## 2.4 Hypotheses

Drawing on this literature, and in this setting, we may pose a few questions and establish certain hypotheses:

1. On the borrowing side, the capital controls regime emphasises borrowing by firms with low credit risk. On the lending side, home bias is likely to be at work. Hence, the firms that undertake FCB are likely to be large and internationally active firms with low credit risk.
2. These are likely to be firms which face low financing constraints in the first place.
3. The combination of capital controls and home bias hampers access to capital through FCB for firms with high credit risk, low size and lower international visibility.
4. Most of the period under examination has substantial currency volatility. This diminishes moral hazard. Firms are likely to want to hedge their foreign currency exposure. Even though onshore currency derivatives are restricted, firms are likely to be able to bypass the capital controls and protect themselves. While the USD/INR exchange rate has experienced substantial fluctuations, this is likely to not induce balance sheet effects and adversely affect the working of hedged firms.

## 3 Data description

### 3.1 Measurement

This paper draws upon the CMIE Prowess database in order to observe characteristics of firms and their foreign borrowing. We study the universe of all firms observed in the CMIE Prowess dataset where two tests are met: The firm should not be a financial firm and the revenues should be above Rs. 50 million in the year, which maps to a cutoff of roughly \$1 million.

Other firm characteristics are defined as follows:

- *Measures of financing constraints:*
  1. Leverage is calculated as total borrowing divided by total assets. High values denote a firm that has been able to borrow, i.e. one that faces low credit constraints.
  2. Asset tangibility is calculated as gross fixed assets divided by total assets. High values denote a firm with low credit constraints.
  3. Liquidity is calculated as the difference between current assets and current liabilities divided by total assets. High values denote a firm with low credit constraints.
- *Measures of firm internationalisation*
  1. Exports/Sales ratio: This is the ratio of exports to sales.
  2. Foreign investment: This is the fraction of the publicly traded shares of the company owned by foreign institutional investors, that is, registered companies who are the only investors allowed to directly engage in investment in Indian shares.
  3. Foreign ownership: This is the fraction of the shares of the company owned by a foreign entity.
  4. OFDI: This is the fraction of the total assets of the firm which are invested outside India through outbound FDI (OFDI).
- *Performance measures*
  1. Return on capital is calculated as net profit divided by capital employed.
  2. Size is defined as the average of income and total assets over the last three years.

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**Table 2** Number of firms in various categories

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We define foreign currency borrowers as those where foreign currency borrowing exceeds 1% of total borrowings. Exporting firms are defined as those where exports exceed 1% of sales. Domestic borrowers are defined as firms where domestic borrowings exceed 1% of total borrowings.

Year	Total firms	FCB firms	Exporters	Domestic borrowers
2004	6134	475	2756	5685
2005	6418	901	2813	5930
2006	6644	939	2905	6107
2007	6919	922	3066	6328
2008	7147	971	3093	6496
2009	7283	883	3158	6556
2010	7077	893	2939	6272
2011	5423	751	2366	4805
2012	4646	740	2077	4114
2013	3686	602	1761	3213

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Firm data is extracted from the CMIE Prowess database from 2001 onwards. Foreign currency borrowing is defined as loans taken by the company denominated in a currency other than the Indian rupee, from any source. The full definition of FCB in Prowess database is “Any loan taken by the company in a currency other than in Indian rupees is a foreign currency loan. Examples of such loans are loans taken from foreign banks, foreign currency loans taken from foreign branches of Indian banks, foreign currency loans taken from Indian banks, loans taken from EXIM banks, loans taken from multinational lending institutions such as World Bank, IBRD, and Asian Development Bank, external commercial borrowings, suppliers/buyers credit, global depository receipts and American depository receipts.” This is a somewhat more inclusive definition than ECB, in particular including trade credit as well.

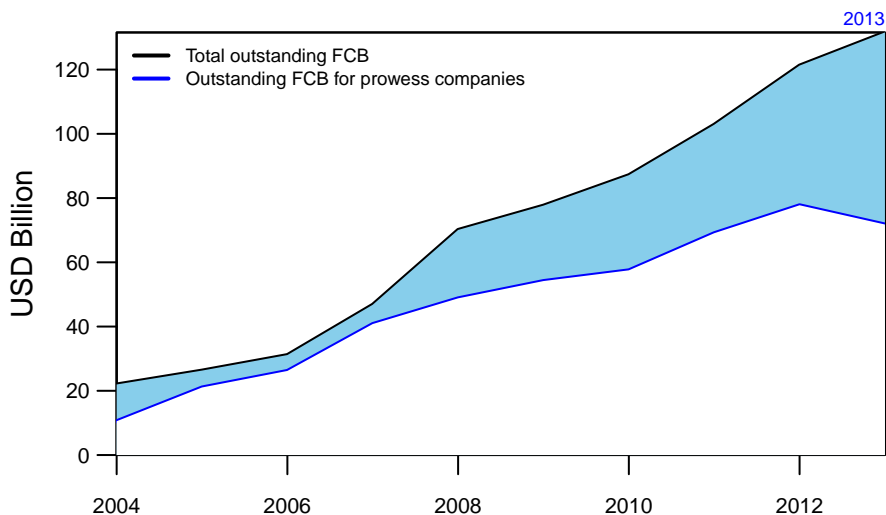
Foreign currency borrowing by Indian firms began on a significant scale from 2007 onwards, in response to changes in the capital controls regime and favourable macroeconomic conditions. This gives an opportunity to observe firms make the transition from no FCB to having FCB, which is the basic identification strategy of this paper. By matching the firms which made this transition against firms which did not, we achieve a quasi-experimental design within which a difference-in-difference estimator is feasible with treated and control firms.

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**Figure 3** Coverage of the dataset

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This figure shows the total outstanding long term FCB by all non-financial firms in the country, and the sum of the FCB by the firms in our dataset. The blue part of the graph is the scale of FCB by Indian firms which is not in our dataset.



### 3.2 Describing firms and their foreign borrowing

Table 2 shows the number of firms in each year, in the dataset. It shows that most firms are domestic borrowers. Only some of these are exporters and the smallest number is found for the firms that borrow abroad.

Figure 3 compares the sum of FCB seen in the firms in our dataset against the aggregate for the full country. It shows that roughly half of the overall FCB of India is in our dataset. There are two factors at work in explaining this gap. Some of the borrowing is by financial firms, which are excluded in our dataset. In addition, some borrowing is by firms which are absent in the CMIE Prowess dataset. For the purposes of the empirical analysis of this paper, the fact that roughly half of the aggregate borrowing by Indian firms is within the firms in our dataset suggests that the results are fairly representative.

Table 3 organises FCB firms by size quartiles. It shows that the bulk of FCB firms are in the 3rd and 4th quartile by size. The magnitude of the borrowing in each quartile is shown in Table 4. The bulk of the borrowing is in firms in the top quartile.

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**Table 3** Number of FCB firms, expressed by size quartiles

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The bulk of FCB firms have a size that is above median.

Year	Q1	Q2	Q3	Q4
2004	1	30	137	307
2005	0	31	250	620
2006	0	36	249	654
2007	0	28	207	687
2008	0	27	201	743
2009	0	17	156	710
2010	0	18	162	713
2011	1	21	155	574
2012	0	46	164	530
2013	0	36	129	437

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**Table 4** Sum of FCB within each size quartile

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The sum of foreign borrowing for each year is shown by size quartiles. The bulk of the borrowing is in the firms of the top quartile.

Year	Q1	Q2	Q3	Q4
2004	0.00	0.02	0.19	10.08
2005	0.00	0.02	0.29	20.21
2006	0.00	0.01	0.30	26.36
2007	0.00	0.01	0.29	36.81
2008	0.00	0.01	0.35	52.25
2009	0.00	0.01	0.32	56.37
2010	0.00	0.01	0.36	54.99
2011	0.00	0.01	0.60	69.91
2012	0.00	0.05	0.95	83.73
2013	0.00	0.06	0.64	76.38

All values are in USD Billion

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**Table 5** Summary statistics

Variable	Category	Mean	SD	Min	25th	Median	75th	Max	Observed
Leverage (Ratio)	All firms	0.35	0.31	0.00	0.12	0.31	0.49	2.36	76520
	Non-FCB firms	0.37	0.31	0.00	0.16	0.33	0.50	2.36	61338
	FCB firms	0.41	0.25	0.00	0.25	0.39	0.52	2.36	8778
Asset Tangibility (Ratio)	All firms	0.31	0.21	0.00	0.13	0.28	0.45	0.87	76518
	Non-FCB firms	0.31	0.21	0.00	0.14	0.29	0.46	0.87	61366
	FCB firms	0.36	0.20	0.00	0.21	0.35	0.50	0.87	8768
Liquidity (Ratio)	All firms	0.20	0.23	-0.72	0.06	0.21	0.35	0.75	75763
	Non-FCB firms	0.20	0.23	-0.72	0.06	0.21	0.35	0.75	60870
	FCB firms	0.20	0.19	-0.71	0.07	0.19	0.32	0.75	8771
Exports/Sales (Percent)	All firms	13.25	24.78	0.00	0.00	0.19	13.00	99.88	76520
	Non-FCB firms	12.06	23.74	0.00	0.00	0.02	10.58	99.88	61525
	FCB firms	21.05	28.06	0.00	0.01	6.65	33.74	99.88	8781
Foreign investment (Percent)	All firms	2.04	8.02	0.00	0.00	0.00	0.00	91.39	77287
	Non-FCB firms	1.42	6.71	0.00	0.00	0.00	0.00	91.39	62033
	FCB firms	6.54	13.61	0.00	0.00	0.00	5.20	88.26	8850
Foreign ownership (Percent)	All firms	2.35	10.91	0.00	0.00	0.00	0.00	96.80	77293
	Non-FCB firms	1.92	9.72	0.00	0.00	0.00	0.00	96.77	62039
	FCB firms	3.63	13.09	0.00	0.00	0.00	0.00	96.80	8850
OFDI/Total assets (Percent)	All firms	0.37	2.04	0.00	0.00	0.00	0.00	25.09	76520
	Non-FCB firms	0.29	1.80	0.00	0.00	0.00	0.00	25.02	61553
	FCB firms	0.89	3.02	0.00	0.00	0.00	0.00	25.09	8651
Return on capital (Percent)	All firms	4.66	18.99	-124.07	0.39	4.06	10.71	110.19	75580
	Non-FCB firms	3.54	18.68	-124.07	0.21	3.59	9.67	110.19	60649
	FCB firms	4.19	13.97	-116.84	0.98	4.55	9.51	106.51	8757
Size (INR Million)	All firms	5456.71	43541.81	10.40	215.80	587.30	1985.10	3181391.80	77293
	Non-FCB firms	3369.02	21532.49	10.40	203.00	513.90	1596.65	1544910.70	62039
	FCB firms	21720.10	111779.80	24.40	776.10	2746.05	10025.30	3181391.80	8850

Table 5 shows summary statistics about the firms in the dataset where we observe 76,520 firm-years.

The median size of FCB firms is Rs.2746 million while the median size of non-FCB firms is Rs.513.9 million: the firms that borrow abroad are more than five times bigger on average than the firms that do not. The home bias literature suggests that foreign investors are likely to favour large, low credit risk and internationally active firms. This is exacerbated by the Indian capital controls which limit foreign borrowing to firms with low credit risk.

When we look at measures of financing constraints, small differences between FCB and non-FCB firms are visible. Asset tangibility for FCB firms has a mean of 0.36 while it is 0.31 for non-FCB firms. On the other hand, there is no difference in the liquidity ratio. While high leverage suggests more borrowing, it can also be interpreted as a lack of equity capital. In our data, the average leverage of FCB firms is 0.41 while for non-FCB firms it is 0.37.

We examine three internationalisation measures – exporting, foreign equity ownership and outbound FDI. The firms that borrow abroad are much more internationalised by all three measures. The exports/sales ratio has a mean of 21.05% for FCB firms while it is 12.06% for non-FCB firms. Half of the non-FCB firms have zero exports, while the median value of exports for FCB firms is 6.65% of sales.

In terms of foreign investment, the mean value for FCB firms is 6.54% while for non-FCB firms it is 1.42%. Foreign ownership by non-financial firms is 3.63% for FCB firms on average while it is 1.92% for non-FCB firms. Outbound FDI by FCB firms is 0.89% of assets on average while it is 0.29% of assets for non-FCB firms. This is consistent with the home bias literature, which finds that foreign investors favour internationally active firms. There may also be interconnections between the various modes of firm internationalisation, where each mechanism of international engagement reinforces the others.

In terms of operating performance, the return on capital for FCB firms has a median value of 4.55% while for non-FCB firms it is 3.59%. This is consistent with the idea that better performing firms are likely to be larger and have lower credit risk, which enables their overcoming home bias and satisfying the Indian capital controls.

We now turn to the question of natural hedges. The fact that FCB firms export more and own more assets overseas suggests that they have greater natural hedges. The simplest case of a natural hedge is a firm which has net exports that pay for the flow of repayments associated with an FCB. We

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**Table 6** Number of firms who have natural hedges

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FCB firms in each year are classified into ‘High’, ‘Low’ or ‘None’ based on the extent to which net exports pay for the ongoing cost of repayment and interest on FCB.

	High	Low	None
2004	38.32	3.37	58.32
2005	42.95	2.89	54.16
2006	42.49	3.62	53.89
2007	42.30	4.01	53.69
2008	40.47	4.33	55.20
2009	38.96	3.85	57.19
2010	36.51	3.70	59.80
2011	38.48	3.60	57.92
2012	37.97	3.65	58.38
2013	39.87	2.99	57.14

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**Table 7** Number of firms who have natural hedges

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FCB firms in each year are classified into ‘High’, ‘Low’ or ‘None’ based on the extent to which net exports pay for the ongoing cost of repayment and interest on FCB.

	High	Low	None
2004	19.19	0.73	80.08
2005	24.65	3.86	71.49
2006	18.04	7.81	74.15
2007	21.18	5.45	73.37
2008	18.21	8.46	73.33
2009	19.53	4.80	75.66
2010	15.64	5.72	78.64
2011	14.80	2.66	82.54
2012	16.25	1.95	81.80
2013	13.86	6.98	79.17

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undertake a simple quantification of the extent to which FCB is covered by exports as follows.

The average maturity of Indian firm borrowing is 5 years. We may approximate the cost of borrowing at 350 bps above LIBOR. This permits an estimate of the annual payments that would have to be made as a consequence of a given level of FCB. This estimate, of the flow of repayments, is compared against the net exports of the firm to assess the extent to which a natural hedge is present. We classify firms into three discrete categories based on the extent of hedging: ‘High’ are firms where net exports are over 80% of the flow of repayments, ‘None’ are firms with below 20%, and ‘Low’ are those in between. The cutoffs are based on the observed distribution of firm hedging, as described in Table 6 and 7.

Table 6 shows a bimodal structure where, in 2013, 39.87% FCB firms have a



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**Table 8** Tobit results

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We use a tobit regression model to study the characteristics of firms which take on foreign currency debt. The dependent variable here is the ratio of FCB to total borrowing.

	Q2	Q3	Q4
Intercept	-224.18 (0.00)	-146.38 (0.00)	-66.95 (0.00)
Asset Tangibility	56.73 (0.00)	61.28 (0.00)	34.73 (0.00)
Liquidity	57.89 (0.00)	34.37 (0.00)	3.68 (0.41)
Leverage	37.19 (0.00)	12.01 (0.00)	6.7 (0.03)
Exports to Sales	0.85 (0.00)	0.53 (0.00)	0.25 (0.00)
Foreign investment	0.48 (0.6)	1.02 (0.00)	0.93 (0.00)
OFDI to TA	-1.71 (0.43)	-0.39 (0.63)	1.59 (0.00)
Foreign ownership	0.98 (0.01)	0.87 (0.00)	0.02 (0.79)
Age	4.44 (0.00)	4.31 (0.00)	3.95 (0.00)
Observations	12601	25330	28666

Values in parentheses are  $p$ -values

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strong natural hedge based on net exports, and 57.14% FCB firms where net exports are smaller than 20% of the required repayment in foreign currency, and 2,99% firms lie in between. For the firms who do not have natural hedges, there is the possibility of hedging using financial derivatives, or of holding unhedged exposure.

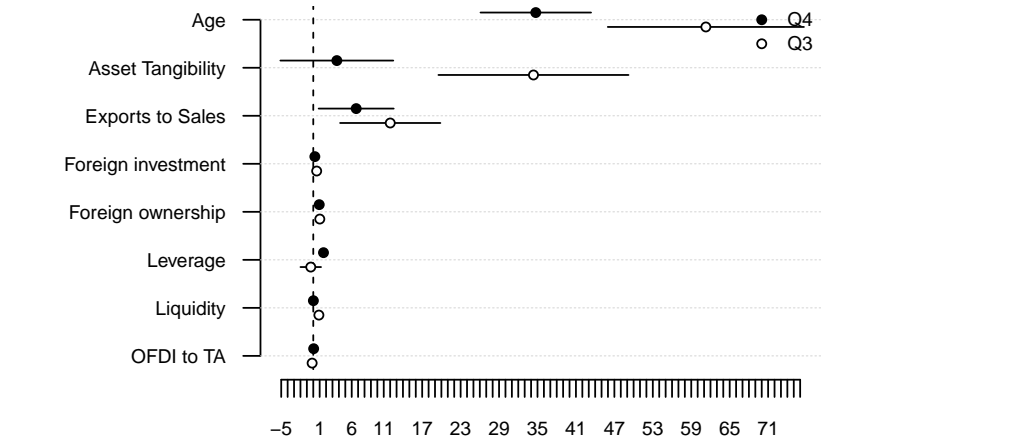
## 4 Which firms undertake FCB?

There are a large number of firms with zero foreign currency borrowing, and some firms which have undertaken it. In order to explore descriptive linear relationships in the data, we estimate a tobit model. There is strong heterogeneity in the relationships found in the data across size categories. Hence, we estimate the model separately within size quartiles. In the smallest quartile (Q1) there are too few FCB firms and hence the model cannot be estimated. The remaining three within-size-quartile estimates are shown in Table 8.

In a less developed financial system, firms are able to borrow against tangible collateral, and lenders lack the skill required for assessing their prospects. Asset tangibility powerfully influences FCB in Q2 and Q3 but has a lower

**Figure 4** Visualising the tobit estimates

This figure shows the range of tobit estimates calculated as  $\beta \pm 1.96 * s$ ; where  $\beta$  is the coefficient from the tobit regression and  $s$  is the standard error of the coefficients.



effect in Q4. This shows that for Q2 and Q3 firms, foreign lenders are very strongly influenced by the presence of tangible collateral. While asset tangibility matters for Q4 firms also, the coefficient is halved.

Less financially constrained firms are those that are more liquid, and in some sense, these firms require debt capital the least. The coefficient of liquidity is 57.89 for the Q2 firms, 34.04 for the Q3 firms and 3.64 for the Q4 firms. This shows that FCB is going to the least constrained firms, particularly when they are relatively small. To the extent that leverage can be interpreted as *access* to debt capital, a similar relationship is found with leverage also.

Internationalisation measures are positively associated with FCB, other than the presence of outbound FDI which is not important for Q2 and Q3 firms. This is consistent with two perspectives: More international firms are likely to have natural hedges, and under conditions of home bias, foreign investors are likely to choose internationally visible firms.

The results for Q2 and Q3 are qualitatively similar to each other. In order to better visualise the differences between Q4 (the largest firms) and Q3 (the next smaller quartile), Figure 4 displays the 95% confidence interval of all the estimates. This shows that for the Q3 firms, it is much more important to have *low* financing constraints, in order to do FCB.

## 5 Causal impact of FCB on firm outcomes

Our methodology for setting up a quasi-experimental design for foreign currency borrowing by firms builds on Patnaik and Shah (2013) which developed this approach for foreign versus domestic institutional investment into firms.

### 5.1 A quasi-experimental design

The previous analysis has shown that there is a strong selection process in operation with FCB. Large, internationalised firms with low financing constraints are likely to do FCB. In order to identify the causal impact of FCB upon the outcome for the firm, we require observations of some firms which did FCB, and controls which have similar characteristics which did not do FCB. This will permit a comparison of firm performance in the period after the first FCB date. These differences in performance can be causally attributed to FCB.

The two key elements of our strategy are propensity score matching (Rosenbaum and Rubin, 1983) coupled with analysis in event time. Propensity score matching helps us identify a matched control firm at time  $t$ , for each firm which first undertakes FCB at time  $t$ . This helps address selection on observables. Analysis in event time helps average out changes in laws and macroeconomic conditions which would affect both treatment and control units. This improves external validity when compared with the analysis of any one year, by averaging across a greater range of external conditions.

The key event date is the transition where a firm is observed for one year without foreign borrowing and is seen with foreign borrowing for the next two consecutive years. We identify firms which have followed the trajectory  $(0, 1, 1)$ . The control pool is composed of all firms which never borrowed abroad.

The first stage in propensity score matching is the estimation of a logit regression that predicts which firms did FCB. This logit is estimated using firm characteristics at time  $t - 1$  in order to avoid endogeneity bias. Nearest neighbour matching without replacement is done within each year. If  $P_{it}$  is the predicted probability of FCB at time  $t$  for firm  $i$  (a firm in the treatment group), a firm  $j$  is chosen as its matched partner if its probability to borrow is the closest to  $P_{it}$  amongst all firms in the control group in year  $t$ . If the best available  $j$  is not sufficiently close to  $i$  then  $i$  is dropped from the analysis.

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**Table 9** Number of treated and control firms

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This table shows the number of treated and control firms using our trajectory definition.

Year	Number of controls	Number of treated	Matched pairs
2002	2341	49	20
2003	2303	68	31
2004	2617	143	65
2005	2687	349	135
2006	2938	130	59
2007	3146	126	47
2008	3284	123	58
2009	3266	71	35
2010	2334	77	33
2011	2037	142	50

---

Table 9 shows the number of firms in each year which survive the matching process. As an example, in 2008, in the full data, there were 123 events of a firm which did FCB for the first time. There was a control pool of 3284 firms available which have never done FCB. Of the 123 treated firms, it was possible to find high quality matches, using propensity score matching, for 58 firms. For the remaining 65 firms, we observe firm outcomes after FCB, but we do not see a plausible control firm with similar characteristics that did *not* do FCB. Hence, these remaining 65 firms are not useful in understanding the causal impact of FCB. In this fashion, the events of each year yield some observations where a treated firm can be paired against a highly similar control. In total, this yields a design with 533 matched pairs.

## 5.2 Has match balance been achieved?

The essence of credible quasi-experimental econometrics is match balance: the outcomes for treatment and control can be compared as in an experiment because the control unit is much like the treatment unit.

The matching procedure is effective if it delivers balance. We use standardised differences, and Kolmogorov Smirnov tests, to verify that the treatment and control group are not significantly different based on the calculated propensity score and firm characteristics in the year prior to treatment.

Table 10 shows the standardised differences between treated and control firms before and after the matching process. As an example, the standardised difference in the exports/sales ratio is 0.34 before matching: FCB firms have a higher exports/sales ratio. After the matching process, this standardised difference drops to -0.08, which shows that there is match balance; the treated

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**Table 10** Goodness of matched pairs: Standardised difference

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This table shows the standardised difference for different variables for treatment and control group. After matching, the standardised difference drops to zero.

	Before Matching	After Matching
Propensity score	0.68	-0.00
Asset tangibility $_{i,t-1}$	0.25	0.08
Liquidity $_{i,t-1}$	0.08	-0.01
Leverage $_{i,t-1}$	-0.04	0.10
Export to sales $_{i,t-1}$	0.34	-0.08
Log(Size) $_{i,t-1}$	0.12	-0.01
Log(Size) $^2_{i,t-1}$	0.64	-0.03
Age $_{i,t-1}$	0.03	-0.03
FII $_{i,t-1}$	0.28	-0.01
Foreign promoter $_{i,t-1}$	0.10	0.01
OFDI/TA $_{i,t-1}$	0.13	-0.01

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and control firms are alike.

We go beyond the first two moments to the entire distribution in Table 11, which shows results of the Kolmogorov-Smirnov test for all variates. As an example, the  $p$  value of the test that compares the exports/sales ratio is 0 for the raw data. This shows that the exports/sales ratio is emphatically different between FCB firms and non-FCB firms. After matching, the  $p$  ratio of the KS test is 0.5501; it is not possible to reject the null hypothesis of equality of distribution.

Figure 5 shows the cumulative density of the propensity score. Before matching, the two distributions are clearly different from each other. Once the matching process has been done, the two distributions lie on top of each other. This justifies causal inference through propensity score matching, within the constraint of only matching on observables.

### 5.3 Analysis of the matched dataset

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**Table 11** Goodness of matched pairs: KS test

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This table shows the Kolmogorov-Smirnov test for different variables for treatment and control group. The null of equality of distributions is always rejected in the raw data and is never rejected after matching.

	Before Matching	After Matching
Propensity score	0.459 (0)	0.0056 (1)
Asset tangibility $_{i,t-1}$	0.1188 (0)	0.0488 (0.5501)
Liquidity $_{i,t-1}$	0.0596 (3e-04)	0.0338 (0.9215)
Leverage $_{i,t-1}$	0.0961 (0)	0.0769 (0.0854)
Export to sales $_{i,t-1}$	0.2555 (0)	0.0488 (0.5501)
Log(Size) $_{i,t-1}$	0.3129 (0)	0.0394 (0.8025)
Log(Size) $^2_{i,t-1}$	0.3129 (0)	0.0394 (0.8025)
Age $_{i,t-1}$	0.0397 (0.0423)	0.045 (0.6523)
FII $_{i,t-1}$	0.2114 (0)	0.03 (0.97)
Foreign promoter $_{i,t-1}$	0.053 (0.0021)	0.0206 (0.9999)
OFDI/TA $_{i,t-1}$	0.1205 (0)	0.0338 (0.9215)

Values in parentheses are  $p$ -values

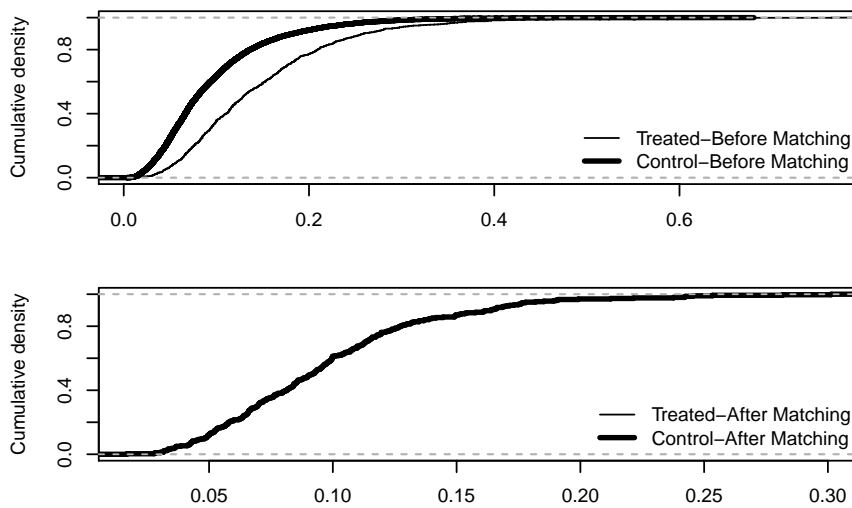
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**Figure 5** Cumulative density of propensity score

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This figure shows the cumulative density of the propensity score of treated and control firms, before and after matching. After matching, the distribution of the treated and control firms is similar.



**Table 12** Summary statistics after matching

Variable	Category	Mean	SD	Min	25th	Median	75th	Max	Observed
Leverage (Ratio)	Treatment	0.39	0.29	0.00	0.19	0.35	0.51	2.30	533
	Control	0.36	0.23	0.00	0.22	0.34	0.47	1.74	533
Asset Tangibility (Ratio)	Treatment	0.35	0.20	0.00	0.20	0.32	0.50	0.87	533
	Control	0.34	0.20	0.01	0.18	0.31	0.48	0.87	533
Liquidity (Ratio)	Treatment	0.23	0.20	-0.50	0.09	0.25	0.37	0.70	533
	Control	0.23	0.20	-0.65	0.11	0.23	0.37	0.75	533
Exports/Sales (Percent)	Treatment	13.68	23.89	0.00	0.00	0.83	16.98	99.75	533
	Control	15.90	27.02	0.00	0.00	1.30	18.05	99.77	533
Foreign investment (Percent)	Treatment	0.65	4.24	0.00	0.00	0.00	0.00	58.42	533
	Control	0.77	4.27	0.00	0.00	0.00	0.00	57.09	533
Foreign ownership (Percent)	Treatment	2.64	11.93	0.00	0.00	0.00	0.00	86.48	533
	Control	2.57	10.29	0.00	0.00	0.00	0.00	82.33	533
OFDI/Total assets (Percent)	Treatment	0.22	1.51	0.00	0.00	0.00	0.00	21.21	533
	Control	0.24	1.44	0.00	0.00	0.00	0.00	23.26	533
Return on capital (Percent)	Treatment	3.66	14.79	-106.91	0.45	3.70	9.49	88.81	528
	Control	5.25	11.50	-93.02	1.62	4.87	10.20	41.68	532
Size (INR Million)	Treatment	2112.51	8062.58	35.60	279.60	637.40	1347.50	124934.50	533
	Control	2538.29	8506.09	47.60	294.80	610.00	1468.60	118581.40	533



As emphasised above, our ability to make causal claims is limited to the support of the data where similar firms are observed, where some have done FCB and others have not. For many large firms that undertake FCB, it is not possible to find controls as all their peers have also done FCB. Table 12 shows summary statistics of the treatment and control firms. This shows match balance: the treated firms are much like the controls. The gross differences between FCB and non-FCB firms, which are visible in Table 5 for the full dataset, have been eliminated.

In the full dataset, summarised in Table 5, the mean size of FCB firms was Rs.21,720 million and the mean size of non-FCB firms was Rs.3,369 million: the FCB firms were much bigger than the non-FCB firms. In the matched dataset, the two means are Rs.2,113 million and Rs.2,538 million respectively. Here, the two means are alike. In addition, it was only possible to find similar control units for smaller firms, so the average size of firm in the matched dataset is smaller than that seen in the full dataset. It is important to emphasise that the summary statistics in Table 5 were across all firm-years, whereas what is shown in Table 12 only pertains to the year  $-1$  in event time for the 533 treated firms and their 533 matched controls.

With this matched dataset in hand, the difference in difference estimator is calculated based on the following specification:

$$\Delta y_{i,s} - \Delta y_{j,s} = a_0 + e_{ij,s}$$

where  $y$  is the firm characteristic of interest;  $s$  denotes event time, that is 0 is the time at which the firm starts borrowing, 1 is one year after firm begins to borrow and so on;  $i$  is the treated firm and  $j$  is the matched control firm. In all cases, we show results for a simple OLS estimator and also a robust MM-type estimator for linear regression.

The main result is shown in Table 13. The robust regression shows that FCB firms have substantially higher growth in fixed assets in year 1 and 2 after the FCB in year 0. There is some growth in employment in year 0 and 1. This yields improved growth of exports (in year 2) and output (in year 0 and 2).

The fact that FCB gave an increase in inputs of fixed assets, and of labour, suggests that firms use FCB for growing their operations and not for financial intermediation. If there had been large currency mismatches, and if fluctuations of the exchange rate were adversely affecting the firm, then the impact on output measures would have been hampered. This does not seem to be the case, as there is some statistically significant increase in exports and sales by year  $+2$ .

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**Table 13** Results

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OLS and robust regression for  $\Delta y_{i,s} - \Delta y_{j,s} = a_0 + e_{ij,s}$  are estimated for various outcomes of interest  $y$  in event time  $s$ .  $i$  is the treated firm and  $j$  is the matched control firm. Estimated  $a_0$  is reported in each case.

As an example, consider an outcome of interest: log gross fixed assets. The robust regression estimates show that firms that take on FCB have a growth in assets over a one year horizon after treatment that is larger than that observed for controls by 0.13 with a standard error of 0.023.

Growth of gross fixed assets			Employee growth		
	OLS	Robust		OLS	Robust
0	0.09 (0.032) **	0.02 (0.022)	0	0.05 (0.035)	0.03 (0.024)
1	0.16 (0.034) ***	0.11 (0.03) ***	1	0.11 (0.036) **	0.07 (0.026) **
2	0.03 (0.032)	0.04 (0.024)	2	0 (0.036)	0.03 (0.025)
Obs	251	251	Obs	246	246

Growth of exports			Sales growth		
	OLS	Robust		OLS	Robust
0	0.02 (0.088)	0 (0.077)	0	0.08 (0.028) **	0.05 (0.023) *
1	-0.07 (0.1)	-0.02 (0.055)	1	0.05 (0.029)	0.02 (0.023)
2	0.07 (0.094)	0.07 (0.086)	2	0.05 (0.029)	0.04 (0.021) .
Obs	85	85	Obs	252	252

---

If firms were financially constrained, and FCB eased a financing constraint, then there would be a sharp impact upon output for the FCB firm when compared with the control. This is not the case; the effects are modest. This may, in turn, reflect the fact that home bias and capital controls have limited access to FCB to relatively financially sound Indian firms, as was demonstrated in Section 4, our analysis of the characteristics of the firms that have obtained FCB.

## 5.4 How do natural hedges change the outcome?

To further explore the issues of incomplete markets and unhedged foreign currency exposure, the dataset is broken up into two groups: those with above average hedge cover through exports, versus those with below average hedge cover through exports.

If there was moral hazard associated with exchange rate pegging, or incomplete markets, and some firms with unhedged foreign currency borrowing, then there would be greater difficulties in the years following the FCB. Conversely, the impact of FCB would be much better for the firms with greater natural hedges.

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**Table 14** Results: Hedge coverage ratio

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The overall dataset is broken into two groups: those with above average natural hedges through exporting, versus those with below average natural hedges.

Above average			Below average		
<b>Growth of gross fixed assets</b>					
	OLS	Robust		OLS	Robust
0	0.03 (0.044)	-0.02 (0.03)	0	0.11 (0.042) **	0.05 (0.029)
1	0.12 (0.041) **	0.09 (0.042) *	1	0.17 (0.046) ***	0.12 (0.042) **
2	0.01 (0.06)	0.01 (0.047)	2	0.04 (0.038)	0.04 (0.029)
Obs	76	76	Obs	175	175
<b>Employee growth</b>					
	OLS	Robust		OLS	Robust
0	-0.03 (0.051)	0 (0.034)	0	0.09 (0.045) *	0.05 (0.032)
1	0.1 (0.07)	0.01 (0.041)	1	0.12 (0.042) **	0.1 (0.033) **
2	0.04 (0.065)	0.07 (0.047)	2	-0.01 (0.043)	0.01 (0.03)
Obs	75	75	Obs	171	171
<b>Export growth</b>					
	OLS	Robust		OLS	Robust
0	0.1 (0.108)	0.02 (0.109)	0	-0.04 (0.134)	-0.04 (0.123)
1	-0.02 (0.111)	-0.09 (0.07)	1	-0.12 (0.158)	0.03 (0.086)
2	-0.11 (0.131)	-0.02 (0.107)	2	0.21 (0.131)	0.16 (0.146)
Obs	38	38	Obs	47	47
<b>Sales growth</b>					
	OLS	Robust		OLS	Robust
0	0.01 (0.047)	0 (0.038)	0	0.11 (0.035) **	0.08 (0.03) **
1	0.06 (0.056)	0.01 (0.04)	1	0.04 (0.033)	0.02 (0.028)
2	0 (0.046)	0.04 (0.038)	2	0.07 (0.037)	0.04 (0.026)
Obs	76	76	Obs	176	176

---

Table 14 compares the key inputs (labour and capital) and outputs (exports and sales) for the two groups of firms. The results for firms with low natural hedges are relatively benign. If firms with low natural hedges had suffered from impaired balance sheets owing to currency fluctuations, this would have impaired their future investments. However, the robust regression coefficients for future fixed asset growth for those with strong hedges (0.09) is not significantly different than those without (0.12).

By  $t = 2$  the firms with low hedging achieve strong export growth and strong output growth. This is consistent with the idea that India has enough exchange rate flexibility to deter firms from imprudently hedging, and that even though the domestic currency derivatives market is weak, the firms are able to do adequate financial engineering in order to hedge their exposures.

## 5.5 Is FCB easing financing constraints?

The second dimension in which we explore heterogeneous treatment effects is about financing constraints. If firms were domestically financially constrained, then access to FCB could make a big difference in yielding high output growth. If, on the other hand, the combination of home bias and capital controls was limiting FCB access to firms that were relatively unconstrained, then the economic impact of FCB is relatively limited.

The dataset is split into two sub-samples: those with high financing constraints versus those with low financing constraints, and the analysis is repeated. The results are shown in Table 15. The results for both groups are similar. If anything, the results are somewhat better for the firms with *low* financing constraints.

This suggests that easing financing constraints is not an important part of the role that FCB is playing among Indian firms, under present levels of home bias and under the present system of capital controls.

## 6 Conclusion

The results of this paper may be summarised as follows. There is a strong selection process which determines which Indian firms engage in foreign currency borrowing (FCB). The traditional problems of home bias have limited access to international capital markets to large and internationally active firms. These have been exacerbated by the Indian capital controls which

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**Table 15** Results: Financing constraints
 

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The overall dataset is broken into two groups: those with above median financing constraints, versus those with below median financing constraints.

<b>Above median</b>			<b>Below median</b>		
<b>Growth of gross fixed assets</b>					
	OLS	Robust		OLS	Robust
0	0.09 (0.052)	0 (0.03)	0	0.11 (0.046) *	0.06 (0.03) *
1	0.07 (0.053)	0.05 (0.05)	1	0.24 (0.049) ***	0.18 (0.04) ***
2	0.05 (0.052)	0.04 (0.038)	2	0.03 (0.045)	0.04 (0.036)
Obs	105	105	Obs	123	123
<b>Employee growth</b>					
	OLS	Robust		OLS	Robust
0	0.05 (0.061)	0.01 (0.04)	0	0.04 (0.044)	0.05 (0.032)
1	0.03 (0.057)	0 (0.039)	1	0.19 (0.05) ***	0.13 (0.039) **
2	-0.02 (0.064)	0.01 (0.045)	2	0 (0.045)	0.04 (0.034)
Obs	103	103	Obs	120	120
<b>Export growth</b>					
	OLS	Robust		OLS	Robust
0	-0.05 (0.153)	-0.08 (0.132)	0	0.11 (0.102)	0.08 (0.1)
1	-0.19 (0.181)	-0.07 (0.097)	1	0.07 (0.105)	0.02 (0.073)
2	0.22 (0.119)	0.18 (0.125)	2	-0.03 (0.159)	0.03 (0.129)
Obs	40	40	Obs	39	39
<b>Sales growth</b>					
	OLS	Robust		OLS	Robust
0	0.06 (0.048)	0.04 (0.037)	0	0.07 (0.034) *	0.05 (0.031) .
1	0.03 (0.048)	-0.02 (0.036)	1	0.07 (0.038) .	0.04 (0.032)
2	0.03 (0.048)	0.02 (0.032)	2	0.07 (0.041) .	0.06 (0.031) .
Obs	105	105	Obs	124	124

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favour firms with low credit risk. Put together, FCB has been the preserve of large and internationally active firms, with relatively low financing constraints.

There is a strong bimodal pattern where roughly half the firms have good natural hedges through exporting, while the other half do not. Access to currency hedging is limited by weak domestic financial markets development coupled with problems in capital controls. However, our results are consistent with the moral hazard hypothesis. The fact that the USD/INR exchange rate has substantial flexibility has given incentives to firms to be careful about exchange rate exposure. As a consequence, the outcomes for firms with low natural hedges do not betray difficulties with impaired balance sheets for firms with low natural hedging through exports.

Foreign currency borrowing could have been a mechanism for overcoming financing constraints. However, the firms which obtain access to international capital markets tend to be less constrained, and the Indian capital controls restrict access to firms with low credit risk. There is mild evidence that fixed asset growth of borrowing firms is higher than for the firms that borrow abroad. But this does not kick off a sharp spurt of output growth or exports growth, which is what would have obtained under financing constraints.

There is also no evidence that firms which have access to FCB are engaged in financial intermediation, lending out their borrowed resources to other, more constrained, firms. Fixed asset growth is found within the FCB firms.

The contribution of this paper lies in a thorough analysis of foreign currency borrowing at the firm level using a quasi-experimental design. The results suggest a relatively benign and modest set of phenomena. The Indian arrangements for foreign borrowing are not fraught with risk owing to original sin. At the same time, foreign borrowing is not going to financially constrained firms, and it is not filling the gaps in access to capital in the domestic financial system.

Forbes (2007) has emphasised that capital controls can favour large firms against small firms. Such phenomena may well be present in India, where the capital controls explicitly require low credit risk. The analysis of these questions is left to future research.

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