The determinants of currency derivatives usage among Indian non-financial firms

An empirical study

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Abstract

Purpose – Theoretical studies suggest that hedging helps firms to reduce their financial distress costs and underinvestment problem especially if the markets are imperfect. Hence hedging, through the use of currency derivatives, is one of the important financial policies for firms. The purpose of this paper is to empirically examine the determinants of derivatives usage by Indian firms using financial disclosures on currency derivatives by non-financial constituents of S&P CNX 500 for 2009.

Design/methodology/approach – We manually collect the data on foreign currency derivatives from firms' annual reports for 2009 and then follow Haushalter's (2000) approach to examine the determinants of firms' decision to hedge. A firm can make its hedging decision at once, deciding whether to hedge and how much to hedge. Given the nature of dependent variable that is censored, it is appropriate to use Tobit regression. A firm can also decide its hedging decision in two steps by deciding first on whether to hedge and later how much to hedge. The former is modelled by probit regression and later by conditional regression.

Findings – Our empirical evidence suggests that forwards are the main instruments for managing currency risk followed by options and swaps. The objectives, in the order of priority, are reduction in exposure associated with foreign currency receivables, foreign currency long-term loans and foreign currency payables. Firm's decision to hedge is positively related to size, foreign exchange exposure and leverage, while negatively related to liquidity and investment opportunities. We find evidence of higher derivative usage by firms with both higher currency risk and higher financial distress costs.

Practical implications – The findings of this paper will help corporates, researchers and regulators to understand firms' motives behind hedging.

Originality/value – This is the first empirical study that examines the determinants of firm's decision to hedge and the extent of hedging in the context of emerging economies like India.

Keywords Hedging, Currency derivatives, Currency risk, Corporate risk management

Paper type Research paper

1. Introduction

Over the past decade, the volume of currency derivative contracts has substantially grown in India. The triennial central bank surveys on foreign exchange and derivative market activity conducted by Bank for International Settlements (BIS) for the 2001 and 2010 show that the average daily turnover of over-the-counter (OTC) foreign exchange derivatives for India has increased from US$1,848m in April 2001 to US$13,947m in April 2010[1]. Such a phenomenal increase in OTC derivatives in an emerging country, like India, is attributed to the growth of

foreign trade (as measured by export and import of goods) and increase in per capita gross domestic product (GDP) (Mihaljek and Packer, 2010). The Indian export (import) of goods has increased from US$44,560m (US$50,536m) in the financial year 2000-2001 to US$1,85,295m (US$3,03,696m) in 2008-2009[2]. The per capita GDP at current prices of India is US$465.07 in 2000 as compared to US$1,078.58 in 2009[3]. Other possible reasons for such phenomenal growth of currency derivatives at firm level may be due to increase in exchange rate returns volatility and increase in foreign exchange turnover (as measured by foreign revenue). The annualized daily volatility of USD/INR returns has been 11.20 per cent in the financial year 2009 as compared to 2.06 per cent in the financial year 2000[4] (See Figure A1). The median value of the ratio between foreign revenue and total revenue has increased from 4.93 per cent in 2000 to 8.17 per cent in 2009 (See Figure A2). Correspondingly, the recent studies based on survey data also find that Indian firms use foreign currency derivatives to manage their currency risk (Anand and Kaushik, 2008; Jain *et al.*, 2009). In this study, we empirically examine the determinants of derivatives usage at firm level among Indian firms using financial disclosures on currency derivatives.

This paper contributes to risk management literature in two ways. First, empirical studies conducted so far focus on developed markets, and studies done in the emerging market contexts are relatively scarce. Some studies in the Indian context, namely, Anand and Kaushik (2008) and Jain *et al.* (2009), examine the managerial intentions behind currency hedging by using survey method, but do not analyse firm-level data. In this paper, we hand-collect data on currency derivatives from firm's annual reports to circumvent the problem of non-availability of data on currency hedging in electronic databases. Thus, our analysis sheds light on firm-level factors that determine the extent of hedging and propensity to hedge for a large sample of emerging market firms. Second, there are studies that employ either a binary variable approach (Geczy *et al.*, 1997; Clark and Judge, 2005; Judge, 2006; Bartram *et al.*, 2009; Danila and Huang, 2016) or a continuous measure of hedging (Howton and Perfect, 1998; Gay and Nam, 1998; Aabo and Ploeen, 2014). However, the determinants affecting these two measures of hedging are different. Therefore, we apply Cragg model (1971) to examine the determinants of firm's decision to hedge and the extent of hedging currency derivatives separately[5]. In this regard, we find that firms that are larger in size are more likely to hedge their currency risk. This result confirms the economies of scale argument that larger firms enjoy transactional and informational economies of scale in implementing the risk management programme. However, the relationship between a firm's size and its decision on how to hedge among hedgers is negative. This result suggests that smaller firms tend to hedge more than the larger firms since the former is more likely to face higher bankruptcy costs than the latter. This result is comparable to the findings of Haushalter (2000), who examines the hedging practices for oil and gas producers in the context of the USA.

Our study documents that the extent of hedging is higher for the firms with lower profitability and lesser liquid assets. A firm's propensity to hedge is higher with more total assets and financial leverage, while it is lower with more liquid assets. Our results support the hypothesis that firms with higher financial distress costs prefer to use more derivatives. Further, we find statistically insignificant association between highly leveraged growth-firms and usage of derivatives by firms. This result implies that underinvestment problem is not a determining factor for firms' derivatives usage. Finally, we document that firms with extensive foreign exchange revenue prefer to hedge more. This finding is robust to firms' alternative measures of hedging.

The remainder of the paper is organised as follows. Section 2 reviews the determinants of derivatives usage and empirical literature. Section 3 describes data sources and methodology

used in the study. Section 4 discusses the empirical results and robustness tests. Section 5 forms the conclusion.

2. The determinants of derivatives usage and empirical evidences: a brief review

2.1 Determinants of derivatives usage

One of the major determinants of hedging is financial distress costs (Smith and Stulz, 1985; Clark and Judge, 2005; Judge, 2006; Bartram *et al.*, 2009). Hence, it is imperative to examine whether firms with high financial distress costs are more likely to use derivatives to hedge their currency exposure. Hedging reduces firms' cash flows volatility, and hence these firms find it easier to meet their fixed obligations on time and thereby reduce their expected costs of financial distress. Firms with higher leverage tend to have higher incentive to hedge their exchange rate exposure since these firms face the higher probability of financial distress costs (Bartram *et al.*, 2009). Firms facing liquidity problem tend to have higher financial distress costs and thus are more likely to use derivatives to hedge their currency risk (Geczy *et al.*, 1997; Bartram *et al.*, 2009). Further, we expect firms with higher profitability prefer to hedge less, as these firms are less likely to be financially distressed. This empirical relationship has been addressed by Bartram *et al.* (2009).

Firms with higher foreign exchange exposure are more likely to hedge their exposure to exchange rates. This is due to the fact that these firms are more likely to generate significant amount of revenues and/or incur costs in multiple foreign currencies (Geczy *et al.*, 1997; Clark and Judge (2005); Davies *et al.*, 2006; Bartram *et al.*, 2009). Similarly, we expect the firms with higher dividend payouts are less likely to hedge since these firms may have lower liquidity constraint and stable cash flows.

The relationship between size and hedging is ambiguous. The propensity to use derivatives is higher for larger firms as compared to smaller firms for two reasons. First, larger firms enjoy the transactional and informational economies of scale than smaller firms in implementing the risk management programme. Second, the fixed costs involved in setting up treasury desk dealing in derivatives is high, and larger firms find it more affordable (Geczy *et al.*, 1997; Clark and Judge, 2005; Judge, 2006; Bartram *et al.*, 2009; Danila and Huang, 2016). On the contrary, Warner (1977) documents an inverse relationship between the costs of bankruptcy and size of the firm; which indicates that larger firms are less likely to hedge their currency exposure than smaller firms.

Another rationale for firms to hedge emanates from convex corporate tax function in countries like the USA. Smith and Stulz (1985) show that under such tax structure, it is beneficial for firms to hedge to reduce the volatility of expected tax liability. However, in Indian context that is not completely true; though tax credit and carry forward of losses are permitted subject to some exceptions[6]. Empirical studies (Graham and Smith, 1999; Graham and Rogers, 2002) use tax rate and income tax credits as proxies to test this theoretical prediction.

Underinvestment problem arises when the firms' leverage is high and shareholders have less incentive to take up safe, profitable and positive net present value (NPV) projects. It is due to the fact that cash flows out of these projects primarily accrue to debt holders (Myers, 1977). It also occurs when the firms are not able to fund their growth and investment opportunities with their internal cash flows and find external financing is costly. Gay and Nam (1998) use price-to-book, price-to-earnings, Tobin's Q and research and development (R&D) expenses as a percentage of sales as proxies for underinvestment problem.

Triki (2005) interprets the findings of Froot *et al.* (1993) in his paper by arguing that underinvestment problem may be severe if firms meet two conditions. First, firms must have

positive NPV projects, which can be identified by examining a firm's growth opportunities. Second, these firms may not able to undertake the projects due to high external financing costs, which can be measured by its leverage ratio. Therefore, it is essential to include the proxies that consider the interaction effect of both a firm's growth opportunities and costly external financing. Geczy *et al.* (1997) measure underinvestment problem by considering the interaction effects among a firm's growth opportunities and its leverage. While reviewing the papers on the determinants of hedging, Aretz and Bartram (2010) argue that firms with higher growth opportunities tend to have more underinvestment problem. Hence, these firms are more likely to hedge. On the other hand, they further argue that firms with higher growth opportunities are less likely to hedge since these firms suffer less from free cash flow problems (Table I).

2.2 Review of empirical literature

The lack of publicly available information on usage of derivatives has been a major constraint for empirical research in this area. Given this limitation, earlier research has

Independent variables	Predicted sign	Definition of the variables
QR	−	Ratio between current assets minus inventory and current liabilities
DPO	−	Ratio of dividend per share to earnings per share
FR	+	Ratio of foreign revenue to total revenue
TAX	−	Ratio of income taxes to profit before taxes
LOG of TA	±	Natural logarithm of total assets
ROA	−	Ratio of profit before interest and taxes to average total assets
CAPEX	+	Ratio of change in gross fixed assets to sales
LEV	+	Ratio of long-term debt to long-term debt and net worth
BP	−	Book value of equity to closing market price of equity ratio
TOBIN's Q	+	Ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets
LEV × (1/BP)	+	The product of two continuous variables i.e. leverage ratio and inverse of book value of equity to market price of equity ratio
LEV × TOBIN's Q	+	The product of two continuous variables i.e. the leverage ratio and Tobin's Q ratio

Notes: The second column of the table indicates the predicted sign of the relationship with different measures of currency hedging by firms; We assign + = positive; − = negative; and ± = indeterminate relationship with firm's different measure of hedging. The third column indicates definition of the variables. In the above table, QR is the quick ratio, which is computed as the difference between current assets and inventory scaled by current liabilities; DPO is the ratio of dividend per share to earnings per share; FR is the ratio of a firm's foreign revenue to its total revenue; TAX is the ratio of income taxes to profit before taxes; LOG of TA is the natural logarithm of firm's total assets; ROA is the ratio of profit before interest and taxes to average total assets; CAPEX is the ratio of change in gross fixed assets to sales; LEV is a firm's long-term debt scaled by its sum of its long-term debt and net worth; BP is the ratio of firm's book value of equity to its market price of equity; TOBIN's Q is the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; LEV × (1/BP) is the product of firm's leverage ratio and its inverse of book value of equity to market price of equity; LEV × TOBIN's Q is the product of firm's leverage ratio and Tobin's Q ratio

Table I.
Variable definitions and empirical predictions

mainly relied on a survey-based approach. Nance *et al.* (1993) examine the use of derivatives among firms in the USA for 1986, and find that large firms and firms with more growth opportunities, measured by high levels of R&D expenses, are more likely to hedge.

There are studies that empirically examine the determinants of firm's decision to hedge (i.e. a binary variable equals to one if the firm uses derivatives to hedge its currency, interest rate and/or commodity exposure and zero otherwise) using annual reports disclosure (Geczy *et al.*, 1997; Bartram *et al.*, 2009). There is a surge in empirical research work in this area using disclosures on annual reports for two reasons. First, Financial Accounting Standards Board (FASB) in USA has mandated that all firms starting from 1990 should disclose the usage of derivatives in their annual reports. Second, it overcomes the problem of non-response bias from survey-based analysis. However, these studies do not consider notional amount of derivatives that suffer from aggregation and netting (Geczy *et al.*, 1997). Geczy *et al.* (1997) investigate a sample of USA firms for 1990. Their findings indicate that large firms and firms with higher foreign exchange exposure are more likely to use derivatives to hedge their currency exposure. They also find that firms with significant growth opportunities and leverage tend to have higher underinvestment problem. To quantify this effect, they use interaction effects between price-to-book ratio and leverage ratio. Using a sample of firms over 50 countries, Bartram *et al.* (2009) find that the probability of hedging is positively related to leverage, size and profitability, while negatively related to interest coverage ratio, quick ratio, stock options and market-to-book ratio.

The studies mentioned above document why firms use derivatives to hedge their currency exposures but fail to answer how much they hedge. Zhou and Wang (2013) document that investors would react favourably to firms' disclosure on quantitative information on derivatives, which helps them to reduce cost of capital and thereby increase their value. There are very few empirical studies that empirically examine how much firms do hedge. Howton and Perfect (1998) investigate the use of derivatives for USA firms for 1994. They find that firm's extent of hedging is higher if they have higher currency exposure. Gay and Nam (1998) document a positive relationship between firms' growth opportunities and their derivative usage. They also state that firms with high growth opportunities and low cash availability prefer to hedge more. These findings imply that underinvestment problem is a significant determining factor in firms' hedging policy.

There are two recent notable studies that examine both firm's decision to hedge and the extent of hedging (Khumawala *et al.*, 2016; Lievenbruck and Schmid, 2014). In both these studies, the data on derivatives have been gathered from firm's annual reports. Khumawala *et al.* (2016) investigate the determinants of firm's decision to hedge financial risks[7] and the extent of derivatives usage among large USA municipalities between 2005 and 2008. They find that municipalities that are larger in size and more financially constrained are more likely to hedge their financial risks. This result remains robust to alternative measure of hedging. Lievenbruck and Schmid (2014) examine a sample of firms that belong to energy utilities industry across 50 countries from 2000 to 2009. They find that culture difference among countries, besides firm's size, is one of the important determinants of both firm's decision to hedge and the extent of hedging by firms.

Some of the studies on derivatives usage in the context of the UK are Clark and Judge (2005), Judge (2006) and Marshall *et al.* (2013). Clark and Judge (2005) investigate the hedging activities of UK firms in 1995 by using primary data collected through survey method as well as information gleaned from annual reports. The results suggest that firms with higher financial distress costs and firms with higher underinvestment problem are more likely to hedge with currency derivatives. Similarly, firms with higher levels of foreign currency exposure or that suffer from liquidity, and also those that enjoy transaction and information

scale of economies in hedging are more likely to hedge with currency derivatives. Judge (2006) analyses the hedging practices of firms in the UK for 1995 using hand-collected data on currency derivatives from firm's annual reports and reports firms mainly use currency derivatives to reduce financial distress costs. Further, the author argues that the expected costs of financial distress are higher for the firms in the UK than for the firms in the USA, as the bankruptcy code in the UK is in favour of debt-holders. They also find that larger firms are more likely to hedge their currency exposure, which supports the economies of scale argument. Marshall *et al.* (2013) examine the currency hedging practices of firms that are listed on the Alternative Investment Market (AIM) in the UK for 2006, and find that larger firms are more likely to hedge their currency risk.

Studies relating to other European countries other than the UK are Davies *et al.* (2006) in the context of Norway and Aabo and Ploeen (2014) in the context of Germany. Davies *et al.* (2006) find that firms that are larger in size and firms with larger percentages of revenues denominated in foreign currency are more likely to hedge their currency exposure. However, they do not find the evidence of reduction of financial distress costs due to the usage of currency derivatives. Aabo and Ploeen (2014) find that firm's size and firms with higher growth opportunities tend to use more derivatives to hedge their currency exposure. Further, their findings suggest that there is an inverted U-shape relationship between a firm's exchange rate exposure, measured by foreign sales, and its extent of hedging.

Given the extreme currency volatility and high inflation among emerging countries, it is important to understand the determinants of derivatives usage in the context of emerging countries. In the context of Indonesia, Danila and Huang (2016) examine a sample of 276 listed firms for 2012. They find that size of the firm is positively associated with firm's propensity to use currency derivatives. Earlier research in this area in the Indian context has adopted a survey-based approach. This is due to the fact that Indian firms are recommended to disclose the information on derivatives from April 1, 2009[8]. There are two notable survey studies from India (Anand and Kaushik, 2008; Jain *et al.*, 2009). Anand and Kaushik (2008) examine the use of derivatives for 2005. They find that Indian firms use currency derivatives to reduce volatility in profitability and cash flows as well as to improve firm value. A similar study by Jain *et al.* (2009) documents that Indian firms mainly use currency derivatives to minimise their variability of the following: cash flows, accounting earnings and firm value.

From the above-mentioned studies, it can be inferred that existing empirical evidence on the determinants of firm's hedging decisions is mixed. To integrate the findings from different empirical studies, Arnold *et al.* (2014) review the empirical literature on the determinants of firm's hedging by employing statistical meta-analysis[9]. They find that firms with both higher leverage ratio and lower current ratio leading to higher propensity to hedge by firms. This result implies that firms with higher financial distress costs have greater incentives to hedge. Further, they do not find statistical association between underinvestment problem and firm's hedging decisions at the conventional levels.

3. Data and methodology

3.1 Data

We construct our sample of firms from S&P CNX 500 for 2009. The selection of this particular index is appropriate, as it represents 92.57 per cent of total market capitalization on the National Stock Exchange (NSE) of India Limited as of September 30, 2009[10]. Of the S&P CNX 500 firms, we drop 63 firms from banking and financial services sector, as they use some or all of their derivatives for trading and not for hedging purposes. We are left with 437 non-financial firms. The sample size further reduces to 431 due to non-availability of annual reports pertaining to six firms from Capitaline database[11]. Our final sample is 332 firms out

of 431, as the remaining firms do not report their usage and/or non-usage of derivatives in their annual reports for 2009.

The data on currency derivatives are hand-collected from firms' annual reports. The electronic version of the annual reports is obtained from the Capitaline database, which is maintained by Capital Market Publishers India Limited. We search the annual reports with each of the key words such as derivative, hedge, forward, option, call, put, swap, foreign and currency to identify the information on currency derivatives. A similar methodology is employed by researchers to gather the information on the usage of derivatives in risk management literature (Bartram *et al.*, 2009; Allayannis *et al.*, 2012; Lievenbruck and Schmid, 2014). A firm is identified as a currency derivative user (hedger) if its annual report clearly states the usage of derivatives to hedge its foreign exchange exposure (Allayannis *et al.*, 2012). A firm is considered to be currency derivative non-user (non-hedger) if its annual report mentions that it does not use currency derivatives to hedge its foreign exchange exposure and/or disclose only non-hedged information on foreign exchange exposure. The information on firms' notional amount of derivative instruments outstanding is collected from their annual reports as reported as on the date of their balance sheet. The notional amounts of derivative exposures expressed in terms of foreign currency are converted into Indian Rupee by using the exchange rates from Thomson Reuters' database. The notional amount of derivatives is the sum of forwards, options and swaps under receivables, payables and long-term loans hedging. Among firms with disclosure on the notional amount of currency derivatives, hedged firms are further classified as completely and selectively hedged firms. Completely hedged firms are those which report the information on hedged but no information on non-hedged currency exposures in their annual reports. Selectively hedged firms are those which report the hedged and non-hedged information on currency exposure in their annual reports. The Nifty Index values and the financial statement information are collected from Prowess database of CMIE (Centre for Monitoring Indian Economy)[12]. We winsorise all accounting ratios used in our analysis at one and 99 percentiles respectively to eliminate some apparent data errors or the impact of outliers.

3.2 Methodology

In this study, we follow Haushalter's (2000) approach to examine the determinants of firms' decision on currency hedging[13]. A firm can make its hedging decision in one step, deciding whether to hedge and how much to hedge. Given the nature of dependent variable, it is appropriate to use Tobit regression. A firm can also decide its hedging decision in two steps by deciding first on whether to hedge and later how much to hedge. We model this two-step process by using Cragg model (1971)[14]. A firm's decision to hedge is modeled by probit regression and the firm's decision on how much to hedge is modeled by conditional regression.

3.2.1 Tobit regression model. To investigate the determinants of a firm's hedging policy, we use cross-sectional Tobit regression model. In these regressions, we examine the determinants of derivatives usage with the notional amount of currency derivatives holdings scaled by total assets as dependent variable. We find a significant number of zero observations for the amount of currency derivatives holdings. There are a few reasons why the dependent variable could be censored. First, smaller firms may not be able to initiate the hedging programme as compared to larger firms due to the fixed cost involved in setting up of trading desk dealing in derivatives. Second, managers could have been able to anticipate that the exchange rate movement might occur in their favour. Third, larger firms enjoy significant transaction and informational cost economies of scale as compared to smaller firms in accessing the risk management expertise.

The following Tobit regression model is estimated:

$$y_i = \max[0,\ \beta_0 + x_i^{'}\beta + \varepsilon_i] \tag{1}$$

y_i equals a firm's notional amount of currency derivatives holdings scaled by total assets for currency derivative users and is equal to zero for currency derivative non-users. The subscript i indexes observation. x_i is a k × 1 vector of firm-specific characteristics: quick ratio (QR), which is measured as the ratio between current ratio minus inventory and current liabilities; book-to-market ratio (BP), which is computed as the book value of equity divided by the market value of equity; dividend payout ratio (DPO), which is defined as dividend per share to earnings per share; foreign revenue ratio (FR), which is estimated as foreign revenue divided by total revenue; tax rate (TAX), which represents income taxes to profit before taxes; natural logarithm of total assets (LOG of TA); return on assets ratio (ROA), which is measured as profit before interest and taxes over average total assets; capital expenditure divided by sales (CAPEX), which is measured as change in gross fixed assets to sales; Tobin's Q ratio (TOBIN's Q), which is computed as the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; leverage (LEV), which is considered as the ratio between long-term debt ratio and the sum of long-term debt ratio and the net worth. (LEV × 1/BP) is the product of two continuous variables, such as the leverage ratio and the inverse of book value of equity to market value of equity ratio; (LEV × Tobin's Q ratio) is an interaction variable, which is the product of two continuous variables, such as the leverage ratio and Tobin's Q ratio; and ε is the error term of Tobit regression, respectively. We re-estimate equation (1) with Tobin's Q ratio in place of book-to-market ratio and also replace the interaction variable between leverage and inverse of book-to-market ratio (Lev × 1/BP) with the interaction variable between leverage and Tobin's Q ratio (Lev × Tobin's Q ratio). β_0 being the intercept, and β is a k × 1 vector of the parameters of Tobit regression. The rationale for considering the covariates in equation (1) has been explicated succinctly in the Section 2.1.

3.2.2 Cragg model. We employ Cragg model (Cragg, 1971) to separate the decision to hedge from the extent of hedging among hedgers (Haushalter, 2000). We use a probit regression model to examine the effects of firm-specific determinants that influence firm's decision to hedge. The dependent variable is equal to one if the firm discloses its currency derivatives usage to hedge its foreign currency exposure in its annual reports and zero otherwise. In a conditional regression model, we examine the determinants of the extent of hedging, conditional on firm hedging. The dependent variable is the amount of currency derivatives holdings scaled by total assets given that firm hedges.

3.2.2.1 Probit regression model. In probit regression model, *hedge* is equal to one if a firm discloses its usage of currency derivatives to hedge its foreign currency exposure and zero otherwise.

$$Prob\ (hedge = 1 \mid x_i) = \Phi[a_0 + x_i^{'}\ \alpha + \eta_i] \tag{2}$$

where, Φ is the cumulative distribution function of the standard normal; x_i is a k × 1 vector of firm-specific characteristics, which is same as equation (1), and η_i is the error term of probit regression. α_0 being intercept, and α is a k × 1 vector of the parameters of probit regression.

3.2.2.2 Conditional regression model. In conditional regression, y_i^* is amount of currency derivatives holdings scaled by total assets given that firm hedges.

$$y_i^* = \delta_0 + x_i^{'}\ \delta + \upsilon_i \tag{3}$$

where, x_i is a k × 1 vector of firm-specific characteristics, which is the same as equation (1), and υ_i is the error term of the conditional regression. δ_0 being the intercept, and δ is a k × 1 vector of parameters of conditional regression.

4. Empirical results

The empirical findings of this study are reported in Tables II-VII.

In Table II, the number of completely hedged firms (percentage of firms) and selectively hedged firms (percentage of firms) are 37 (18.97 per cent) and 158 (81.03 per cent). The table presents the frequency and notional amounts of foreign currency forwards, options and swaps outstanding on the basis of the contract type across all firms. Among the firms that disclose the notional amount of currency derivatives, 6.63 per cent of firms have not disclosed their contract type of derivatives usage, namely, forwards, options or swaps. Since the majority of firms use forwards as the main instrument of choice to hedge currency risk, we

Firm category	Forwards	Options	Swaps
(i) All hedged firms			
Number of users	174	55	50
Notional amount:			
Mean	9,316.97	5,382.26	4,588.90
Median	1,746.28	2,022.40	1,369.45
Notional amount/Total assets			
Mean (in %)	17.26	10.64	6.32
Median (in %)	6.29	4.35	3.71
(ii) Completely hedged firms			
Number of users[a]	34	11	5
Notional amount:			
Mean	7,730.07	1,429.46	1,992.98
Median	1,912.73	464.00	2,566.04
Notional amount/Total assets			
Mean (in %)	28.64	12.96	7.24
Median (in %)	16.87	2.61	4.00
(iii) Selectively hedged firms			
Number of users[b]	140	44	45
Notional amount:			
Mean	9,702.36	6,370.46	4,877.34
Median	1,415.96	2,492.17	1,217.30
Notional amount/Total assets			
Mean (in %)	14.50	10.06	6.22
Median (in %)	4.95	5.60	3.71

Notes: The above table reports the number of currency derivative users, the notional amount of currency derivatives (Rs in millions) and the notional amount of currency derivatives holdings scaled by total assets on the basis of contract type; Completely hedged firms are those firms that report the information on hedged but no information on non-hedged currency exposures in their annual reports; Selectively hedged firms are those firms that report the hedged and non-hedged information on currency exposure in their annual reports; The sum of completely hedged and selectively hedged currency exposures is under all hedged firms; [a]The total number of completely hedged firms is 37; This does not add up to the total number of firms using forwards, options and swaps because a single firm can use more than one derivative instrument to hedge currency risk; [b]The total number of selectively hedged firms is 158; This does not add up to the total number of firms using forwards, options and swaps because a single firm can use more than one derivative instrument to hedge currency risk

Table II. Descriptive statistics for currency derivatives user firms based on contract type

Firm category	Receivables hedging	Payables hedging	Long-term loans hedging
(i) All hedged firms			
Number of users	149	75	79
Notional amount:			
Mean	8,473.32	4,624.55	6,800.73
Median	1,751.91	1,390.14	1,536.16
Notional amount/Total assets:			
Mean (in %)	17.78	7.70	8.59
Median (in %)	7.47	2.42	4.49
(ii) Completely hedged firms			
Number of users[a]	31	9	13
Notional amount:			
Mean	7,145.23	3,162.47	2,965.17
Median	1,771.88	1,574.59	2566.04
Notional amount:			
Mean (in %)	26.42	10.28	18.53
Median (in %)	16.87	4.38	14.43
(iii) Selectively hedged firms			
Number of users[b]	118	66	66
Notional amount:			
Mean	8,822.22	4,823.92	7,556.22
Median	1,718.68	1,208.77	1,493.92
Notional amount:			
Mean (in %)	15.51	7.35	6.63
Median (in %)	6.29	2.33	3.86

Notes: The above table reports the number of users, mean and median notional amount of currency derivatives (Rs in millions) and mean and median notional amount of currency derivatives holdings scaled by total assets depending upon the firms' purpose; Completely hedged firms are those firms that report the information on hedged but no information on non-hedged currency exposures in their annual reports; Selectively hedged firms are those firms that report the hedged and non-hedged information on currency exposure in their annual reports; The sum of completely hedged and selectively hedged currency exposures is under all hedged firms; [a] The total number of completely hedged firms is 37; This does not add up to the total number of firms using currency derivatives to hedge foreign currency receivables, foreign currency payables and foreign currency long-term loans because a single firm can hedge more than one form of currency exposure; [b] The total number of selectively hedged firms is 158; This does not add up to the total number of firms using currency derivatives to hedge receivables, payables and long-term loans (all expressed in foreign currency) because a single firm can hedge more than one form of currency exposure

Table III.
Descriptive statistics for currency derivatives user firms based on the purpose

classify these non-reporting firms under forwards. The mean (median) notional amounts of forwards, options and swaps of all hedged firms are 9,316.97 (1,746.28) millions, 5,382.26 (2022.4) millions and 4,588.90 (1,369.45) millions, respectively. The mean (median) notional amounts of forwards, options and swaps scaled by total assets of all hedged firms are 17.26 (6.29) per cent, 10.64 (4.35) per cent and 6.32 (3.71) per cent, respectively. These results imply that forwards are the main instrument of choice for managing currency risk followed by options and swaps. This may be due to the fact that forwards and options are relatively more cost effective than swaps (Geczy *et al.*, 1997). Using mean (median) notional amount of forwards, options and swaps scaled by total assets, we find qualitatively similar results for completely hedged and selectively hedged firms.

Table III shows the frequency and notional amounts of foreign currency derivatives outstanding depending on the purpose of usage across all firms. Among the firms that

Independent variables	Hedgers ($N = 280$) Median	Non-hedgers ($N = 52$) Median	z statistic
QR	1.20	1.42	2.08**
DPO	0.17	0.19	−0.06
FR	0.14	0.03	−4.68***
TAX	0.14	0.21	1.63
LOG of TA	7.79	7.13	−1.76*
ROA	0.10	0.12	1.17
CAPEX	0.06	0.08	0.45
LEV	0.45	0.24	−3.53***
BP	0.93	0.70	−1.92*
TOBIN's Q	1.02	1.20	1.95*
LEV × (1/BP)	0.35	0.22	−2.41**
LEV × TOBIN's Q	0.46	0.22	−2.97***

Notes: The above table presents the median for hedgers ($N = 280$) and non-hedgers ($N = 52$); The last column presents z statistic values of Wilcoxon rank sum (Mann Whitney) test, which tests for differences in medians between hedgers and non-hedgers; In the above table, QR is the quick ratio, which is computed as the difference between current assets and inventory scaled by current liabilities; DPO is the ratio of dividend per share to earnings per share; FR is the ratio of a firm's foreign revenue to its total revenue; TAX is the ratio of income taxes to profit before taxes; LOG of TA is the natural logarithm of firm's total assets; ROA is the ratio of profit before interest and taxes to average total assets; CAPEX is the ratio of change in gross fixed assets to sales; LEV is a firm's long-term debt scaled by its sum of its long-term debt and net worth; BP is the ratio of firm's book value of equity to its market price of equity; TOBIN's Q is the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; LEV × (1/BP) is the product of firm's leverage ratio and its inverse of book value of equity to market price of equity; LEV × TOBIN's Q is the product of firm's leverage ratio and Tobin's Q ratio; ***significant at the 0.01 level; **significant at the 0.05 level; *significant at the 0.10 level

Table IV. Comparison of financial characteristics of hedgers and non-hedgers

disclose the notional amount of currency derivatives based on their purpose of usage, 17.95 per cent of firms do not disclose whether they use these derivatives to hedge receivables or payable or long-term loans. For our analysis, we classify those non-reporting firms under receivables[15]. The mean (median) notional amounts of foreign currency derivatives for all hedged firms under receivables hedging, payables hedging and long-term loans hedging are 8,473.32 (1,751.91) millions, 4,624.55 (1,390.14) millions and 6,800.73 (1,536.16) millions, respectively. The mean (median) notional amounts of foreign currency derivatives for all hedged firms under receivables hedging, payables hedging and long-term loans hedging scaled by total assets are 17.78 (7.47) per cent, 7.70 (2.42) per cent and 8.59 (4.49) per cent, respectively. This implies that firms use currency derivatives to hedge mainly for receivables followed by long-term loans and payables. Qualitatively similar results are found when we observe the mean (median) notional amount of currency derivatives for completely and selectively hedged firms. In Tables II and III, the distribution of derivatives use is skewed with mean derivative contract values higher than median derivative contract values. This result implies that larger firms use more currency derivatives than smaller firms.

4.1 Comparison of financial characteristics of hedgers and non-hedgers

Table IV reports the medians of independent variables used in our study for hedgers (i.e. currency derivative users) and non-hedgers (i.e. currency derivative non-users). The table also reports the results from Wilcoxon rank sum (Mann Whitney) tests for differences in medians.

Independent variables	Model 1	Model 2
QR	−0.03** (−2.00)	−0.03* (−1.73)
DPO	0.01 (0.02)	0.01 (0.08)
FR	0.51*** (6.20)	0.50*** (6.06)
TAX	0.01 (0.06)	−0.04 (−0.32)
LOG of TA	−0.01 (−0.98)	−0.01 (−0.94)
ROA	−0.54** (−2.61)	−0.47** (−2.03)
CAPEX	−0.06* (−1.66)	−0.07* (−1.84)
LEV	0.01 (0.07)	−0.05 (−0.33)
BP	0.03 (1.33)	
TOBIN's Q		−0.04 (−1.14)
LEV × (1/BP)	0.03 (1.05)	
LEV × (TOBIN's Q)		0.08 (0.84)
INTERCEPT	0.14 (1.35)	0.22** (2.04)
No. of observations	244	244
F statistic (10,234)	5.73***	5.89***
Pseudo R^2	0.63	0.63

Notes: The above table reports the results of Tobit regression in which the dependent variable is the amount of currency derivatives holdings scaled by total assets; Robust *t* statistics are reported in parentheses; In the above table, QR is the quick ratio, which is computed as the difference between current assets and inventory scaled by current liabilities; DPO is the ratio of dividend per share to earnings per share; FR is the ratio of a firm's foreign revenue to its total revenue; TAX is the ratio of income taxes to profit before taxes; LOG of TA is the natural logarithm of firm's total assets; ROA is the ratio of profit before interest and taxes to average total assets; CAPEX is the ratio of change in gross fixed assets to sales; LEV is a firm's long-term debt scaled by its sum of its long-term debt and net worth; BP is the ratio of firm's book value of equity to its market price of equity; TOBIN's Q is the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; LEV × (1/BP) is the product of firm's leverage ratio and its inverse of book value of equity to market price of equity; LEV × TOBIN's Q is the product of firm's leverage ratio and Tobin's Q ratio; INTERCEPT is the intercept term of the Tobit regression; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.10 level

Table V.
Tobit regression results–analysis of hedging policy

In this study, we find that 84.34 per cent of sample firms have hedged their foreign currency exposure, and the remaining 15.66 per cent of sample firms do not hedge their foreign currency exposure. Consistent with the financial distress cost hypothesis, hedgers have significantly higher leverage but lower quick ratio as compared to non-hedgers. Additionally, foreign exchange exposure of hedged firms is higher than non-hedged firms. This implies that geographically diversified firms prefer to hedge. Hedged firms are significantly larger in size than non-hedged firms, which support economies of scale argument that larger firms prefer to hedge more than smaller firms. The profitability ratio, dividend payout ratio and tax rate of hedgers are not statistically different from non-hedgers. Hedgers have a significantly higher book-to-market ratio but lower Tobin's Q ratio than non-hedgers. Capital expenditure to sales ratio of hedged firms is lesser than non-hedged firms, and it is also statistically insignificant. However, the interaction effects between a firm's leverage and the inverse of its book- to-market ratio is statistically different from zero. This suggests that hedged firms are highly leveraged with higher growth than non-hedged firms. These results are consistent with Bartram *et al.* (2009). The results are qualitatively similar when we observe the interaction effects among a firm's leverage and Tobin's Q ratio, which supports our argument that hedged firms are more likely to have higher debt with higher growth.

Most of the firm characteristics which are statistically significant are consistent with theoretical motivations on derivative usage. This supports the fact that firm-specific characteristics are important

Independent variables	Model 1	Model 2
QR	−0.15** (−2.27)	−0.16** (−2.60)
DPO	0.45 (0.90)	0.73 (1.36)
FR	1.95*** (3.92)	1.85*** (3.75)
TAX	−0.21 (−0.26)	−0.76 (−0.90)
LOG of TA	0.11 (1.40)	0.13* (1.64)
ROA	−1.69 (−1.48)	−0.48 (−0.40)
CAPEX	−0.31** (−2.09)	−0.33** (−2.07)
LEV	1.30** (2.15)	0.57 (0.68)
BP	−0.01 (−0.03)	
TOBIN's Q		−0.33** (−2.02)
LEV × (1/BP)	−0.13 (−0.71)	
LEV × (TOBIN's Q)		0.23 (0.43)
INTERCEPT	−0.02 (−0.03)	0.31 (0.42)
No. of observations	328	328
Wald chi-square (10)	39.40***	43.53***
Pseudo R^2	0.18	0.19

Notes: The above table reports the results of probit regression in which the dependent variable is equal to one if the firm discloses its usage of currency derivatives to hedge its currency exposure and zero otherwise; Robust *z* statistics are reported in parentheses; Wald chi-square test tests the hypothesis that the coefficient estimate for all of the independent variables is zero; In the above table, QR is the quick ratio, which is computed as the difference between current assets and inventory scaled by current liabilities; DPO is the ratio of dividend per share to earnings per share; FR is the ratio of a firm's foreign revenue to its total revenue; TAX is the ratio of income taxes to profit before taxes; LOG of TA is the natural logarithm of firm's total assets; ROA is the ratio of profit before interest and taxes to average total assets; CAPEX is the ratio of change in gross fixed assets to sales; LEV is a firm's long-term debt scaled by its sum of its long-term debt and net worth; BP is the ratio of firm's book value of equity to its market price of equity; TOBIN's Q is the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; LEV × (1/BP) is the product of firm's leverage ratio and its inverse of book value of equity to market price of equity; LEV × TOBIN's Q is the product of firm's leverage ratio and Tobin's Q ratio; INTERCEPT is the intercept term of the probit regression; ***significant at the 0.01 level; **significant at the 0.05 level; *significant at the 0.10 level

Table VI. Probit analysis for firm's participation decision on usage of currency derivatives

in determining the firm's risk management policy. We further examine the characteristics of completely and selectively hedged firms. The results are qualitatively similar to base case results. Owing to constraints of space, we do not report the results.

4.2 Tobit regression results – the extent of hedging

In Table V, we examine the determinants of currency derivatives usage by estimating a Tobit regression model with the notional amount of currency derivatives holdings scaled by total assets as dependent variable.

The quick ratio is negatively related to extent of hedging. This result supports financial distress cost hypothesis: firms with more internal funds prefer to hedge less. This finding is in line with Howton and Perfect (1998). There is a positive and significant relationship between foreign exchange exposure and the extent of hedging. This indicates that geographically diversified firms prefer to hedge more to reduce their volatility of cash flows, as these firms' revenue and/or cost are in different currencies. This result is comparable to the findings of Howton and Perfect (1998).

The result for the variable pertaining to profitability is negatively related to the extent of hedging. This result suggests that firms would have lower financial distress costs with higher profitability. On the other hand, the capital expenditure to sales ratio measure is

Independent variables	Model 1	Model 2
QR	−0.01 (−0.67)	−0.01 (−0.38)
DPO	−0.07 (−0.91)	−0.08 (−1.04)
FR	0.39*** (4.63)	0.38*** (4.53)
TAX	0.04 (0.33)	0.02 (0.19)
LOG of TA	−0.02* (−1.77)	−0.02* (−1.93)
ROA	−0.59** (−2.37)	−0.63** (−2.43)
CAPEX	−0.02 (−0.83)	−0.03 (−1.04)
LEV	−0.13 (−1.16)	−0.11 (−0.65)
BP	0.03 (1.28)	
TOBIN's Q		−0.01 (−0.04)
LEV × (1/BP)	0.03 (1.43)	
LEV × (TOBIN's Q)		0.04 (0.34)
INTERCEPT	0.33*** (2.89)	0.39*** (3.31)
No of observations	195	195
F statistic (10,184)	3.69***	3.63***
Adjusted R^2	0.21	0.20

Notes: The above table reports the results of conditional regression in which the dependent variable is the amount of currency derivatives holdings scaled by total assets given that firm hedges; Robust *t* statistics are reported in parentheses; In the above table, QR is the quick ratio, which is computed as the difference between current assets and inventory scaled by current liabilities; DPO is the ratio of dividend per share to earnings per share; FR is the ratio of a firm's foreign revenue to its total revenue; TAX is the ratio of income taxes to profit before taxes; LOG of TA is the natural logarithm of firm's total assets; ROA is the ratio of profit before interest and taxes to average total assets; CAPEX is the ratio of change in gross fixed assets to sales; LEV is a firm's long-term debt scaled by its sum of its long-term debt and net worth; BP is the ratio of firm's book value of equity to its market price of equity; TOBIN's Q is the ratio between book value of total assets minus book value of equity plus market value of equity and book value of total assets; LEV × (1/BP) is the product of firm's leverage ratio and its inverse of book value of equity to market price of equity; LEV × TOBIN's Q is the product of firm's leverage ratio and Tobin's Q ratio; INTERCEPT is the intercept term of the conditional regression; ***significant at the 0.01 level; **significant at the 0.05 level; *significant at the 0.10 level

Table VII.
Conditional regression model–the extent of hedging among hedgers

negative, which is contrary to our expectation. This result suggests that our sample firms may not hedge to increase their investment opportunities.

4.3 Cragg's model – separating the firm's likelihood to hedge from the extent of hedging among hedgers

4.3.1 Probit regression results. The dependent variable is equal to one if a firm discloses its usage of currency derivatives to hedge its currency exposure and zero otherwise.

In Table VI, we find a significant negative relationship between quick ratio and the firms' decision to hedge. This implies that more internally generated funds would result in lower probability of hedging. This strengthens our argument that firms with higher liquid assets tend to have lower financial distress costs. This finding is consistent with the results of Geczy *et al.* (1997) and Bartram *et al.* (2009). In particular, the firm's size is positively associated to its likelihood of hedging. This supports the fact that larger firms when compared with smaller firms enjoy transactional and informational economies of scale in accessing the risk management expertise. This result is comparable to the findings of Geczy *et al.* (1997) and Bartram *et al.* (2009).

The significantly positive coefficient on leverage ratio implies that firms are able to increase their debt capacity or able to reduce their financial distress costs through hedging. This result is in line with the findings of Bartram *et al.* (2009). Capital expenditure to sales

ratio is statistically significant and negatively related to firm's likelihood of hedging, which is contrary to our expectation.

A consistent positive relationship between foreign exchange exposure and the firm's decision to hedge, suggests that the geographically diversified firms prefer to hedge. This result is consistent with Geczy *et al.* (1997). The relationship between a firm's growth opportunities, as measured by Tobin's Q ratio, and its decision to hedge is significant and negative. This result is contrary to the predictions of underinvestment problem. A plausible explanation for this contradictory result is that firms with higher growth opportunities are less likely to have free cash flow problems, and hence are less likely to engage in hedging (Aretz and Bartram, 2010).

4.3.2 Conditional regression results. The dependent variable is the amount of currency derivatives holdings scaled by total assets given that firm hedges its currency exposure.
The estimated coefficient for profitability is negative and significant in conditional regression. This finding suggests that profitable firms tend to decrease their usage of currency derivatives since these firms tend to have lower financial distress costs. The results also indicate that there is a positive relationship between foreign exchange exposure and the extent of hedging among hedgers. This evidence implies that firms with higher foreign exchange exposure prefer to hedge more.

Firm's size is negatively related to the extent of hedging among hedgers in all the specifications. This result implies that smaller firms should hedge more than larger firms since there is an inverse relationship between firm size and bankruptcy costs. This result is in line with the findings of Haushalter (2000). On the other hand, the probit regression model indicates a positive relationship between a firm's size and its decision to use derivatives to hedge currency exposure. This difference highlights the fact that economies of scale are important to initiate hedging programme. This argument is in line with Haushalter (2000). However, Tobit regression model finds no significant relationship between firm's size and the extent of hedging since it estimates one coefficient for both the decisions and cannot identify whether a firm's size affects these two decisions differently. This finding is similar to the findings of Haushalter (2000).
In probit, conditional and Tobit regressions, we find that the coefficients of interaction effects among a firm's leverage and inverse of book-to-market ratio, and also interaction effects among a firm's leverage and its Tobin's Q are statistically insignificant. These results imply that underinvestment problem may not be a determining factor for either a firm's decision to hedge or a firm's extent of hedging.

As a control for industry fixed effects in Tobit, probit and conditional regressions, we use industry dummies based on National Industrial Classification (NIC) three digits code and find them jointly insignificant. Therefore, we report the regression results without industry fixed effects.

4.5 Robustness tests

We conduct a series of robustness checks of our results. To control for endogeneity in any of our independent variables, we measure all independent variables as of 2008 and the firms' measures of hedging as of 2009 (Geczy *et al.*, 1997; Greene, 2000; Shiu and Moles, 2010). Most of our results are similar in sign, but lower magnitude in statistical significance. We measure all flow variables and the firm's measures of hedging as of 2009 and the stock variables as of 2008 (Geczy *et al.*, 1997). Measuring flow variables as of 2009 is a better proxy for management's expectations. The results are qualitatively similar.

Finally, we control for potential endogeneity between the capital structure represented by long-term debt ratio and firm's different measures of hedging. We re-estimate the regression

models by excluding the long-term debt ratio and find that the results are qualitatively similar. This argument is comparable with the findings of Geczy *et al.* (1997). To conserve the space, the results of above mentioned robustness checks are not reported in the paper.

5. Conclusions

In this paper, we examine the determinants of firms' different hedging measures like firms' decision to use derivatives and the extent of hedging. We find significant differences in firm characteristics between derivative users and non-users and firm-specific determinants like profitability, size and exposure to currency risks significantly impact the extent of derivatives usage. We find that the larger firms are more likely to hedge, which signifies the importance of economies of scale in accessing the risk management expertise. Firms' leverage ratio is positively associated to their likelihood of hedging while the liquidity measure is negatively related to firms' propensity to use derivatives to hedge currency risk and the firm's decision on how much to hedge. The profitability measure is negatively associated to the extent of hedging and also to the extent of hedging among hedgers. The size is negatively associated to the extent of hedging given that the firm hedges. These findings suggest that firms with higher financial distress costs tend to use more derivatives. Further, we find that firms with higher foreign exchange exposure use more derivatives to hedge their currency exposure since these firms tend to have revenue and/or cost in multiple currencies. This finding is robust across different measures of hedging.

Using a firm's growth opportunities and also interaction effects among firms' growth opportunities and leverage, as proxies for underinvestment problem, we investigate whether firms with higher underinvestment problem prefer to hedge more with derivatives. We find statistically insignificant relationship between variables capturing underinvestment problem and firms' usage of derivatives. This implies that the underinvestment problem may not be a determining factor for firms' derivatives usage.

Notes

1. Available at: www.bis.org/
2. Source: available at: www.rbi.org
3. Source: International Monetary Fund, World Economic Outlook Database, October 2012.
4. In this paper, we measure daily volatility of USD/INR returns by the standard deviation of daily USD/INR returns for each financial year. Then we annualise this by multiplying it by square root of 252, assuming 252 trading days in a financial year, to estimate annualised daily volatility of USD/INR returns.
5. We follow an approach which was employed by Haushalter (2000) in examining the determinants of hedging practices for oil and gas producers in the context of US.
6. For more details see Singhania and Singhania (2008).
7. Firm's decision to hedge financial risk is defined in terms of dummy variable, which is equal to one if firm hedges any one of the types of risks such as currency risk, interest rate risk and commodity risk.
8. Accounting standard (AS) 30, Financial Instruments: Recognition and Measurement, issued by the Council of the Institute of Chartered Accountants of India.
9. Glass (1976) defines statistical meta-analysis as "statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings".
10. Source: available at: www.nseindia.com

11. The database, which is maintained by Capital Market Publishers India Private Limited, Mumbai, India (accessed 9 September 2010). It contains electronic version of financial statements. The same database has been used by Siegel and Choudhury (2012).
12. The database that is maintained by CMIE (accessed 9 September 2010), and the same database has been used by studies done in the Indian context such as Khanna and Palepu (2000) and Anand and Kaushik (2008).
13. Haushalter (2000) examines firms' hedging behavior related to commodities, specifically oil and gas in the US
14. For more details, see Greene (2000).
15. Most of the Indian firms hedge their anticipated currency exposures together with current years' exposure, and the Indian Rupee has appreciated vis-à-vis foreign currencies in 2008. For example, the US Dollar/INR was 39.99 and 43.60 in March 2008 and March 2007, respectively. Hence, we conjecture that Indian firms are more apprehensive about Indian Rupee appreciation during 2008.

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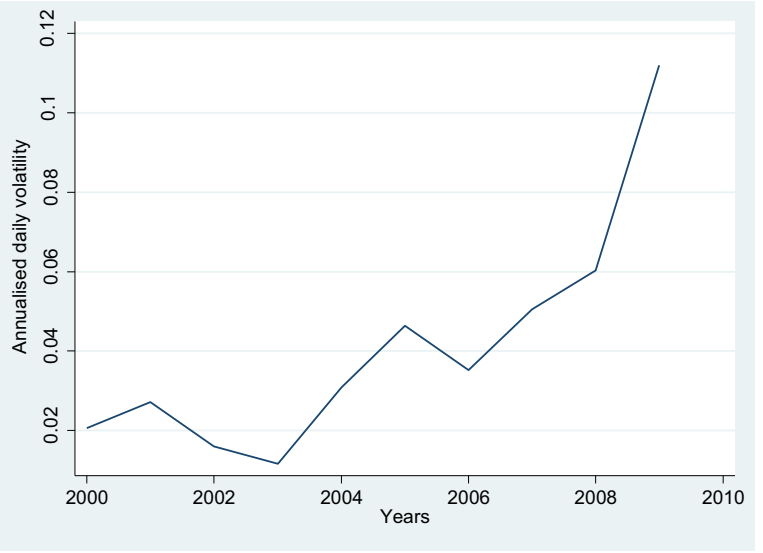
Appendix



Notes: The data on exchange rates are collected from Thomson Reuters' database; We measure the daily volatility of USD/INR returns by the standard deviation of daily USD/INR returns for each financial year; Then,we annualise this by multiplying it by square root of 252, assuming 252 trading days in a financial year, to estimate annualised daily volatility of USD/INR returns
Source: Authors'calculation

Figure A1. Annualised daily returns volatility of USD/INR from 2000 to 2009

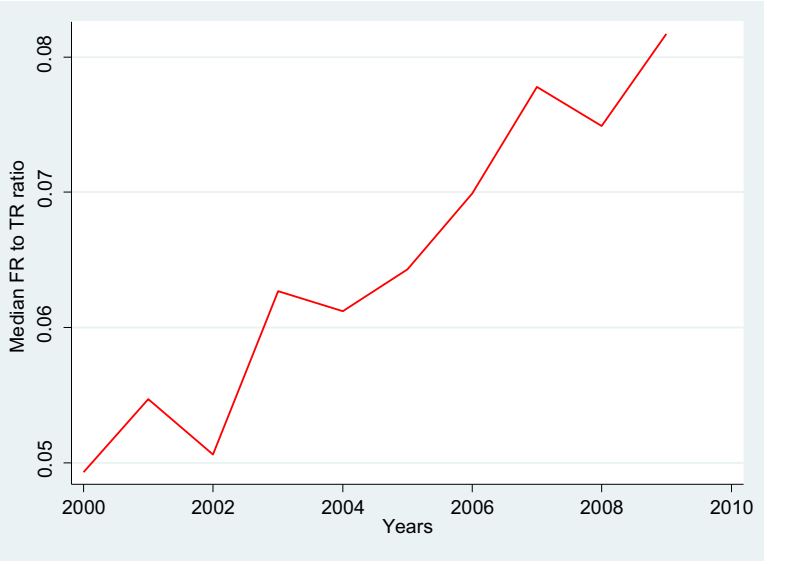


Figure A2.
Foreign exchange exposure of Indian firms from 2000 to 2009

Notes: The data on foreign revenue to total revenue (FR to TR) ratio is computed based on data available from CMIE Prowess database; In all, 437 non-financial firms are considered for generating the graph
Source: Authors' calculation

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