

ASYMMETRIC EXCHANGE RATE EXPOSURE AND ITS DETERMINANTS: ANALYSIS OF THE EMERGING MARKET FIRMS

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Abstract

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The wave of globalization has increased international trade and business to many folds. Countries moving toward capital account convertibility have enabled investors to invest in any part of the world. Consequently, financial integration has led to volatility in the currency and capital market. The variation in the exchange rate leads to fluctuation in stock return. However, the response of firms to currency fluctuation may vary for periods of appreciation and depreciation. The daily return of 260 firms was analyzed from 2004 to 2019. The study uses the orthogonalized model developed by Di Iorio and Faff (2000) and Koutmos and Martin (2003). The result shows that 66.54% of firms were affected by currency fluctuations and 12.2% of firms responded asymmetrically to periods of appreciation and depreciation. The analysis revealed that service sector firms are more exposed to currency fluctuation than the manufacturing sector. The study also explores a comprehensive range of determinants of exchange rate exposure. The research revealed that size and quick ratio are inversely related while asset turnover, foreign sales, and book-to-market value have a positive relationship with exchange rate exposure. The research will act as a guiding force to the policymakers to make an efficient exchange rate policy while portfolio managers can use the findings of the study in forming hedging strategies.

Keywords: Foreign Exchange, Exchange Rate Exposure, Multinational Firms, International Financial Markets, Asymmetry, Panel Data

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1. INTRODUCTION

The interdependence of the exchange rate and the stock price has attracted much attention in international finance and macroeconomics literature. In the light of internationalization of trade, relaxation of control on capital movement, and flexible exchange rate, the scope of global

investment has broadened. However, it has intensified the volatility and risk related to the investment decision. These investment opportunities in the capital market are accompanied by currency volatility. An infusion of foreign investment leads to the demand for home currency, thereby appreciating it. However, the outflow of capital leads to the depreciation of the currency

(Frankel, 1983; Branson, 1983). Currency fluctuation leads to the variability of the cash flow of the firm. The flow approach postulates that the currency value affects the international competitiveness of export. It impacts assets, liabilities, profit, and hence the equity value (Dornbusch & Fischer, 1980). Depreciation of the currency leads to increased demand for exports if the product is relatively elastic. Higher demand increases the profitability and stock value of the firm. Alternatively, appreciation makes export expensive in the international market. A fall in exports leads to reduced share value. Alternatively, if the product is relatively inelastic, depreciation or devaluation will worsen the situation. Traditional theory suggests a causative relationship from the currency market to stock prices. With this background, the current study attempts to study the impact of exchange rate volatility on stock prices. Adler and Dumas (1984) defines currency exposure as the sensitivity of the firm's stock value to currency fluctuation. Unexpected changes in the exchange rate affect the competitive position of the company, changing the market value. Most of the earlier research studies the response of a firm to currency movement in the linear framework. The symmetric response postulates appreciation and depreciation have similar effects in magnitude on stock returns. However, empirical evidence has documented mixed findings. In the nonlinear framework, firms respond differently to a period of appreciation and a period of depreciation. The study contributes by exploring currency exposure in a nonlinear framework for an emerging country like India.

India represents an interesting case to study the currency exposure of firms. The rapid growth of the Indian economy has attracted a lot of foreign investors to India. India's opening its international barriers to multinational companies in 1991 was a step towards a market economy. The liberalization of foreign portfolio investments in 1992 strengthened the financial integration of the Indian currency and the stock market. The magnitude of capital flows has increased over the period, and today India is one of the leading destinations of foreign investment. Though foreign investment is determining the structure of the Indian economy, it has increased the pressure on the Indian Forex market. In conjunction with the traditional "flow-oriented" theory, the resulting variability in the exchange rate movements might affect the value of stock prices of Indian firms. Hence understanding the nature of exchange rate exposure is of importance to investors.

The issue is of critical interest to investors and corporate managers who intends to hedge their portfolio against the adverse effect of currency fluctuation. An investor forms his portfolio strategy while keeping in mind the exchange rate exposure of a firm. The literature on portfolio management hypothesizes that negative shocks have a more pronounced effect on asset prices. Consequently, understanding the spillover effect of extreme appreciation and depreciation of the currency is pre-request for an investor to increase the return and reduce the risk of his investment. Thus, understanding currency exposure in a non-linear framework enables the investor to form an efficient hedging strategy for the international portfolio. The topic is of keen interest to corporate managers

who develop hedging strategies using asymmetric instruments. Analysis of the asymmetric response of stock prices to currency fluctuation will enable the policymakers to make an efficient exchange rate policy.

The co-movement of the currency market and the stock market is of interest to policymakers. Volatility in the exchange rate affects global trade, investment decisions, and overall macroeconomic stability. Policymakers are interested in the association between the two financial markets as it can lead to a significant swing in international investment. This study can form the basis of a prudent exchange rate policy, a prerequisite for a stable macroeconomic environment.

The existing literature on asymmetric currency exposure; using firm-level data is limited to developed countries. The current research contributes to the literature by extending the concept of asymmetric currency fluctuation in an emerging country like India. There have been limited studies on currency exposure in India using firm-level data (Kanagaraj & Sikarwar, 2011; Mohapatra & Rath, 2017). Most of the previous studies have been conducted in a linear framework. The current study is the first attempt to explore the asymmetric response of Indian firms to currency fluctuation. The study also contributes to the literature by detailing a comprehensive list of firm-specific factors affecting currency exposure. The study also analyses if the factors vary for manufacturing and service-oriented firms.

In the current study, currency exposure is calculated using the model developed by Di Iorio & Faff (2000) and Koutmos and Martin (2003). Firms' stock returns are regressed on the orthogonal component of the market portfolio and the changes in the exchange rate. The dummy variable in the model captures the response of firms to periods of appreciation and depreciation. Firms with significant exposure are analyzed in the second phase using panel data analysis. It details firm-specific factors affecting exchange rate exposure. The study compares if the factors affecting currency exposure varies for manufacturing and service firms.

The remainder of the paper has the following structure. Section 2 reviews the relevant literature on the exchange rate exposure of firms. The review includes studies in the linear and non-linear framework. Section 3 discusses the methodology used to study the asymmetric response of firms to currency fluctuation. Section 4 documents the result of the econometric models, followed by the conclusion in Section 5.

2. LITERATURE REVIEW

There is a vast body of literature available on the currency exposure of firms. These studies have been conducted in the linear and non-linear framework. The existing literature has been reviewed to develop a conceptual framework on the impact of exchange rate fluctuation on stock prices in the nonlinear framework. The literature also details the firm-level factors affecting currency exposure.

Previous research conducted in the linear framework uses the Adler and Dumas' model. In this model, exchange rate coefficient exposure is calculated by regressing the stock price returns on exchange rate returns. Jorion (1990) improved the model by adding a stock market index return as

a control variable. The market return was subsequently replaced by the orthogonal component of the market portfolio. The researcher investigated the currency exposure of 287 US multinationals between 1971 and 1987 and reported that only 5.2% of the sample was affected by currency fluctuation. In their study, He and Ng (1998) documented that 25% of 171 Japanese firms were affected by currency fluctuation. Bartov and Bodnar (1995) studied 208 US firms between 1978 and 1989 and documented that lagged movement in the currency inversely affects the stock returns. The works of Doukas, Hall, and Lang (2003) reported an inverse relationship of currency exposure and stock price return of 1079 Japanese firms across 25 industries from 1975 to 1999. Similar results were documented by Choi and Prasad (1995), Allayannis and Ofek (2001), and El-Masry and Abdel-Salam (2007) for countries like the US and UK.

Most of the above studies explore the variables in the linear framework. The researchers assumed that the exchange rate has a symmetric effect on the stock return. Consequently, if currency depreciation leads to increased stock prices, appreciation will reduce the stock value.

However, researchers like Mann (1986), Froot and Klemperer (1989), Marston (2001), Knetter (1994), Goldberg (1995) argue that firms respond differently to periods of appreciation and depreciation due to pricing-to-market (PTM). As per PTM, firms manipulate export prices keeping in mind global competition. Firms tend to pass on the benefits of depreciation to the consumer. To maintain the customer base, the firm does not increase the export prices during appreciation. It results in an asymmetric response of the firms to currency fluctuation. Baldwin (1988) and Christophe (1997) argue that the asymmetric response of firms may be due to hysteresis. If depreciation persists for a longer time, new firms may enter the business, consequently reducing, and the firm's profitability.

The asymmetric response of firms can also be explained by firms using real options. Miller and Reuer (1998) and Jayasinghe and Premaratne (2014) documented that exporting firms may use the option. It protects them from currency appreciation, at the same time unhedged to domestic currency depreciation. Consequently, the use of options results in an asymmetric response of firms to currency fluctuation. Di Iorio and Faff (2000) and Koutmos and Martin (2003) added a dummy variable to the Jorion's model. This model has been used in the current study to study the impact of currency fluctuation in a nonlinear framework.

The literature also explores firm-level factors affecting currency exposure. The past literature documents mixed findings while studying factors affecting exchange rate exposure. Jorion (1990), He and Ng (1998) document that large firms are more exposed to exchange rate exposure. But the findings contradict the hedging theory, which postulates that big firms have more resources to mitigate the risk in international transactions, thereby lowering the exchange rate exposure. Empirical evidence of hedging theory was documented by Dominguez and Tesar (2001), Doukas et al. (2003), Rossi (2011). Jorion (1990), Choi and Prasad (1995) documented that firms with increased foreign involvement are more likely to get exposed to currency exposure. Consequently, exports and foreign borrowing

increases the currency exposure. Booth and Rotenberg (1990) analyzed 156 Canadian firms from 1979 to 1983 and found that foreign sale is positively related to currency exposure. The works of Homma, Tsutsui, and Benzion (2005) also corroborate with previous researchers. According to them, export intensity and foreign net position are the principal sources through which exchange rate exposure is transmitted to individual firms. However, the findings are in complete contradiction to the hedging theory, which postulates an inverse relation of foreign debt to currency exposure.

Researchers argue that the effects of exchange rate exposure can be mitigated using operational and financial hedging. Due to the unavailability of the data, researchers like Choi and Prasad (1995), Allayannis and Ofek (2001), and Nydahl (2002) have used proxies for financial hedging. The literature supports that firms with good liquidity position reduce the probability of a firm going bankrupt. However, the hedging theory postulates that firms with unfavorable liquidity position or high financial leverage are more likely to hedge. Consequently, such firms are less exposed to exchange rate exposure. Empirical evidence of hedging theory was found by Nance, Smith, and Smithson (1993) and Homma et al. (2005). Researchers documented that hedging can reduce the problem of underinvestment, promoting growth opportunities for firms. Consequently, Geczy, Minton, and Schrand (1997) and He and Ng (1998) have used growth opportunities as a proxy for hedging. The study documented that firms with a high book value to market ratio have higher incentives to hedge, thus are exposed to less exposure. Holman, Correia, Pitt, and Majoni (2013) in their research found empirical evidence of an inverse relationship between hedging and currency exposure. Cheung and Sengupta (2013) studied the ability of the firm to overcome financial distress by assessing the ability to borrow funds. According to the researcher, firms with high collateral assets have less exchange rate exposure.

He, Liu, and Zhang (2020) explored foreign currency exposure for firms listed on the Chinese Stock Exchange from 2005 to 2018. The study documented significant exposure both in the linear and nonlinear framework. The study inferred that large firms with a small leverage ratio tend to have reduced currency exposure. However, exposure increases with growth opportunities. Zubairu and Iddrisu (2019) explored the determination of currency exposure of multinational corporation in the UK from 1993 to 2013. The study documented 20% of firms were affected by currency fluctuation. The currency exposure was explained by the level of foreign sales, market value of equity, and quick ratio. Šimáková (2017) used Jorion's model and panel data regression for a sample period 2002-2016. The study documented an inverse relationship between currency fluctuation and stock return. The study documents currency exposure highest in Hungary and Czechia. Tomanová (2017) analyzed currency exposure of 142,626 Romanian firms using panel data regression. The study documented that currency invoicing strategy and hedging reduces exposure for firms.

Kanagaraj and Sikarwar (2011) and Mohapatra and Rath (2017) are the only two researchers who studied the exchange rate exposure and its determinants in the Indian context. The current

study differs from the above-motivated studies on two grounds. Previous studies used the Jorion's model to calculate exposure. However, in the present study, the research design has been improved to include the orthogonal component of the market portfolio to calculate exposure. Improved methodologically will enable us to capture the currency exposure of the firm in an effective manner. Secondly, the researches in India have been conducted in a linear framework. But the current study is an attempt to study the asymmetric response of the firm to currency fluctuation. To our knowledge, no research gives a comprehensive list of firm-level factors that affect exchange rate exposure in the Indian context. The study also attempts to study if firm-level factors vary for manufacturing or service-oriented firm. Thus, the current study will add value to the existing body of literature in the current field.

3. RESEARCH METHODOLOGY

The current study uses firms listed on the S and P BSE 500 index from 2004 to 2019. Bombay Stock Exchange (BSE) is the largest stock exchange in Asia. The companies listed in the BSE cover all business sectors, thereby representing the Indian economy. The data reveals that 140 firms were not listed on the BSE for the entire sample period. Backed by the literature review, financial companies (60) have been dropped from the analysis (Jorion, 1990; He & Ng, 1998; Cheung & Sengupta, 2013; Afriyie, Kong, Ampimah, Akuamoah, Vanderpuije, & Xinlei, 2020). These companies invest in derivatives for speculative purposes, not to mitigate risk. They invest in hedging instruments to promote the derivative market. Consequently, they do not qualify as end-user of hedging instruments. Table 1 documents that out of 500 companies, 260 are used for analysis in the current study, of which 217 firms are manufacturing and 43 are service sector firms.

Table 1. Determination of sample companies

Financial companies	80
New companies added over the sample period	160
Companies selected for analysis	260
Total companies	500

Source: Bombay Stock Exchange (<https://www.bseindia.com/>)

In the first stage, the study uses the orthogonalized asymmetric regression model to study the asymmetric response of 260 firms to

$$\sqrt{|B_{it}|} = \beta_{0i} + \beta_{0i}S + \beta_{1i}AT + \beta_{2i}FS + \beta_{3i}FCB + \beta_{4i}QR + \beta_{5i}L + \beta_{6i}NFA + \beta_{7i}GO \quad (6)$$

where, $\sqrt{|B_{it}|}$ is the square root of the absolute value of exchange rate exposure calculated using equation (1). Taking the square root of modulus of exchange rate coefficient reduces the transaction bias (Huston & O'Driscoll, 2010). *S* is size, *AT* is *asset turnover*, *FS* is *foreign sales*, *FCB* is *foreign currency borrowing*, *QR* is *quick ratio*. *L* stands for *leverage*, *NFA* is *net fixed asset*, and *GO* stands for *growth opportunities*. Hausman test has been used to choose between the fixed effect and random effect model.

Backed by literature (Jorion, 1990; Choi & Prasad, 1995; He & Ng, 1998), the study expects a positive relation of exchange rate exposure and

currency fluctuation. The model presented in the paper is based on Jorion's model. In this model, stock returns are regressed on returns of exchange rates and market return:

$$R_{it} = \beta_0 + \beta_1 R_{mt} + \beta_2 R_{st} + \varepsilon_{it} \quad (1)$$

where, R_{it} is the stock return of firm *i*, in period *t*; R_{mt} is the return of the market portfolio in period *t*; R_{st} is the exchange rate change in period *t*; ε_{it} is the error term in period *t*. To reduce collinearity, the return of the market portfolio is regressed on the changes in the exchange rate as shown by equation (2):

$$R_{mt} = \gamma_0 + \gamma_1 R_{xt} + \varepsilon_t \quad (2)$$

Then, the component of the market portfolio return that is orthogonal to the changes in the exchange rate is obtained by calculating:

$$F_{mt} = R_{mt} - (\gamma_0 + \gamma_1 R_{xt}) \quad (3)$$

Finally, firms' exchange rate exposure is estimated by regressing firms' stock market returns on the orthogonal component of the market portfolio and the changes in the exchange rate, as illustrated by equation (4):

$$R_{it} = \beta_0 + \beta_{mi} F_{mt} + \beta_{xi} R_{xt} + \varepsilon_{it} \quad (4)$$

where, F_{mt} is the estimated orthogonal component of the market portfolio and R_{xt} is a return of exchange rate series.

The current study biases its researchers on the model proposed by Di Iorio and Faff (2000) and Koutmos and Martin (2003). In their research, the orthogonalized model has been extended to include a dummy variable. This model captures the asymmetric responses of individual stock returns to and the exchange return.

$$R_{it} = \beta_0 + \beta_1 R_{mt} + \beta_2 R_{st} + \beta_3 D_{it} R_{st} + \varepsilon_{it} \quad (5)$$

where, $D_{it} = 0$, if $R_{st} \leq 0$, $D_{it} = 1$, if $R_{st} > 0$.

In the second stage, panel data regression is used to identify firm-specific variables that affect currency exposure. Only that firm with significant currency exposure is used in the panel regression. The estimated exchange rate coefficient is regressed on firm-specific factors. The following equation is used for panel regression.

foreign operations of firms. Big firms are usually multinational firms; consequently, they are likely to have higher currency exposure. Similarly, firms with higher foreign sales and foreign borrowing are likely to increase the firm's exposure to currency fluctuation. Supported by Choi and Prasad, (1995), Allayannis and Ofek (2001), Nance et al. (1993), Homma et al. (2005), the study expects that efficient firms can mitigate currency exposure. Thus, firms with good liquidity position have an inverse relation with currency risk. Consequently, firms with high asset turnover, quick ratio, and good ability to borrow are less exposed to currency exposure. Consistent with the works of Geczy et al. (1997) and

He and Ng (1998), the study expects that companies with high growth opportunities tend to big companies. As a result, book value/market value and collateral have a higher exposure to currency fluctuation.

Table 2 discusses the definition of the independent variables and the sources of the data.

Data on stock prices of 260 firms have been taken from the BSE price website, while the bilateral exchange rate between rupee-USD is taken from Reserve Bank of India (RBI) website. Prowess database of Centre for Monitoring Indian Economy (CMIE) is used to collect firm-level secondary data.

Table 2. Variables used in the study

<i>Variables</i>	<i>Formula</i>	<i>Source</i>
R_t	Firms stock return	BSE
$R_{m,t}$	Market return	BSE
ER	The difference of US dollar exchange rate	RBI
<i>Exposure coefficient</i>	Estimated exposure coefficient	Authors' calculation
<i>Size (S)</i>	log of firms asset	Prowess
<i>Asset turnover (AT)</i>	Firms sales/asset	Prowess
<i>Foreign sales (FS)</i>	Firms foreign sales/total sales	Prowess
<i>Leverage (L)</i>	Firms borrowing/(reserves plus capital)	Prowess
<i>Foreign borrowing (FCB)</i>	Firms foreign currency borrowing/total borrowing	Prowess
<i>Growth opportunity (BV/MV)</i>	Firm's book value/market value	Prowess
<i>Quick ratio (QR)</i>	Firms (current asset - inventory)/current liabilities	Prowess
<i>Collateral (NFA)</i>	Firms net fixed asset to asset	Prowess

Note: Based on literature review.

4. RESULTS AND DISCUSSION

The research attempts to capture the asymmetric response of firms to periods of fluctuation in the exchange rate. The asymmetric model, represented by equation (5), is used in the current study. Table 3 documents the exchange rate exposure of 260 firms and shows that 173 out of 260 firms are exposed to currency fluctuation. Out of 173 firms, 144 firms are manufacturing firms, while 29 are service sector firms. 69.8% of firms in the service sector, and 65.8% of firms in the manufacturing sector, are exposed to currency

exposure. The service sector is more affected by currency fluctuation as compared to manufacturing firms. The findings of the current research corroborate with earlier researchers (Mohapatra & Rath, 2017). The service sector drives Indian export, making it prone to foreign exchange fluctuation. Despite the manufacturing sector being import sensitive, hedging protects it against exposure. Under the *Make in India* scheme, the subsidy is given to the manufacturing sector, enabling it to mitigate the exchange rate exposure. Twenty-two out of 173 firms (12.72%) confirmed to asymmetric response to currency fluctuation.

Table 3. Descriptive analysis of coefficient of exchange rate exposure of 260 firms

	<i>Full sample β</i>					<i>Significant β</i>				
	<i>N</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>+ive</i>	<i>-ve</i>	<i>N</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>+ive</i>	<i>-ve</i>
				<i>B</i>	<i>β</i>				<i>B</i>	<i>β</i>
All firms	260	-1.235	0.7599044	7	253	173	-1.566	0.659702	0	173
Manufacturing	217	-1.235	0.7745518	7	210	143	-1.581	0.6617019	0	144
Service	43	-1.239	0.6896378	0	43	30	-1.495	0.656491	0	29

Source: Authors' calculation using EViews software.

In the second stage, the research attempts to identify firm-specific variables affecting the currency exposure of firms. Table 4 discusses the descriptive statistics for firm-specific factors.

Table 4 documents mean, median, maximum, minimum, and standard deviation of the firm-level factors affecting exposure.

Table 4. Descriptive statistics of determinants of exchange rate exposure

<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>Max</i>	<i>Min</i>	<i>Standard deviation</i>
<i>Size (S)</i>	4.408	4.343	6.621	2.192	0.656
<i>Asset turnover (AT)</i>	1.109	0.969	4.056	0.066	0.613
<i>Foreign sales (FS)</i>	0.169	0.075	4.057	0	0.3182
<i>Foreign borrowing (FCB)</i>	0.173	0.048	4.055	0	0.3259
<i>Leverage (L)</i>	0.794	0.516	13.14	-1.413	1.1849
<i>Growth opportunity (BV/MV)</i>	0.600	0.4055	15.649	-32.00	1.9566
<i>Collateral (NFA)</i>	0.312	0.289	4.056	0.004	0.2858
<i>Quick ratio (QR)</i>	1.297	0.957	20.32	-0.715	1.6547

Source: Authors' calculation using EViews software.

Table 5 depicts the result of panel regression to identify the determinants of exchange rate exposure. Panel regression is only run on firms that show significant exchange rate exposure (173 firms). The sample period is divided into three subparts (2004-2007, 2008-2012, and 2012-2019). By doing

so, we get three betas for each company. Next, we get a panel where $T = 3$ and $N = 173$. Similarly, the average value for each sub-period for every explanatory variable is used in the analysis. Thus, the total number of observations is 591. The square root of the absolute value of currency exposure

(beta) is used as a dependent variable and all the determinants as the independent variable. Hausman test results reveal that the random effect

model is an appropriate model for the service sector, while for the overall sector and the manufacturing sector fixed effect model is used.

Table 5. Determinants of exchange rate coefficient

Variable	Overall	Manufacturing	Services
Constant	2.0474*** (0)	2.251160*** (0)	1.203375*** (0.0041)
Size (S)	-0.2304*** (0.0038)	-0.233722*** (0.0017)	-0.030399* (0.0786)
Asset turnover (AT)	0.1387* (0.0584)	0.052032* (0.074)	0.090374* (0.0622)
Foreign sales (FS)	0.2242** (0.0441)	0.017656* (0.0780)	0.056649* (0.0897)
Foreign borrowing (FCB)	0.0843 (0.5753)	-0.008035 (0.9544)	0.273992 (0.2453)
Quick ratio (QR)	-0.0150* (0.0549)	-0.001442* (0.0981)	-0.044567* (0.0615)
Leverage (L)	0.0136 (0.6806)	-0.024537 (0.4524)	0.056497 (0.6502)
Collateral (NFA)	-0.3090 (0.3302)	-0.156897 (0.5673)	-0.154222 (0.6720)
Growth Opportunities (GO)	0.0077* (0.0779)	0.019995* (0.0670)	0.149259* (0.0877)
N	522	434	90
F-test	1.207581	1.192590	0.831918
R ²	0.393321	0.394550	0.394064
Hausman test	00001(F.E)	0.0001(F.E)	0.2856 (R.E)

Note: Table 5 shows determinants of exchange rate coefficient for only significant firms. Prob. of t-statistics is in the parenthesis. ***, **, * represents significance of 1%, 5% and 10% respectively.

Source: Authors' calculation using EViews software.

The result documents that size, asset turnover, foreign sales significantly affect currency exposure. Asset turnover and foreign sales have a positive relationship with exchange-rate exposure (10% significance). High asset turnover represents an efficient company. There are chances that such firms are multinational firms, hence are exposed to more currency. Size has an inverse relation with exchange rate fluctuation. Big firms have more resources to mitigate currency risk. Consequently, they can reduce exposure. These results corroborate with the hedging theory.

Foreign currency borrowing increases the exchange rate exposure for the entire sample and service sector firms. Depreciation increases the local liability of foreign currency, thereby adversely affecting the balance sheet. Consequently, the currency exposure of the firm increases, having an adverse effect on the stock value. The Indian manufacturing sector is dependent on domestic loans. The variable has an inverse impact on the manufacturing sector. Similarly, leverage is positively related to currency exposure for the service industry and the overall sector. Collateral defines the ability of the firm to borrow. High collateral decreases the impact of exchange rate movement on the firms. Book-to-market value and quick ratio is inversely related to exchange rate exposure. Book-to-market value is taken as a proxy for growth opportunities. A low book to market value ratio indicates an increase in foreign activities, which increases the chances of exchange-rate exposure. Similarly, firms with a higher quick ratio have a higher ability to meet short-term obligations. Consequently, exchange rate exposure is reduced.

5. CONCLUSION

This research adds to the existing literature of currency exposure of Indian firms in an asymmetric framework. For this purpose, the impact of the exchange rate movement is studied for 260 firms listed on the BSE from 2004 to 2019. The study documents that 69.8% of firms in the service sector, and 65.8% of firms in the manufacturing sector, are exposed to currency exposure. 12.72% of the firms react differently to periods of appreciation and depreciation, while 87.28% have symmetry exposure. The study also contributes by reviewing firm-level indicators affecting currency exposure. Panel data regression is used to document that size, asset turnover, foreign sales significantly affect exchange rate exposure. The size of the firm and the quick ratio is inversely related to currency fluctuation. While asset turnover, foreign sales, and book to the market value increase exchange rate exposure for firms.

Portfolio managers and investors can use the findings of the research to develop hedging strategies. This research is an original attempt to study the asymmetric response of firms listed on the S and P 500 index to currency fluctuation. It will aid the manager while deciding on hedging, invoicing policy. The firm can use asymmetric hedging instruments to reduce exposure. The research will also give insights into the asymmetrical response of companies on periods of appreciation and depreciation. These findings can guide policymakers in designing an efficient exchange rate policy. The study is limited in its scope. It only calculates exposure for non-financial companies. Future research can study the currency exposure of financial companies like banks, insurance companies, etc. Despite the limitation, the current study will act as a guiding force to the policymakers and other stakeholders in forming efficient strategies.

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APPENDIX

Table A.1. Correlation matrix for determinants of exchange rate exposure

	<i>SQURT</i>	<i>S</i>	<i>AT</i>	<i>FS</i>	<i>FCB</i>	<i>L</i>	<i>GO</i>	<i>Collateral</i>	<i>QR</i>
<i>SQURT</i>	1								
<i>S</i>	0.0404	1							
<i>AT</i>	-0.072	-0.17	1						
<i>FS</i>	-0.043	-0.08	0.09	1					
<i>FCB</i>	-0.058	0.099	0.23	0.633	1				
<i>L</i>	-0.022	-0.05	0.04	0.183	0.269	1			
<i>GO</i>	0.0001	0.072	-0	0.102	0.164	0.266	1		
<i>Collateral</i>	-0.060	-0.06	0.24	0.638	0.715	0.298	0.06	1	
<i>QR</i>	0.076	-0.12	-0.2	0.154	-0.01	-0.11	0.01	-0.03	1

Source: Authors' calculation using EViews software.