Comparing Approaches to Measuring Foreign Exchange Exposure of Indian firms

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Abstract: Studies on measuring exposure suggest varied approaches and methods over the recent past. Estimating firm level exposure on the basis of capital market variables have been traditionally practiced as the Capital Market Approach (CM), along with the recent approach of considering transaction variables from company financials under the Cash Flow Approach (CF). This study measures the exchange rate exposure of the constituent firms of BSE S&P 500 index using both CM and CF approaches for a period of 17 years (2001-2017). The resulting exposure measures are compared across time and industrial sectors. The results indicate marked differences in the measured values from both approaches. Graphs and tabular analysis is used for discussion of the results.

Index Terms - **Exchange Rate Exposure, Capital Market Approach, Cash Flow Approach**

1. Introduction

Growing awareness of risks arising from the changing exchange rates has impacted the ways in which firms measure, monitor and manage their exposure to such variations and impacts from adverse situation arising due to unforeseen changes in them. In the academic spheres, there has been a growing interest in the topic with tremendous contributions by experts on how to measure exposure, manage the determinants and control the impact of adverse movement in the exchange rate. As measuring the exposure is the key to understanding the level of possible risks, studies and research on measuring exchange rate exposure has become of increasing importance in the recent years for both academicians and practitioners. Empirical research suggest that exchange rate exposure have had significant affect on the firms' market positions, firm value, cash flows, sales and performances (Bartram, Brown, & Minton, 2010). Theoretical research have also indicated possible impact on firm level factors and market related factors when exposed to volatility in the exchange rate (G. M. M. Bodnar & Marston, 2002; Sayed & Jayapal, 2017a). Measures to quantifying the firm level exchange rate exposure vary depending on the definition of the term. In a general parlance exchange rate can be defined as the impact of the changes in the exchange rate on the firm value (Jorion, 1991). The implication is to measure the impact of changing exchange rate to movement of firm value, as measured during a period of time. Another definition would indicate the extent of changes in the cash flow at a given level of exchange rate. In this case the researcher would measure the elasticity of the exchange rate by measuring the difference in cash flows arising due to exchange transactions in consideration of the profits earned. Thus whether a single period cash flow or earnings is considered or time series variation in the firm value is considered would be the basis of the measure under different approaches. Measures which use stock market variables may not provide an insight into the actual firm activities and approaches which use only the firm level transaction data from financial statements may miss out on the impact of exposure on the stock market performance of the firms (Rugman & Oh, 2011).

The two popular approaches to measure exchange rate exposure of firms to currency rate are the Capital Market Approach (CM) and the Cash Flow Approach (CF) which each use the varying logic and definitions as explained above. Consolidating the measurements using both this approach should provide a context of comparing the results and reflecting on selecting the right approach to suit the requirement of the researcher who would get an insight on how each approach should be used for different studies; firm management to measure and manage the risk related to exchange rate volatility or the government who would take precise action to regulate or assist firms in measuring and managing the unforeseen changes in the exchange rates. Therefore the current study contemplates the two approaches in measuring the exchange rate exposure and compares the results thereof.

1.1 Research Objectives:

1. Measuring Exchange rate exposure of Indian firms using Capital Market Approach.
2. Measuring Exchange rate exposure of Indian firms using Cash flow Approach.
3. Comparative study of the measured value of exchange rate exposure under capital market and cash flow approaches

2. Literature Review

The vast literature on this topic suggests, measuring or gauging the exchange rate exposure of companies is challenging and often misleading. Many researchers have found conflicting results ranging from no effect of exchange rate on the stock performance to high risk measure due to volatility of the exchange rates on the corporate performance business (Du, Ng, & Zhao, 2013; Hekman, 1983; Lee, 2011; Peter B, Kenen. Dani, 1986; Rugman & Oh, 2011). In the recent years the researchers have been able to identify specific exposures and relate them to the performance of the corporate and guide in managing such risks with the use of hedging instruments.

Beyond the general definition of the term exchange rate exposure, a researcher, intending to conduct analysis with the measure of exchange rate risk should quantify the effect of such variation in statistical terms. One such definition is provided by Adler and

Dumas who stated three criteria for a risk to be defined as currency risk exposure. Firstly the effect of the exposure must be measurable in terms of some currency, domestic or foreign depending on the transactions of the firms. A second criterion is that the measure of the change in the value of asset and liability, physical or otherwise must be considered from the investors' or stakeholders' viewpoint. And a third criterion is that it must have a dual dimension of measurability and manageability. This means the exposure should be both measurable and manageable quantitatively by using financial tools (Adler & Dumas, 1984). The selection of a model or formula must thus consider these criteria in choosing the variables and the instruments to calculate the values.

The factors that affect exchange rate exposure needs to be evaluated for their impact on the firm value and returns so as to be able to discern the seriousness of the risk that a firm faces due to volatility in the foreign exchange rates internationally. Understanding the determinants of the exchange rate and investigating the effect of these factors could prove to be valuable for the firms as they look into this aspect of financial risks (Agyei-Ampomah, Mazouz, & Yin, 2013).   Studies have used regression model with varying number of independent variables identified as factors affecting exposure like the return on stock value (S. M. Bartram & Karolyi, 2006; Jorion, 1991), Market to book value (Aggarwal & Harper, 2010; Apergis, Artikis, & Sorros, 2011; Chen, Lee, Lee, & Huang, 2016), size of the firm (Allayannis & Ofek, 2001; El-Masry, Abdel-Salam, & Alatraby, 2007) etc.

Measuring exchange rate exposure has been gaining popularity in the contemporary research in international finance and risk measurement and management. Since 1990 Jorion method of calculating exchange rate exposure has been rigorously followed in empirical studies which needed the firm level calculation of exchange rate exposure. Under this method, the stock market index and exchange rates are used as independent variable with the firm closing price as the dependent variable. The regression coefficient for exchange rate is the measure of changes in the firm closing prices for a change in the exchange rate and this is the measure of exchange rate exposure (Al-Shboul & Anwar, 2014; Nie, Zhang, Zhang, & Zhou, 2015). This approach has been extended with more independent variables added to the regression equation and making it more reliable as factors beyond the exchange rate and index prices do affect the firm prices(Sayed & Jayapal, 2017b). As of today this approach is called the Capital market approach as all the variables are taken from the capital market. Traditionally a single factor with either the return of stock value or size has been the variable used in the measure and recently a three factor model has become popular (Huffman, Makar, & Beyer, 2010). The studies using multiple factors do not in any way justify that their method is superior to the traditional one factor model.

Non regression models used in the contemporary research takes the form of cash flow approach which considers net cash flows from the forex activities as a percentage of total income and the profit figures over the total income to measure the elasticity of exposure to exchange rate changes for each firm (S. M. Bartram, 2008; Prasad & Suprabha, 2015). The elasticity of exchange rate exposure is considered as changes in the foreign currency denominated cash flows as its impact on the firm performance measured using the financial statement profit figures. Cash flow approach has been developed only a few years ago. This measure provides an insight into the extent to which the actual cash flows of the firms are impacted as a result of the exchange rate changes (Prasad & Suprabha, 2015).

This paper uses both the approach in measuring exchange rate exposure and compares the results to identify the specificity of each approach by using sub classification of the sample companies into their industrial sectors. There are very few studies which actually measures exposure with two approaches (S. M. Bartram, Brown, & Minton, 2007; Prasad & Suprabha, 2015). This study contributes to the existing literature by addressing the gaps in the study by providing an insight into the two measures and evaluating the impact of exchange rate on the sample firms by ordering their exposures over time and classifying them into their industrial sectors.

3. RESEARCH METHODOLOGY

The study follows a multistep approach in measuring the exchange rate exposure of 500 constituent companies of BSE S&P500 index of the Bombay Stock Exchange (BSE) in India. As a first step the exchange rate exposure under both the methods are calculated for all 500 companies listed on the index in July 2018. The measures are calculated as per the respective formulas prescribed in seminal papers. In step 2, the data was cleaned to remove companies with missing data under either of the methods. As a result, 254 constituent companies of BSE S&P 500 index formed the sample for this study. In step 3 the sample companies were classified according to their industrial sectors as followed by the BSE for all the listed companies. In step 4, the exposure measures were averaged horizontally across the industrial sectors and across time line to arrive at two different set of measures for each sector across the study period and for each study period across the industrial sector. This was the final data used in all resulting analysis.

3.1 Data Collection

The required monthly or annual data was collected for variables from 2001 to 2017 from the Prowess Database, RBI and BSE websites. For the capital market approach, the monthly data from Dec 2000 to Dec 2017 were individually collected. The closing index and the firm closing stock prices were collected from the BSE historical index and equity archives respectively. The Real Effective Exchange Rate (REER) relating to a 6 currency trade weighted average was collected from the RBI public archive for the same frequency and duration. For the Cash Flow approach the firm related financial indictors/ variables were collected from the Prowess data base from their annual financial data repository for the period Dec 2001 to Dec 2017. The classification of the listed firms into industrial groups and sectors was collected from prowess and confirmed using the listing made on the BSE website.

3.2 Measuring the Exchange Rate Exposure

Exchange rate exposure measure was captured under two approaches. For the Capital Market Approach, the foreign exchange exposure was measured using the two factor regression model as described by (Phillipe Jorion, 1990) and followed by many

popular studies like (Agyei-Ampomah, Mazouz, & Yin, 2013; Asaolu, 2011; Chernobai, Jorion, & Yu, 2011; Philippe Jorion, 1991). The measure of exposure was the regression coefficient of Exchange rate exposure on the stock returns. This was done for all 500 constituent firms of BSE S&P500 index as listed on the BSE on 7 July 2018. The following regression equation was used.

$$R_{it} = \alpha + \beta_1 \epsilon_{it} + \beta_2 R_{mt} + \gamma_{it} \qquad (1)$$

Here R_{it} is the return on closing price of individual firms; α is the constant term; β_1 is the extent of changes to the return due to a change in the index return; γ_{it} is the error term i represents the number of firms studied, which were 500 and the coefficient β_2 represents the exchange rate exposure of each firm. Monthly closing values of all capital market variables were collected for 17 years (204 data points). The foreign exchange exposure was thus computed by calculating the coefficient of time series regression of returns for each company with respect to the monthly fluctuations of foreign exchange rate. After regression, the exposure value for each company for every study year was computed (8500 numeric values). Firms for which the exposure calculations were missing due to non-existent variable values were removed from the sample.

3.3 Cash flow approach

The second approach considers the financial statement variables in the calculation of the exchange rate exposure. Since it considers the effect of the exchange rate on the actual movement of cash within and out of the firm, it is called the cash flow approach (G. M. Bodnar & Wong, 2003). The exposure is calculated as an elasticity measure by considering the changes in the value of the foreign earnings over total earning from the foreign spending over total cost adjusted with the profits. The logic of using this method of measuring exposure is that changes in exchange rates drive changes in cash flows and ultimately the value of the firm (Fraser & Pantzalis, 2004)

$$\delta = h_1 + (h_1 - h_2)(\frac{1}{r} - 1) \qquad (2)$$

δ refers to exchange rate exposure elasticity of a firm; h_1 is the foreign earnings over total revenue; h_2 is the foreign spending over total spending; r indicates net profit after tax over total revenue. The resulting measures were computed as exchange rate exposure for each firm over the each one of the study period (8,500 numeric values). The firms with missing data and insufficient information were removed from the sample set. Thus the residual firms formed the sample.

4. DATA ANALYSIS AND FINDINGS

With the computation of annual exchange rate measure for each firm (254 firms) for each of the 17 years under both approaches, the next task was to evaluate the exposure level figures calculated under the two approaches. A longitudinal time span and an industry sector wise comparison for the period were conducted. For the longitudinal study the firms were not classified in any way but an overall average of the exposure was considered for the sample firms. For the industrial sector wise study, the sample firms were classified into standard BSE industrial sector classification. BSE classifies all listed firms under ten industrial sectors, with specific identifiers for each sector based on the industry groups and sub groups. The sample companies were separated into their respective industrial sectors (refer Table1). The number of firms in each sector ranged from 58 firms in the CDGS sector to just 4 firms in the energy and the utilities sectors each. Among the sample firms, 47 % had positive exposure and 53% had negative exposure under the CM approach which was 58% and 42% respectively under the CF approach. Thus not much difference was noted among the approaches in identifying the positively and negatively exposed firms. Positively exposed firms are those which benefit from an appreciation in the exchange rate of the country as compared to the basket of currencies represented by the REER. Negatively exposed firms are those which suffer loss when the exchange rate depreciates as compared to the REER. Among the sample firms of 147 firms were negatively exposed while 108 were positively exposed when using CM approach and 135 firms were negatively exposed and 119 were positively exposed under the CF approach. The minimum values and ranges in the measure of exposure were observed under the CM approach while the CF approach provided a wide range of exposure measure considering the whole sample as well as under industrial sectors.

Table 1: FXE Summary of Indian firms under CM and CF Approach

Sectors	No. of Firms	CM Approach					CF Approach				
		(-)*	(+)*	Max	Min	Range	(-)*	(+)*	Max	Min	Range
Basic Materials	55	0.56	0.44	2.62	-3.17	5.79	0.60	0.40	74.91	-24.45	99.36
CDGS**	58	0.47	0.53	2.70	-2.02	4.72	0.59	0.41	325.20	-19.12	344.32
Diversified	10	0.50	0.50	1.02	-1.05	2.07	0.70	0.30	1.57	-11.31	12.88
Energy	4	0.75	0.25	0.87	-1.05	1.92	1.00	0.00	-0.20	-2.32	2.12
Finance	15	0.53	0.47	0.97	-1.98	2.95	0.80	0.20	0.04	-2.41	2.46
FMCG**	24	0.54	0.46	0.90	-5.03	5.93	0.42	0.58	9.73	-1.48	11.22
Healthcare	21	0.52	0.48	1.58	-1.05	2.63	0.29	0.71	15.67	-6.63	22.30
Industrials	52	0.52	0.48	1.46	-11.54	13.00	0.69	0.31	371.87	-20.30	392.18
Information Technology	11	0.64	0.36	1.28	-1.58	2.86	0.00	1.00	5.05	0.01	5.04
Utilities	4	0.75	0.25	0.29	-1.05	1.34	1.00	0.00	-0.11	-1.53	1.42
All Sample	254	0.53	0.47	2.70	-11.54	14.24	0.58	0.42	371.87	-24.45	396.32

firms									

% of firms with Negative(-) Positive(+) Exposure *

Consumer Discretionary Goods & Services (CDGS) ** Fast Moving Consumer Goods (FMCG) **

      Table 2 provides details about the number of firms in each industry which were positively or negatively exposed to exchange rate during the study period. Generally both methods estimated similar number of firms to be exposed positively or negatively. However, for the FMCG, Healthcare and Information technology the CM measured more companies to be positively exposed as compared to CF approach which indicates more firms were negatively exposed. In all other cases both CM and CF approach indicates more number of firms to be negatively exposed to the exchange rate exposure. The implication is that most Indian companies across different industries will be disadvantaged both from the capital market perspective and its own transactions through foreign earnings and profits generation as compared to foreign spending. This would necessitate firms to take corrective actions by either hedging activities or entering into balancing transactions in the exchange markets.

Table 2: Distribution of Exposure measure under different industrial sectors

Sectors	No. of Firms	CM Approach		CF Approach	
		(-)*	(+)*	(-)*	(+)*
Basic Materials	55	33	22	31	24
CDGS	58	34	24	27	31
Diversified	10	7	3	5	5
Energy	4	4	0	3	1
Finance	15	12	3	8	7
FMCG	24	10	14	13	11
Healthcare	21	6	15	11	10
Industrials	52	36	16	27	25
Information Technology	11	0	11	7	4
Utilities	4	4	0	3	1
Totals	**254**	**147**	**107**	**135**	**119**

      Variations in the exchange rate exposure across different industrial sector were studied in detail by plotting the exposure trend of each industry under both methods. The following observation is recorded across each industrial sector and the full sample of all industries together.

4.1 Longitudinal study

With all sample companies together, the exchange rate exposure was averaged for all sample firms for each year. This result indicated the exchange rate exposure of all Indian firms, which was calculated for each of the study period under both approaches. A plot of such exposure measure indicates vast variations in the measure of exchange rate exposure among the CM and CF approach. While the CF approach provides conservative values of exposure across all years, CM approach actually captures the variations in the exposure of firms in different years. In figure 1, a higher level of exchange rate exposure can be seen in the years 2011, 2016 and 2017. This has not been very well captured by the CF approach. This is in contrast to the observations in the industrial sector measures, where the CF approach was found to be more sensitive.


Figure 1: FXE of All Firms - CF and CM
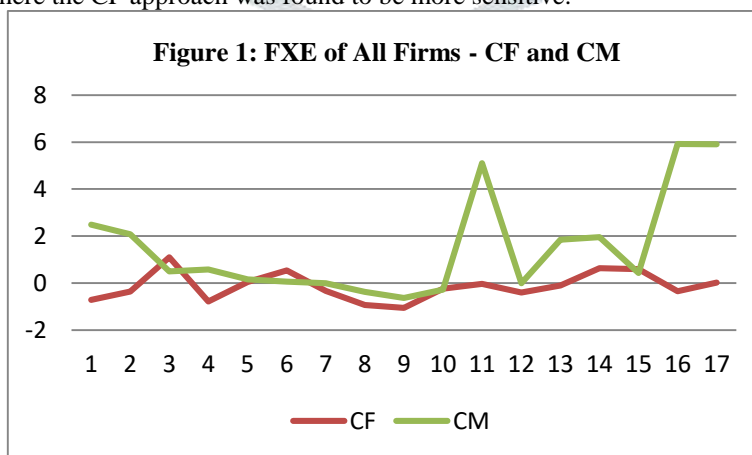
4.2 Sector wise Study

      To evaluate exchange rate exposure of Indian firms classified into industrial sectors for each of the study period, the sample firms were first classified according to their respective industrial sectors (See table 2) and exposures were calculated according to

their respective equations under the CM and CF approach and averaged across all firms in the industry for each year. The figures so obtained were then plotted for each industry for both approaches.

Three interesting patterns can be observed from the plot of the exchange rate exposure among the industry level classification of firms. The CF measures were more sensitive and picked up the high and the low variations across the industrial average exposure for the basic materials, CDGS, Diversified and Industrials sectors more than the CM approach. In the Industrials and CDGS sector though in most years, both the approaches provided similar results, it was interesting to note that CF approach picked up the time specific exposure in couple of years.

Figure 2: Basic Materials

Figure 3: CDGS

Figure 4: Diversified

Figure 5: Industrials
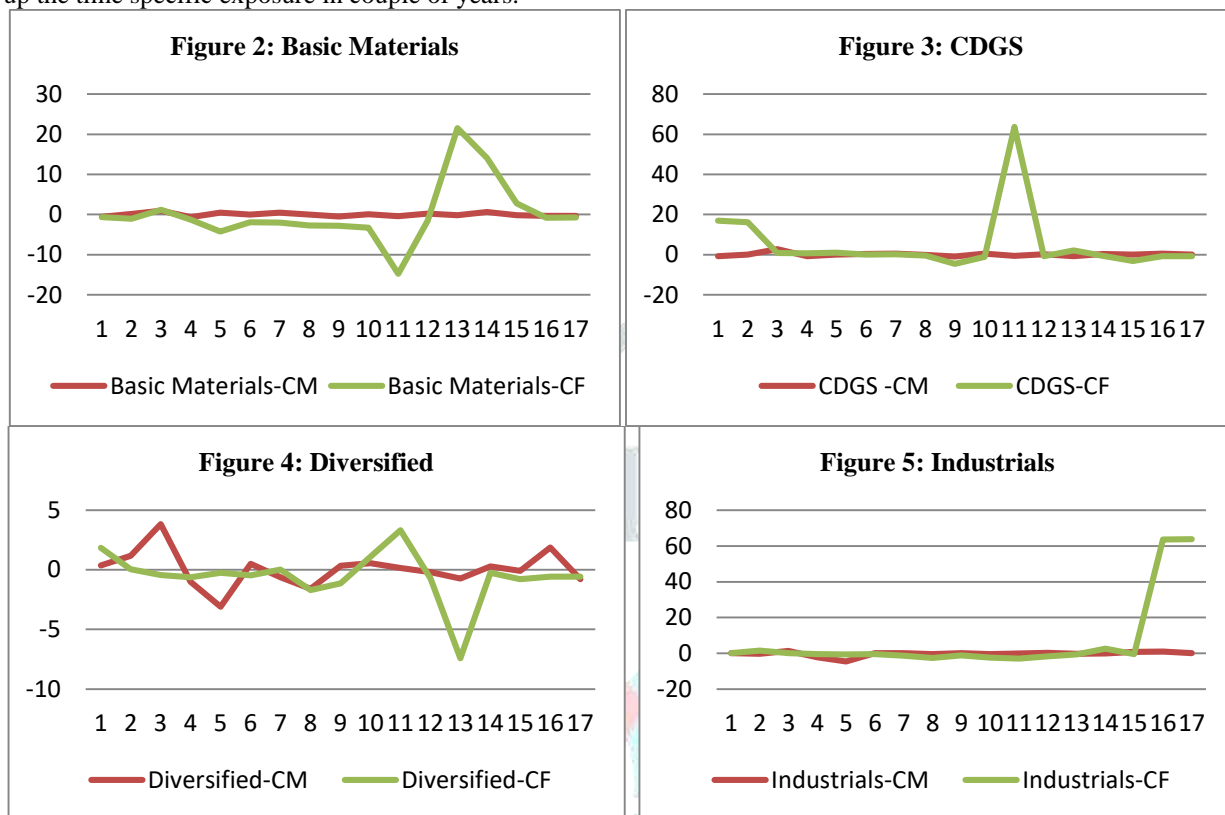
Under the following patterns for the energy and finance sectors, it was the CM approach which picked up the high- low variations that affected the firms in their respective industries as compared to the CF approach measures. For the energy and finance sectors, the CF approach could not pick up the sharp variations observed with the CM approach. Thus it indicates that either there were more shocks in the stock market due to the exchange rate variations for these industries and the firm level variations have been controlled or that the CM approach better captured the market variations caused by exchange rate changes.

Figure 6: Energy

Figure 7: Finance
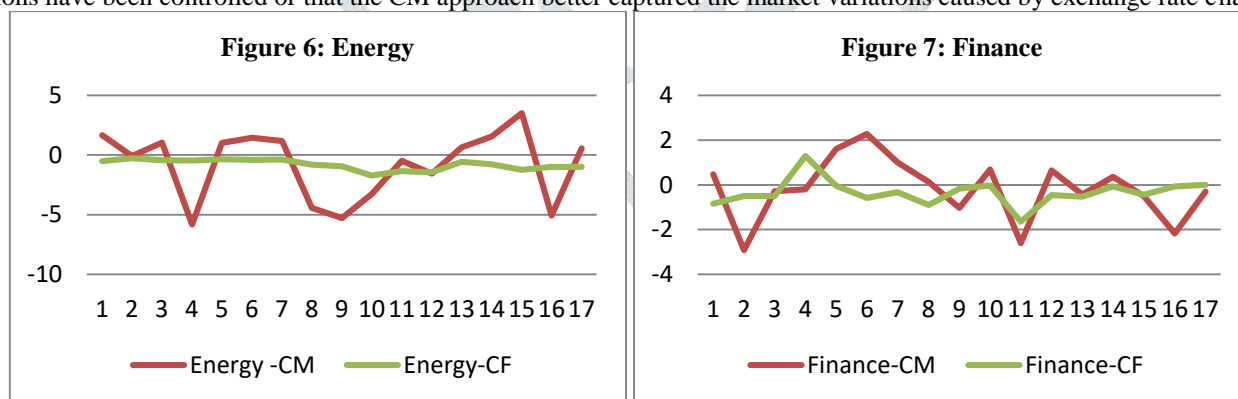
The third pattern in the plot of exposures across the study period was observed in the FMCG, healthcare, information technology and utilities sectors, where both approaches captured different variations in different years. The exposure measurement lines move in diverse direction as compared to each other. This could indicate that either the exposure of firms in this industry affected their stock market performances and the cash flow performance in different ways or else there were other factors which affected the exchange rate exposures that would need further study and analysis.

Figure 8: FMCG

Figure 9: Healthcare

Figure 10: Information Technology

Figure 11: Utilities
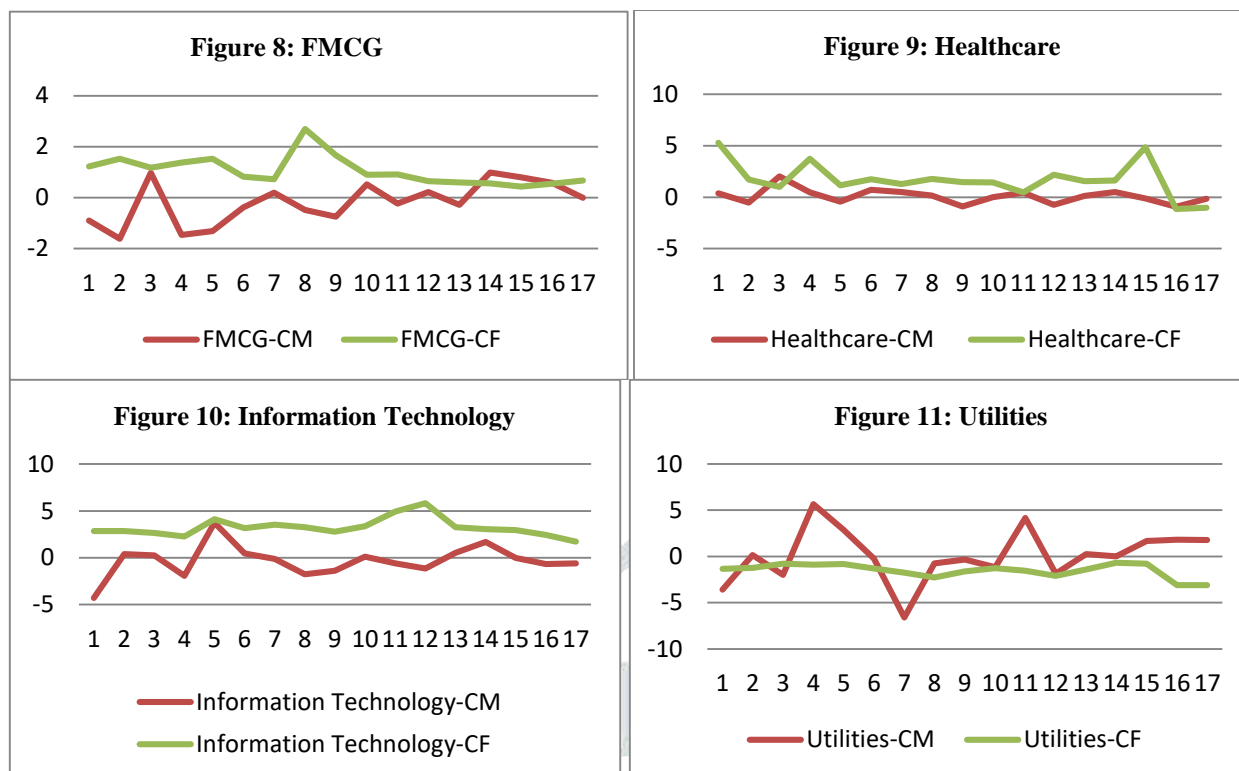
5. CONCLUSION AND RECOMMENDATIONS

As in the contemporary studies, this study has made some interesting observations about the firm level exposure to exchange rate. This empirical research included 254 firms in the sample across 17 years in the study of exchange rate exposure under two approaches to measuring the exchange rate exposure. The capital market approach and the cash flow approach were used in measuring the firm level exchange rate exposure for each firm from 2001 to 2017. An analytical comparison of the exposure values indicate that each of these approach identifies different level of exposure across time and industry and there was not much similarities in the exposure coefficient as calculated in the CM approach or the elasticity of exposure as measured under the CF approach. Both methods however generally conceded with the number of firms facing positive or negative exposures across the industries and time. This information could be valuable for firms, investors and regulators who can use this information to take firm and industry level decisions.

The research suggests a deeper study of the variations among the approaches by considering more factors which determine the exchange rates and evaluating the impact of exposure on firm level variables to provide an insight into the specific use of each measure. Further a model predicting the future exchange rate exposure of firms may be designed with such an understanding.

5.1 Limitations of the study

A more expansive and detailed study on the topic could have provided deeper insight on the reasons for the differences in the measured value of exposure under the two measures. The study did not use any sophisticated tools or models to test or predict the values of exchange exposure.

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