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Exchange Rate Exposure on the Automotive Industry: Evidence from USA and Japan

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Abstract

This study analyses the impact of exchange rate shocks on firm value as well as on the portfolio of automotive firms from U.S and Japan over a time period of 1999-2007. The effect of intra industry competition on the relation between exchange rate and firm value is also incorporated. The results indicate that Japanese firms are more exposed to the dollar than U.S firms to yen and the exposure to yen and dollar for the U.S and Japanese firms respectively is due to the market share of Japanese firms in the U.S while the exposure to euro for the Japanese firms is due to the market share of German firms in Japan as well as Japanese firms in Germany.

Keywords: Exchange rate exposure; automotive industry; USA & Japan

JEL classification: F31, G30, G39

I. Introduction

Financial theory predicts that a change in an exchange rate should affect the value of a firm or an industry. According to Eiteman et al. (1995) and Shapiro (1992), the exchange rate exposure is conventionally classified as transaction exposure and economic exposure. Transaction exposure is the effect of exchange rate changes on committed cash flows such as accounts receivables and is short term in nature. Economic exposure is the effect that exchange rate changes have on a firm's long-term cash flows and is long term in nature. Chow et al (1997) provide evidence that transaction exposure, economic exposure and the interest rates changes associated with exchange rate changes work together to determine the exchange rate exposure of stock returns. A firm is subject to "economic exposure" if the firm's value, as measured by the present value of its expected future cash flows, is sensitive to

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changes in exchange rates. For example, the value of an exporting firm is likely to fall if the domestic currency appreciates, while the value of an importing firm is likely to rise with that same appreciation. A change in exchange rate through its effect on the costs of inputs, outputs, and substitute goods affects the competitive position of domestic companies with no direct international involvement relative to foreign corporations. Exchange rate movements can affect an individual investor who owns a portfolio consisting of securities in different currencies, multinational company (MNC) with subsidiaries and branches in foreign locations, an exporter/importer who concentrates on international trade and even a firm that has no direct international activities.

It is assumed that the automotive industry is competitive and that competition acts as a proxy for the elasticity of demand for a product therefore competition that a firm faces in the domestic and foreign markets should be a determinant of a firm's exposure in that specific market. In this study the impact of competition will be measured by examining the market share of firms in U.S of Japan and Germany, in Japan the market shares of firms of U.S and Germany and in Germany the market shares of U.S and Japan to analyse the impact of international sales on exposure. This is consistent with the notion that the currency exposure of a firm is a function of the export sales and the competition faced in a specific market. Williamson (2001) results show that domestic competition from foreign firms plays a vital role in determining exposure.

This study will be investigating the effect of real exchange rate changes on the value of firms in the automotive industry and the impact of competition on exposure. Automobile manufacturers are often multinationals as they have subsidiaries and manufacturing plants in many different countries. Automobile industry has strong international dependence for both production inputs and exports of finished products and is likely to be sensitive to foreign exchange rates. The automotive industry has progressed from one of national competition, particularly in North America, to one of international competition, in which firms from the U.S. Japan etc export to foreign markets, to one of global competition, in which firms produce and sell in many countries.

1.2. Exchange rate exposure and firm value

A company which manages its productions or delivers its services in more than one country with export sales and costs in home currency should depict exchange rate exposure. The exchange rate exposure tends to change with the competition that the industry undergoes and also with the foreign currency position of the firm's operations. If there is no competitor and the exporter have costs in the local currency while selling in a foreign market the cash flows will be affected by changes in exchange rates. The sensitivity of a firm's cash flows to exchange rate changes is mainly a function of elasticity of demand for the firm's product. If a firm has low elasticity of demand for the firm's product but high export sales it will face a low exposure as it can increase prices in the local market when faced with depreciation of the local currency and this in turn lessens the impact on the home currency cash flows.

As the number of local competitors increases in the foreign market the sensitivity of the firm's cash flows to exchange rates should increase. With the introduction of competitors the ability to increase prices if the local currency depreciates will be affected. Conclusively with the introduction of competitors the sensitivity of the firm's cash flows to exchange rates will also increase.

Global industries undergo structural changes. This type of industry evolution has important implications for exposures for multinational firms and global competitors because it has a severe impact on their competitive makeup. If there is a firm that exports to a foreign market and does not compete directly with firms in that market, the firm's exposure will only be a function of its foreign currency revenues because the firm may have national competition but little or no competition from foreign markets. If the foreign firm then faces competition in the local market, exposure becomes a function not only of its foreign currency revenues but also of the elasticity of its own and its competitor's product. The firm then becomes more competitive worldwide and therefore have to be more concerned with local competitors in a foreign market or foreign competitors in the firm's domestic market. The complexity of a firm's exchange rate exposure evolves as the industry becomes more global, that is when firms begin to produce in various markets.
Firms can be exposed to exchange-rate risk through various channels. For instance a firm with foreign sales is exposed to exchange-rate risk because the value of foreign sales in terms of domestic currency changes when the

exchange rate changes. The same firm may source inputs from abroad and this may increase or decrease its exchange rate exposure depending on whether the imports and exports are in the same currency. Furthermore, this firm may also have assets and liabilities abroad; this can also increase or decrease a firm's exposure. Exchange-rate exposure is not limited to exporters, importers or multinational firms. Even a domestic firm with no foreign activities may be exposed to exchange-rate risk, for example a local firm facing import competition.

This paper is structured in the following manner. Section Π reviews the literature available on exchange rate exposure. Section ΙΙΙ presents the model specification and data set. Section IV describes the estimation procedure and presents empirical results. The last section provides the conclusion and policy implications

II. Literature Review

The theoretical exchange rate exposure literature supports the common belief that exchange rate changes should impact firms that import from foreign markets, export to foreign markets, or face foreign competition. Shapiro (1975) argues that a multinational firm with export sales and competition should exhibit exchange rate exposure and that the firm's exposure should be related to the proportion of export sales, the level of foreign competition, and the degree of substitutability between local and imported factors of production. Second Generation studies in contrast to First Generation studies document exchange rate exposure as being significant. To estimate the effect of an exchange rate shock on firm value, only those shocks should be identified that are permanent and unanticipated.

2.1. First generation

For a set of US firms, Jorion (1990) shows insignificant exchange-rate exposure. Over the period from 1971 to 1987 only 15 out of 287 internationally operating firms or 5.2% of the sample have a significant exchange rate exposure at the 5 percent significance level. This occurred because firms effectively managed their exposure which is quite similar to the study of Bodnar and Gentry (1993). Their study tested for exchange rate exposure at the industry level in the US, Japan and Canada and found insignificant exposure for countries which are less open and small. Bartov and Bodnar (1994) provide an additional justification for finding insignificant exchange risk exposure. They suggest that firms that can respond to exchange

rate changes and overall international market conditions at low cost will tend to have insignificant exchange risk exposure. Choi and Prasad (1995) examine exchange-rate exposure of a sample of 409 multinational firms that have foreign sales, profits and assets of at least 25 percent of their respective totals. When they examined exchange risk exposures at the industry level by grouping the firms into 20 portfolios they found limited support for the importance of the exchange rate factor. This was explained by the fact that although firms in a given industry are in the same primary line of business, they are still heterogeneous in terms of their operational and financial characteristics. Since industry groups include firms with positive and negative exchange risk exposure, aggregating across such firms will result in finding an insignificant exposure coefficient for the industry group.

2.2. Second generation

Some studies demonstrate that exchange rate movements can have an economically significant impact on firm value. A firm is said to exhibit exchange rate exposure if its share value is influenced by changes in currency values. Priestley and Odegaard (2002) study uses data from the Norwegian equity market to investigate currency exposure. The Norwegian market is particularly well suited for such an investigation as it is an open economy and their results provide comprehensive evidence that exchange rate exposure is statistically significant and economically important. This study analyzes the currency exposure of industry stock returns. They show that when measuring currency exposure in regressions including the local stock market one has to account for the currency exposure of the local market itself in the estimates, account for possible regime changes by the monetary authorities in exposure estimations and use individual currencies of the major trading partners instead of a currency basket. When these issues are accounted for, exposure estimates are important in both an economic and statistical sense. Ligterink and Macrae (2006) examine the relationship between exchange-rate changes and stock returns for a sample of Dutch firms over 1994–1998. They find that over 50 percent of the firms are significantly exposed to exchange-rate risk. With respect to the determinants of exposure, they find total assets and the foreign sales ratio to be significantly and positively related to the firms' exchange-rate exposure. In comparison with other economies in the world, the Netherlands has a relatively open economy, which may be an explanation for the

prominent exchange-rate exposures for the Dutch firms. Williamson (2001) findings show that there is significant exchange rate exposure in the automotive industry. He finds evidence supportive of the theoretical determinants of foreign exchange rate exposures for firms in a globally competitive industry. His tests reveal that the ratio of foreign sales to total sales and competition are major determinants of exchange rate exposure. Therefore firms in the automotive industry show a significant amount of exchange rate exposure. Dominguez and Tesar (2006), Doidge, Griffin, and Williamson (2006), Bartram and Bodnar(2007) Priestley and Odegaard (2007) findings are also consistent with the result that exchange rate exposure is significant.

III. Methodology

3.1. Sample selection

This study incorporates information regarding automotive firms headquartered in U.S.A and Japan. The automotive firms of both countries compete in major markets and manage a large percentage of worldwide contestable cash flows linked with the automotive industry. Contestable cash flows involve no significant barriers to foreign competition. Japanese Automotive industry is selected because it is one of the leading and prominent industries of the world. The sample comprises of the big three of U.S.A and six companies of Japan namely General Motors[2], Ford Motor, Chrysler LLC[3],

[2] General Motors Corporation is an American automaker based in Detroit, U.S. For 77 consecutive years (1931- 2007), GM was the global sales leader. On June 1, 2009 General Motors Corporation filed for bankruptcy under chapter 11 of the Bankruptcy Code. It is the third largest bankruptcy filing of the world and the former General Motors Corporation is now known as Motors Liquidation Company. Therefore, the stock price taken to compute stock returns is of Motors Liquidation Company.

[3] Chrysler Group, LLC is an American automobile manufacturer headquartered in Detroit. In 1998 German based automobile manufacturer Daimler acquired Chrysler. From 1998 to 2007 Chrysler was part of the German based Daimler Chrysler. On May 14, 2007, Daimler Chrysler announced the sale of 80.1% of Chrysler Group to an American private equity firm. Therefore to compute the stock returns for Chrysler I have used the stock price of Daimler as a proxy for Chrysler. The time period for this study is eight years. As Chrysler is a significant automaker in U.S.A. I included it in my study; excluding it from the sample would have affected the results. Therefore, I had to truncate the time of the study to take account of Chrysler's sale.

Toyota Motor, Nissan Motor, Honda Motor, Suzuki Motor, Mitsubishi Motor and Subaru Motor respectively.

3.2. Data set

The information on exchange rates and market return is taken from DataStream International. The data on stock returns, market return and exchange rates are with a monthly frequency. The data on stock price for U.S firms has been taken from Bloomberg while the data for stock price of Japanese firms is from DataStream International. The stock return is calculated by taking the logarithmic difference between stock prices of the current and previous month.

Stock return = $(\ln P_t - \ln P_{t-1})$ this is because returns are typically taken as percentual return:

$$\%return = 100(\Delta X / X) = 100(X_t - X_{t-1}) / X_{t-1} \sim (\ln X_{t-1})$$

For the second regression equation the impact of sales in each market as shown in figure 1, 2 and 3 depict market shares in each country. The sales figures are taken for a period of eight years (1999-2007). The information for the market shares is taken from the Japanese Automobile Manufacturer's Association also known as JAMA and auto insight data by accessing Global Insight. To analyze the impact of competition on exposure market shares of firms in U.S.A, Japan and Germany are examined. The firms in Germany's sample include Porsche, B.M.W and Daimler. Market share is evaluated by calculating the portion of a firm's sales to total sales in the particular country and the figures are in percentage.

The firm's stock return is used as a proxy for changes in firm value. To compute the stock returns I have taken the logarithmic difference between stock prices. A firm's stock price measures the value of its expected future cash flows. These expected cash flows can follow many different patterns, and the patterns can vary dramatically from firm to firm. There is a high positive correlation between low (high) firm value and low (high) stock price. Firms that have performed poorly (well) recently tend to have lower (higher) share prices due to this poor performance.

Previous studies have been using the trade weighted exchange rate to measure the extent of a firm's exposure to exchange rates but this can mute

the effect of an exchange rate shock on firm value. Therefore in this study to investigate a firm's or a country's automotive industry exposure individual currencies are used as well as real exchange rates. The real exchange rate can be defined as the nominal exchange rate that takes the inflation differentials among the countries into account. Its importance stems from the fact that it can be used as an indicator of competitiveness in the foreign trade of a country. When there are nominal assets and liabilities present in the foreign currency a firm can be exposed to the nominal exchange rate because these assets and liabilities should be interpreted at the nominal rate. In the absence of foreign assets or liabilities a nominal rate change which is affected by changing price levels across countries should have no effect on the real value of the firm. Conclusively, the exchange rate change that should affect firm value is the real exchange rate.

The work of Dumas (1978) and Adler and Dumas (1980, 1984) suggest that exchange rate exposure can be quantified as the sensitivity of stock returns to exchange rate movements. According to Adler and Dumas (1984) exchange rate exposure is the influence of exchange-rate changes on the future cash flows of the firm. In their view firm value represents the present value of future cash flows and exchange-rate exposure is the sensitivity of firm value to exchange-rate changes. Under this assumption, exposure can be determined from the elasticity of firm value with respect to the exchange rate. He defines the exposure elasticity as the change in the market value of the firm resulting from a unit change in the exchange rate. With this approach the exposure elasticity of the firm can be obtained from the coefficient on the exchange rate variable in the following regression. Following Adler and Dumas empirical studies which have measured exchange-rate exposure by the slope coefficient from a regression of stock returns on exchange-rate changes we will be able to evaluate the effect of exchange rate on firm value. To estimate the effect of exchange rate on the firm value the following regression will be used.

$$r_t = \alpha + \beta^m R_{mt} + \sum \beta^e \Delta S_t + \varepsilon_t \qquad (1)$$

where r_t is the monthly return of a firm and portfolio, α is the intercept, ΔS_t is the change in real exchange rate, β^e measures the exposure of the country-specific industry portfolio, R_{mt} is the return on the country-specific market portfolio, β^m is the market risk of firms and ϵ_t is the error term. The exchange

rate exposure is tested for the specific firms as well as for the portfolio of both Japanese and American automotive manufacturers.

The equation although very similar to Adler and Dumas (1984) is consistent with Jorion (1990) as it includes the market factor. Market factor is added to prevent misspecification of the model and control for macroeconomic factors. It is seen to be a significant component of the returns generating process. This market portfolio addition controls for market-wide factors that represent macroeconomic effects correlated with the exchange rate and it changes the statistical properties and distribution of the exposure estimates. Because the market return explains a substantial amount of the typical firm's stock return variation, its inclusion in the exposure estimation model reduces the residual variance of the regression and improves the accuracy of the exposure estimates. The market return has the additional feature of explicitly controlling for movements in the stock market.

It is widely accepted that, for some industries, competition between countries is economically important and this competition is strongly affected by exchange rate changes. Economists around the world argue that some of the industries in their countries compete vigorously with the same industries in other countries and that exchange rate shocks affect their competitiveness. In the U.S. it is routinely stated that some U.S. industries compete with Japanese industries and that an appreciation of the yen is good for these U.S. industries and bad for the competing Japanese industries. A firm's exchange rate exposure is a function of foreign sales, the elasticity of demand in the foreign market and the elasticity of demand in the domestic market (Marston, 1996) It is assumed that the automotive industry is competitive and that competition acts as a proxy for the elasticity of demand for a product therefore competition that a firm faces in the domestic and foreign markets should be a determinant of a firm's exposure in that specific market. Therefore, a firm has more significant exposure to a particular currency not only if the firm has substantial sales in the foreign market but also if the firm faces competition in the same market. This also holds for the domestic market. If the firm faces competition from foreign firms, then the firm has exposure to the currency of that competitor. To evaluate the impact of competition on exchange rate exposure for U.S firms the market share of Japanese and German firms in US is analysed as well as the market share of U.S firms in Japan and Germany

and similarly for the Japanese firms. Germany is included as a third country to take into account the export sales and competition encountered in a particular market.To test the exposure of a firm to competition in the home and foreign markets the following regression is used as follows:

$$r_t = \alpha + \beta^m R_{mt} + y_1 \Delta S_{¥,t} MS_{jp,us} + y_{2\Delta} S_{¥,t} MS_{us,jp} + \partial_1 \Delta S_{dm,t} MS_{gr,us} + \partial_2 \Delta S_{dm,t} MS_{us,gr} + \varepsilon_t \quad (2)$$

Where β^m is the market risk, R_{mt} is the return on the country's market, y_1 and ð1 are the exposure of the interaction between the exchange rate and portfolio market share $_{in}$ which $MS_{A,B}$ represents the market share of portfolio of country A in country , $\Delta S_{k,t}$ represents the rate of change of the real exchange rate in currency k at time t and r_t is the monthly return.

IV. Empirical Results

4.1. USA firms

Table 1a shows the results for the USA portfolio and US firm-specific exchange rate exposure. A negative exchange rate coefficient corresponds to a decrease in the firm's stock returns when the home currency appreciates (as would be the case for an exporter).The US portfolio shows an insignificant exposure to yen and euro along with a negative sign indicating that the U.S portfolio loses values as yen and euro depreciate relative to the dollar. At the firm specific level it can be seen that Ford loses value as yen and euro depreciate relative to dollar, Chrysler loses (gains) value as yen (euro) depreciates and General Motors loses (gains) value as euro (yen) depreciate relative to dollar. The results of the portfolio for yen/dollar are driven by Chrysler and Ford as they both carry a negative sign while General motors and Ford show a negative sign for the euro and therefore the negative sign of the portfolio for euro/dollar is driven through these two.

Table: 1a. USA portfolio and firm - specific exchange rate exposure

Firm	Intercept	market risk	yen/dollar	euro/dollar	Adj.R^2 (%)
U.S. portfolio	-0.0128	0.7375	-0.3191	-0.0128	14.8916
	[-1.6783]	[4.1255]***	[-1.0468]	[-0.0418]	
G.M	-0.0087	1.1482	0.3626	-0.2002	23.2602
	[-0.9466]	[5.3110]**	[0.9832]	[-0.5406]	
Ford Motor	-0.0234	0.7961	-0.1943	-0.6380	8.2814
	[-1.8881]*	[2.7321]**	[-0.3893]	[-1.2839]	
Chrysler	-0.0062	0.2703	-0.6829	0.3560	1.0961
	[-0.6350]	[1.1748]	[-1.7401]*	[0.9033]	

*, **, ***denotes 10%, 5% and 1% significance level.

The full sample results of General Motors, Ford and Chrysler reveal that they have insignificant exposure to both yen and euro resulting in an insignificant exposure of the portfolio. Each firm and portfolio has been tested for the standard tests of autocorrelation, multicollinearity, misspecification and heteroskedasticity problems and there was none present in any firm. The adjusted R^2 is in percentage; the highest value for General Motors and the lowest value for Chrysler Motors.

4.2. Japanese firms

Table 1b shows the results for the Japanese portfolio and firm-specific exchange rate exposure. The Japanese portfolio shows a negative and significant exposure for dollar/yen while an insignificant and positive exposure for euro/yen. This reveals that the Japanese portfolio loses value as dollar depreciates relative to yen and gains in value as euro depreciates relative to yen.

Table: 1b. Japanese portfolio and firm - specific exchange rate exposure

Firm	Intercept	market risk	dollar/yen	euro/yen	Adj.R^2(%)
Japan Portfolio	0.0013	0.6439	-0.4272	0.2118	0.3389
T- statistic	[0.2621]	[6.9207]	[-2.4926]**	[1.2302]	
Toyota	0.0067	0.7371	-0.6481	0.0070	31.880
T- statistic	[1.0731]	[6.3463]**	[-3.0294]**	[0.0328]	
Nissan	0.0088	0.6420	-0.3437	0.1512	11.6529
T- statistic	[0.9849]	[3.8567]**	[-1.1208]	[0.4910]	
Honda	0.0050	0.5793	-0.9650	0.0195	28.4657
T- statistic	[3.6276]**	[4.8831]**	[4.4225]**	[-0.9562]	
Suzuki	0.0046	0.7120	-0.6504	0.4230	25.3624
T- statistic	[0.6561]	[5.3897]**	[-2.6728]**	[1.7306]*	
Mitsubishi	-0.0114	1.0918	-0.1188	0.1490	11.5016
T- statistic	[-0.7628]	[3.9132]**	[-0.2312]	[0.2887]	
Subaru	-0.0059	0.093806	0.16895	0.5189	-0.2247
T- statistic	[-0.6296]	[0.5344]	[0.5226]	[1.5979]	

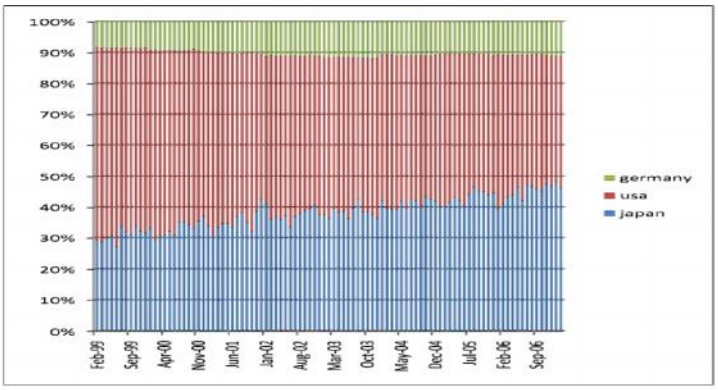
*, **, ***denotes 10%, 5% and 1% significance level.

At the firm-specific level for dollar/yen Toyota, Honda, Suzuki, Mitsubishi, Nissan all have negative sensitivity to the dollar depicting that as dollar depreciates there is a loss in their firm value. The sign of the sensitivity is consistent with the previous findings. Sensitivity to the dollar is driven primarily by Honda, Toyota and Suzuki as they have a higher percentage of cars in the U.S compared to others and from the table it can be seen that these three firms have negative as well as significant exposures; therefore it can be said that the results for the Japanese portfolio for dollar/yen is driven by Toyota, Honda and Suzuki. Subaru shows a positive and insignificant exposure along with Mitsubishi and Nissan. At the firm specific level for euro all the firms in the portfolio have insignificant and positive exposure. The sign of the coefficient discloses that all the firms along with the portfolio enhance their value as euro depreciates relative to dollar. Standard tests for autocorrelation, multicollinearity, misspecification and heteroskedasticity were run to check for any of the problems present. The adjusted R^2 is in percentage; the highest value for the Japanese portfolio and the lowest value for Subaru.

4.3. Market shares of Japan, U.S and Germany

Before analysing the impact of competition on exchange rate exposure market shares should be taken into consideration. Figures 2a, 2b and 2c show that the U.S automotive market has a higher market share of Japanese firms compared to the number of U.S firms selling in Japan while Japan has a lower

Figure: 3a. USA Automobile Market Share



market share in Germany than U.S firms. German market share is higher in U.S than Japan but it has quite a significant share in its own country similar to Japan although U.S is on the course of losing its market share in its own country to Japan. Figure 3a, b, c present market share for U.S.A, Japan and Germany for the years 1975-1995 therefore the change in market share over the years can be analysed.

Figure: 3b. Japan Automobile Market Share

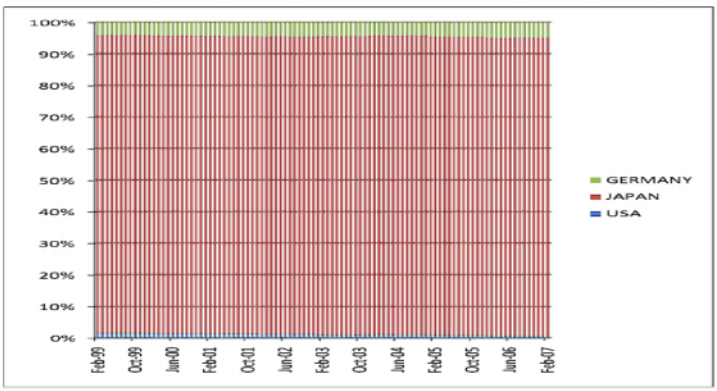
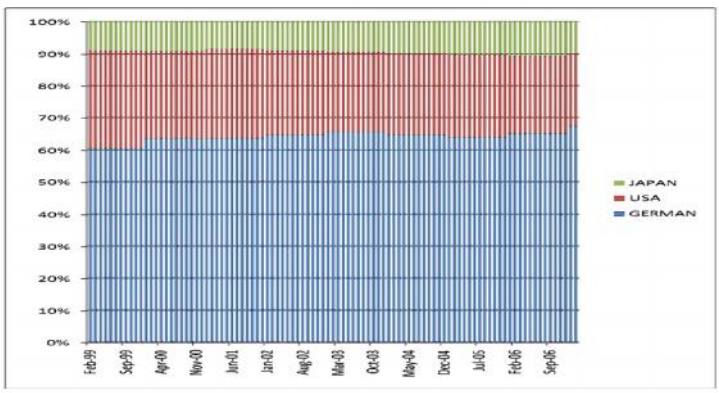


Figure: 3c. German Automobile Market Share



4.4. US firms and market share

In tables 2 and 3 the results for equation 2 are shown. In this equation the market share and exchange rates are interacted. The interaction term shows that the fluctuations in the exchange rates will affect the exposure of firms as the market share increases. To illustrate further the relationship

between the explanatory variables and the dependent variable a distributed lag model will be used which includes lagged terms of independent variables. It is quite possible in time series models to have time playing a key role. In this equation Y_t is not only depending on the current value of X_t but also on past values of X_t. Therefore to capture the effects of time lagged independent variables will be used. It can be seen from table 2b that when the interactions are lagged independently they become significant.

Table: 2a. Interaction between Market share and exchange rate

Market share and exchange rate interaction	**U.S Firms**
Intercept	-0.01093
	[-1.3652]
Country-specific market risk	0.7417
	[4.0928]**
Interaction-USA market share for Japanese firms and ¥/$	-0.0219
	[-0.8438]
Interaction-Japanese market share for USA firms and ¥/$	0.6038
	[0.8175]
Interaction-German market share for USA firms and €/$	-0.0487
	[-0.7946]
Interaction- USA market share for German firms and €/$	0.0931
	[0.5972]

*, **, ***denotes 10%, 5% and 1% significance level

From table 2a it can be inferred that the interaction between the U.S market shares of Japanese firms with yen to dollar shows a negative sign and similarly the interaction between German market share for U.S firms and euro to dollar shows a negative sign although both of them are not significant. The interaction between the Japanese market share for U.S firms and yen to dollar as well as German market share for U.S firms and euro to dollar are both positive and insignificant.

The results in table 2b show that the U.S portfolio exposure to the yen is due to the share of the U.S market held by Japanese firms. North American car maker's steady loss of domestic market share has not been driven by imports from Japan but by the success of foreign-owned automobile plants operating in the United States. Since the 1980s, Japanese automakers such as Toyota, Honda, Nissan and Mazda dramatically have increased their production capacity in the United States. Therefore U.S.A's real competition

is not Japanese factories in Japan but in California, Ohio, Kentucky etc in the United States and when US market share for Japanese firms is lagged separately it shows a negative as well as a significant sign which is also similar to the previous studies.

The exposure to euro for U.S portfolio should occur due to the share of the German market held by American firms as has been predicted in previous studies. If we compare figure 3c with 2c it can be seen that there has been a steady increase in Germany's market share of U.S. At its inception euro depreciated for some time but since 2002 it has progressively appreciated versus the dollar. This can be a rationale for American firms comprising a steady increase in market share in Germany as their cars are comparatively cheaper in Germany. The German share in U.S has gradually increased but is still not very substantial; although exposure to euro for both the countries' firms is not significant.

From table 2c and 2d it can be inferred that when the interaction between the country specific industry portfolio's market shares with exchange rate is lagged it does not reveal a significant sign suggesting that there is no significant relationship between them and U.S firm returns. On the whole it can be said that the U.S firms are more exposed to yen than euro which is due to the share of Japanese firms in U.S.

4.5. Japanese firms and market share

It can be seen from table 3a that the sign for the interaction between the U.S market share for Japanese firms and dollar to yen as well as German market share for Japanese firms and euro to yen is positive and insignificant. The interaction between Japanese market shares for U.S firms and German firms with dollar and euro to yen respectively is negative while the latter one being significant. The results however are clearer when these interactions are lagged as shown in table 3c.

As predicted in previous studies exposure to dollar for the Japanese firms should be due to the share of U.S market held by Japanese firms. As said before this occurs because they constitute a very large market share of the American market as shown in fig 1c. The rationale for this as said above is that the market share of Japanese cars has greatly increased in the past years and as the yen has been appreciating over the past years they are also heavily

exposed to the dollar. According to economic theory, a yen appreciation detracts from the international competitiveness of Japanese automakers by raising the relative costs and thus prices of their vehicles. When producing autos if a company utilizes Japanese labour and other inputs whose costs are denominated in yen; the firm's yen costs of these inputs remain constant if yen appreciates. However, the firm's input costs rise in dollar terms thus reducing the firm's international competitiveness. After lagging the interaction it becomes significant as shown in table 3c verifying its importance.

Table: 3a. Interaction between market share and exchange rate

Market share and exchange rate interaction	**Japanese firms**
Intercept	0.0021
	[0.3921]
Country-specific market risk	0.6375
	[6.8136]**
Interaction-USA market share for Japanese firms and $/¥	0.0147
	[0.9896]
Interaction- German market share for Japanese firms and €/¥	0.0701
	[0.3297]
Interaction- Japanese market share for USA firms and $/¥	-0.8545
	[-1.8503]*
Interaction-Japanese market share for German firms and €/¥	-0.0984
	[-0.2500]

*, **, ***denotes 10%, 5% and 1% significance level.

The exposure to euro must be due to the share held by Japanese firms in Germany and also the share held by German firms in Japan. This is because both the countries have small market share in both countries and exposure is the result of market shares of both countries. The exposure to the euro is due to the shares of both German firms in Japan and Japanese firms in Germany; this can be seen in table 3c that these interactions are significant and verify that both of the market shares have an impact on exposure.

The interaction of the market share of U.S firms in Japan with dollar/yen is also significant although the market share is extremely small; this result is different from the past studies. This might be due to the effect of the appreciation of yen against the dollar making American products cheaper in Japan than ever before. Therefore it is beneficial for American car industry that can export more cars to Japan, when Japanese car manufacturers cannot

sell as many cars in the U.S giving Gm, ford and Chrysler a large comparative advantage.

Similar to table 2b when the market shares are lagged separately in table 4b for Japanese firms they turn out to be insignificant and when these interactions are lagged along with the market share and exchange rates they are also insignificant as depicted in table 4d.

Table: 4. North American Production by Japanese Manufacturers

Years	Production
1999	2797175
2001	3061612
2002	3375453
2003	3840744
2004	3840744
2005	4080713
2006	4001639
2007	4049068

On the whole the essence of this study is that the exposure to yen for both Japanese and U.S firms is due to the market share of Japanese firms in U.S. According to Japanese Automobile Manufacturer's Association as close to the end of the first decade of the millennium reported that the Japanese vehicle sales account for more than 40 percent of the U.S. auto market which has risen by about 11 percentage points over the last five years. Their companies no longer operate as foreign competitors but as enterprises which are fully integrated into the American auto industry. Japanese automakers in 2007 supplied 63% of their total U.S. sales from their North American plants, compared with less than 12% in 1986, exported about 3.4 million vehicles from Japan to the U.S in 1986 but in 2007 this figure dropped to 2.2 million vehicles and produced 617,000 vehicles in the U.S. in 1986, compared to more than 3.4 million vehicles in 2007.

------ Japanese firms exports to USA ------ Japanese firm's USA production

The graph for North American production replacing exports is shown in figure 3 and table 6 reports the North American production of Japanese firms. Japanese firms have been making a lot of effort to produce outside of its home market but North America has been its preferred destination as they could reduce their exposure because of the hedging value of dollar denominated costs.

V. Conclusion

It is a widely held belief that fluctuations in exchange rates have important implications for financial decision making as well as the profitability of firms. The key findings of this paper suggest that there is exchange rate exposure present for some multinational firms in a globally competitive industry. Using a sample of automotive firms from the U.S and Japan there is evidence that most Japanese firms are exposed to the dollar in comparison with euro while U.S firms show insignificant exposure to both the currencies. At the firm - specific level, there is evidence of some firms facing significant exposure while others facing insignificant exposure; this is consistent with the theories of the determinants of exposure.

The structure of a firm's operations as well as the competition faced within an industry plays a key role in determining the relationship between firm value and exchange rate exposure. As said before the currency exposure

of a firm is a function of its foreign sales, the cost structure of the foreign competition as well as the degree of competition. These are incorporated in this study by taking into consideration the market shares of firms out of their home country and in their home country. Analysing the market shares of firms and the competition faced by firms in each market, results represent that domestic competition from foreign firms is a critical determinant of exposure. This study reveals that U.S firms are greatly exposed to yen and Japanese firms to dollar due to the presence of Japanese firms in U.S. while U.S firms are exposed to euro because of their market share in Germany and Japanese firms are exposed to euro because of mutual market shares.

Measuring exchange rate exposure and examining factors affecting it are of great interest to policy makers who are keen in understanding the impact of exchange rates on certain sectors of the economy and who are trying to understand the relation between policies that affect exchange rates and relative wealth affects. It also has important implications for investors who under or overweight multinational organisations in their portfolios.

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Appendices

Table: 2b. Lagged Market Shares

	U.S FIRMS		U.S FIRMS
Intercept	-0.1962	Intercept	-0.0412
T-Stat.	(-1.9153)*	T-Stat	(-0.6558)
Country-specific market risk	0.7369	Country-specific market risk	0.7333
T-Stat	(4.3006)***	T-Stat	(4.1836)***
US market share for German firms	0.0196	US market share for Japan firms	0.0008
T-Stat	(1.7988)	T – statistic	(0.4618)
Intercept	0.0343	Intercept	0.0281
T-Stat	(0.7260)	T-Stat	(0.9319)
Country-specific market risk	0.7417	Country-specific market risk	0.7139
T-Stat	(4.2791)***	T-Stat	(4.1085)***
German market share for US firms	-0.0021	Japan market share for US firms	-0.0371
T-Stat	(-1.0014)	T-Stat	(-1.3869)
Intercept	-0.1712	Intercept	-0.0852
T-Stat	9-1.5529)	T-Stat	(-1.2262)
Country-specific market risk	0.7829	Country-specific market risk	0.7504
T-Stat	(4.3815)***	T-Stat	(4.3321)***
US market share for German firms (-1)	0.071781	US market share for Japan firms (-1)	-0.008019
T-Stat	(1.36097)	T-Stat	(-2.0052)**

US market share for German firms (-2)	0.020693	US market share for Japan firms (-2)	0.001356
T-Stat	(0.2852)	T-Stat	(0.3055)
US market share for German firms (-3)	-0.016043	US market share for Japan firms (-3)	0.0098
T-Stat	(-0.2211)	T-Stat	(2.2135)**
US market share for German firms (-4)	-0.059826	US market share for Japan firms (-4)	-0.0009
T-Stat	(-1.1565)	T-Stat	(-0.2357)
Intercept	0.03666	Intercept	0.02001
T-Stat	(0.6649)	T-Stat	(0.6017)
Country-specific market risk	0.77893	Country-specific market risk	0.760689
T-Stat	(4.19600)***	T-Stat	(4.0533)***
German market share for US firms (-1)	-0.004261	Japan market share for US firms (-1)	-0.1389
T-Stat	(-0.56685)	T-Stat	(-0.690)
German market share for US firms (-2)	-0.005343	Japan market share for US firms (-2)	0.047165
T-Stat	(-0.48907)	T-Stat	(0.17321)
German market share for US firms (-3)	0.008438	Japan market share for US firms (-3)	0.02918
T-Stat	(0.7209)	T-Stat	(0.10836)
German market share for US firms (-4)	-0.00105	Japan market share for US firms (-4)	0.031677
T-Stat	(-0.12466)	T-Stat	(0.1614)

Table: 2c. Lagged Market share and exchange rate interaction

	U.S FIRMS		U.S FIRMS
INTERCEPT	-0.01225	INTERCEPT	-0.012522
T- stat	[-1.612026]	T- stat	[-1.662282]
Country-specific market risk	0.727527	Country-specific market risk	0.744619
T- stat	[4.099472]***	T- stat	[4.310452]***
Japan for US yen to dollar	-0.104401	German for US euro to dollar	-0.014791
T- stat	[-0.445215]	T- stat	[-1.285138]
INTERCEPT	-1.662282	INTERCEPT	-0.012092
T- stat	[-1.717841]	T- stat	[-1.593722]
Country-specific market risk	4.310452	Country-specific market risk	0.713922
T- stat	[4.263989]***	T- stat	[4.011542]***
US for German euro to dollar	-1.285138	US for Japan yen to dollar	-0.005766
T- stat	[-1.206662]	T- stat	[-0.751301]
INTERCEPT	-0.011687	INTERCEPT	-0.011098
T- stat	[-1.500879]	T- stat	[-1.422291]
Country-specific market risk	0.775329	Country-specific market risk	0.72717
T- stat	[4.301895]***	T- stat	[3.961518]***
Japan for US yen to dollar (-1)	0.085764	German for US euro to dollar (-1)	0.01677
T- stat	[0.351658]	T- stat	[1.390599]
Japan for US yen to dollar (-2)	0.010742	German for US euro to dollar (-2)	-0.005515
T- stat	[0.044442]	T- stat	[-0.459553]

Japan for US yen to dollar (-3)	0.343628	German for US euro to dollar (-3)	-0.00498
T- stat	[1.458121]	T- stat	[-0.413033]
Japan for US yen to dollar (-4)	0.076822	German for US euro to dollar (-4)	-0.001456
T- stat	[0.328929]	T- stat	[-0.123878]
INTERCEPT	-0.010832	INTERCEPT	-0.011907
T- stat	[-1.377296]	T- stat	[-1.528969]
Country-specific market risk	0.721876	Country-specific market risk	0.763322
T- stat	[3.961794]***	T- stat	[4.193191]***
US for German euro to dollar(-1)	0.043104	US for Japan yen to dollar (-1)	0.004483
T- stat	[1.490263]	T- stat	[0.563966]
US for German euro to dollar (-2)	-0.008939	US for Japan yen to dollar (-2)	-0.000973
T- stat	[-0.310015]	T- stat	[-0.122122]
US for German euro to dollar (-3)	-0.015532	US for Japan yen to dollar (-3)	0.009625
T- stat	[-0.533935]	T- stat	[1.218156]
US for German euro to dollar (-4)	0.003435	US for Japan yen to dollar (-4)	0.006456
T- stat	[0.119363]	T- stat	[0.829416]

Table: 2d. Lagged Market share and exchange rate interaction along with exchange rate and Market share

	U.S FIRMS		**U.S FIRMS**
INTERCEPT	-0.052201	INTERCEPT	-0.16992
T – stat	[-0.819271]	T – stat	[-1.564327]
Country-specific market risk	0.692805	Country-specific market risk	0.741137
T – statistic	[3.831474]***	T – stat	[4.265437]***
US for Japan yen to dollar	-0.06507	US for German euro to dollar	0.108515
T – stat	[-0.968426]	T – stat	[0.28968]
Yen to dollar	2.043492	Euro to dollar	-1.216247
T – stat	[0.881351]	T – stat	[-0.34606]
US market share for Japan firms	0.001181	US market share for German firms	0.016866
T – stat	[0.641492]	T – stat	[1.457969]
INTERCEPT	0.02974	INTERCEPT	0.022355
T – stat	[0.979347]	T – stat	[0.443318]
Country-specific market risk	0.681136	Country-specific market risk	0.743772
T – stat	[3.807353]***	T – stat	[4.203125]***
Japan for US yen to dollar	0.748356	German for US euro to dollar	-0.013569
T – stat	[0.804269]	T – stat	[-0.161377]
Yen to dollar	-0.998982	Euro to dollar	0.016912
T – stat	[-0.94727]	T – stat	[0.008897]
Japan market share for US firms	-0.038425	German market share for US firms	-0.001552
T – stat	[-1.426969]	T – stat	[-0.693251]

Table: 3b. Lagged Market shares

	Japanese firms		**Japanese firms**
INTERCEPT	0.007545	INTERCEPT	-0.098229
T – stat	[0.356141]	T – stat	[-0.952975]
Country-specific market risk	0.60413	Country-specific market risk	0.609774
T – stat	[6.281639]***	T – stat	[6.402478]***
Japan market share for US firms	-0.004688	Japan market share for German firms	0.023118
T – stat	[-0.250632]	T – stat	[0.977502]
INTERCEPT	0.044209	INTERCEPT	0.007854
T – stat	[0.707581]	T – stat	[0.181004]
Country-specific market risk	0.621525	Country-specific market risk	0.607833
T – stat	[6.343567]***	T – stat	[6.324097]***
Germ market share for japan firms	-0.005257	US market share for japan firms	-0.000159
T – stat	[-0.671523]	T – stat	[-0.12663]
INTERCEPT	-0.035727	INTERCEPT	0.086442
T – stat	[-0.709693]	T – stat	[1.241067]
Country-specific market risk	0.584436	Country-specific market risk	0.634305
T – stat	[5.681498]***	T – stat	[6.301533]***
US market share for japan firms(-1)	-0.000814	German market share for japan firms(-1)	-0.001124
T – stat	[-0.281608]	T – stat	[-0.041507]
US market share for japan firms(-2)	0.000717	German market share for japan firms (-2)	-0.01426
T – stat	[0.224543]	T – stat	[-0.381328]
US market share for japan firms (-3)	-0.002414	German market share for japan firms (-3)	-0.029091
T – stat	[-0.765767]	T – stat	[-0.779622]
US market share for japan firms (-4)	0.003605	German market share for japan firms (-4)	0.033669

T – stat	[1.259035]	T – stat	[1.270408]
INTERCEPT	0.010013	INTERCEPT	-0.131412
T – stat	[0.438119]	T – stat	[-1.149395]
Country-specific market risk	0.604098	Country-specific market risk	0.603691
T – stat	[6.014752]***	T – stat	[6.083453]***
Japan market share for US firms (-1)	-0.192649	Japan market share for German firms (-1)	0.090296
T – stat	[-1.453943]	T – stat	[0.957708]
Japan market share for US firms (-2)	0.293911	Japan market share for German firms (-2)	-0.112049
T – stat	[1.615007]	T – stat	[-0.853198]
Jap market share for US firms (-3)	-0.115032	Japan market share for German firms (-3)	0.107267
T – stat	[-0.632704]	T – stat	[0.817885]
Japan market share for US firms(-4)	0.004783	Japan market share for German firms(-4)	-0.05526
T – stat	[0.036068]	T – stat	[-0.580162]

Table: 3c. Lagged Market share and exchange rate interaction

	Japanese firms		**Japanese firms**
INTERCEPT	0.001895	INTERCEPT	0.001816
T – stat	[0.372603]	T – stat	[0.363478]
Country-specific market risk	0.624902	Country-specific market risk	0.628559
T – stat	[6.701543]***	T – stat	[6.862232]***
US for Japan dollar to yen	-0.011852	Japan for US dollar to yen	-0.454803
T – stat	[-2.362376]**	T – stat	[-3.017634]***
INTERCEPT	0.001939	INTERCEPT	0.001746
T – stat	[0.374069]	T – stat	[0.335657]
Country-specific market risk	0.631529	Country-specific market risk	0.630698

T – stat	[6.569114]***	T – stat	[6.549483]***
German for Japan euro to yen	0.032482	Japan for German euro to yen	0.057408
T – stat	[1.454898]	T – stat	[1.380317]
INTERCEPT	-0.000723	INTERCEPT	0.000821
T – stat	[-0.136926]	T – stat	[0.16241]
Country-specific market risk	0.58496	Country-specific market risk	0.573423
T – stat	[5.948503]***	T – stat	[5.995854]***
Japan for German euro to yen (-1)	0.039909	Japan for US dollar to yen(-1)	-0.276518
T – stat	[0.977001]	T – stat	[-1.739644]*
Japan for German euro to yen (-2)	0.069937	Japan for US dollar to yen (-2)	-0.174619
T – stat	[1.707714]*	T – stat	[-1.120061]
Japan for German euro to yen (-3)	0.025047	Japan for US dollar to yen (-3)	-0.362721
T – stat	[0.610185]	T – stat	[-2.388688]**
Japan for German euro to yen (-4)	0.059178	Japan for US dollar to yen (-4)	-0.218605
T – stat	[1.429318]	T – stat	[-1.45159]
INTERCEPT	-4.44E-05	INTERCEPT	0.000652
T – stat	[-0.008486]	T – stat	[0.126911]
Country-specific market risk	0.59015	Country-specific market risk	0.552728
T – stat	[6.024505]***	T – stat	[5.575843]***
German for Japan euro to yen (-1)	0.022311	US for Japan dollar to yen(-1)	-0.010261
T – stat	[1.015852]	T – stat	[-1.918668]*
German for Japan euro to yen (-2)	0.038638	US for Japan dollar to yen (-2)	-0.006317
T – stat	[1.758912]*	T – stat	[-1.204578]
German for Japan euro to yen (-3)	0.013072	US for Japan dollar to yen (-3)	-0.007626
T – stat	[0.594217]	T – stat	[-1.470467]
German for Japan euro to yen (-4)	0.028774	US for Japan dollar to yen (-4)	-0.009726

T – stat	[1.297762]	T – stat	[-1.901337]*

Table: 3d. Market share and exchange rate interaction along with market share and exchange rate

	Japanese firms		**Japanese firms**
INTERCEPT	0.008155	INTERCEPT	0.008571
T – stat	[0.195194]	T – stat	[0.422464]
Country- specific market risk	0.629707	Country- specific market risk	0.621992
T – stat	[6.819719]***	T – stat	[6.731103]***
US for Japan dollar to yen	0.083122	Japan for US dollar to yen	-1.149336
T – stat	[1.894655]*	T – stat	[-1.871998]*
Dollar to yen	-3.306902	Dollar to yen	0.809189
T – stat	[-2.181867]**	T – stat	[1.165601]
US market share for Japan firms	-0.000162	Japan market share for US firms	-0.006217
T – stat	[-0.134302]	T – stat	[-0.346994]
INTERCEPT	0.01993	INTERCEPT	-0.076934
T – stat	[0.300316]	T – stat	[-0.731153]
Country- specific market risk	0.635509	Country- specific market risk	0.629027
T – stat	[6.399447]***	T – stat	[6.499003]***
German for Japan euro to yen	0.132159	Japan for German euro to yen	-0.75454
T – stat	[0.478488]	T – stat	[-0.714052]
Euro to yen	-0.803597	Euro to yen	3.435025
T – stat	[-0.368709]	T – stat	[0.763179]
German market share for US firms	-0.002205	Japan market share for German firms	0.018366
T – stat	[-0.26404]	T – stat	[0.759405]