Does exchange rate volatility matter for international sales? Evidence from US firm level data

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HIGHLIGHTS

- We analyze the effect of exchange rate volatility on firms' foreign sales.
- We use destination-specific US firm-level data and utilize quantile regression.
- The effect of the volatility on foreign sales depends on firm characteristics.

ABSTRACT

We explore the effect of exchange rate volatility on firms' foreign sales using destination-specific US firm-level data at different quantiles of the conditional distribution. Results show that the sign and significance of the effect depend on the economic conditions, firm characteristics, the sector that the firms operate and the quantile of the conditional distribution. Hence, using aggregated data, utilizing mean-regression methods and ignoring firm-specific factors can explain the mixed results provided by the existing literature.

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1. Introduction

The role of exchange rate volatility on firms' decisions to sell at home or abroad has been investigated many times in the past. Both theoretical and empirical works, however, have provided mixed results (e.g. Hooper and Kohlhagen, 1978; Cushman, 1986; Pozo, 1992; Assery and Peel, 1991). One reason, as argued in the literature, is the use of aggregated data which might mask the effect of exchange rate volatility on foreign sales (McKenzie, 1999; Huchet-Bourdon and Korinek, 2011; Tang, 2014; Wang and Barrett, 2007). Hence, one must look at the firm level data to understand the effect of exchange rate volatility on firms' decisions to sell in foreign markets. Yet, there are few studies in the literature using firm-level data (Solakoglu et al., 2008; Solakoglu, 2010; Cheung and Sengupta, 2013; Guillou, 2008; Hericourt and Poncet, forthcoming; Dekle and Ryoo, 2007; Gourlay and Seaton, 2004).

In this study, we explore the relationship between exchange rate volatility and firms' foreign sales, taking into account several firm-specific characteristics and using destination-specific foreign sales data for US firms. In addition, we apply the Regression Quantile estimation developed by Koenker and Bassett (1978) to evaluate the effect at different points of the conditional distribution. We show that the sign and significance of exchange rate volatility on firms' foreign sales differs based on economic conditions, the sector in which the firm operates, and firm characteristics. Moreover, the effect is not stable across all quantiles of the conditional distribution.

The remainder of the paper is organized as follows. Section 2 discusses the data and model specification. Section 3 presents the

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estimation results as well as a discussion of these results. Finally, the last section presents our main conclusions.

2. Model specification and implementation

Our sample covers firms located in the US listed in the S&P400, S&P500, or S&P600, with positive foreign sales in 2006 and 2008, thus representing a non-crisis and crisis period. Destination markets are the United Kingdom, France, Germany, Canada, Japan, China, Brazil, Mexico, and Singapore. All firm level data are obtained from Thomson Reuters Worldscope database; other variables except for exchange rates are taken from the World Bank database. Exchange rate volatility is estimated as the standard deviation of exchange rate returns over the previous 12 months compared to the relevant month. As a check of robustness, we also calculated a GARCH-based measure using weekly exchange rate returns obtained from Datastream database.

Descriptive statistics, provided in Table 1, reveal that the share of foreign sales, foreign-market dependence, and the size of foreign sales increased from 2006 to 2008. This should not be surprising, as 2008 represents the beginning of crisis years that originated from the United States. Moreover, the share of foreign sales is larger for "Information Technology" and smaller in "Industrials" than for other sectors in both periods. A possible reason is that the US is technologically one of the most advanced countries, with high R&D intensity and vast exports of high-tech products such as aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Further, the percentage of firms that has a higher dependence on foreign sales – that is, the level of foreign sales is greater than the median – is higher in "Consumer Discretionary". Interestingly, even though the "Information Technology" sector has a higher share of foreign sales, the percent of firms that depend on foreign market is smaller and the average of foreign sales is smaller than the overall average.

As suggested in the literature, we expect a negative relationship between exchange rate volatility and the share of foreign sales. However, we also expect firm size, foreign-market dependence, and the sector in which the firm operates to be important. In particular, we expect larger and more foreign market dependent firms to be affected less by higher volatility as they should have resources and incentives to hedge against such risks.

Using the Regression Quantile (RQ) approach, the θth Regression Quantile is a vector $\hat{\beta}(\theta)$ that solves the following minimization problem with linear programming:

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i : y_i \geq x'_i \beta\}} \theta |\log(\text{share})_{i,j,t} - x'_{i,j,t}\beta| \right.$$
$$\left. + \sum_{i \in \{i : y_i < x'_i \beta\}} (1-\theta)|\log(\text{share})_{i,j,t} - x'_{i,j,t}\beta| \right] \quad (1)$$

where $x'_{i,j,t}\beta$ is given by:

$$\begin{aligned} x'_{i,j,t}\beta = {}& \propto + \beta_1 \log(GDP)_{j,t} + \beta_2 \log(RCPI)_{j,t} \\ & + \beta_3 \log(Exrate)_{j,t} + \beta_4 \log(Volatility)_{j,t} \\ & + \beta_5 \left[\log(Volatility)_{j,t} \times sector1\right] \\ & + \beta_6 \left[\log(Volatility)_{j,t} \times sector2\right] \\ & + \beta_7 \left[\log(Volatility)_{j,t} \times sector3\right] \\ & + \beta_8 \left[\log(Volatility)_{j,t} \times size\right] \\ & + \beta_9 \left[\log(Volatility)_{j,t} \times dependence_{j,t}\right]. \end{aligned} \quad (2)$$

The dependent variable is firm i's share of foreign sales for the foreign market j at time t, in logs. The variable GDP is the gross domestic product in constant 2000 US dollars of the destination market at time t. RCPI represents the relative prices and is calculated as the ratio of the consumer price index in the destination market to that in the US. Exrate is the bilateral exchange rate expressed as the price of one US dollar in terms of the destination currency. The exchange rate risk is denoted by the variable "volatility". For firm-specific characteristics, we use industry, size, and dependency on foreign sales. For industry dummies, we focus on "Consumer Discretionary", "Industrials", and "Information Technology", gathering other industries together. Size is a dummy variable that identifies smaller firms if they are listed in the S&P400 or S&P600. Foreign-market dependence is indicated by the dummy variable "dependence" in the equation.

3. Results and discussion

Estimation results for 2006, reported in Table 2, reveal that exchange rate risk has a significant and negative effect on the share of foreign sales for large firms that do not depend on foreign sales and operate in other sectors (as represented by β_4). Moreover, this finding is stable across all quantiles of the conditional distribution, which is consistent with the mean regression result. However, the quantile regression estimation conveys a different result than the mean regression estimation for firms operating in the information technology sector: that is, only firms located at the left tail of the distribution lower their share of foreign sales due to higher volatility. A similar result is observed for firms in the industrials and consumer discretionary sectors. Firms located at the far left tail appear to be more sensitive to exchange rate risk.

Contrary to our expectation, we do not find a smaller (larger) impact of exchange rate volatility on foreign sales for larger (smaller) firms. In fact, there is some evidence that smaller firms actually use higher volatility to their advantage, as the sign of the coefficient for smaller firms ($\beta_4 + \beta_8$) is positive and significant in the left tail of the conditional distribution. Our sample in 2006 indicates that 79% of smaller firms and 26% of larger firms are dependent on foreign sales, implying that smaller firms also have incentives to hedge. With the GARCH-based volatility measure, we have a positive and significant effect at the right tail of the conditional distribution as well.[1] According to mean regression estimation, while firm size is statistically insignificant ($\beta_4 + \beta_8$) with the first volatility measure, the coefficient becomes significant with the GARCH-based measure. Furthermore, with the GARCH-based measure, we find that foreign-sale dependent firms are positively impacted by higher volatility across almost the entire conditional distribution.

Similarly, the estimation results for 2008, provided in Table 3, reveal that exchange rate volatility has a negative impact on firms' foreign sales if the firms operate in other sectors, are larger in size, and depend less on foreign sales. Comparing the 2008 results to those of 2006, we see that the sectoral effect becomes irrelevant under a crisis environment. All firms are affected negatively by higher exchange rate volatility. Nevertheless, our findings differ for smaller firms and also for firms that depend more on foreign sales. For these firms, we find that the share of foreign sales responds negatively and significantly to exchange rate volatility at the right tail of the conditional distribution. At the left tail of the conditional distribution, neither for smaller firms nor for firms that depend more on foreign sales do we find an effect of exchange rate volatility on the share of foreign sales. In sum, our results show

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[1] To save space, we do not report estimation results with GARCH-based measure but only discuss the differences.