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Exchange Rate Movements and Exporter Profitability: Empirical Evidence from Chinese Manufacturing Sectors

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Most products exported by Chinese manufacturing firms are characterized by high labor-intensity and low markup. *Renminbi* (RMB) appreciation undoubtedly worsens this situation as exporters have to pay RMB-denominated wages and charge dollar-denominated prices. This paper studies the correlation between exchange rate movements and the profitability of exporters. We find significant negative effects of RMB appreciation on the profitability of exporters.

Keywords: Exchange Rate; Profitability; ROE

JEL: F14; F31; F61

1. Introduction

On July 21, 2005, China began to implement the floating exchange rate system based on market supply and demand and referenced to a basket of currencies. Consequently the RMB appreciated by 2.1%. The exchange rate of the RMB has been rising steadily for the past ten years. This raises a concern about whether the appreciation of RMB exchange rate has affected China's export enterprises. As a consequence of the country's deflation policy combined with the increasing cost of labor, some medium and small enterprises in Zhejiang Province and Wenzhou Municipality—places in which light industry exporting firms are concentrated—began to go bankrupt one after the other. At the same time, enterprises in South China began to have business accounting problems. Some economists believe that if the RMB exchange rate continues to rise at the current rate, China's economy will be hard-pressed. Nevertheless, other people, especially Chinese officials, point out that a stronger RMB also means cheaper imports. That could help China achieve its goal of boosting domestic consumption as imported consumer items become more affordable. They also argue that RMB appreciation will reduce import costs and provide more access to capital goods, intermediate goods and advanced technologies. Considering the weakening external demand and rising labor costs, it is worthwhile to explore whether RMB appreciation has had a negative or positive effect on the profitability of exporters. Our paper intends to shed some light on this topic.

A growing literature has investigated the effects of exchange rate movements on exporting firms. However, controversial conclusions have been reached. Theoretical research, such as Marshall (1923) and Lerner (1944), argue that currency appreciation and exports are negatively correlated. Large numbers of empirical studies supporting this

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view are provided (Berman et al., 2012; Das et al., 2007; Greenaway et al., 2007; Yu, 2012). Nevertheless, there is also an extensive empirical literature implying insensitivity of exports to exchange rates (Campa, 2004; Hooper et al., 1998; Dell' Ariccia, 1999). The inconsistent findings are due to the various data and methodologies employed by different researchers. Most previous studies are likely to suffer from problems of endogeneity.

Different from existing literature, this paper uses China's firm-level data from 2001–2007 in manufacturing sectors to investigate the effects of RMB exchange rate changes on profitability. We implement a difference-in-difference (DID) regression method and compare the effects of exchange rate changes on exporters and non-exporters. Exporters and non-exporters have different exposures to exchange rate volatility. We find that RMB appreciation decreased the profitability of exporters compared to non-exporters. Using DuPont Analysis, we decompose ROE into asset turnover, sales margin and leverage ratio, and find that exporter profitability declines as a result of decreased revenue generating capacity and abated sales margins.

This paper contributes to the literature in at least two important ways. First, it enriches the understanding of the economic growth of China, the second largest economy in the world. On the one hand, with weakening external demand and rising labor costs, many Chinese manufacturing firms have run into trouble. Many economists in China and abroad are concerned that RMB appreciation may reduce the price competiveness of "Made in China". It is meaningful to investigate the effects of exchange rate movements on the behavior of firms. On the other hand, profitability is the most important factor that affects a firm's entry into and exit from the exporting market. Only a few studies have dealt with this topic from the perspective of profitability. Second, rarely has firm-level data been used to investigate the effects of exchange rate movements. As far as we know, our paper is among the first in the literature that attempts to explore this topic with micro-level data. Previous studies are likely to suffer from problems like endogeneity. To avoid these biases, our paper use highly disaggregated firm-level production data to perform estimations.

The remainder of the paper proceeds as follows. Section 2 introduces the econometric method. Section 3 describes the datasets used in our empirical analysis. Section 4 presents the empirical results. Finally, Section 5 concludes.

2. Empirical Specification

We use DID methods to implement empirical tests. The exchange rate in China is highly regulated by the People's Bank of China (PBOC). As we can see from Figure 1, before 2005, the nominal exchange rate of the RMB against the US dollar remained constant. It rose gradually after the reform in 2005. The real exchange rate of RMB had been decreasing since 2001 and began to increase after 2005. RMB appreciation from 2005–2007 can be taken as a natural experiment. We divide the whole sample into two periods, 2001–2004 and 2005–2007, and categorize firms into exporters and non-exporters. We consider exporters as "the treatment group" and non-exporters as "the control group".

Using DuPont Analysis, we decompose ROE (Net_Income/Equity) into asset turnover (Sales/Total_Asset), sales margin (Net_Income/Sales) and leverage ratio (Total_Asset/Equity). ROE is useful for comparing the profitability of firms. It measures a firm's profitability by revealing how much profit a firm generates with the money shareholders have invested. Asset turnover is an indicator of the efficiency with which a firm is deploying its assets. It measures the amount of sales or revenues generated per dollar of assets. Sales margin measures how much out of every dollar of sales a firm actually keeps in earnings. A higher profit margin indicates a more profitable firm that has better control

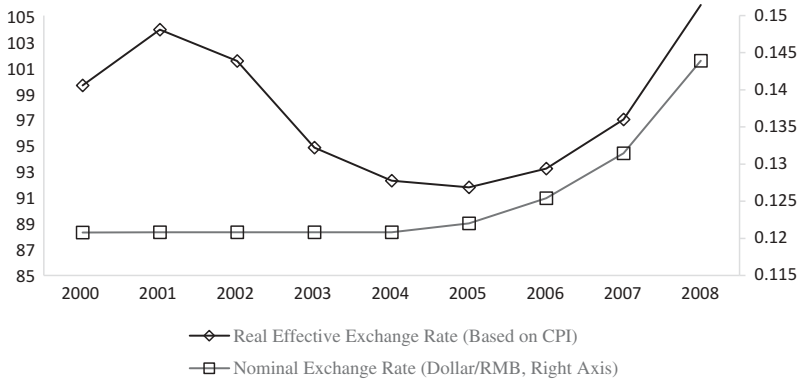

Figure 1 Import Tariffs of Chinese Manufacturing Firms.
Source: International Monetary Fund E-library.

over its costs compared to its competitors. Leverage ratio is used to calculate the financial leverage of a firm to get an idea of the firm's methods of financing or to measure its ability to meet financial obligations. Leverage ratio is a relatively stable indicator within each specific firm. We estimate the impact of exchange rate movement on exporters' profitability. An empirical equation is specified as follows:

$$y_{ft} = \beta_0 + \beta_1 Post_t \times Exporter_f + \alpha_f + \lambda_t + \varepsilon_{ft} \quad (1)$$

We let f denote firms and t denote years. y_{ft} is the outcome variable, here referring to ROE, asset turnover and sales margin. $post_t$ is an indicator whether year t is after RMB appreciation. $Exporter_f$ is an indicator of firms which engage in exporting. They are expected to have a high level of exposure to exchange rate volatility. The decisions whether to export and how much to export might be correlated with firm-level profitability. We identify firm f as an exporter if it took up exporting trade for the period 2001–2004 during which the RMB exchange rate remained nearly constant (see Figure 1). α_f and λ_t are firm-specific and year-specific fixed effects. ε_{ft} is an idiosyncratic error term. If RMB appreciation raised profitability of exporters compared to non-exporters, $\beta_1 < 0$. If it dragged down profitability, $\beta_1 < 0$.

3. Data

To investigate the impact of RMB appreciation on firm profitability, we rely on the firm-level production dataset collected and maintained by China's National Bureau of Statistics in an annual survey of manufacturing enterprises. It contains complete information on the three major accounting statements (i.e., balance sheet, profit & loss account, and cash flow statement). Briefly, it covers two types of manufacturing firms: all SOEs and non-SOEs whose annual sales are more than RMB five million (or equivalently, USD 750 thousand). The data set includes more than 100 financial variables listed in the main accounting statements of all these firms. We use this dataset to calculate firm-level variables.

We find some abnormal values in this dataset. The reason may be that some small firms don't employ specialized accountants. Following Feenstra et al. (2013), we delete observations if any of the following are true of the data:

Table 1. Summary Statistics of Variables.

Variable	Mean	Std. Dev.	Min	Max
ROE	0.158	0.237	-0.951	2.793
Profit_Margin	0.044	0.086	-5.157	3.31
Asset_Turnover	1.69	1.679	0.002	122.776
Leverage_Ratio	3.159	23.584	-6464.33	1254.767
Exporter	0.9	0.3	0	1

Notes: Summary statistics are based on 2001-2007 unbalanced panel data.

(1) the total number of workers is less than eight;
(2) any one of total sales, total asset, fixed asset, current asset, total output, intermediate good or wages is negative or missing;
(3) current assets exceeding total assets or fixed assets exceeding total assets;
(4) value added and sales ratio is negative or larger than 1;
(5) export intensity is negative or larger than 1.

Note that firms that engaging in processing trade are quite different from others. Their exporting and importing behaviors are highly correlated and this may lead to estimation bias of our empirical results. We delete observations that are engaged in processing trade. As the decision to engage in or give up processing trade might be endogenously affected by RMB appreciation, we identify a firm to be a processing trade firm if it took up processing imports before 2005. Finally, Table 1 reports summary statistics of key variables.

Figure 2 illustrates the trends of profitability indicators for exporters and non-exporters. Before RMB appreciation, the gaps between ROE, asset turnover and sales

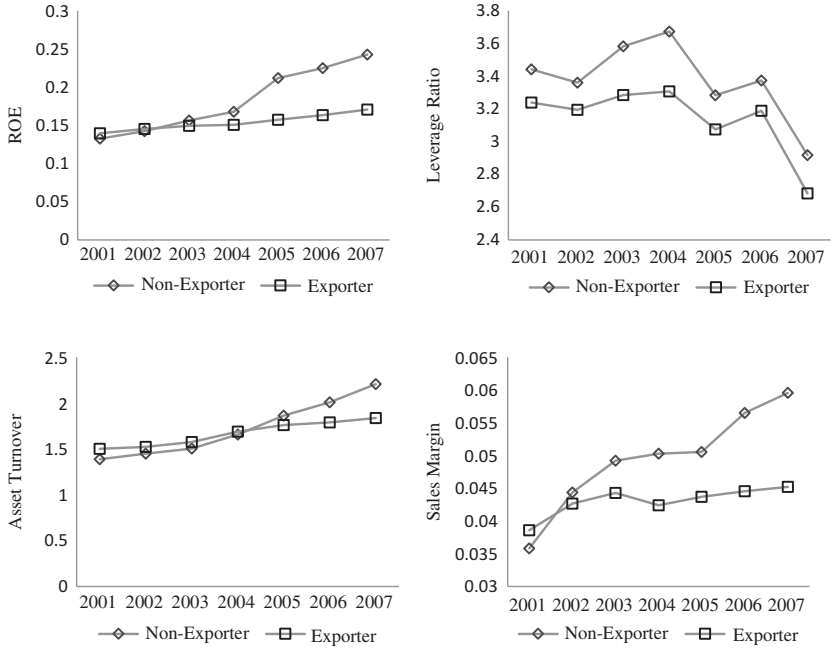

Figure 2. Trends of Profitability Indicators for Exporters and Non-Exporters.

margin of exporters and non-exporters remained small and nearly constant. They were widened after the PBOC set about exchange rate reform. Non-exporters exceeded exporters in ROE, asset turnover and sales margin. As one can see from Figure 2, the gap between the leverage ratios of both types of firms stayed nearly at the same level.

4. Estimation Results

4.1. ROE

Table 2 reports the regression results for ROE. The same degree of RMB appreciation has different effects on exporters and non-exporters. Compared to non-exporters, ROEs of exporters decreased as a consequence of RMB appreciation. To avoid the influences of firm entries and exits, we run regressions using both balanced and unbalanced panel data. The coefficient of the interaction term remains negative and statistically different from zero at the 1% level.

4.2. DuPont Analysis

Using DuPont Analysis, we decompose ROE into three parts: asset turnover (Sales/Total_Asset), sales margin (Net_Income/Sales) and leverage ratio (Total_Asset/Equity). Since the leverage ratio is a stable factor within each specific firm, we only investigate how exchange rate volatility affects asset turnover and sales margin. Table 3 shows the regression results for asset turnover. Compared to non-exporters, RMB appreciation has a negative effect on asset turnovers of exporters. For exporters, the capacity for generating revenues from per dollar of assets was weakened. A higher exchange rate means higher product price, which abates the competitiveness of "Made in China".

Table 4 reports the regression results for sales margin. It turns out that the coefficient for the cross term is significantly negative. In other words, the sales margin for exporters declines by 0.8% compared to that for non-exporters. The exchange rate movement weakened exporters' competitiveness in price, which induced them to spend more on marketing, cut prices or invest more to develop new products. According to a survey conducted by China's Ministry of Commerce in 2013, the average sales margin for 1000 enterprises investigated was lower than 3%. 26.8% of them were suffering losses in business. 73.4% attributed the underperformance to RMB appreciation.

Table 2. Effects of RMB Appreciation on ROE.

Dependent Variable	Unbalanced Panel		Balanced Panel	
ROE	(1)	(2)	(3)	(4)
Post × Exporter	-0.057***	-0.051***	-0.058***	-0.058***
	(-7.19)	(-6.79)	(-4.79)	(-4.79)
Exporter	-0.006		-0.004	
	(-1.00)		(-0.47)	
Year Fixed Effect	YES	YES	YES	YES
Firm Fixed Effect	NO	YES	YES	NO
Observations NO.	89,174	89,174	35,945	35,945
R-square	0.006	0.003	0.004	0.004

Notes: *** p<0.01, ** p<0.05, * p<0.1. The numbers in brackets report the T-test statistics considering intra-firm correlations.

Table 3. Effects of RMB Appreciation on Asset Turnover.

Dependent Variable	Unbalanced Panel		Balanced Panel	
Asset_Turnover	(1)	(2)	(3)	(4)
Post × Exporter	-0.294***	-0.250***	-0.186***	-0.186***
	(-5.78)	(-5.46)	(-3.02)	(-3.02)
Exporter	0.067*		0.037	
	(1.83)		(0.61)	
Year Fixed Effect	YES	YES	YES	YES
Firm Fixed Effect	NO	YES	YES	NO
Observations NO.	89,174	89,174	35,945	35,945
R-square	0.007	0.006	0.003	0.009

Notes: *** p<0.01, ** p<0.05, * p<0.1. The numbers in brackets report the T-test statistics considering intra-firm correlations.

Table 4. Effects of RMB Appreciation on Profit Margin.

Dependent Variable	Unbalanced Panel		Balanced Panel	
Profit_Margin	(1)	(2)	(3)	(4)
Post × Exporter	-0.007***	-0.005**	-0.008**	-0.008**
	(-3.02)	(-2.18)	(-2.53)	(-2.53)
Exporter	-0.004		-0.004	
	(-1.64)		(-1.14)	
Year Fixed Effect	YES	YES	YES	YES
Firm Fixed Effect	NO	YES	YES	NO
Observations NO.	89,174	89,174	35,945	35,945
R-square	0.001	0.001	0.002	0.003

Notes: *** p<0.01, ** p<0.05, * p<0.1. The numbers in brackets report the T-test statistics considering intra-firm correlations.

5. Concluding Remarks

Given the weak external demand and rising labor costs faced by Chinese exporters in the new century, it is worthwhile to examine the effect of RMB appreciation on the profitability of exporting firms. Using China's highly disaggregated firm-level data from 2001 to 2007, we adopted the DID regression method and implemented the DuPont analysis of profitability. We find significant negative effects of RMB appreciation on exporters' profitability. The profitability declines result from the decreased capacities of exporters to generate revenues and the abated sales margin.

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