Exports, Exchange Rates, and Labor Market Rigidity

Abstract

In this paper, we show that labor market rigidity, measured by minimum wages, is key to understand the heterogeneous reactions of exporters to exchange rate changes. Labor market rigidity restricts firms to lower their labor expenses when facing negative exchange rate shocks. As a consequence, higher labor market rigidity harms exporters's survivability further when domestic currency appreciates. Firm-level Chinese customs trade data, industrial data, combined with hand-collected city-level minimum wage data, enables us to estimate, and confirm, the interaction effect of exchange rate and wage rigidity on exporters' survivability.

Keywords: Exports; Exchange rates; Labor market rigidity; China

Catalog

Exchange Rates, Labor Market Rigidity and Exporters' Survivability

1. Introduction

A country is by nature a one currency area to save costs for its interregional trade. If different countries form a common currency area like Eurozone, they can also greatly save trade costs among the members. A large country like the US or a large common currency area like Eurozone can also enjoy the benefits by having their currencies used as international vehicle currency. However, the members of the common currency area also lose the independence of monetary policies. In particular, the lagged member country/region will not be able to depreciate their currency to increase their competitiveness in the global market when it encounters negative shocks on productivity. In a common currency region like Eurozone where GDP per capita in Greece is only half of that in Germany and France, the lagged members can only keep their competitiveness by reducing the labor costs when they experience a negative shock on their productivity. However, labor market is usually rigid, because reducing labor costs through cutting wage or social welfare may arouse domestic opposition and result in greater income disparity among members of the common currency area, both of which are not politically plausible. Thus, the labor market rigidity of a member and the exchange rate of the common currency area will interact to affect the international trade.

One of the most important source of labor market rigidity is minimum wage regulation. In China, *Regulation on Enterprise Minimum Wages* was introduced in 1993, indicating that China began to implement minimum wage regulation. In 1994, the related regulations were written into *Labor Law of the People's Republic of China*, ensuring their legal status. However, only about 130 cities adopted the policy in 1995. Minimum wage regulations were generalized into every province and almost all cities until *Regulation on Minimum Wages* was put into effect in 2004. The enforcement of minimum wage regulations was also strengthened by *Regulation*: the penalty for firms violating regulations ranges from 100% to 500% of the owned wage. Fig.1 presents the real minimum wages[1] in China from 2001 to 2010. It is obvious that minimum wages grew more rapidly after 2004. The monthly minimum wage increased about 30% during

[1] It is the GDP weighted average of city level minimum wages shown in the figure. This is because minimum wage standards are determined by local governments rather than central government considering different city conditions, such as living expenses, house prices etc.

2001-2004, from 349 to 454 yuan. However, during 2005-2010, the minimum wage increased more than 70% from 515 yuan to 887 yuan.

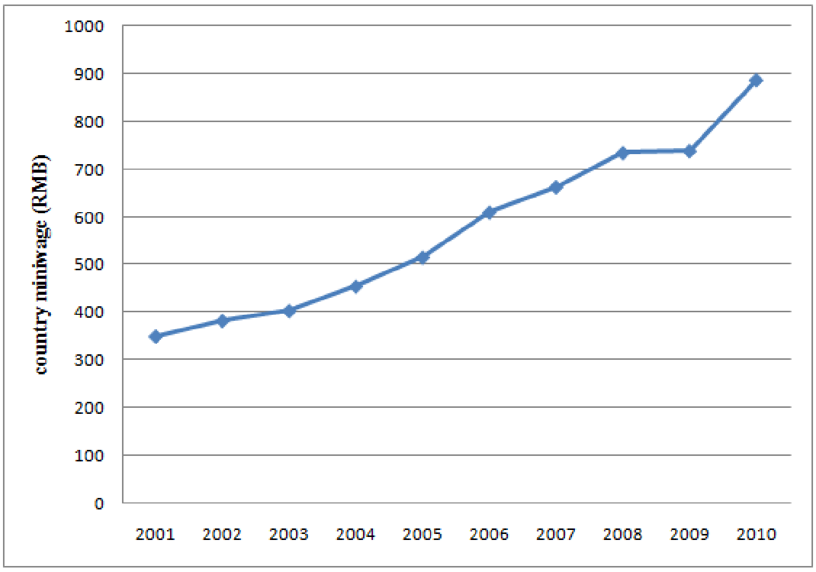

Figure 1: Trend of minimum wages in China (2001-2010)

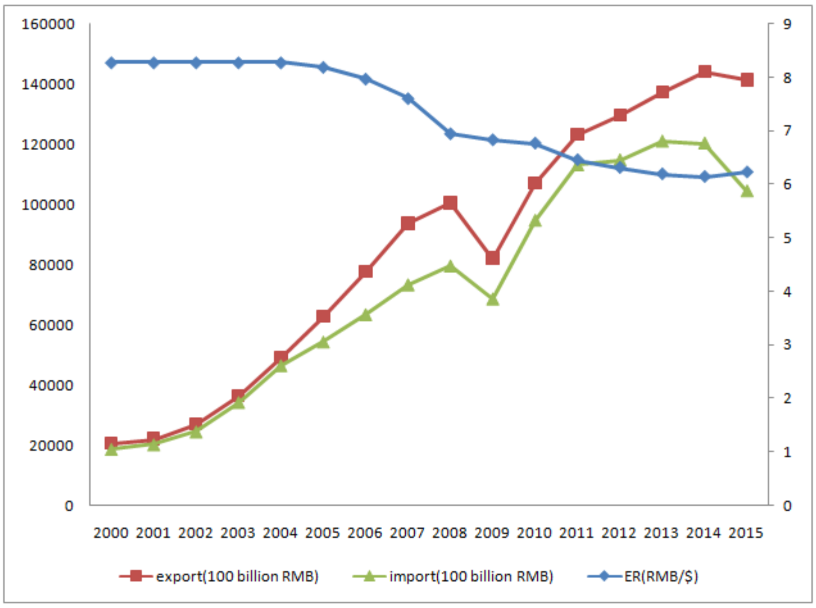

Figure 2: Chinese Exchange Rate and Trade (2000-2015)

China's rapidly appreciating RMB and rising minimum wage in the past decade has provided a good opportunity to evaluate how labor market rigidity has interacted with exchange rate to affect regional competitiveness. China is by nature a common currency area, and now also the second largest economy and the most populous country in the world. Meanwhile, it has a wide interregional disparity of labor productivity. In 2015, the per capita GDP of the poorest province, Gansu with value of 26,209.56 in RMB, is only about 1/5 that of the richest region that is Tianjin with value of 109,032.71. However, ever since 2005, China has seen a rapid appreciation of its RMB as the country has continuously run surplus in its international trade (See Fig.2). The appreciation trend is especially caused by the reform of RMB exchange rate regime enforced in July, 2005. The reform made RMB exchange rate more flexible to move in line with strong macroeconomic fundamentals after 2005. This is the main reason that RMB exchange rate appreciated about 25% during 2005-2015 while RMB exchange rate almost had no change during 2000-2005. If the labor market is flexible, the negative effect of RMB appreciation on international trade may be alleviated by keeping low wage growth. However, during almost the same period, China also experienced a significant rise in its minimum wage as shown in Fig.1, which is a major variable of labor market rigidity. The lagged inland cities even saw a more rapid growth rate of minimum wage during 2002 to 2010 in general. As Fig.3 shows, during 2002-2010, the growth rates of minimum wages[2] in inland region are lower than that of eastern region except 2005. The dilemma China faces is: If the exchange rate is to respond to the rising trade surplus, export could be reduced. If the less productive regions want to alleviate the negative effects of currency appreciation, their wage growth should have been slower. This will lead to a widening interregional income disparity, which is not politically acceptable by both the central and the local governments. However, to narrow the interregional inequality, minimum wage was actually raised faster in the lagged regions. Consequently, the negative effects of currency appreciation were amplified by labor market rigidity.

Figure 3: Growth of Minimum Wage Standards (2002-2010)

[2] As before, the region's minimum wage growth rate is the GDP weighted average of all city level minimum wages in that region.

In this paper, we matched Chinese large scale industrial survey data with its custom data. A real exchange rate is computed for each industry and matched with a hand-collected minimum wage dataset to form a panel throughout 2001-2007. Using detailed Chinese firm-level data, we find that exchange rate appreciation reduces the survivability of exporters. If the exporter is located in cities with higher labor market rigidity, this negative effect of appreciation on survivability is more severe compared to those in the cities of lower labor market rigidity. Besides the interaction effect of exchange rate and wage rigidity, the paper also finds that firms in eastern China are relatively easier to survive in the export market. However, this advantage diminishes as exchange rate appreciates. Furthermore, although RMB exchange rate appreciation in recent years may reduce the trade gap between regions by driving out of more exporters in the east, relatively higher wage rigidity in western regions adversely widens the gap. We mainly focus on the interaction effect of exchange rate movements and wage rigidity on the extensive margin of exporters in terms of their survivability. The results are robust to alternative measures of real effective exchange rate, region divisions, and wage rigidity and the other city level control variables.

The rest of the paper is structured as follows. Section 2 summarizes the related literature. Section 3 describes our empirical specifications to examine the interaction effect of exchange rate movements and wage rigidity and variables we focus on. Section 4 introduces the dataset and describes the stylized patterns in the data. Section 5 presents the main empirical findings and section 6 shows robustness tests. Section 7 concludes.

2. Development of China's Minimum Wage Standards

Minimum wage regulations have long been adopted by governments around the world to regulate and control their labor markets. More specifically, these regulations are aimed at protecting laborer's rights, especially lower wage workers, improving people's living standards, and facilitating income equality etc. As early as 1938, the minimum wage standards were established in the United States in *Fair Labor Standards Act*. However, minimum wage regulation in China has long been neglected by government and legislature after China's liberation in 1949, and only in recent decades have they concern this type of regulation in China.

In China, *Regulation on Enterprise Minimum Wages* was introduced by the Ministry of

Labor in 1993 and marked China's first legal framework of minimum wage regulations. *Regulation on Enterprise Minimum Wages* specified the definition and application scope of minimum wages and the method to identify minimum wage standards, to implement and supervise the enforcement of minimum wage and so forth.

In 1994, *Regulation on Enterprise Minimum Wages* were written into *Labor Law of the People's Republic of China*, ensuring its legal status further. According to *Labor Law*, central government enforces the implementation of minimum wage standards, while the specific standards in each province, autonomous regions, and municipalities are determined by local governments and then submitted to the State Council for the record. It showed clearly that minimum standards should consider 5 factors: the lowest living costs of laborers themselves and that of the average number of family members they support, social average wage level, labor productivity, local employment situation, and the disparity of economic development level among regions.

In 2004, the Ministry of Labor and Social Security (or the Ministry of Labor before 1998) issued *Regulation on Minimum Wages* and this regulation was brought into effect in the same year. The more detailed and specific new regulation replaced the previous *Regulation on Enterprise Minimum Wages*. Compared to the previous one, the new regulation amended and supplemented many provisions. For example, the factors required to consider when stipulating minimum wages are now different: The consumer price index of urban residents, social insurance charges and housing accumulation fund are new factors needed to consider, while labor productivity do not need to be taken into account. The enforcement of minimum wage regulations was also strengthened by this new *Regulation*: Compared to previous from 20%-100% penalty of the wage owed, the penalty for firms violating regulations now ranges from 100%-500% of the owned wage. In particular, this new regulation marked that minimum wage standards were fully implemented in China: all of the provinces, autonomous regions, and municipalities have set their minimum wage standards by the end of 2004.

Since *Regulation on Enterprise Minimum Wages* emphasized that the frequency of minimum wage standard adjustments should not be less than once every two years, the minimum wage adjustments, or increases, have become more frequent after 2004. However, because of the recent financial crisis, the Ministry of Human Resources and Social Security (i.e. the Ministry of Labor and Social Security before 2008, the Ministry of Labor before 1998) informed local governments to delay increases of minimum wages at the end of 2008.

As is shown by the above events and analysis, China has witnessed great development in minimum wage regulations since 1993's *Regulation on Enterprise Minimum Wages*, accompanied by rapid increase in minimum wages (Fig.1).

3. Literature Review

This paper builds on the literature on trade and minimum wage. In the model of Brecher (1974), removing minimum wage to restore full employment may not increase social welfare in home country and may reverse direction of trade. The model is extended by Davis (1998), demonstrating how trade would increase unemployment rate in Europe where there exists minimum wage. While in a large economy, as in Flug and Galor (1986), the imposition of a minimum wage creates an artificial comparative advantage in the skill-intensive good.

Another strand of literature studies the relationship between a different dimension of labor market rigidity, search and matching friction, and trade. Davidson, Martin and Matusz (1999) find that when a capital-abundant large country begins to trade with a small, labor-abundant country, unemployed workers in the large country, due to search friction in labor market, suffer welfare losses. More recently, Helpman and Itskhoki (2010) use the framework in spirit of Melitz (2003) to show that welfare can both rise in response to falling labor market frictions and falling trade costs.

There is a rich strand of literature estimating the impact of exchange rate movements, on both the intensive margin and extensive margin of export. For example, Zhang and Liu (2012) analyze how Chinese exporters react to exchange rate changes in terms of probability of export market entry and export share of sales and they show that real depreciation will increase both of them. However, using data from manufacturing firms in the UK, Greenaway, Kneller and Zhang (2007) show that exchange rate movements have little effect on firm's export participation and exit decisions while they do have a significant impact on export shares after entry. Baggs, Beaulieu and Fung (2009), exploiting detailed Canadian firm-level data, find negative impact of exchange rate appreciations on firm survival and sales. The responses of exporters in China to exchange rate changes are investigated in great detail in Li, Ma and Xu (2015). They find that RMB appreciation reduces the probability of entry as well as the probability of continuing in the export market.

Although the effect of exchange rate movements on export are intensively studied, no empirical study has taken into account one of the most salient binding factors of the production, wage rigidity in labor market, in the research of trade during exchange rate shocks. Labor market rigidity is widely documented[3] and usually considered to have negative impact on economy, especially on the employment as in Fehr and Goette (2005). In this paper, we show that the wage rigidity, introduced by minimum wage regulation, is key to understand the heterogeneous reactions of exporters to exchange rate changes. Briefly stated, wage rigidity restricts firms to lower labor expenses when facing exchange rate shocks. As a consequence, higher wage rigidity worsen the situation of exporters further when exchange rate appreciates. The firm-level Chinese trade data, combined with city-level minimum wage data, enables us to estimate the interaction effect of exchange rate and wage rigidity on exporters' survivability.

The minimum wage regulation is commonly known to increase the rigidity of labor market. The direct effects of minimum wage regulations and employment protection on wage, employment, and income distribution of a country have been intensively studied[4]. While limited studies find the detrimental effects of the minimum wages on firm performance in terms of profitability (such as in Draca, Machin and Van Reenen, 2008; Long and Yang, 2016; and Cuong, 2013), few focuses on firms' survivability. The current paper contributes to the literature in this aspect.

The interaction effect of exchange rate movements and wage rigidity has specific implications for China. Similar to euro zone situation, China also has the common currency area dilemma[5] because of the great interregional disparity in productivity. The unique "hukou" system in China severely impedes free labor mobility. To narrow the income disparity between regions, the minimum wage standards are enforced in the laggard provinces with a faster growth rate than that in the more developed provinces, rather than facilitating labor mobility. However, these minimum wage restricts the flexibility of exporters when facing RMB appreciation, and thus worsen their competitiveness and survivability. The exports in Chinese laggard provinces shrinks more and the income gaps between regions are therefore widening.

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[3] Lebow, Saks and Wilson (1999) find strong evidence for downward rigidity. Similar results are found in Altonji and Devereux (1999).

[4] For example, Botero et al. (2003), Neumark, Cunningham and Siga (2006), and Lemos (2009).

[5] The optimal common currency area should have sufficient factor mobility. If factors, such as labor and capital, are insufficiently mobile within a country, uniform exchange rate of the national currency may attribute to varying unemployment rates in different regions. This argument was introduced by Mundell as early as 1961.

4. Empirical Model

To examine the interaction effect of exchange rate movements and wage rigidity on firms' survivability, the benchmark regression is specified as follows.

$$\Pr\left(exit_{fict} = 1\right) = \alpha_0 + \alpha_1 REER_{it} + \alpha_2 \, REER_{it} * wagerigidity_{ct} + \lambda \, x_{ft-1} + \gamma \, y_{ct} + \mu_t + \varepsilon_{ijt} \quad (4.1)$$

This empirical specification is mainly referring to Berman, Martin and Mayer (2012) and Baggs, Beaulieu and Fung (2009), where $exit_{fict}$ is a dummy variable indicating whether export firms f in industry i at city c is forced to exit export market in year t. Exporters are more likely to be driven out of the market when exchange rate appreciates, or $REER$ decreases in this model. Therefore, the coefficient α_1 is expected to be negative. Considering wage rigidity the exporters in city c faced, the negative effect on firms' survivability of exchange rate appreciation will be more serious when wage rigidity is higher. The coefficient of α_2 is expected to be negative. x_{ft-1} is a vector of firm-level control variables, including firms' productivity measured by total factor productivity tfp[6], size, measured by the number workers in the firm $size$, soe dummy indicating whether the firm is stated owned, foe indicating whether the firm is a foreign enterprise, capital-to-labor ratio k_l measuring the capital intensity, and processing trade dummy $PTdummy$ measuring whether the exporter does processing trade rather than ordinary trade. y_{ct} is the vector of city level control variables, including average wage level $wage$ and income level measured by GDP in city c. The control variable tfp, $size$, k_l, $wage$, and GDP are all in logarithm form. In addition, time fixed effect is controlled as μ_t. To examine the above equation, probit model is employed in this paper.

REER in this paper is measured in direct quotation where an increase indicates depreciation. It should be noted that $REER_{it}$ is measured as the 4-digit industry real effective exchange rate in above equation. The industry level REER not only measures the exchange rate faced by each firm more accurately compared to the county level REER, but also can avoid potential endogeneity problem caused by the firm-level REER. In the robustness test, we also

[6] Please refer to Levinsohn and Petrin (2003) for the calculation of total factor productivity.

use alternative measures of REER to substitute industry specific REER.

The main variable of interest, city-level wage rigidity $wagerigidity_{ct}$, is the growth rate of city c's minimum wage standards enforced by their local government.

In this specification, $PTdummy$, the processing trade dummy, is controlled because of Chinese particular trade features. Chinese exports include a large share of processing-and-assembly exports, amounting to more than 50 percent of the total exports. The processing trade is distinct from ordinary trade since intermediate inputs and components needed for production of exporting goods are imported abroad and treated as duty free. Exchange rate appreciation, which may do harm to export, also leads to cost reduction for processing trade. Therefore, the effect of exchange rate movements on processing trade should be distinguished from that on ordinary trade.

In addition to the interaction effect of exchange rate movements and wage rigidity, we examine the different reactions of firms in different areas of China. To compare the survivability of firms in eastern China and those in western China, the specification examined is as follows.

$$\Pr(exit_{fict}=1)=\alpha_0+\alpha_1 REER_{it}+\alpha_2 east_{it}+\alpha_3\, REER_{it}*east_{it} +\alpha_4\, REER_{it}*wagerigidity_{ct}+\lambda\, x_{ft-1}+\gamma\, y_{ct}+\mu_t+\varepsilon_{ijt} \qquad (4.2),$$

where $east_{it}$[7] is the dummy indicating whether the firm is located in eastern region of China. East areas in China benefit not only from the better economic development, they also have geological advantage when exporting as they are much closer to the port and thus faced with lower export barrier. It is expected to find that eastern firms are easier to survive in foreign market compared to non-eastern firms. However, the lower export barrier gives eastern firms more flexibility to entry and exit exporting. When exchange rate appreciates, they are more likely to exit market because of the exact lower export barrier. In other words, the coefficients α_2 and α_3 are both expected to be negative.

5. Data Description

Our empirical results draw on both a large and comprehensive database on Chinese

[7] East China is normally considered as including 11 provinces, Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. Middle and west China indicate the remaining 20 provinces. Middle region of China includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. Western China includes Sichuan, Chongqing, Guizhou, Xizang, Yunnan, Shanxi, Gansu, Qinghai, Ningxia, Xinjiang, Neimenggu, Guangxi.

exporting firms, Chinese city-level indicators and macro level data of countries traded with Chinese firms.

5.1 Firm level data

The firm-level data are constructed by combining two database, firm level trade data and firm level production data. The yearly firm-level trade data is aggregated from monthly export and import data for the period from 2000 to 2007, collected by the Chinese Customs. The aggregated data includes export value of each firm every year, export value to each destination of each firm every year, export value in each 4-digit industry[8] each year, trade type of ordinary trade or processing trade. The exit dummy indicating whether firms are driven out of the foreign market is constructed in this dataset. It equals 0 if the exporting firms have positive total export value in year t. If a firm exports in year $t-1$ but does not export in year t, the exit dummy equals 1 in year $t-1$.

The firm-level industrial data is the yearly financial information for all the state-owned enterprise (henceforth SOE) and non-SOEs with sales over RMB 5 million. This dataset is from the Annual Census of Enterprises by the Chinese National Bureau of Statistics from 1998 to 2008, including three accounting statements (balance sheet, profit and loss, and cash flow) and basic information about the firm such as the location city. This dataset allows us to know the firm level characteristics which are not recorded in the trade data, such as the location, the industry[9], valued added, employees and other financial variables.

The combined firm level data are therefore yearly data from 2000-2007, including firm specific characteristics in great detail.

5.2 City level data

The firm level data includes the city firms located. Each city implements different minimum wage standards. The minimum wage data is collected from 2001 to 2010. After match minimum wage data and the city level control variables, city level GDP and average wage, there are 286 prefecture-level city data from 2001 to 2010.

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[8] The trade information collected by Chinese Customs includes the six-digit HS product classification. According to Upward, Wang and Zheng (2013), we can make the concordance between HS product to four-digit industry the transactions belonging to.

[9] The four-digit industry code of firms operate in is classified according to Brandt, Biesebroeck and Zhang (2012)

5.3 Macro-data for each country

To construct the four-digit industry level real effective exchange rate, nominal bilateral exchange rate and consumer price indices of each trading partner are needed. Real effective exchange rate is a weighted average real exchange rate of all bilateral real exchange rates.

Two commonly used methods are arithmetically and geometrically weighted average methods. Following Bernard and Jensen (2004) and IMF, we use the geometrically weighted average method to calculate industry level REER. The REER for industry i in year t is calculated as $\sum_{n=1}^{N}(RER_{nt})^{w_{nt}}$, where N is the total number of the industry's trading partners. RER_{nt} is the real exchange rate for country n in year t with the direct quotation calculated by $NER_{nt} * CPI_{nt}/CPI_t$. NER_{nt} is the nominal exchange rate, CPI_{nt} is the CPI in country n used to measure price level, and CPI_t is Chinese CPI. The nominal exchange rate, CPI of all trading partners and China are from World Development Indicators (WDI) from World Bank. For each industry i, w_{nt} is the trade weight of country n in year t with $\sum_{n=1}^{N} w_{nt} = 1$. The trade weight w_{nt} is obtained from the previous firm level trade data, where we can also aggregate to get the export value and import value in each four-digit industry each year. Specifically, it is calculated as $\omega_{nt} = (M_{nt} + X_{nt})/(\sum_{n=1}^{N} M_{nt} + X_{nt})$. M_{nt} is the import value in the industry from country n. X_{nt} is the export value to country n in the industry.

After combining the trade data, production data, city-level data, and industry REER, taking lags of firm level control variables as suggested in equation (4.1) and (4.2), and removing firms with missing values or duplicate records, we get the final sample used for regression.

6. Empirical Results

The basic results based on (4.1) is presented in Table 1. Column (1) first shows that exchange rate appreciation increases the firms' probability of being forced out of export market, as reflected by the significantly negative coefficient on trade-weighted industry-specific real effective exchange rate. This basic result is consistent from (1) to (5). Column (2) takes labor market rigidity, the growth rate of the minimum wage standard $Gminiwage$, into account. The coefficient on the interaction term is significantly negative, consistent with our expectations. This basic finding suggests that when exchange rate appreciation deteriorates firms' survival ability, higher wage rigidity faced by firms will worsen firms' situation further.

Table 1: Interaction effect of wage rigidity and REER

	Dependent variable: $exit_{fict} = 1$				
	(1)	(2)	(3)	(4)	(5)
IndReer	-0.0181***	-0.0242***	-0.0188***	-0.0168***	-0.0168***
	(0.00196)	(0.00271)	(0.00269)	(0.00269)	(0.00270)
IndReer*Gminiwage		-0.0264***	-0.0396***	-0.0333***	-0.0328***
		(0.00938)	(0.00947)	(0.00943)	(0.0100)
ln_tfp			-0.0673***	-0.0621***	-0.0622***
			(0.00443)	(0.00447)	(0.00454)
ln_size			-0.0643***	-0.0682***	-0.0679***
			(0.00458)	(0.00462)	(0.00463)
soe			0.382***	0.366***	0.366***
			(0.0159)	(0.0161)	(0.0163)
foe			-0.0872***	-0.0728***	-0.0709***
			(0.01000)	(0.0101)	(0.0102)
k_l			0.0176***	0.0188***	0.0188***
			(0.00340)	(0.00342)	(0.00342)
PTdummy			-0.196***	-0.189***	-0.190***
			(0.0117)	(0.0119)	(0.0119)
ln_gdp				-0.0118*	-0.0200***
				(0.00631)	(0.00710)
ln_wage				-0.111***	-0.0987***
				(0.0179)	(0.0225)
Constant	-1.468***	-1.375***	-0.586***	0.697***	0.744***
	(0.00931)	(0.0137)	(0.0329)	(0.137)	(0.162)
Year FE	No	No	No	No	Yes
Observations	310,147	209,940	205,173	197,379	197,379
Number of id	80,386	67,642	66,929	66,684	66,684

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1. Probit model is adopted in the estimation. Dependent variable is exit dummy, equal to 1 if an exporter exits foreign market. *IndReer* is 4-digit industry real effective exchange rate. A decrease in *IndReer* indicates appreciation. *Gminiwage* growth rate of minimum wage standards in city *c*.

Column (3) in Table 1 controls firm level characteristics and column (4) controls city level characteristics further. The significantly negative coefficient on the interaction term support the basic result further. In addition, column (5) controls time fixed effect based on column (4). The significantly negative coefficient on the interaction term suggests that appreciation deteriorates firms' survival ability, while higher wage rigidity faced by firms will worsen firms' situation further.

Consistent with intuition, firms with higher productivity and larger size are less likely to exit export market. However, firms with higher capital-labor ratio appears to be easier to exit market. This may be consistent with the phenomenon that exporters in China are labor-intensive. Processing trade firms are less sensitive to exchange rate shocks and are shown to have higher survivability.

In addition, state owned firms are more likely to stop exporting than private firms while they are easier to be forced out than foreign owned firms. It shows that foreign exporters are most competitive in the market, then followed by private firms, and state owned firms. The city level control variable GDP shows positive influence on firms' survivability. The cities with higher wage level are associated with lower probability of exiting export market, which may be consistent with efficiency wage theory.

To examine whether the negative effect of wage rigidity is resulted from a specific region or a specific type of firms, Table 2 presents results from each of the 3 regions and all the 3 firm types. Column (1)-(3) are results from stated owned firms, privately owned firms, and foreign firms respectively. The coefficients on REER in column (1)-(3) are all negative, while only column (1) is insignificant. It implies that real appreciation reduces firms' survival ability. The interaction between industry REER and wage rigidity shows negative sign in all of the 3 columns, though insignificant when only considering stated owned firms in column (1). This may be because stated owned firms have more preferential policies thus less affected by minimum wage standards. Basically, the results show that higher wage rigidity deteriorates firms' survivability further when facing negative exchange rate shocks.

Column (4)-(6) in Table 2 are results from east, middle and west region respectively. The interaction between industry REER and wage rigidity shows negative sign in all of the 3 columns, though insignificant in west region in column (6). The results show that the negative effect of wage rigidity when facing appreciation is not caused by a specific region. The firm level and city level control variables show almost the same influence on firms' survivability as what table 1 presents.

Table 2: Interaction effect of wage rigidity and REER: different samples

	(1)	(2)	(3)	(4)	(5)	(6)
SAMPLE	SOE	POE	FOE	East	Middle	West
VARIABLES	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy
IndReer	-0.000840	-0.0277***	-0.0143***	-0.0204***	-0.000444	-0.000178
	(0.00427)	(0.00472)	(0.00380)	(0.00304)	(0.00402)	(0.0118)
IndReer*Gminiwage	-0.0163	-0.0416***	-0.0338**	-0.0374***	-0.0596***	-0.00746
	(0.0260)	(0.0161)	(0.0148)	(0.0120)	(0.0230)	(0.0335)
ln_tfp	-0.118***	-0.0867***	-0.0339***	-0.0561***	-0.114***	-0.0872***
	(0.0116)	(0.00801)	(0.00627)	(0.00489)	(0.0161)	(0.0194)
ln_size	0.0111	-0.00650	-0.136***	-0.0876***	0.0284*	0.00848
	(0.0117)	(0.00797)	(0.00676)	(0.00504)	(0.0158)	(0.0195)
soe				0.379***	0.280***	0.0952*
				(0.0186)	(0.0460)	(0.0536)
foe				-0.0553***	-0.0410	-0.180***
				(0.0109)	(0.0414)	(0.0528)
k_l	0.0424***	0.0142**	0.0100**	0.0103***	0.0314**	0.0595***
	(0.0104)	(0.00612)	(0.00459)	(0.00364)	(0.0133)	(0.0156)
PTdummy	-0.171***	-0.167***	-0.191***	-0.177***	-0.267***	-0.158*
	(0.0430)	(0.0286)	(0.0143)	(0.0122)	(0.0709)	(0.0933)
ln_gdp	0.00810	0.0263**	-0.0629***	-0.00914	0.0731***	-0.0482*
	(0.0199)	(0.0115)	(0.0103)	(0.00785)	(0.0276)	(0.0264)
ln_wage	-0.219***	-0.256***	0.0840**	-0.0269	-0.297***	-0.130
	(0.0637)	(0.0354)	(0.0332)	(0.0249)	(0.0864)	(0.111)
Constant	1.551***	1.448***	-0.255	-0.0492	0.977	1.186
	(0.439)	(0.266)	(0.237)	(0.184)	(0.702)	(0.953)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,372	62,591	119,416	179,759	10,907	6,713
Number of id	7,188	27,010	39,799	60,168	3,961	2,555

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

There may exist endogeneity problem when we control some firm level characteristics, the ln_tfp, ln_size, k_l and $PTdummy$. Table 3 uses one period lag of these variables to alleviate endogeneity problem.

Table 3: Interaction effect of wage rigidity and REER: lagged control variable

	(1)	(2)	(3)	(4)	(5)	(6)
SAMPLE	Whole	Whole	East	Non-east	SOE	Non-SOE
VARIABLES	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy
IndReer	-0.0146***	-0.0145***	-0.0182***	-0.000128	-0.000840	-0.0172***
	(0.00271)	(0.00271)	(0.00306)	(0.00369)	(0.00426)	(0.00299)
IndReer*Gminiwage	-0.0276***	-0.0267***	-0.0284**	-0.0468**	-0.0155	-0.0286***
	(0.00945)	(0.0100)	(0.0121)	(0.0182)	(0.0259)	(0.0109)
L.ln_tfp	-0.000413	0.000598	0.00490	-0.0294**	-0.0891***	0.0151***
	(0.00454)	(0.00456)	(0.00491)	(0.0124)	(0.0119)	(0.00498)
L.ln_size	-0.0878***	-0.0878***	-0.105***	-0.0185	-0.0172	-0.101***
	(0.00467)	(0.00465)	(0.00507)	(0.0122)	(0.0116)	(0.00515)
soe	0.367***	0.364***	0.375***	0.221***		
	(0.0163)	(0.0164)	(0.0187)	(0.0350)		
foe	-0.0800***	-0.0810***	-0.0654***	-0.111***		
	(0.0102)	(0.0103)	(0.0109)	(0.0327)		
L.k_l	0.0264***	0.0262***	0.0168***	0.0605***	0.0581***	0.0203***
	(0.00342)	(0.00341)	(0.00364)	(0.0101)	(0.0105)	(0.00364)
L.PTdummy	-0.139***	-0.140***	-0.128***	-0.144**	-0.169***	-0.158***
	(0.0120)	(0.0120)	(0.0124)	(0.0580)	(0.0428)	(0.0123)
ln_gdp	-0.0143**	-0.0264***	-0.0156**	-0.00204	0.00484	-0.0367***
	(0.00636)	(0.00715)	(0.00791)	(0.0187)	(0.0199)	(0.00769)
ln_wage	-0.128***	-0.0916***	-0.0211	-0.178***	-0.227***	-0.0679***
	(0.0180)	(0.0226)	(0.0250)	(0.0647)	(0.0636)	(0.0245)
Constant	0.548***	0.422***	-0.362*	0.657	1.602***	0.294*
	(0.138)	(0.163)	(0.185)	(0.547)	(0.437)	(0.177)
Year FE	No	Yes	Yes	Yes	Yes	Yes
Observations	196,806	196,806	179,163	17,643	15,443	181,363
Number of id	66,643	66,643	60,113	6,530	7,242	62,939

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

Column (1) in Table 3, which does not include year fixed effects, is the basic results similar to column (4) in Table 1, while column (2) with year fixed effects is corresponding to column (5) in Table 1. Both basic regressions show significantly negative coefficients on REER and its interaction with wage rigidity, which support real appreciation drives exporters out and high wage rigidity faced by firms worsen exporters' survivability further. Column (3) and (4) report the result of eastern firms and non-eastern firms respectively, where the negative impact of wage rigidity when appreciation is confirmed further. Column (5) and (6) are results of SOEs and non-SOEs. Similar to column (4)-(6) in table 2, the interaction between industry REER and wage rigidity shows negative sign in both columns, but insignificant within SOEs in column (6).

Table 4 presents the results of equation (4.2). Column (1) shows that the exporters in eastern China show better survivability in general as reflected by significantly negative coefficient on $east$. However, the significantly negative coefficient of the interaction between industry REER and $east$ suggests that they also have higher probability of exiting exporting facing exchange rate appreciation. Both of the results are consistent with the expectation before. That is, exporters in east region have geological advantage as they are much closer to the port and thus faced with lower export barrier. That is why they are easier to survive in foreign market compared to non-eastern firms. However, the lower export barrier also means that eastern firms are more flexible to choose entry or exit exporting. When exchange rate appreciates, they are more likely to exit market because of the exact lower export barrier.

Column (2) confirms the results in (1) by controlling firm level and city level characteristics. My focus of the interaction effect between REER and wage rigidity are incorporated in column (3). It shows the same result as before. It is obvious that exchange rate appreciation reduces the trade performance gap between inland and eastern regions in China. However, more rapidly rising minimum wage in inland region, as shown in Figure 2, impedes this process.

Column (4) and (5) in Table 4 use a different definition for "eastern China",$dis500$, indicating that whether the city is within 500 kilometers to the nearest ports like Shanghai, Tianjin, or Hong Kong. Although the interaction between REER and $east$ has the same negative sign as in column (1), it is not significant. However, the results in column (5) are exactly the same as column (3). Using different $east$ definition confirms the finding that minimum wage in inland region will widen the its trade gap with east region, even if real appreciation should have narrow it down.

Table 4: Interaction effect of wage rigidity and REER

	(1)	(2)	(3)	(4)	(5)
East division	Geological	Geological	Geological	dis500	dis500
VARIABLES	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy
IndReer	-0.00560	-0.00210	-0.000553	-0.0177***	-0.00390
	(0.00440)	(0.00387)	(0.00379)	(0.00441)	(0.00465)
east	-0.213***	-0.0958***	-0.109***	-0.174***	-0.0701**
	(0.0234)	(0.0236)	(0.0265)	(0.0239)	(0.0280)
IndReer*east	-0.0128***	-0.0164***	-0.0198***	-0.00774	-0.0161***
	(0.00490)	(0.00452)	(0.00472)	(0.00495)	(0.00538)
IndReer*Gminiwage			-0.0354***		-0.0403***
			(0.00991)		(0.00997)
ln_tfp		-0.0445***	-0.0626***		-0.0627***
		(0.00384)	(0.00454)		(0.00454)
ln_size		-0.0377***	-0.0717***		-0.0695***
		(0.00392)	(0.00464)		(0.00463)
soe		0.373***	0.352***		0.357***
		(0.0134)	(0.0163)		(0.0163)
foe		-0.00325	-0.0619***		-0.0713***
		(0.00892)	(0.0103)		(0.0102)
k_l		0.0237***	0.0150***		0.0171***
		(0.00290)	(0.00342)		(0.00342)
PTdummy		-0.145***	-0.180***		-0.183***
		(0.0103)	(0.0119)		(0.0119)
ln_gdp		0.00655	-0.00556		-0.0190***
		(0.00623)	(0.00722)		(0.00712)
ln_wage		-0.0603***	-0.0460**		-0.0287
		(0.0196)	(0.0230)		(0.0236)
Constant	-1.285***	-0.468***	0.134	-1.262***	0.131
	(0.0210)	(0.142)	(0.169)	(0.0214)	(0.173)
Year FE	No	Yes	Yes	No	Yes
Observations	310,147	272,865	197,379	289,853	197,379
Number of id	80,386	77,756	66,684	78,842	66,684

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

7. Robustness Tests

Different sets of robustness checks have been conducted by using alternative measures of real effective exchange rate, wage rigidity and other city level variables.

7.1 REER measure

Rather than using industry-specific REER, we use firm-specific REER in columns (1) to (3) in Table 5 to replicate the baseline regressions. The firm REER is calculated similar to the industry REER but using firm-level trade weights. It measures exchange rate faced by firms more accurately compared to industry REER, in the following two respects.

First, many firms are operating in more than one industry and therefore the single industry-specific REER is not so precise. Second, each firm has different trading weights in each country. The trade weights aggregated from the whole industry cannot represent the case of each individual firm. However, as being accused in the literature, firm-level REER may induce more endogeneity problem.

Furthermore, to mitigate the endogeneity problem of firm-level REER, we try the third REER (FW REER), by fixing the trade weight of each industry when a firm starts exporting or at the beginning of the sample in year 2000, the new REER for each firm is calculated as the weighted industry-level REER using the fixed weights for each industry. The results based on this REER are presented in column (4)-(5) of Table 5.

Both of the firm REER and FW REER are firm specific. To alleviate the endogeneity problem, we use one-period lag of both REER in regression. All of the coefficients on REER and its interaction with minimum wage growth rate are consistent with previous tables. The results first show that the REER coefficients are significantly negative, which means that appreciation drive exporters out. Then the significantly negative coefficient on the interaction term between real exchange rate and wage rigidity indicate that higher wage rigidity worsens the exporters' survivability further when exchange rate appreciates. The results are robust to different measurements of REER.

We also replicate the results in Table 5 using lagged firm level control variables. The basic results of the effect of REER and its interaction effect with wage rigidity remain the same. Similar results are also obtained for the control variables. To save the space, we do not put the result here. The result may be provided upon request.

Table 5: Robustness test: Alternative measures of REER

	(1)	(2)	(3)	(4)	(5)
REER measures	Firm REER	Firm REER	Firm REER	FW REER	FW REER
VARIABLES	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy
L.REER	-0.00598***	-0.00605***	-0.00636***	-0.0217***	-0.0212***
	(0.00142)	(0.00138)	(0.00138)	(0.00319)	(0.00317)
L.REER*Gminiwage	-0.0278***	-0.0273***	-0.0248***	-0.0336***	-0.0407***
	(0.00850)	(0.00837)	(0.00859)	(0.0104)	(0.0110)
ln_tfp		-0.0607***	-0.0606***		-0.0568***
		(0.00448)	(0.00454)		(0.00466)
ln_size		-0.0679***	-0.0677***		-0.0734***
		(0.00462)	(0.00463)		(0.00477)
soe		0.367***	0.366***		0.368***
		(0.0161)	(0.0163)		(0.0169)
foe		-0.0769***	-0.0755***		-0.0654***
		(0.0101)	(0.0102)		(0.0105)
k_l		0.0215***	0.0214***		0.0173***
		(0.00339)	(0.00339)		(0.00349)
PTdummy		-0.193***	-0.195***		-0.194***
		(0.0119)	(0.0119)		(0.0121)
ln_gdp		-0.00948	-0.0194***		-0.0206***
		(0.00628)	(0.00710)		(0.00729)
ln_wage		-0.118***	-0.100***		-0.0853***
		(0.0178)	(0.0225)		(0.0232)
Constant	-1.465***	0.659***	0.683***	-1.408***	0.621***
	(0.00907)	(0.137)	(0.162)	(0.0156)	(0.168)
Year FE	No	No	Yes	No	Yes
Observations	209,936	197,375	197,375	204,044	191,751
Number of id	67,641	66,683	66,683	66,072	65,118

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

7.2 Alternative city level variables

It should be noted that there are many firms operating and exporting with branches in different cities. Therefore, using wage rigidity and other variables of a single city[10] to measure the situation faced by firms is not very accurate.

Table 6: Robustness test: Trade-weighted city variables

	(1)	(2)	(3)	(4)	(5)	(6)
REER measures	Industry REER	Industry REER	FW REER	FW REER	Firm REER	Firm REER
VARIABLES	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy	exitdummy
REER	-0.0417***	-0.0189***	-0.0701***	-0.0418***	-0.0134***	-0.0106***
	(0.00463)	(0.00476)	(0.00656)	(0.00661)	(0.00337)	(0.00341)
REER*Gminiwage	-0.0794***	-0.0456**	-0.110***	-0.0526*	-0.0868***	-0.0227
	(0.0188)	(0.0220)	(0.0236)	(0.0269)	(0.0211)	(0.0218)
ln_tfp		0.0465***		0.0396***		0.0386***
		(0.00797)		(0.00944)		(0.00935)
ln_size		-0.0586***		-0.103***		-0.0933***
		(0.00803)		(0.00969)		(0.00955)
soe		0.424***		0.458***		0.448***
		(0.0299)		(0.0358)		(0.0353)
foe		0.212***		0.194***		0.188***
		(0.0206)		(0.0247)		(0.0244)
k_l		0.149***		0.171***		0.176***
		(0.00660)		(0.00817)		(0.00811)
PTdummy		-0.0392*		-0.0908***		-0.0799***
		(0.0201)		(0.0234)		(0.0233)
ln_gdp		0.0515***		0.0510***		0.0517***
		(0.0116)		(0.0132)		(0.0132)
ln_wage		-0.0130		-0.0505		-0.0300
		(0.0358)		(0.0400)		(0.0404)
Constant	-2.317***	-3.755***	-2.358***	-3.132***	-2.642***	-3.521***
	(0.0313)	(0.280)	(0.0439)	(0.322)	(0.0409)	(0.322)
Year FE	No	Yes	No	Yes	No	Yes
Observations	249,080	233,471	190,510	178,545	195,365	183,184
Number of id	75,177	74,102	62,901	62,004	64,326	63,432

Note: Standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

[10] The location cities of each firm are provided in dataset from the Annual Census of Enterprises by the Chinese National Bureau of Statistics. However, this location information is unique as a firm's registration location. From the custom dataset, we find that one firm may export from several cities. According to this dataset, we can construct trade weights of each city that a firm exports from.

Considering this phenomenon, we construct trade-weighted city level characteristics, including wage rigidity, GDP, and average wage level, where the weights of each city is the firm's trade proportion occurring in this city.

Table 6 presents the results using the constructed trade-weighted variables. Replicating previous regression, column (1)-(2) employ industry specific REER. Column (3) and (4) use the fixed-weight REER, and column (5)-(6) use firm REER. The results, the effect of REER and interaction effect of it with wage rigidity reflected by minimum wage standards growth rate, are exactly consistent with previous results and expectation.

8. Conclusion

In this paper, we present the evidence of how labor market rigidity interacted with exchange rate appreciation influence the survivability of exporting firms. The result shows that higher labor market rigidity faced by firms will worsen firms' situation further when exchange rate appreciates.

We also analyze how exporters' responses vary across regions when exchange rate changes. The evidence shows that eastern firms are more likely to be driven out of the export markets when exchange rate appreciates. In this case, moderate appreciation of RMB may narrow the trade disparity between eastern and other regions. However, the higher growth minimum wage standards in non-eastern region worsen firms' survivability there adversely, which will widen the trade gap.

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