Minimum Wage and Export with Heterogeneous Firms *

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Abstract

This paper proposes a two-country trade equilibrium model with heterogeneous firms to investigate the influence of minimum wage on firms' exports. The theoretical analysis postulates that the influence of minimum wage on firms' exporting probability and foreign sales is negative. Following econometric analysis based on the firm-level data (Annual Survey of Chinese Industrial Firms) matched with prefecture-level-city data including urban minimum wages from 1998 to 2007 verifies these predictions.

Keywords: Minimum wage, heterogeneous firm, productivity, export

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1 Introduction

China is a developing country and has achieved high economic growth, with annual GDP growth rates of around 10 percent over the past 30 years. International trade held an important role in China's rapid economic growth and China has been considered to be the "world factory" up till now under it's export-oriented policy in the past three decades. This policy succeeded ascribing to the lower wage paid to China' tremendously abundant labors. However, the central government of China and local governments of various provinces and cities[1] has increased the nominal monthly, daily and hourly minimum wage during the past twenty years.[2]

With the disappearing of China's "demographic dividend", more and more worries on China' role of "world factory" are paid to the increasing "minimum wages". Continuing debates about positive and negative impacts of minimum wage on foreign trade emerges successively in China. There are a large number of advocates of the minimum wages, which argues that the increase of minimum wage will lead to an increase in aggregate demand and economic growth. Under home market effect, this leads to the increase of the country's foreign export. Some argues that the increase of minimum wage will have small effects on production, business and employment. On the contrary, there are critics that the increase of minimum wage can result in high production costs and unemployment, and add burdens to enterprises, especially when there is on-going economic stagnation and thus reduces their exports.

However, the above arguments against or in favor of minimum wage on trade are often made without theoretical supports and empirical evidences. The question that how minimum wage affects international trade in China remains unanswered so far. The purpose of the paper is to investigate the influence of the minimum wage on firms' exports. This paper proposes a two-country and two-factor trade equilibrium model with heterogeneous firms to investigate the impacts of minimum wages on firms' exports. In our model, firms are heterogeneous in productivity. A firm must pay a fixed entry cost before it observes its productivity,

[1] Beijing first set a minimum wage in 1994, and many other provinces and cities set their minimum wages successively.

[2] A minimum wage is the lowest monthly, daily or hourly wage that employers are compelled to pay to employees. It is expected to increase the living standards of labors, especially the poor and vulnerable. Moreover, it is generally considered to generate other effects such as promotion of laborers' work and productivity, reduction of people covered in subsidy programs, increasing consumption, aggregate demand and generation of multiplier effects, etc. In addition to these effects, it results in the increase of labor cost, which thus reduces firms' output and labors hired.

which is *ex ante* random. After that, it decides whether or not to start production. In the latter case another fixed production cost is incurred. Firms are heterogeneous both in terms of productivity. The firm employs capitals and labors to produce its variety, where the price of capital is determined by the market while that of labor is exogenously determined and is usually above its equilibrium level. The firm can decide to export its product to the foreign market or not. In the former case it has to pay another exporting fixed cost. According to the above setting, we find that the increase of the domestic minimum wage decreases firms' exporting possibilities by selection effect (i.e., forcing low-productivity firms to exit the market) and decreases firms' exporting sales by increasing their unit production costs. Moreover, firms' productivity has positive impacts on their exports.

In this paper, we apply firm-level data from the Annual Survey of Industrial Firms cross-sectional data collected by the National Bureau of Statistics of China from 1998 to 2007 to estimate the impacts of local minimum wage on their exports. To realize our theoretical postulation, we first estimate firm-level productivity in each year and then regress firms' exports with respect to their productivity, minimum wages, and other control variables. The empirical results verify our theoretic results.

The rest of this paper is arranged as follows. Section 2 reviews the literatures on the relationship between minimum wage and international trade. Section 3 introduces the closed-economy model with heterogeneous firms and minimum wages. Section 4 analyzes the open-economy model and the impact of minimum wages on firms' exports. Empirical models, data treatments, summary descriptions of data including prefecture-level-city monthly minimum wage, and productivity estimations are introduced in Section 5. Empirical results are stated in Section 6. Section 7 concludes the paper.

2 Literature review

Literatures on the relationship between minimum wages and international trade can be classified into two groups. One considers the case that inter-industry wages are distorted while real wages are flexible. The other considers the case that all industrial wages are distorted. Hagen (1958), Bhagwati and Ramaswami (1963) and Magee (1976) investigated the first case. Summarizing their findings, we can see that the increase of the minimum wage in an industry leads to the increase of capital intensity and the decrease of outputs within this industry and

the decrease of capital intensities and the increase of outputs in other industries if capitals are industry-specific and labors are mobile across industries. This implies that the increase of the minimum wage in an industry leads to the increase of exports in this industry and the decrease of imports in labor-intense industries if the country exports capital-intense and import labor-intense goods before the change of minimum wages, vice versa. If labors are not mobile across industries, then the results still hold as before. However, unemployment occurs in the industry whose minimum wage increases.

Haberler (1950), Brecher (1974a,b) investigated the second case. Brecher (1974a,b) analyzed the case with two countries, two goods, two factors and constant-return-to-scale production technologies. They showed that the increase of the minimum wage in a labor-abundant country decreases the exports of labor-intensive goods and increases the exports of capital-intensive goods. The situation is reversed if the country is capital-abundant. The decrease of the minimum wage in a country may lead the reverse of trade directions. That is, the country may change to import capital-intensive while export labor-intensive goods. Their models were extended to the case with multiple goods and multiple factors by Schweinberger (1978), where the number of goods and that of factors are equal. Based on Schweinberger (1978)'s idea, Brecher (1980) considered a small-country open economy with three factors (capital, labor and land) and two goods. It found that the increase of the minimum wage in a country will increase the exports of both capital-intensive and labor-intensive goods if the country specializes incompletely, the production technologies of the two goods are constant return to scale and one good is more capital-intensive and more labor-intensive. Neary (1985) further investigated the case that the number of factors are larger than that of goods and concluded similar results to those given in Brecher (1974a,b).

The above findings may change if the interaction effects between endowment and trade structure are involved into consideration. Flug and Galor (1986) constructed a general equilibrium with two countries, two goods and two factors (skilled and unskilled labors) , where an unskilled labor can change to skilled labor by accumulating human capitals. It showed that the increase of the minimum wage on the unskilled labors in a small country leads to the increase of the exports of skilled-labor-intensive goods if this country specializes incompletely. The result is reversed if the country exports unskilled-labor-intensive goods. The case for large countries is a little different. If the country exports unskilled-labor-intensive good at first, then the increase of the minimum wage on the unskilled labors may reverse the trade structure. When the minimum wage is sufficiently

high, the country will specialize in the production of and export the skilled-labor-intensive goods in the short run and its exports will keep increasing in the long run.

The above researches are based on the assumption of homogeneous firms and their results are only industry-level. Firms' heterogeneity needs to be considered to investigate the impacts of minimum wages on individual firms' exporting behaviors. However, this can not be done under the frameworks of the Ricardian model, the Heckscher-Ohlin theory and the new trade theory. [3] In fact, few literatures are focusing on this topic. This paper constructs a trade equilibrium model with heterogeneous firms and minimum wages to investigate the impacts of minimum wages on firms' exports. Different from Melitz (2003), countries in our model are asymmetric and the number of factors is two (capital and labor). Because of the minimum wages on labor are above their market-equilibrium levels, only the capital markets clears. Our model is also different from that in Egger et al. (2009), in which there is only one production factor (labor) and there is one final good and many intermediate goods whose number is endogenously determined. Moreover, it did not investigate the impact of minimum wages on firms' exports. According to our model, we get the following main result: the increase of domestic minimum wage will decrease all firms' exporting probabilities and their exporting sales.

3 Closed economy with minimum wage and heterogeneous firms

In the economy we investigate are there two countries (i.e., the domestic and the foreign country, denoted by H and F, respectively). In each country, there are M monopolistically competitive industries. We assume that each variety in each of which is produced by only one firm. Suppose that there are N_l and N_l^* firms in industry l in H and F, respectively (hereafter we use "*" to index the corresponding variables of F). The production of each variety uses two factors, the capital (K) and the labor (L), where K is industry-specific, which is only mobile within the

[3] Many empirical results since 1990s have shown that firms in the same industry in a country have different exporting behaviors. First, exporters are relatively few among all firms in an industry. Second, exporters are relatively more larger and more productive. Third, most exporters exports only a small part of their outputs. Fourth, exporters' performance variables affect significantly and positively their exports. Fifth, exporters have higher wages and higher innovation levels. Please refer to Tybout (2003) for a survey of these literatures and Melitz (2003) and Bernard et al. (2003) for theories developed to explain these phenomena.

same industry, while L is mobile across industries. As this paper does not investigate the impact of country size on firms' exports, we assume that each country is normalized with one unit of infinitely divisible labor. Suppose that the preferences of consumers of both countries are the same, which can be represented by the following utility function

$$U = \prod_{l=1}^{M}\left(\int_0^{N_l} x_{li}^{\rho_l} di\right)^{\frac{\beta_l}{\rho_l}}, \ 0<\beta_l,\rho_l<1, \ \sum_{l=1}^{M}\beta_l = 1, \tag{1}$$

where β_l represents the share of consumption in industry l among total consumption expenditure, $\rho_l = \frac{\sigma_l - 1}{\sigma_l}$, σ_l is the substitution elasticity between varieties in industry l and x_{li} is the consumption of variety i in industry l. Suppose that each consumer's income comes only from his wage w.[4] As what is concerned in this paper is the impact of minimum wage standard on firms' exports, we make the following assumption.

Assumption 1 *The minimum wages are higher than or equal to the market equilibrium wages in H and F, respectively. Moreover, they are set so that each consumer in the two countries can get at least the minimum wage income.*

Our rationale to make Assumption 1 is of two folds: (1) If the minimum wage in a country is lower than the market wage, then it has no impact on the market equilibria, and thus we do not need to consider it. (2) If the minimum wage can not guarantee that all the labors's expected incomes are higher than it, then the minimum wage standard is of no sense.[5]

Under Assumption 1, unemployment occurs in the economy as the minimum wage is higher than the market equilibrium wage. Since firms are rational, it's natural for them to pay labors with minimum wage if there's no incomplete information or sticky labor market wage or other institutional barriers.

Let the price index in industry l be P_l, where $P_l = \left(\int_0^{N_l} p_{li}^{1-\sigma_l} di\right)^{\frac{1}{1-\sigma_l}}, l = 1, \cdots, M$. Then the demand q_{li} for and the expenditure r_{li} on variety i in industry l are, re-

[4] When the firms' entry attains its equilibrium, their expected profits are zero, so that each consumer's capital income is 0.

[5] The minimum wage standard which is higher than the market equilibrium wage always leads to unemployment, and thus each labor's income is equal to the unemployment rate times the minimum wage. We do not investigate unemployment by assuming that each labor gets the minimum wage at equilibrium following Mejean and Patureau (2010), whose economy consists of unskilled and skilled workers and the unskilled ones get the minimum wage. Mejean and Patureau (2010) does this by assuming that there's an entirely lump-sum unemployment benefits system, in which lump-sum taxes on employed workers are redistributed as lump-sum subsidies to those unemployed ones. This assumption applies to this paper.

spectively,

$$q_{li} = Q_l \left(\frac{p_{li}}{P_l}\right)^{-\sigma_l}, \; r_{li} = R_l \left(\frac{p_{li}}{P_l}\right)^{1-\sigma_l}, l = 1, \cdots, M, \tag{2}$$

where $Q_l = \frac{\beta_l w}{P_l}$ is the total consumption and $R_l = P_l Q_l = \beta_l w$ is the total expenditure on varieties in industry l in the economy.

Since all industries have similar monopolistic competitive market structure, we only consider the representative firm's behaviors in industry l, and thus ignore the firm-index i in the sequel. Suppose the representative firm's production function is $Y = \theta K^{\alpha_l} L^{1-\alpha_l}$ (herein the capital-output elasticity α_l varies with industries), where Y, K, L are, respectively, the firm's output, capital and labor hired, and θ is it's productivity. In each industry l, firms' productivity is heterogeneous. Suppose that the distribution function of firms' productivity in industry l is of the following form:

$$G_l(\theta) = \begin{cases} 1 - (b_l/\theta)^{k_l} & \theta \geq b_l, \\ 0 & \text{else}, \end{cases} \tag{3}$$

where $b_l > 0$ is the lower bound and $k_l > 2$ is the shape parameter of $G_l(\theta)$, which measures the concentration degree of firms' productivity distribution in industry l.

Each firm does not know its productivity level before it enters into the market. It observes its productivity θ after it pays the industry-specific fixed entry cost F_l, which is invested in the form of entrepreneur spirit but is measured by money.[6] After the representative firm observes its productivity, the firm needs to decide whether or not to produce and sell its variety. In the former case, another fixed production cost f_l is incurred, which is also invested in the form of entrepreneur spirit but is measured by money. If the firm begins to produce and sell its variety, it is faced with the demand function given in (2). Thus, its optimal capital and labor inputs are, respectively,

$$K = \rho_l^{\sigma_l} P_l^{\sigma_l} Q_l \varpi_l^{1-\sigma_l} \theta^{\sigma_l - 1} \left(\frac{r_l}{\alpha_l}\right)^{-1}, \; L = \rho_l^{\sigma_l} P_l^{\sigma_l} Q_l \varpi_l^{1-\sigma_l} \theta^{\sigma_l - 1} \left(\frac{w}{1-\alpha_l}\right)^{-1}, \tag{4}$$

[6]Here we assume that entrepreneur spirits are supplied without elasticity. It's worthy to point out that analysis will be much more complicated if the fixed entry cost F_l is invested in the form of labor or capital.

where $\varpi_l = \left(\frac{r_l}{\alpha_l}\right)^{\alpha_l}\left(\frac{w}{1-\alpha_l}\right)^{1-\alpha_l}$ is the unit production cost of varieties in industry l. Therefore, the firms' optimal output and pricing rule are, respectively,

$$q_l = \rho_l^{\sigma_l} P_l^{\sigma_l} Q_l \varpi_l^{-\sigma_l} \theta^{\sigma_l},\ p_l = \frac{\varpi_l}{\rho_l \theta}. \tag{5}$$

(5) implies that: (1) a firm's output is higher and its price is lower, the higher is its productivity; (2) a firm's output is lower and its price is higher, the higher is the industrial unit production cost ϖ_l. The net profit of the firm with productivity θ in industry l in each period is

$$\pi_l \ = \ (1-\rho_l) D_l - f_l, \tag{6}$$

where $D_l = M_l \theta^{\sigma_l - 1}$ is the firm's domestic sale and $M_l = \rho_l^{\sigma_l - 1} P_l^{\sigma_l} Q_l \varpi_l^{1-\sigma_l}$. Define the weighted productivity level as $\tilde{\theta}_l = \left[\int_0^{+\infty} \theta^{\sigma_l - 1} \mu_l(\theta) d\theta\right]^{\frac{1}{\sigma_l - 1}}$, where $\mu_l(\theta)$ is the density function of productivity distribution of incumbents in industry l. Then we have

$$P_l = N_l^{\frac{1}{1-\sigma_l}} \frac{\varpi_l}{\rho_l \tilde{\theta}_l},\ Q_l = N_l^{\frac{1}{1-\sigma_l}} \frac{\beta_l \rho_l w \tilde{\theta}_l}{\varpi_l}. \tag{7}$$

The firm decides to produce only if $\pi_l \geq 0$, from which we can get $\underline{D}_l$ and $\underline{\theta}_l$, the cut-offs of firms' domestic sales and their productivity (such that the profit of the firms with $\underline{D}_l$ is zero):

$$\underline{D}_l = \sigma_l f_l,\ \underline{\theta}_l = \left(\frac{\sigma_l f_l}{\beta_l w}\right)^{\frac{1}{\sigma_l - 1}} N_l^{\frac{1}{\sigma_l - 1}} \tilde{\theta}_l. \tag{8}$$

This implies that the productivity cut-off $\underline{\theta}_l$ is higher, the higher is the industrial weighted productivity level $\tilde{\theta}_l$.

According to the relationship between the *ex post* productivity distribution $\mu_l(\theta)$ and the *ex ante* one $g_l(\theta)$, and also by the form of $G_l(\theta)$, we rewrite the industrial weighted productivity level $\tilde{\theta}_l$ as

$$\tilde{\theta}_l(\underline{\theta}_l) \ = \ \left(\frac{k_l}{k_l + 1 - \sigma_l}\right)^{\frac{1}{\sigma_l - 1}} \underline{\theta}_l. \tag{9}$$

Substituting (9) into (8), we can solve the equilibrium number of firms N_l as:

$$N_l \ = \ \frac{\beta_l w}{\sigma_l f_l} \frac{k_l + 1 - \sigma_l}{k_l}. \tag{10}$$

This implies that the larger number of firms within the industry in equilibrium, the higher the minimum wage is.

As the minimum wage is fixed above the market equilibrium wage, only the capital market clears in equilibrium. Substituting (8), (9) and (10) into the clearing condition of capital market, we can solve the equilibrium interest of the capital in industry l:

$$\frac{r_l}{\alpha_l} = \rho_l \beta_l w \bar{K}_l^{-1}, \tag{11}$$

which implies that the lower minimum wage and the higher capital stock lead to the higher interest of the capital in industry. This indicates that the increase of the minimum wage will increase the industrial unit production cost ϖ_l, which can be simplified as $\varpi_l = (\beta_l \rho_l)^{\alpha_l}(1-\alpha_l)^{-(1-\alpha_l)} \bar{K}_l^{-\alpha_l} w$.

Substituting (11) into (7), we can get the equilibrium expressions of P_l and Q_l, respectively, as follows:

$$P_l = N_l^{\frac{1}{1-\sigma_l}} \beta_l^{\alpha_l} ((1-\alpha_l)\rho_l)^{-(1-\alpha_l)} \bar{K}_l^{-\alpha_l} w \tilde{\theta}_l^{-1}, Q_l = N_l^{\frac{1}{1-\sigma_l}} (\beta_l \rho_l (1-\alpha_l))^{1-\alpha_l} \bar{K}_l^{\alpha_l} \tilde{\theta}_l. \tag{12}$$

Moreover, by (10), (12) and (6), we can find the equilibrium output of the firm with productivity θ in industry l as

$$q_l = \frac{\rho_l k_l \sigma_l f_l}{k_l + 1 - \sigma_l} \theta^{\sigma_l} \tilde{\theta}_l^{1-\sigma_l} \varpi_l^{-1}, \tag{13}$$

which implies that the firm's output is higher, the higher is its productivity and the lower is the minimum wage.

The free entry condition implies that each firm's *ex ante* expected net profit upon entry shall be zero, which determines the equilibrium number of incumbents in the industry. The entry condition can be written as follows:

$$\frac{1 - G_l(\underline{\theta}_l)}{\delta_l} f_l \left[\left(\frac{\tilde{\theta}(\underline{\theta}_l)}{\underline{\theta}_l} \right)^{\sigma_l - 1} - 1 \right] = F_l, \tag{14}$$

where δ_l is the survival probability of firms in each period in industry l. As G_l is given by (3), we can get the equilibrium productivity cut-off $\underline{\theta}_l$ as follows:

$$\underline{\theta}_l = \left(\frac{f_l}{\delta_l F_l} \frac{\sigma_l - 1}{k_l + 1 - \sigma_l} \right)^{1/k_l} b_l. \tag{15}$$

According to (15) and the expression of $\tilde{\theta}(\underline{\theta}_l)$, we know that both industrial productivity cut-off and industrial weighted productivity are not affected by the minimum wage level.

According to (9), (10), (15) and the fact $\sigma_l > 1$, (12) implies that industrial price index P_l and industrial output Q_l are higher, the higher is the minimum wage. One interesting result is that industrial output is positively correlated with the minimum wage, which implies that consumers' total consumption and hence their welfare increases with the increase of the minimum wage in the closed economy under Assumption 1.[7] This result has some seeming conflicts with our initial intuition, as the increase of the minimum wage increases firms' unit production costs. However, it holds because the increase of the minimum wage increases consumers' demand and hence industrial output.

Summarizing above discussion, we have the following proposition.

Proposition 1 *In the closed economy and under Assumption 1, the increase of the minimum wage will increase industrial capital interest, industrial unit production cost, industrial price index, industrial output, and the equilibrium number of firms in the industry. Moreover, it will decease each firm's output and increase their pricing rules. However, it does not change industrial productivity cut-off and industrial weighted productivity level.*

We can explain the latter part of Proposition 1 as follows. Under Assumption 1, all labors get the minimum wage. Though the increase of the minimum wage increases firms' unit production costs and thus the industrial price index, it increases faster than the industrial price index, and thus consumers' purchasing powers increase, which attracts more firms to enter into the market. Furthermore, as all firms are facing with the same increasing unit production cost, the increase of the minimum wage does not change the industrial productivity cut-offs and thus does not change the industrial weighted productivity levels.

Although Proposition 1 holds in the closed economy, it does not hold in the open economy. In the latter case, firms in the home country are facing with different increasing competition pressures from their foreign rivals - the competition power of domestic firms decreases while that of foreign firms increases. Under

[7] It seems that this result will cause the following paradox - the increase of the minimum wage will increase consumers' welfare infinitely. This paradox is caused by Assumption 1. As we argued that Assumption 1 holds conditionally, i.e., the total output are large enough to pay each consumer the minimum wage. However, this condition will be broken when the minimum wage is set enough high.

free trade, the increase of the domestic minimum wage will increase industrial productivity cut-offs and hence industrial weighted productivity levels.

4 The impact of the minimum wage on the exports of heterogeneous firms

4.1 Equilibrium in the open economy

Firms in industry l must pay a fixed exporting cost κ_l to enter into the foreign market. Suppose the iceberg transportation cost is τ_l for transporting one unit of good from the home country to the foreign market. For simplicity, we assume that the corresponding variables κ_l^* and τ_l^* in the foreign country are, respectively, equal to those in the home country. Then the exporting profit of the firm with productivity θ in industry l in the home country is:

$$\pi_{Xl} = \max\left\{0, (1-\rho_l)M_{Xl}^*\theta^{\sigma_l-1} - \kappa_l\right\}, \tag{16}$$

where $M_{Xl}^* = \rho_l^{\sigma_l-1}P_l^{*\sigma_l}Q_l^*\varpi_l^{1-\sigma_l}\tau_l^{1-\sigma_l}$, and P_l^* and Q_l^* are, respectively, foreign industrial price index and foreign total output in industry l. The firm chooses to export only if $\pi_{Xl} \geq 0$, from which we can get the domestic and foreign exporting productivity cut-offs in industry l, as follows:

$$\begin{aligned}
\underline{\theta}_{Xl} &= (N_l^* + N_{Xl})^{\frac{1}{\sigma_l-1}} \frac{\kappa_l^{\frac{1}{\sigma_l-1}}\rho_l\tau_l\frac{\varpi_l}{\varpi_l^*}}{[(1-\rho_l)\beta_l w^*]^{\frac{1}{\sigma_l-1}}}\tilde{\theta}_{Tl}^*, \\
\underline{\theta}_{Xl}^* &= (N_l + N_{Xl}^*)^{\frac{1}{\sigma_l-1}} \frac{\kappa_l^{\frac{1}{\sigma_l-1}}\rho_l\tau_l\frac{\varpi_l^*}{\varpi_l}}{[(1-\rho_l)\beta_l w]^{\frac{1}{\sigma_l-1}}}\tilde{\theta}_{Tl},
\end{aligned} \tag{17}$$

where $\tilde{\theta}_{Tl}$ and $\tilde{\theta}_{Tl}^*$ are the domestic and foreign aggregate productivity, respectively, which have the following forms:

$$\tilde{\theta}_{Tl}^{\sigma_l-1} = \frac{k_l}{k_l+1-\sigma_l}\frac{N_l\underline{\theta}_l^{\sigma_l-1} + N_{Xl}^*\underline{\theta}_{Xl}^{*\sigma_l-1}}{N_l+N_{Xl}^*}, \tilde{\theta}_{Tl}^{*\sigma_l-1} = \frac{k_l}{k_l+1-\sigma_l}\frac{N_l^*\underline{\theta}_l^{*\sigma_l-1} + N_{Xl}\underline{\theta}_{Xl}^{\sigma_l-1}}{N_l^*+N_{Xl}}, \tag{18}$$

in which N_{Xl} and N_{Xl}^* are, respectively, the domestic and foreign numbers of exporters. After observing the exporting productivity cut-offs of domestic and foreign firms in industry l, it's easy for us to find the productivity distributions $\mu_{Xl}(\theta)$ and $\mu_{Xl}^*(\theta)$ of domestic and foreign exporters. When $G_l(\theta)$ adopts the form given

in (3), we can conclude the expressions of $\tilde{\theta}_{Tl}^{\sigma_l-1}$ and $\tilde{\theta}_{Tl}^{*\sigma_l-1}$ from (18) and solve $\underline{\theta}_{Xl}^{\sigma_l-1}$ and $\underline{\theta}_{Xl}^{*\sigma_l-1}$, respectively, as follows:

$$\underline{\theta}_{Xl}^{*\sigma_l-1}=\frac{\kappa_l}{f_l}\left(\frac{\rho_l\varpi_l^*}{\varpi_l}\right)^{\sigma_l-1}\underline{\theta}_l^{\sigma_l-1},\underline{\theta}_{Xl}^{\sigma_l-1}=\frac{\kappa_l}{f_l}\left(\frac{\rho_l\varpi_l}{\varpi_l^*}\right)^{\sigma_l-1}\underline{\theta}_l^{*\sigma_l-1}. \tag{19}$$

Moreover, we have

$$P_l^{\sigma_l}Q_l=\frac{f_l\tau_l^{\sigma_l-1}}{1-\rho_l}\left(\frac{\varpi_l}{\rho_l}\right)^{\sigma_l-1}\underline{\theta}_l^{1-\sigma_l},\ P_l^{*\sigma_l}Q_l^*=\frac{f_l\tau_l^{\sigma_l-1}}{1-\rho_l}\left(\frac{\varpi_l^*}{\rho_l}\right)^{\sigma_l-1}\underline{\theta}_l^{*1-\sigma_l}. \tag{20}$$

When a firm exports, its optimal capital and labor inputs are

$$\begin{aligned}K_X &= \left[\rho_l P_l^* Q_l^{*\frac{1}{\sigma_l}}\tau_l^{1-\sigma_l}\theta^{\rho_l}\varpi_l^{-\rho_l}\right]^{\sigma_l}\left(\frac{r_l}{\alpha_l}\right)^{-1}, \\ L_X &= \left[\rho_l P_l^* Q_l^{*\frac{1}{\sigma_l}}\tau_l^{1-\sigma_l}\theta^{\rho_l}\varpi_l^{-\rho_l}\right]^{\sigma_l}\left(\frac{w}{\alpha_l}\right)^{-1}.\end{aligned} \tag{21}$$

Under Assumption 1, only the capital market clears. Hence according to the clearing condition of the capital market (20) and (21), we have

$$\begin{aligned}\frac{r_l}{\alpha_l} &= \frac{\rho_l k_l \bar{K}_l^{-1}\tau_l^{\sigma_l-1}}{(1-\rho_l)(k_l+1-\sigma_l)}\left[f_l N_l+\tau_l^{1-\sigma_l}\kappa_l N_{Xl}\right], \\ \frac{r_l^*}{\alpha_l} &= \frac{\rho_l k_l \bar{K}_l^{*-1}\tau_l^{\sigma_l-1}}{(1-\rho_l)(k_l+1-\sigma_l)}\left[f_l N_l^*+\tau_l^{1-\sigma_l}\kappa_l N_{Xl}^*\right].\end{aligned} \tag{22}$$

When $G_l(\theta)$ adopts the form given by (3), we can get an incumbent's ex ante exporting probability in industry l as follows:

$$\varsigma_l = \frac{N_{Xl}}{N_l}=\frac{1-G_l(\underline{\theta}_{Xl})}{1-G_l(\underline{\theta}_l)}=\left(\frac{\underline{\theta}_l}{\underline{\theta}_{Xl}}\right)^{k_l}=\left[\frac{\kappa_l}{f_l}\left(\frac{\rho_l\varpi_l}{\varpi_l^*}\right)^{\sigma_l-1}\right]^{-\frac{k_l}{\sigma_l-1}}\left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{k_l}. \tag{23}$$

Then the *ex ante* expected profit that a firm enters into the market is:

$$\bar{\pi}_l = \bar{\pi}_{Dl}(\tilde{\theta}_l)+\varsigma_l\bar{\pi}_{Xl}(\tilde{\theta}_{Xl}), \tag{24}$$

where $\bar{\pi}_{Dl}$ is the firm's expected profit from selling domestically, and $\bar{\pi}_{Xl}$ is its expected profit from selling in the foreign market. We thus have

$$\bar{\pi}_l=\frac{\sigma_l-1}{k_l+1-\sigma_l}(f_l+\varsigma_l\tau_l^{1-\sigma_l}\kappa_l),\ \bar{\pi}_{Xl}=\frac{\sigma_l-1}{k_l+1-\sigma_l}\tau_l^{1-\sigma_l}\kappa_l. \tag{25}$$

The sum of expenditures on industry l from both countries is equal to that of all the firms' profits in this industry in both countries. Therefore, we have

$$f_l N_l + \tau_l^{1-\sigma_l}\kappa_l N_{Xl} + f_l N_l^* + \tau_l^{1-\sigma_l}\kappa_l N_{Xl}^* = \frac{k_l + 1 - \sigma_l}{\sigma_l - 1}\beta_l(w + w^*). \tag{26}$$

Moreover, suppose that the probability that a domestic firm in industry l exits the market is δ_l. Then we have $(1-G_l(\underline{\theta}_l))\bar{\pi}_l/\delta_l = F_l$ for the long-term entry condition, from which we have

$$f_l N_l + \tau_l^{1-\sigma_l}\kappa_l N_{Xl} = \frac{k_l + 1 - \sigma_l}{(\sigma_l - 1)b_l^{k_l}} N_l \underline{\theta}_l^{k_l}. \tag{27}$$

(27) implies that a firm's ex ante exporting probability (equal to $\frac{N_{Xl}}{N_l}$) is increasing in the productivity cut-off $\underline{\theta}_l$ of entry into industry l. Combining (27) with that of the foreign country, we can finally get

$$\Omega_l \triangleq \left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{k_l} = \frac{f_l - \tau_l^{1-\sigma_l}\kappa_l\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{-\frac{k_l}{\sigma_l-1}}\left(\frac{\varpi_l}{\varpi_l^*}\right)^{k_l}}{f_l - \tau_l^{1-\sigma_l}\kappa_l\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{-\frac{k_l}{\sigma_l-1}}\left(\frac{\varpi_l^*}{\varpi_l}\right)^{-k_l}}. \tag{28}$$

(28) implies that Ω_l is decreasing in w if $\omega_l \triangleq \varpi_l/\varpi_l^*$ is increasing in w. This together with (23) yields the following lemma.

Lemma 1 *Under Assumption 1, if ω_l is increasing in the domestic minimum wage w, then ς_l is decreasing in w. That is, the increase of the minimum wage leads to the decrease of firms' ex ante exporting probability.*

Proof. See the appendix. ∎

The economic intuition of Lemma 1 is rather straightforward. If the relative unit production cost of the home country to the foreign one increases with the domestic minimum wage in industry l, then the relative variety price of the home country will increase, and thus domestic firms' competitive powers and their foreign sale profits will decrease. This further makes lower-productivity domestic firms exit the exporting market. Therefore, domestic firms' *ex ante* exporting probability decreases with the domestic minimum wage.

From (23), we have $N_{Xl} = N_l\varsigma_l$, $N_{Xl}^* = N_l^* = \varsigma_l^*$. Substituting (19) into (20) and (18), we can get a two-equation system of N_l and N_l^*. Substituting $N_{Xl} = N_l\varsigma_l$, $N_{Xl}^* = N_l^* = \varsigma_l^*$ into the above system, we can find the expressions of N_l and N_l^* (see (37) and (38) in the appendix). Further, according to (26) and (27), we can

finally get the following results:

$$\underline{\theta}_l^{k_l} = \frac{\beta_l b_l^{k_l}}{\delta_l F_{El}} \frac{w + w^*}{N_l + N_l^* \Omega_l^{-1}}, \underline{\theta}_l^{*k_l} = \frac{\beta_l b_l^{k_l}}{\delta_l F_{El}} \frac{w + w^*}{N_l \Omega_l + N_l^*}. \tag{29}$$

Applying (37) and (38) in the appendix, we can prove the following lemma.

Lemma 2 *$\underline{\theta}_l^*$ is increasing in w.*

Proof. See the appendix. ∎

Lemma 2 indicates that the increase of the domestic minimum wage will force the low-productivity domestic firms to exit the market, which increase the average productivity of exporting incumbents in the home country. This further forces those low-productivity firms in the foreign country to exit the market. And thus the exporting productivity cut-off in the foreign country increases.

Finally, to find how the increase of the domestic minimum wage affects firms' exporting behaviors in the home country, we need to know the relationship between $\frac{\varpi_l}{\varpi_l^*}$ and w. According to (22) , (27) and the definitions of ϖ_l and ϖ_l^*, we have:

$$\frac{\varpi_l}{\varpi_l^*} = \left(\frac{w}{w^*}\right)^{1-\alpha_l} \left(\frac{\bar{K}_l^*}{\bar{K}_l}\right)^{\alpha_l} \left(\frac{N_l \underline{\theta}_l^{k_l}}{N_l^* \underline{\theta}_l^{*k_l}}\right)^{\alpha_l} = \left(\frac{w}{w^*}\right)^{1-\alpha_l} \left(\frac{\bar{K}_l^*}{\bar{K}_l}\right)^{\alpha_l} \left(\frac{N_l}{N_l^*} \Omega_l\right)^{\alpha_l}. \tag{30}$$

Using (30), we can analyze the relationship between $\frac{\varpi_l}{\varpi_l^*}$ and $\frac{w}{w^*}$ and prove the following result.

Lemma 3 *Under Assumption 1, $\frac{\varpi_l}{\varpi_l^*}$ is increasing in the relative wage $\frac{w}{w^*}$. That is, the increase of the gap between the domestic minimum wage and the foreign one will increase the difference between the domestic and the foreign unit production cost for each industry.*

Proof. See the appendix. ∎

Lemma 3 indicates that the increase of the domestic minimum wage has different impacts on domestic and foreign industrial unit production costs - the former increases more faster than the latter. This result coincides with our intuition.

4.2 The impact of the minimum wage on firms' exports

According to the expression of M_{Xl}^*, (20) implies that the increase of the domestic minimum wage will increase industrial exporting productivity cut-offs. More-

over, by (20) and (16), if a firm exports, its exporting sale is

$$X_l = \frac{f_l}{1-\rho_l}\left(\frac{\varpi_l^*}{\varpi_l}\right)^{\sigma_l-1}\left(\frac{\theta}{\underline{\theta}_l^*}\right)^{\sigma_l-1}. \tag{31}$$

From Lemma 3, $\frac{\varpi_l^*}{\varpi_l}$ is increasing in w, given the foreign minimum wage w^*. From Lemma 2, $\underline{\theta}_l^*$ is increasing in w. Hence by (31) and Lemma 1, we have the following main proposition of this paper.

Proposition 2 *In the open economy and under Assumption 1, the increase of the domestic minimum wage will decrease firms' ex ante exporting probabilities and exporting sales. Moreover, firms' exporting sales increase with their productivity levels.*

It's necessary to briefly illustrate Proposition 2. First, it implies that firms' *ex ante* exporting possibilities and their exporting sales are all increasing with their productivity, which coincides with the theoretical result proposed in Melitz (2003) and many other empirical literatures. Second, as the main result in the paper, the increase of the domestic minimum wage will decrease firms' *ex ante* exporting possibilities and their exporting sales. This result is easy to understand. On the one hand, the increase of the domestic minimum wage may change the structure of comparative advantages between the two countries, so that the home country uses capitals while the foreign country uses labors more intensely. This increases prices of capitals and thus those of firms' exporting varieties. On the other hand, the increase of the domestic minimum wage will increase the home country's demands for varieties of the foreign country and thus increases their prices. The synthetic effect is that the difference between the two countries' industrial unit production costs increases. Because of the same reason, the increase of the domestic wage will select low-productivity domestic firms out of the exporting markets, and thus increase industrial exporting productivity cut-offs in the home country. This further lowers firms' *ex ante* exporting probabilities.

5 Empirical models

According to (31), we know that minimum wage and firms' productivity both affect firms' exporting behaviors. In this section, we test their impacts on firms' exports using firm-level data from Annual Survey of Chinese Industrial Firms. We first estimate firms' productivity, and then regress firms' exporting choices and

exports with regard to minimum wage, their productivity and other control variables.

5.1 Firms' exporting behaviors

According to (31), we analyze the influence of minimum wage on firms' exporting behaviors by estimating the following equations:

$$DX_{rlit} = \tau_r + \eta_l + \gamma_i + \lambda_t + \psi \ln w_{rt} + \zeta \ln \hat{\theta}_{rlit} + \varphi Z_{rlit} + \nu_{rli} + \epsilon_{rlit}, \quad (32)$$

$$\ln X_{rlit} = \tau_r + \eta_l + \gamma_i + \lambda_t + \psi \ln w_{rt} + \zeta \ln \hat{\theta}_{rlit} + \varphi Z_{rlit} + \nu_{rli} + \epsilon_{rlit}, \quad (33)$$

where DX_{rlit} is a dummy of firm i' exporting state, with 1 for exporter and 0 for non-exporter, and X_{rlit} is firm i's exporting sale in period t, $\hat{\theta}_{rlit}$ is the estimated productivity of firm i in industry l in region r in period t, $\lambda_t, \eta_l, \gamma_i$ and τ_r are, respectively, time, industry, firm and region fixed effects, and Z_{rlit} is a vector containing firm i' characteristics, including other prefecture-level-city-level and firm-level control variables. The random effects, ν_{rli} and ϵ_{rlit}, are normally-distributed *i.i.d.* random variables with mean 0 and variances σ_ν^2 and σ_ϵ^2, respectively. Finally, r, l, i, t are region, industry, firm and time indices, respectively.

5.2 Data Source

We match the city-level macroeconomic data with **ASIF** to generate our empirical data. The city-level data is collected from three major sources: *China Urban Statistic Yearbook, China Statistic Yearbook and China Regional Statistic Yearbook (1990-2009)*. The firm-level data is from the Annual Survey of Industrial Firms (**ASIF**) that is collected by China National Bureau of Statistics between 1998 and 2007.

Here we mainly discusses the usage and treatments of **ASIF** dataset. This dataset contains all detailed information for all state-owned and non-state-owned firms above the designated scale 5 million Yuan with all operational, financial and managerial items in 40 2-digit industries and 90 4-digit and 600 6-digit sub-industries. The number of firms covered by this dataset is 165,118 in 1998 and 336,768 in 2007, respectively. [8]

[8]The industry section of *China Statistic Yearbook, China Industrial Statistic Yearbook* and reports in *China Markets Yearbook* are complied based on this dataset, which covers 95% of the industry gross output in these yearbooks (Lin et al. 2009; Lu and Tao 2009; Brandt et al. 2012). The only difference between **ASIF** and *China Industrial Statistic Yearbook* is that the later is reported in aggregated industries and sectors while the former is individual firms and plants.

5.3 Variables Definition and Consistency

Since 2003, the China National Bureau of Statistics started to implement new National General Specifications of Industry (GBT/4757), therefore there were two systems registered and coded in this dataset: before 2003 and afterwards. In this research, we adjust all industry-related codes by the GBT/4757 system. Apart from these direct adjustments, we unify those variables which are registered differently in different years according to their explicit definitions. [9] By making the above adjustments, we are sure that the whole dataset is consistent internally and tractable in terms of both the cross-section and the longitudinal manner.

5.4 Missing variables, missing values and treatments

There are missing variables and values in differently years of **ASIF**. Missing values can be found in year 2001 to 2007. Some are due to statistical index changes or adjustments of accounting system.[10] Some are due to missing accounting.[11]. Some of these variables can be computed by accounting principles,[12] while missing variables like 'total export value' (2004) can only be calculated by linear interpolation.

We treat missing values with two principles: leaving all accounting variables (operational, financial and managerial variables) unchanged, and 2) matching and refilling all possible firm-idiosyncratic variables, such as firm id, location and postal address, operation status, founding year, registration type, belonging, stock share, etc. This maximizes the coverage and usage of the **ASIF** dataset.

First of all, we checked the dataset's firm id yearly. Not as simple as previous research (Lin et al. 2009; Lu and Tao 2009; Brandt et al. 2012) that claimed that the **ASIF** dataset contains a unique firm id for each firm throughout the 10 years. Instead, there are repetitive firm ids in each year.[13] Comparing with the over-

[9] For example, words like gross value, net value, total value, sum amount are missing in some case or years, 'fixed capital' refers to the net value of fixed capital, 'asset' refers to the gross value of asset, 'employment' refers to the average employment numbers, etc. Since year 2004, the total value of sales was no longer surveyed. Instead, this term was replaced by sum income of major revenue. And the geographic codes were largely extended to 12 digits since 2004 (6 digits for province-city-county, plus other 6 digits for village-district-street accordingly).

[10] For example, 'constant value of total production value ' and 'product sale value' are no longer accounted in the national survey between 2004 and 2007.

[11] For example, 'firm status' (2001), 'firm size' (2002, 2004), 'total value of fixed capital' (2003), 'total export value' (2004), 'current value of gross output' (2004) and 'current value of sales' (2005).

[12] For example, the 'total value-add' equalizes 'sum of current value of output' - 'middle inputs plus' + 'value add tax'.

[13] There are totally 463 repetitive ids and one wrongly registered firm.

all two million firms dataset, those firms seems minute and no harm. However, many of them are large SOEs, such as provincial petro line companies, regional tobacco companies and provincial electricity groups who share the same registered names and are controlled by the central government. They are influential both in terms of local gross domestic product, revenue, taxation income, industrial forward-backward linkages as well as local employment. Some of them are even 80 times larger than some 'ordinary' firms. We believe that deleting these repetitive firms could cause the very problem of selection bias. To deal with this problem, we match these firms' locations, owners' names (legalistic representative names), major product items, accordingly, and then assign these firms with new firm IDs in the **ASIF** dataset, respectively.

Secondly, we identify and recover missing values in variables like location, operation status, founding year, registration type, belonging and stock shares, respectively. To save space, we list here two examples. Taking the operational status in year 1999 as the first case. There are 3,904 firms that are either missing or noted as 0, capital A or letter a. We take these lots as the sub-database and match them with the samples in 1998, 2000 to 2007, accordingly. Our rationale is that if these firms exited after year 1998, they would not be accounted or noted in the 1999 survey, vice versa. If they appeared in the 2000 or later years' survey, their operational status is active instead of frozen or closed. In fact, there are 3,276 firms that were noted in the 1998 survey. Among the other 628 firms, 471 did not exist in the following years' survey since 2000. We can thus safely conclude that these 471 firms only exist in year 1999 and their operational status shall be registered as "canceled" (not belonged to status as 'establishing', 'operating', 'frozen', or 'other') by the end of this year. The second example is treating the missing values of location. Taking the location variable in year 2000 as the case. There are 67 firms whose location codes are missing, noted as 0 or wrongly registered (some letters replaced the literal 6 digits location codes). Following the same way stated above, we match and sort these firms with pre- and after- years' survey data. 57 firms among them were identified with 1998-1999 survey data, 6 of the other 10 firms are found in the 2001-2007 survey data. We match the left 4 firms with their exclusive information - phone number, mail address, firm name, major products and owner names, and finally find their location codes.

5.5 Further discussion of data treatment

Some noteworthy drawbacks in the **ASIF** dataset need further discussions. We believe that these problems are partial reasons causing large estimation bias. The first is that the manufacturing firms covered in the sampling periods increased dramatically since the year 2004. Except that more and more firms' annual sales reached the officially designated scale, the year 2004 was an industry census year and there was more comprehensive survey coverage in it, which may explain the jump of the number of firms from 2003 to 2004 (Lu and Tao 2009). The second is **ASIF** does not cover small non-state-owned firms with annual sales less than five million Yuan, which may result in sampling selection bias. The third is that **ASIF** does not provide information of organization relations among multi-plant firms. As we can not identify whether two firms belongs to the same enterprise, what we can do is ignoring the situation that enterprises have more than one plant. The disaggregate composition of firm TFP could not reflect some multi-plant firms' real performance.

Comparing with researches applying the same data source, this research does not delete firms with zero monetary inputs or outputs (gross assets, net sum of fixed capital value, sales, gross outputs) or employments less than 10 persons (Jefferson and Zhang 2008; Cai and Liu 2009). The endogeneity of firm behavior is our major concern. We are arguing that if researchers need to observe firms endogenous behavior, henceforth estimate their self-adjustments in capitals and labor investments and yearly middle inputs from year to year, the zero monetary accounting is useful and sensitive in indicating their entry and exit dynamics. Since we assume that firms are aware of their productivity changes as well as their profitability, there is less solid ground to assume that they make static decisions responding to each year's productivity shock. Levinsohn and Petrin (2003) proposed a method (LP method) on firm-level productivity estimation that only requires information of middle input as the state variable of capital stock. We apply the LP method to observe firms' entry-exit dynamics in each year. To cross references, we also apply the pooled OLS and the Fixed effect panel data method to estimate firms' productivity.

For the computation of total factor productivity, gross production value, net sales of the plants, investment, middle inputs and all other monetary variables were deflated using price deflators (1978 as the benchmark year).

5.6 Firm Productivity Estimation

There are different methods to estimate firm-level productivity, such as (semi-, non-) parametric or stochastic frontier approaches, etc. In this chapter, we mainly apply the LP method to estimate firms' TFP that was first proposed in Levinsohn and Petrin (2003) (see the appendix for detailed description of this method). The LP method has several advantages over the other methods, such as the pooled OLS method, the fixed-effect method, etc (see Sun et al. (2011) for detailed comparisons about these methods as well as the OP method proposed in Olley and Pakes (1996)).

5.7 Minimum wage and urban amenities

We also collect data of minimum wages and other macroeconomic variables of Chinese cities from 1998 to 2007. As there is not a uniformly statistical origin, we collect data of prefecture-level-city monthly and hourly minimum wages from websites and statistical bulletins of local governments. Though the National Statistic Bureau does not report minimum wages, websites of most provinces, province-capital cities' governments provide their annual government working reports that contains local minimum wages both in terms of monthly and hourly scales. But many peripheral cities in Northwest China have poor public information service on their local minimum wages or government annual reports. To solve this problem, we also implement extensively search of these cities' local People's Court Civil Judgments and Civil Affair Bureau's reports. For example, according to the Marriage Law of China, if the sponsor has no job or requires responsible settlements for divorce, the calculation should be based on the local monthly minimum wage. Moreover, social compensation, pension and insurance payments are calculated based on local monthly minimum wages according to the Civil Affair Bureau's regulations. Hence, we can fill in these cities' minimum wages by court judgements as well as some local civil affair offices reports. Finally, we get totally 2850 minimum wages from 1998 to 2007, covering 85.33% of total 334 prefecture-level cities (autonomous prefectures or prefectures) all around China.

Some scholars have two contrary doubts on minimum wage. The first is that minimum wage is not binding downward. That is, there are some labors whose rewards are less than the minimum wage. We argue that even even if this case occurs, it's not sufficient to judge whether the latter is binding or not. This situation may happen as some forms of amenities and welfare provisions are supplied as the substitution to the monetary wage payment. For instance, some firms

provide free sheltering and food services in accounting to their low wages, non-contract temporary workers in short period time with low payments which are reported as firms' average wage payments, and "off-the-books income" traditions in some firms who are giving "bonus" as the major incentive to motivate workers instead of given wages. Wang (2011) implemented an extensive nationwide survey on "off-the-books income". It found a contradicting phenomenon that some households' consumptions are higher than their actual income relative to to payroll received from work. The second is that the minimum wage is not binding upward. However, even if all firms pay their employers wages higher than the minimum wage, if does not illustrate that the minimum wage is binding for firm's wage decisions. In fact, if this case occurs, it implies that the hypothesis that the minimum wage is binding is not testable as a firm's wage is not always set at the minimum wage because of many factors, such as their monopolistic power, difference between its employees' skills, labors' wage expectation, employment search frictions, etc. For example, Berg (2003) shows that minimum wage will push up market equilibrium wage because of the existence of search friction of the labor market and heterogeneity in the employees' skills. Moreover, if labors are paid by their skills and the wage of the labors with the lowest skill is binding at the minimum wage, then it's easy to deduct that other labors's wages are increasing in the minimum wage. This implies that the minimum wage is binding for all labors' wages in this sense.

We also collect data of infrastructure of these prefecture-level cities, including bus, road area, postoffice, tax, fiscal expenditure and per capita city area. We measure human capital with average education year in a prefecture-level city, which is calculated by $(primary \times 5 + highschool \times 12 + college \times 15)$, where primary, high school and college are per capita primary, high school and college students in the prefecture-level city, respectively. We measure provincial institution level with the indices developed by Gang Fan and Xiaolu Wang.[14] We match firm-level data with prefecture-level-city-level data by firms' location information and match those samples with both firm-level data and city minimum wages. We finally get totally 2,096,899 observation samples within these years.

However, we only use data between 2004 and 2007 to do empirical analysis to avoid possible errors in this chapter according to the following rationales. First, as queried by many researchers, the minimum wages were set too low before

[14] They published a sequence of books titled "China Market Indices" in China Economic science press from 1997 till now, which measures provincial institution levels with 6 upper level indices and many lower level indices. See the books for details. Here we only use those from 1998 to 2007.

2004 and thus they may be lower than the market equilibrium wages. Second, 2004 is the year when the new cabinet appeared on the stage to start a new economic revolution, which influenced thoroughly the development trend of Chinese economy since then. Third, the statistical caliber of Chinese enterprises changed much after 2004 and thus many private enterprises were included into the survey.

Table 1 in the appendix describes the minimum, maximum, mean, and median of minimum wages in each year in the whole country. We can see that they are all increasing in time. It's easy to see that the mean firm wage in the whole country in each year is always larger than the maximum of the minimum wage. Moreover, the differences between minimum wages in different prefecture-level cities are large, which implies the large development and regional differences between countries in China. Table 2 in the appendix shows the mean firm wage, minimum, maximum, mean, and median of minimum wages in each province in year 2007. We can see from both tables that minimum wage is less than the mean firm wage in each prefecture-level city. According to our summary statistics on firm wages, we find that the minimum of them is larger than the minimum wage, which implies that the minimum wage is the lower bound of firm wage.

[*Table 1 is inserted here.*]

[*Table 2 is inserted here.*]

5.8 Summary statistics

In our empirical analysis, a region unit is a prefecture-level city. A region's area A is the area of its metropolitan area. To control some other factors that may affect firms' exports, we involve firms'ownership structure (state-owned, collective-owned, private-owned, ect., here classified by $Stock\ dummy$), belonging relationship (national, regional, provincial, prefecture-level-city-owned firms, classified by $Belonging\ dummy$), size levels (classified by $Size\ dummy$) and their operating status (classified by $Status\ dummy$) for firm-level characteristics (which is defined by China Statistical Bureau in the original dataset), prefecture-level-city-level characteristics like per capita human capital (denoted by $humancapital$), tax (denoted by tax) and fiscal expenditure (denoted by $fiscalexpend$), and institute index (denoted by $institute$) for province-level one. Prefecture-level city infrastructure is measured by per capita bus, road area and postoffice (denoted by

$bus, roadarea, postoffice$, respectively). We also consider the influence of industry and region that firms locate on their exports, which is controlled by industry - and region - dummy (classified by $Industry\ dummy$ and $Region\ dummy$, respectively). In our baseline empirical analysis, firms' total factor productivity is estimated applying the LP method, which is denote by $lptfp$. In the sequel, we will use productivity estimated using the OLS method (denoted by $olsbyind$) to do robust analysis.

Table 3 shows the summary description of the main variables interested in this chapter. We see in the table that the mean of city minimum wages from 2004 to 2007 is 460.75 yuan, and there are 24.8% of exporters among the samples. The average firm exporting sale is 35.17 million yuan and the average total factor productivity in the sample is 0.236. The standard deviations of all the variables implies that the difference between the firms is large in many sides.

[*Table 3 is inserted here.*]

6 Econometric results

We regress Equation (32) in the first step applying the Probit model to investigate how minimum wage affects firms' exporting choices by controlling other factors. In the second step, we examine the influence of minimum wage on firms' exporting sales using the Tobit model (33).

6.1 The effect of minimum wage on firms' exporting choices and sales

This subsection reports the estimation results of the influences of minimum wage on firms' exporting choices (see Table 5) and sales (see Table 6), respectively, which are estimated using (32) and (33) with Probit and Tobit models. We see briefly from these two tables that the influence of minimum wage on firms' exports are significantly negative in all estimation models controlling consecutively firm-level, city-level, industry-level and region-level characteristics, such as firm total productivity, city size, city fiscal expenditure, city human capital and indices of urbanization economy, localization economy, diversification economy, competition economy and other firm specific effects.

[*Table 4 is inserted here.*]

[*Table 5 is inserted here.*]

[*Table 6 is inserted here.*]

In the above regress, we also control the influences of city-level infrastructure and agglomeration variables except for controlling firm-level, industry-level and region-level characteristics. Our rationale is that firms are not isolated from other rivals, industrial connections or spatial correlations within given locations. Moreover, the infrastructure, local public services, education and health care as well as environmental quality are considerably essential for foreign direct investment, firms' clustering and exporting as well as labor immigration.[15] Firms are consciously aware of externality[16] in potential locations and thus their production and exporting decisions are affected by it. It is predictable that the higher expenditure of local government on public goods leads to the more "utility" received by labors. There exists potential substitute effects between governments' transfer payments and minimum wages. Therefore, It is important to introduce firms' selection with inter-city wage "sorting" and intra-city "self-organizing" in a wider perspective.[17] It shows that city fiscal expenditure, size and human capital are positively significant on firms' exports while the influence of minimum wages on them is decreasing in the urban externalities (see model 11 and 12 in Table 6). On the other hand, since firms and labors are aware of the location amenity as well as the "gravity" of production, the agglomeration indicators are influential for local wages as well as exporting preference.

The above results can be explained using related literatures. Rossi-Hansberg (2005) and Aiginger and Rossi-Hansberg (2006) argue that specialization and concentration do not develop in parallel with the decrease of transport costs. Instead, they lead to dispersion as the industrial productivity growth continues. Without considering the urbanization and diversification economies, "urban human capital" along with "minimum wage" have positive influences on firms' productivity (model 5-7, 9 and 11 in Table 5 and 6). While if we consider the actual

[15] Combes et al. (2010) argues that city scale is vital for firms' productivity and production choices. The larger is the city size, the more is potential productivity growth within urban firms.

[16] Such externality can be explained as local labor-pool effects, home-market effect, and regional amenities in terms of basic welfare provision, fiscal expenditure, etc. These "X factors" are common to all firms, which provide positive influences on firms' productivity.

[17] However, the "New" New trade theory seminared by Melitz (2003) and Bernard et al. (2003) rules out heterogenous spaces where firms sort in as well as the self-organization of firms, in which agglomeration of firms generate productivity externality that further attract more firms to agglomerate. Regions having different labor wages are largely regarded as endogenously determined by the equilibrium market clear conditions. The minimum wage policies have been considered as the "distortion" force relating to the *ex ante* "binding" wage conditions to market clearing prices.

self-organizing patterns of firms (the way they locate and gather with each other) within given locations, the urban human capital externality is rather negative to firms productivity. It is sensible that competition and urbanization have positive effects on firms' productivity: the higher is the level of industrial specialization and clustering of similar firms within cities, the higher are the efficiency gains for firms.

For the tobit panel regression estimation of (33), the predictors of export choices are dramatically similar to those of (32). The minimum wage has a significantly negative influence on firms' exporting sales (Table 4). Consider the impact of minimum wage on firms' exporting choices, Méjean and Patureau (2010) argued that the minimum wage policy has a significant influence on the relative attractiveness of the home country, simultaneously affecting its relative cost competitiveness and its aggregate income. Consistent with the above new economy geography prediction, the estimation results indicate that higher minimum wages lead to firms' less exporting possibilities.

6.2 Robust analysis

The above results are obtained using the TFP estimated by the Levinsohn-Petrin method and monthly minimum wages. To provide robust check upon above intuitive findings, in this part we show that the above results hold qualitatively also for TFP estimated by the pooled OLS and hourly minimum wages.

OLS TFP and hourly minimum wages

Table 7 shows the estimation results of minimum wage on firms' exporting choices with TFP estimated using the OLS method, by adding country infrastructure, tax, fiscal expenditure, city area, human capital and province-level institution, firm stock, belonging, status, size, industry and region dummies, sequentially, as controlling variables. Changing TFP measure shall not changes the qualitative influence of minimum wage on firms' exporting behaviors. The new estimation shows that the prefecture-level-city minimum wage still has a significantly negative impact on a firm's exporting possibilities. Different from the previous result, herein firm productivity has a significantly positive influence on firms' exporting choices, which is different from the result with TFP estimated using the LP method while coincides the result predicted in most trade models with heteroge-

neous firms, such as Melitz (2003).[18]

[*Table 7 is inserted here.*]

The regression results of (33) using the fixed-effect panel model are shown in Table 8. It's shown in the table that prefecture-level-city minimum wage decreases firms' exporting sales significantly, no matter controlling prefecture-level-city-level or controlling firm-level characteristics except for monthly minimum wage and firm productivity. Also as predicted in Melitz (2003), a firm's productivity has a significant influence on its exporting sale.

[*Table 8 is inserted here.*]

As it may cause biases by only regressing exporting sales with respect to minimum wage for exporters, we apply further the Tobit model to investigate the effect of minimum wage on firms' exports. Table 9 shows the corresponding results. These results verifies those shown in Table 8 and thus Proposition **??**. These results together with the results estimated with TFP estimated using LP method implies that minimum wage does have a significantly negative influence on firms' exporting behaviors.

[*Table 9 is inserted here.*]

Table 10 and 11 report the estimation results of minimum wages on firms' exporting choices and sales by replacing TFP estimated using the LP method by the one estimated using the OLS method and the monthly minimum wages by hourly ones. We see that Proposition **??** still holds for these TFP and minimum wages.

[*Table 10 is inserted here.*]

[*Table 11 is inserted here.*]

[18]There are two large categories of literatures on the effect of firm productivity on its exports. The classic one including Melitz (2003); Bernard et al. (2003); Bernard and Jensen (1995, 1997a,b) postulates a positive while the other one like Lu (2010) predicts a negative correlation between productivity and export. As what is concerned in this chapter is the relationship between minimum wage and firms' exports, we do not investigate why firm productivity has two contrary results on firm export when it's estimated with different approaches.

The influence of labor intensity

We also do regressions for the two industries (industry 18 and 43) with different capital/labor ratio. The results are show in Table 12 and 13 for industry 18 and Table 14 and 15 for industry 43, respectively. They shows that the negative effect of minimum wage on firms' exports varies with industrial capital/labor ratio. The more labor intensive is the industry, the larger is this effect.

[*Table 12 is inserted here.*]

[*Table 13 is inserted here.*]

[*Table 14 is inserted here.*]

[*Table 15 is inserted here.*]

In fact, the model proposed in this chapter predicts such a result. According to (30), we know that minimum wage has different influences on industrial unit production cost in industries with various labor intensity.[19] The more labor-intensive is an industry, the ratio between domestic and foreign unit production costs in it increases more rapid with the increase of the minimum wage. Furthermore, firms' exporting sales decrease more faster in this industry by (31) by noticing that $\underline{\theta}_l^*$ is increasing in the minimum wage.

Endogeneity issues

There may exist endogeneity problem in the above regressions. For firms, the minimum wages may endogenously influenced by their exports. [20] To solve this possible problem, we carry out two-step systematic GMM estimations between minimum wages and county-level exports.

Our estimation equation is as follows

$$\begin{aligned} \ln X_{ijrt} &= \alpha_0 + \rho_1 \ln X_{ijrt-1} + \beta_1 \ln \theta_{ijrt} + \beta_2 \ln \theta_{ijrt-1} + \beta_3 \ln w_{it} + \beta_4 \ln w_{it-1} \\ &\quad + Z_{ijrt}\eta + \nu_i + \varepsilon_{ijrt}, \end{aligned} \tag{34}$$

[19] The labor intensity is measured by $1 - \alpha_l$. The larger is this value, the more labor-intensive is the industry.

[20] For example, some firms in a county may lobby for delaying the carrying out of the minimum wage standard when see that minimum wages reduce firms' exports in other counties.

where X_{ijrt} is the exporting sale of firm i in industry j in city r in year t, Z_{ijrt} is the vector containing controlling variables including city infrastructure, other observable or measurable externalities (such as effects of competition, diversity, urban economy and local specialization caused by agglomeration), other city-level and firm-level characteristics (such as ownership, operation status, size, belonging relationship, registration type, etc.). The estimation result is shown in Table 16. We can see from the table that minimum wages have significantly negative influences on county-level exports in all the models.[21] This implies that the afore estimation results are robust even considering the endogeneity issue between minimum wage and firms' exports.

[*Table 16 is inserted here.*]

7 Conclusion

This chapter constructs a trade-equilibrium model with heterogeneous firms to investigate the impacts of minimum wages on firms' exports. The results show that the increase of the minimum wage in a country has negative influences on firms' ex ante exporting probabilities and their exporting sales. Empirical analysis using firm-level data of Chinese enterprises confirms this theoretical result.

Based on the framework proposed in this chapter, we can further analyze the welfare effects of minimum wages in the open economy. We can also relax Assumption 1 to investigate the impacts of minimum wages on firms' exports when real wages are affected by unemployment. As minimum wages affect firms' organization and innovation behaviors and thus their productivity levels, it's of sense to explore the interaction effects between minimum wages and firms' productivity. Moreover, the spatial differences of the impacts of minimum wages on firms' exports deserve more researches.

[21] What shall be explained here is that Sargan test is always zero in all the regressions. This may be caused by the large and heterogeneous exporting variations across firms, which can not be completely identified by the instrument variables.

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Appendix

Proof of Lemma 1

We know that N_l and N_l^* satisfy the following equations:

$$N_l + N_l^* \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{1-\frac{k_l}{\sigma_l-1}} \left(\frac{\varpi_l}{\varpi_l^*}\right)^{k_l+1-\sigma_l} \left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{-k_l} = \frac{k_l+1-\sigma_l}{k_l}\frac{(1-\rho_l)\beta_l w}{f_l\tau_l^{\sigma_l-1}}, \quad (35)$$

$$N_l^* + N_l \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{1-\frac{k_l}{\sigma_l-1}} \left(\frac{\varpi_l^*}{\varpi_l}\right)^{\sigma_l-k_l-1} \left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{k_l} = \frac{k_l+1-\sigma_l}{k_l}\frac{(1-\rho_l)\beta_l w^*}{f_l\tau_l^{\sigma_l-1}} \quad (36)$$

from which we can find the equilibrium numbers of firms in both countries as follows:

$$N_l = \frac{\frac{k_l+1-\sigma_l}{k_l}\frac{(1-\rho_l)\beta_l}{f_l\tau_l^{\sigma_l-1}}\left\{w - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \left(\frac{\varpi_l}{\varpi_l^*}\right)^{k_l+1-\sigma_l} \left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{-k_l} w^*\right\}}{1-\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{2(\sigma_l-1-k_l)}{\sigma_l-1}}}, \quad (37)$$

$$N_l^* = \frac{\frac{k_l+1-\sigma_l}{k_l}\frac{(1-\rho_l)\beta_l}{f_l\tau_l^{\sigma_l-1}}\left\{w^* - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \left(\frac{\varpi_l}{\varpi_l^*}\right)^{\sigma_l-k_l-1} \left(\frac{\underline{\theta}_l}{\underline{\theta}_l^*}\right)^{k_l} w\right\}}{1-\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{2(\sigma_l-1-k_l)}{\sigma_l-1}}}. \quad (38)$$

Proof of Lemma 2

First, we know that $N_l\Omega_l$ is decreasing in w according to (37) . Hence $\frac{N_l\Omega_l}{w+w^*}$ is also decreasing in w. Furthermore, from (29), we have

$$\frac{N_l^*}{w+w^*} = \frac{\frac{k_l+1-\sigma_l}{k_l}\frac{(1-\rho_l)\beta_l}{f_l\tau_l^{\sigma_l-1}}}{1-\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{2(\sigma_l-1-k_l)}{\sigma_l-1}}}\left\{1-\left[\left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}}\left(\frac{\varpi_l}{\varpi_l^*}\right)^{\sigma_l-k_l-1}\Omega_l+1\right]\frac{w}{w+w^*}\right\}.$$

As $\frac{w}{w+w^*}$ is increasing in w,[22], $\frac{N_l^*}{w+w^*}$ is also decreasing in w. Therefore, from (29), we know that

$$\underline{\theta}_l^{*k_l} = \frac{\frac{\beta_l b_l^{k_l}}{\delta_l F_{El}}}{N_l\Omega_l/(w+w^*)+N_l^*/(w+w^*)}$$

is increasing in w. This implies that $\underline{\theta}_l^*$ is increasing in w.

[22]This is because that $\left(\frac{\varpi_l}{\varpi_l^*}\right)^{\sigma_l-k_l-1}$ and Ω_l are both decreasing in $\frac{\varpi_l}{\varpi_l^*}$.

Proof of Lemma 3

First, from (37) and (38), we have

$$\frac{N_l}{N_l^*} = \frac{w - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{k_l+1-\sigma_l}\Omega_l^{-1}w^*}{w^* - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{\sigma_l-1-k_l}\Omega_l w}. \tag{39}$$

Second, equation (30) can be rewritten as

$$h(\omega_l) = \left(\frac{w}{w^*}\right)^{1-\alpha_l}\left(\frac{\bar{K}_l^*}{\bar{K}_l}\right)^{\alpha_l},$$

where

$$h(\omega_l) = \omega_l\left(\frac{w\Omega_l - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{k_l+1-\sigma_l}w^*}{w^* - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{\sigma_l-1-k_l}\Omega_l w}\right)^{-\alpha_l}. \tag{40}$$

As

$$g(\omega_l) = \frac{w\Omega_l - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{k_l+1-\sigma_l}w^*}{w^* - \left(\frac{\kappa_l}{f_l}\rho_l^{\sigma_l-1}\right)^{\frac{\sigma_l-1-k_l}{\sigma_l-1}} \omega_l^{\sigma_l-1-k_l}\Omega_l w}$$

is decreasing in ω_l, $h(\omega_l)$ is increasing in ω_l. This implies that equation (30) has a unique solution, which is increasing in $\frac{w}{w^*}$.

The Levinsohn-Petrin Approach

Since the firm's asymmetry knowledge of its productivity is unavailable to the econometrician, the problem of simultaneity will affect firm's endogenous decision on hiring and investment factor inputs. This will lead the pooled OLS estimation of a production function to estimates of the coefficients of exogenous inputs that are biased upwards.

The LP method proposed an alternative for firm-level data estimation which requires no further information about input values, nor subtracting them from the gross-output number to get value added. Since the investment proxy is only valid for plants reporting nonzero investment, firms with "zero investment" are likely to be dropped in previous approach. Instead, L-P method uses intermediate input proxies avoids truncating all the zero investment firms. In many empirical studies (so as in our **ASIF** dataset), firms always report positive use of intermediate inputs like electricity or materials.

Start with the Cobb-Douglas production technology

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t,$$

where y_t is the logarithm of the firm's output, such as value added; l_t and m_t are the logarithm of the freely variable inputs labor and the intermediate input; and k_t is the logarithm of the state variable capital.

The error has two components: the transmitted productivity component given as ω_t and η_t, an error term that is uncorrelated with input choices. The key difference between ω_t and η_t is that the former is a state variable and impacts the firm's decision rules. It is not observed by the econometrician, and it can impact the choices of inputs, leading to the simultaneity problem in production function estimation.

Demand for the intermediate input is assumed to depend on the firm's state variables k_t and ω_t:

$$m_t = m_t(k_t, \omega_t).$$

In the Levinsohn and Petrin (2003) assumption, demand function is monotonically increasing in ω_t. This allows inversion of the intermediate demand function, ω_t can be written as a function of k_t and m_t:

$$\omega_t = \omega_t(k_t, m_t).$$

The unobservable productivity term is now expressed solely as a function of two observed inputs.

A final identification restriction follows Olley and Pakes (1996), whose productivity is governed by a first-order Markov process:

$$\omega_t = E\left[\omega_t \mid \omega_{t-1}\right] + \xi_t,$$

where ξ_t is an innovation to productivity that is uncorrelated with k_t, but not necessarily with l_t.

For the value-added production function, it can be written as

$$v_t = \beta_0 + \beta_l l_t + \beta_k k_t + \omega_t + \eta_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t,$$

where

$$\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \omega_t(k_t, m_t).$$

Substituting a third order polynomial approximation in k_t and m_t in place of $\phi_t(k_t, m_t)$, makes it possible to consistently estimate parameters of the value-added equation using OLS as

$$v_t = \delta_0 + \beta_l l_t + \sum_{i=0}^{3} \sum_{j=0}^{3-i} \delta_{ij} k_t^i m_t^j + \eta_t,$$

where β_0 is not separately identified from the intercept of $\phi_t(k_t, m_t)$. As the first stage of estimation routine from Levinsohn and Petrin (2003), estimates of β_l and ϕ_t are available.

The second stage of the routine identifies the coefficient β_k, It begins by computing the estimated value for ϕ_t using

$$\hat{\phi}_t = \hat{v}_t - \hat{\beta}_l l_t = \hat{\delta}_0 + \sum_{i=0}^{3} \sum_{j=0}^{3-i} \hat{\delta}_{ij} k_t^i m_t^j - \hat{\beta}_l l_l.$$

For any candidate value β_k^*, a prediction for ω_t of all periods t can be computed by

$$\hat{\omega}_t = \hat{\phi}_t - \beta_k^* k_t.$$

Using these values, a consistent (nonparametric) approximation to $E[\omega_t \mid \omega_{t-1}]$ is

given by the predicted values from the regression:

$$\hat{\omega}_t = \gamma_0 + \gamma_1 \omega_{t-1} + \gamma_2 \omega_{t-1}^2 + \gamma_3 \omega_{t-1}^3 + \epsilon_t,$$

which in Levinsohn and Petrin (2003) is given as $E[\omega_t | \widehat{\omega}_{t-1}]$.

Given $\hat{\beta}_0$, β_k^* and $E[\omega_t | \widehat{\omega}_{t-1}]$, Levinsohn and Petrin (2003) writes the sample residual of the production function as

$$\widehat{\eta_t + \xi_t} = v_t - \hat{\beta}_l l_t - \beta_k^* k_t - E[\omega_t | \widehat{\omega}_{t-1}].$$

The estimation $\hat{\beta}_k$ of β_k is defined as the solution to:

$$\min_{\beta_k^*} \sum_t \left(v_t - \hat{\beta}_l l_t - \beta_k^* k_t - E[\omega_t | \widehat{\omega}_{t-1}] \right)^2.$$

Table 1: **Mean firm wage, minimum, maximum, mean, and median of minimum wages in China from Year 2004 to 2007**

year	meanwage	minmwage	maxmwage	meanmwage	meadianmwage
2004	2821.893	240	635	465.835	450
2005	2979.58	280	690	521.495	520
2006	3173.668	320	810	588.613	580
2007	3590.009	400	850	643.62	620

Note: meanwage, minmwage, maxmwage, meanmwage and medianmwage represent the minimum, maximum, mean, and median of minimum wages in each year in the whole country.

Table 2: **Mean firm wage, minimum,maximum, mean, and median of minimum wages in each province in year 2007 (unit: Yuan)**

procode	meanwage	minmwage	maxmwage	meanmwage	medianmwage
11	5908.312	730	730	730	730
12	5528.669	740	740	740	740
13	2849.251	540	580	563.017	580
14	3245.918	570	610	580.313	570
15	4764.891	460	560	512.813	520
21	5847.104	500	700	589.769	580
22	2999.66	600	650	628.757	650
23	2224.671	400	620	519.053	475
31	10249.9	840	840	840	840
32	3532.196	520	750	682.005	620
33	3046.829	700	850	798.306	850
34	1732.487	460	560	512.06	500
35	3518.963	570	650	629.955	650
36	1809.186	450	510	465.652	450
37	3026.44	430	610	542.083	540
41	1852.638	550	650	581.362	550
42	4179.755	460	580	496.244	460
43	2959.24	480	635	527.896	500
44	2991.057	500	850	681.196	690
45	2323.498	500	580	547.205	580
46	4858.973	630	630	630	630
50	3151				
51	2281.836	400	580	494.542	510
52	2540.341	500	550	543.19	550
53	2680.4	480	540	506.953	480
54	5322.853				

61	3850.072	420	540	505.042	500
62	3642.542	400	430	412.193	400
63	4079.948	440	440	440	440
64	3765.164	490	560	549.732	560
65	3100.062	480	560	494.032	480

Note: procode, meanwage, minmwage, maxmwage, meanmwage and medianmwage represent the mean firm wage, minimum, maximum, mean, and median of minimum wages in each province, where the province code 11-15, 21-23, 31-37, 41-46, 50-54, 61-65 represent Beijing, Tianjin, Hebei, Shanxi, Neimenggu (11-15), Liaoning, Jilin, Heilongjiang (21-23), Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong (31-37), Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan (41-46), Chongqing, Sichuan, Guizhou, Yunnan, Xizang (Tibet) (50-54), Shanxi, Gansu, Qinghai, Ningxia, Xinjiang (61-65), repectively. Herein Chongqing (50) and Tibet (54) are lack of data on minimum wage and thus the relevant variables are in blank.

Table 3: **Summary statistics**

Variable	Mean	Std. Dev.	Min.	Max.	N
exportdum	0.248	0.432	0	1	2226422
export	3517.303	77606.032	0	32300000	2226422
monthminiwage	460.757	160.565	140	850	2096895
lptfp	0.236	0.565	-2.176	1.968	2091117

Note: exportdum, export, monthminiwage, lptfp represent, respectively, the exporting dummmy, exporting sale, monthly minimum wage, and total productivity estimated using LP method,

Table 4: **The effect of minimum wage on firms' exporting choices with LP TFP and monthly minimum wage (2004-2007)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum
exportdum										
lnmminiwage	-0.081***	-0.136***	-0.106***	-0.068***	-0.143***	-0.178***	-0.178***	-0.142***	0.0357*	-0.0401**
	(-7.10)	(-11.18)	(-7.56)	(-5.39)	(-12.70)	(-14.74)	(-14.80)	(-11.20)	(2.47)	(-2.78)
lptfp	-0.090***	-0.084***	0.0174	-0.0237**	-0.119***	-0.105***	-0.124***	-0.101***	-0.028***	-0.045***
	(-11.10)	(-10.21)	(1.90)	(-2.82)	(-14.28)	(-12.63)	(-14.89)	(-11.72)	(-3.30)	(-5.14)
lncityarea	-0.060***	-0.031***	-0.0114	-0.037***	-0.257***	-0.114***	-0.262***	-0.262***	-0.231***	-0.291***
	(-7.75)	(-3.66)	(-1.24)	(-4.26)	(-28.89)	(-13.24)	(-29.54)	(-29.56)	(-27.20)	(-33.47)
lnfisexp	0.279***	0.317***	0.369***	0.320***	0.186***	0.271***	0.180***	0.180***	0.146***	0.144***
	(48.71)	(49.52)	(53.93)	(49.78)	(29.04)	(42.64)	(28.24)	(28.06)	(24.93)	(24.29)
lnhumcapital		-0.108***	-0.180***	-0.109***	-0.187***	-0.135***	-0.187***	-0.190***	-0.261***	-0.278***
		(-12.78)	(-19.65)	(-12.89)	(-24.00)	(-14.92)	(-24.01)	(-24.33)	(-30.77)	(-32.47)
div			-1.316***					-0.600***	-0.217**	-1.058***
			(-17.27)					(-8.12)	(-2.87)	(-13.92)
com				-0.012***				-0.005***	-0.007***	-0.005***
				(-20.27)				(-7.91)	(-11.09)	(-8.88)
urb					0.693***		0.537***	0.533***	0.282***	0.436***
					(106.16)		(77.54)	(76.36)	(38.82)	(62.62)
loc						0.280***	0.192***	0.189***	0.164***	0.188***

						(91.61)	(60.03)	(58.64)	(45.19)	(59.46)
Stock dummy	No	No	Yes	No	No	No	No	No	Yes	Yes
Belong dummy	No	No	No	No	No	No	No	No	Yes	Yes
Status dummy	No	No	No	No	No	No	No	No	Yes	Yes
Size dummy	No	No	No	No	No	No	No	No	Yes	Yes
Regitype dummy	No	No	No	No	No	No	No	No	Yes	Yes
Industry dummy	No	No	No	No	No	No	No	No	Yes	No
N	1974375	1931664	1930027	1931664	1931664	1931664	1931664	1931664	1930027	1930027
rho	0.953	0.952	0.967	0.952	0.944	0.945	0.941	0.941	0.870	0.897

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 5: **The effect of minimum wage on firms' exporting sales with LP TFP and month minimum wage (Tobit estimation) (2004-2007)**

lnexport	(1)	(2)	(3)	(4)	(5)	(6)
lnmminiwage	-0.522***	-0.426***	-0.838***	-1.890***	-1.708***	-1.885***
	(-18.02)	(-12.57)	(-23.44)	(-46.63)	(-40.58)	(-40.64)
lptfp		0.00392	0.0826***	-0.00569	0.129***	-0.0397
		(0.16)	(3.40)	(-0.23)	(5.18)	(-1.50)
lncityarea			0.641***	0.0518**	-0.0664***	-0.0518**
			(49.91)	(2.84)	(-3.46)	(-2.69)
lnfisexp				0.895***	0.641***	0.618***
				(59.24)	(34.96)	(33.61)
lnhumcapital					0.714***	0.757***
					(25.21)	(26.53)
com						0.0197***
						(11.06)
Stock Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Belong Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Status Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Regitype Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industrial Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-7.254***	-7.301***	-7.799***	-9.994***	-11.00***	-9.875***
	(-39.83)	(-34.83)	(-37.15)	(-47.40)	(-50.34)	(-39.66)
sigma_u	12.80***	12.51***	12.45***	12.22***	12.23***	12.23***
	(549.96)	(539.46)	(539.23)	(536.74)	(534.72)	(534.82)
sigma_e	2.873***	2.834***	2.837***	2.837***	2.836***	2.835***
	(623.31)	(612.10)	(611.39)	(610.52)	(607.84)	(607.85)
N	1148949	1102238	1102037	1102037	1089076	1089076

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 6: **The effect of minimum wage on firms' exporting sales with LP TFP and month minimum wage (Tobit estimation) (2004-2007) (continued)**

lnexport	(7)	(8)	(9)	(10)	(11)	(12)
lnmminiwage	-1.706***	-2.690***	-2.124***	-1.781***	-3.854***	-3.886***
	(-40.53)	(-62.19)	(-49.54)	(-34.50)	(-66.44)	(-66.26)
lptfp	0.133***	0.240***	0.150***	-0.173***	-0.394***	-0.338***
	(5.34)	(9.22)	(5.85)	(-6.40)	(-13.25)	(-11.11)
lncityarea	-0.0680***	-0.421***	-0.170***	-0.135***	-0.433***	-0.381***
	(-3.54)	(-21.58)	(-8.75)	(-6.87)	(-21.83)	(-19.10)
lnfisexp	0.639***	-0.140***	0.385***	0.574***	-0.287***	-0.196***
	(34.85)	(-7.29)	(20.63)	(29.73)	(-14.03)	(-9.34)
lnhumcapital	0.701***	-0.696***	0.293***	0.177***	-0.762***	-0.678***
	(24.59)	(-22.96)	(10.09)	(5.79)	(-23.64)	(-20.81)
com					0.0323***	0.0296***
					(17.31)	(15.75)
div	-0.982***				-3.153***	-1.466***
	(-4.31)				(-11.77)	(-5.33)
urb		3.568***			2.554***	2.124***
		(149.86)			(95.03)	(73.74)
loc			1.203***		0.704***	0.569***
			(112.50)		(60.87)	(40.62)
Stock Dummy	Yes	Yes	Yes	Yes	No	Yes
Belong Dummy	Yes	Yes	Yes	Yes	No	Yes
Status Dummy	Yes	Yes	Yes	Yes	No	Yes
Size Dummy	Yes	Yes	Yes	Yes	No	Yes
Regitype Dummy	Yes	Yes	Yes	Yes	No	Yes
Industrial Dummy	Yes	Yes	Yes	Yes	No	Yes
Constant	-10.81***	-31.29***	-14.08***	-2.926***	-10.33***	-7.739***
	(-48.35)	(-121.92)	(-62.91)	(-9.23)	(-29.40)	(-19.97)

sigma_u	12.22***	11.65***	11.85***	9.540***	9.139***	8.494***
	(534.65)	(526.82)	(527.96)	(482.98)	(478.37)	(453.98)
sigma_e	2.836***	2.834***	2.853***	2.905***	2.882***	2.899***
	(607.79)	(602.13)	(601.39)	(588.78)	(593.62)	(596.35)
N	1089076	1089076	1089076	1089076	1089076	1089076

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 7: **The effect of minimum wage on firms' exporting choices with OLS TFP and month minimum wage (2004-2007)**

	(1)	(2)	(3)	(4)	(5)	(6)
	exportdum	exportdum	exportdum	exportdum	exportdum	exportdum
lnmminiwage	-0.850***	-4.235***	-3.103***	-3.565***	-3.565***	-3.118***
	(-52.43)	(-117.30)	(-82.08)	(-87.31)	(-87.31)	(-75.95)
olsbyind	0.306***	0.535***	0.603***	0.410***	0.410***	0.565***
	(69.48)	(89.37)	(99.73)	(63.65)	(63.65)	(84.49)
lnbus		0.361***				
		(23.35)				
lntax		0.208***	0.218***	0.165***	0.165***	0.472***
		(15.26)	(16.52)	(12.18)	(12.18)	(30.33)
lnroadarea		0.0762***	-0.0216	0.0530***	0.0530***	-0.0505***
		(5.24)	(-1.55)	(3.73)	(3.73)	(-3.31)
lnpostoffice		0.419***	0.307***	0.312***	0.312***	0.139***
		(35.34)	(25.89)	(25.87)	(25.87)	(11.12)
lnfiscalexpend		-0.499***	-0.164***	-0.0337*	-0.0337*	0.0325*
		(-37.02)	(-12.57)	(-2.44)	(-2.44)	(2.28)
lncityarea		-0.346***	-0.185***	-0.205***	-0.205***	0.0414*
		(-15.02)	(-8.76)	(-9.49)	(-9.49)	(1.98)
lnhumcapital		0.245***	0.177***	0.0730***	0.0730***	-0.503***
		(13.24)	(9.71)	(3.91)	(3.91)	(-24.99)
institute		0.930***	0.827***	0.835***	0.835***	0.398***
		(126.04)	(114.84)	(112.02)	(112.02)	(38.33)
Stock dummy	No	No	Yes	Yes	Yes	yes
Belong dummy	No	No	Yes	Yes	Yes	Yes
status dummy	No	No	No	Yes	Yes	yes
Size dummy	No	No	No	Yes	Yes	Yes
industry dummy	No	No	No	No	No	Yes
Region dummy	No	No	No	No	No	Yes
_cons	-0.965***	10.62***	3.092***	8.310***	8.310***	4.311***

	(-9.73)	(59.87)	(14.86)	(34.79)	(34.79)	(17.14)
lnsig2u						
_cons	3.343***	3.350***	2.774***	2.809***	2.809***	2.512***
	(653.81)	(603.08)	(418.62)	(426.87)	(426.87)	(346.28)
N	1102438	796689	796748	796748	796748	796748

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Olsbyind is the firm-level total factor productivity estimated with the OLS method, lnmminiwage, lnbus, lntax, lnroadarea, lnpostoffice, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 8: **The effect of minimum wage on firms' exporting sales with OLS TFP and month minimum wage (2004-2007)**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnexport	lnexport	lnexport	lnexport	lnexport	lnexport
lnmminiwage	-0.128***	-0.100***	-0.15.58***	-0.0730**	-0.0730**	-0.0738**
	(-12.54)	(-3.94)	(-5.78)	(-2.65)	(-2.65)	(-2.68)
olsbyind	0.572***	0.579***	0.598***	0.583***	0.583***	0.584***
	(15.55.32)	(119.09)	(124.33)	(115.5.70)	(115.5.70)	(115.5.75)
lnbus		0.0184				
		(1.62)				
lntax		0.0673**	0.0241	0.0243	0.0243	0.0248
		(3.26)	(1.17)	(1.09)	(1.09)	(1.11)
lnroadarea		-0.0856***	-0.0665***	-0.0721***	-0.0721***	-0.0723***
		(-8.59)	(-6.91)	(-7.48)	(-7.48)	(-7.50)
lnpostoffice		-0.00687	0.0134	0.0195*	0.0195*	0.0193*
		(-0.80)	(1.56)	(2.28)	(2.28)	(2.25)
lnfiscalexpend		0.0549***	-0.0513***	-0.0579***	-0.0579***	-0.0583***
		(5.34)	(-4.82)	(-5.42)	(-5.42)	(-5.45)
lncityarea		0.0686***	0.0334*	0.0271	0.0271	0.0274
		(4.56)	(2.21)	(1.80)	(1.80)	(1.81)
lnhumcapital		0.0642**	0.0599**	0.0737***	0.0737***	0.0724***
		(3.02)	(2.81)	(3.45)	(3.45)	(3.39)
institute		-0.0416***	-0.118***	-0.118***	-0.118***	-0.118***
		(-5.79)	(-15.5.72)	(-15.5.69)	(-15.5.69)	(-15.5.70)
Stock dummy	No	No	Yes	Yes	Yes	yes
Belong dummy	No	No	Yes	Yes	Yes	Yes
status dummy	No	No	No	Yes	Yes	yes
Size dummy	No	No	No	Yes	Yes	Yes
industry dummy	No	No	No	No	No	Yes
Region dummy	No	No	No	No	No	Yes
_cons	4.469***	3.179***	5.850***	5.787***	5.787***	5.642***

	(81.06)	(13.33)	(23.12)	(24.15.5)	(24.15.5)	(11.06)
N	296270	210397	210398	210398	210398	210398

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Olsbyind is the firm-level total factor productivity estimated with the OLS method, lnmminiwage, lnbus, lntax, lnroadarea, lnpostoffice, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 9: **The effect of minimum wage on firms' exporting sales with OLS TFP and month minimum wage (Tobit estimation) (2004-2007)**

	(1) exportdum	(2) exportdum	(3) exportdum	(4) exportdum	(5) exportdum	(6) exportdum
lnmminiwage	-0.274***	-1.212***	-1.032***	-1.158***	-0.272***	-0.975***
	(-63.87)	(-132.60)	(-103.48)	(-115.04)	(-96.20)	(-94.07)
olsbyind	0.0987***	0.137***	0.150***	0.106***	0.0294***	0.149***
	(78.07)	(86.81)	(92.63)	(62.08)	(63.52)	(84.68)
lnbus		0.0868***				
		(20.92)				
lntax		0.0429***	0.0606***	0.0368***	0.00957***	0.145***
		(10.31)	(14.79)	(9.10)	(9.03)	(32.05)
lnroadarea		0.0451***	0.0389***	0.0565***	0.00256*	0.0158***
		(11.71)	(10.10)	(14.92)	(2.40)	(3.97)
lnpostoffice		0.0935***	0.0674***	0.0681***	0.0291***	0.0178***
		(30.13)	(21.21)	(21.85)	(32.27)	(5.43)
lnfiscalexpend		-0.142***	-0.0637***	-0.0167***	-0.00260**	0.00178
		(-37.81)	(-16.92)	(-4.46)	(-2.74)	(0.46)
lncityarea		-0.0593***	-0.0491***	-0.0533***	-0.0128***	0.0111*
		(-10.22)	(-8.63)	(-9.55)	(-8.32)	(2.01)
lnhumcapital		0.111***	0.0876***	0.0549***	0.00250	-0.128***
		(20.08)	(15.64)	(9.98)	(1.69)	(-21.88)
institute		0.271***	0.258***	0.250***	0.0615***	0.104***
		(136.22)	(128.45)	(126.21)	(122.06)	(37.19)
Stock dummy	No	No	Yes	Yes	Yes	yes
Belong dummy	No	No	Yes	Yes	Yes	Yes
status dummy	No	No	No	Yes	Yes	yes
Size dummy	No	No	No	Yes	Yes	Yes
industry dummy	No	No	No	No	No	Yes
Region dummy	No	No	No	No	No	Yes
_cons	-0.237***	3.067***	1.515***	2.699***	1.192***	1.316***

	(-9.35)	(67.56)	(26.56)	(45.81)	(69.43)	(19.92)
sigma_u						
_cons	1.560***	1.359***	1.282***	1.255***	0.347***	1.124***
	(521.16)	(448.86)	(427.38)	(425.42)	(733.63)	(409.29)
sigma_e						
_cons	0.389***	0.400***	0.406***	0.397***	0.200***	0.398***
	(603.54)	(444.15)	(442.54)	(438.22)	(897.20)	(454.62)
N	1102238	796689	796748	796748	796748	796748

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Olsbyind is the firm-level total factor productivity estimated with the OLS method, lnmminiwage, lnbus, lntax, lnroadarea, lnpostoffice, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level month minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 10: **The effect of minimum wage on firms' exporting choices with OLS TFP and hourly minimum wage (2004-2007)**

exportdum	(1)	(2)	(3)	(4)	(5)	(6)
lnhminiwage	-0.882***	-4.169***	-3.018***	-3.457***	-3.457***	-2.994***
	(-54.29)	(-113.78)	(-80.23)	(-85.12)	(-85.12)	(-74.03)
olsbyind	0.309***	0.535***	0.600***	0.408***	0.408***	0.565***
	(69.95)	(89.80)	(99.27)	(63.26)	(63.26)	(84.36)
lnbus		0.365***				
		(23.56)				
lntax		0.197***	0.210***	0.159***	0.159***	0.475***
		(14.41)	(15.87)	(11.65)	(11.65)	(30.43)
lnroadarea		0.0714***	-0.0259	0.0475***	0.0475***	-0.0593***
		(4.92)	(-1.85)	(3.33)	(3.33)	(-3.89)
lnpostoffice		0.424***	0.309***	0.315***	0.315***	0.135***
		(35.95)	(26.05)	(26.01)	(26.01)	(10.71)
lnfiscalexpend		-0.496***	-0.159***	-0.0286*	-0.0286*	0.0389**
		(-36.74)	(-12.12)	(-2.07)	(-2.07)	(2.73)
lncityarea		-0.362***	-0.199***	-0.223***	-0.223***	0.0240
		(-15.77)	(-9.42)	(-10.32)	(-10.32)	(1.15)
lnhumcapital		0.258***	0.186***	0.0845***	0.0845***	-0.496***
		(13.89)	(10.18)	(4.52)	(4.52)	(-24.62)
institute		0.914***	0.811***	0.816***	0.816***	0.370***
		(121.55)	(112.72)	(109.50)	(109.50)	(35.92)
Stock dummy	No	No	Yes	Yes	Yes	Yes
Belong dummy	No	No	Yes	Yes	Yes	Yes
Status dummy	No	No	No	Yes	Yes	yes
Size dummy	No	No	No	Yes	Yes	Yes
Industry dummy	No	No	No	No	No	Yes

Region dummy	No	No	No	No	No	Yes
Constant	-5.301***	-10.95***	-12.70***	-9.840***	-9.840***	-11.56***
	(-160.61)	(-116.26)	(-108.00)	(-65.35)	(-65.35)	(-62.54)
lnsig2u						
_cons	3.345***	3.355***	2.782***	2.821***	2.821***	2.519***
	(654.58)	(603.38)	(418.87)	(428.07)	(428.07)	(347.40)
N	1102238	796689	796748	796748	796748	796748

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Olsbyind is the firm-level total factor productivity estimated with the OLS method, lnhminiwage, lnbus, lntax, lnroadarea, lnpostoffice, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level hourly minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 11: **The effect of minimum wage on firms' exporting sales with OLS TFP and hourly minimum wage (2004-2007)**

	(1)	(2)	(3)	(4)	(5)	(6)
lnhminiwage	-0.127***	-0.0908***	-0.148***	-0.0742**	-0.0742**	-0.0751**
	(-12.41)	(-3.59)	(-5.82)	(-2.72)	(-2.72)	(-2.75)
olsbyind	0.572***	0.578***	0.598***	0.583***	0.583***	0.584***
	(155.34)	(119.07)	(122.33)	(115.70)	(115.70)	(115.75)
lnbus		0.0192				
		(1.69)				
lntax		0.0689***	0.0248	0.0226	0.0226	0.0231
		(3.34)	(1.21)	(1.10)	(1.10)	(1.13)
lnroadarea		-0.0867***	-0.0662***	-0.0718***	-0.0718***	-0.0720***
		(-8.71)	(-6.88)	(-7.44)	(-7.44)	(-7.46)
lnpostoffice		-0.00684	0.0133	0.0195*	0.0195*	0.0193*
		(-0.80)	(1.56)	(2.27)	(2.27)	(2.25)
lnfiscalexpend		0.0550***	-0.0515***	-0.0580***	-0.0580***	-0.0584***
		(5.35)	(-4.85)	(-5.43)	(-5.43)	(-5.47)
lncityarea		0.0677***	0.0326*	0.0268	0.0268	0.0270
		(4.50)	(2.16)	(1.78)	(1.78)	(1.79)
lnhumcapital		0.0624**	0.0581**	0.0728***	0.0728***	0.0716***
		(2.93)	(2.73)	(3.41)	(3.41)	(3.35)
institute		-0.0437***	-0.119***	-0.118***	-0.118***	-0.118***
		(-6.13)	(-15.91)	(-15.82)	(-15.82)	(-15.84)
Stock dummy	No	No	Yes	Yes	Yes	Yes
Belong dummy	No	No	Yes	Yes	Yes	Yes
Status dummy	No	No	No	Yes	Yes	yes
Size dummy	No	No	No	Yes	Yes	Yes
Industry dummy	No	No	No	No	No	Yes

Region dummy	No	No	No	No	No	Yes
Constant	3.816***	2.676***	5.105***	5.419***	5.419***	5.269***
	(160.81)	(12.24)	(22.07)	(23.19)	(23.19)	(10.63)
N	296270	210397	210398	210398	210398	210398

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Olsbyind is the firm-level total factor productivity estimated with the OLS method, lnhminiwage, lnbus, lntax, lnroadarea, lnpostoffice, lnfiscalexpend, lncityarea and lnhumcapital represent the logarithm of county-level hourly minimum wage, tax, road area, post office, fiscal expenditure, city area and human capital per person, respectively, and institute refers to the province-level institute. Com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 12: **The effect of minimum wage on firms' exporting choices in industry 18 (2004-2007)**

exportdum	(1)	(2)	(3)	(4)	(5)	(6)
lnmminiwage	-0.262***	-0.331***	-0.460***	-0.454***	-0.555***	-0.142*
	(-4.61)	(-5.99)	(-8.43)	(-8.32)	(-9.58)	(-2.21)
lptfp	0.221***	0.228***	0.297***	0.307***	0.314***	0.407***
	(4.64)	(4.99)	(6.74)	(6.96)	(6.86)	(10.33)
lncityarea	-0.217***	-0.309***	-0.239***	-0.201***	-0.189***	-0.142***
	(-6.12)	(-8.43)	(-6.83)	(-5.58)	(-5.26)	(-4.20)
lnfisexp	0.198***	0.132***	0.0798**	0.0936***	0.115***	0.102***
	(6.96)	(4.60)	(2.84)	(3.32)	(4.06)	(3.83)
lnhumcapital	-0.227***	-0.249***	-0.260***	-0.255***	-0.235***	-0.289***
	(-6.33)	(-6.95)	(-7.38)	(-7.23)	(-6.65)	(-8.62)
div					2.609***	1.604***
					(5.95)	(4.16)
com	0.00183				0.00305	0.00327
	(0.89)				(1.49)	(1.62)
urb		0.339***		-0.153***	-0.195***	-0.184***
		(11.47)		(-4.15)	(-5.13)	(-5.21)
loc			0.377***	0.431***	0.449***	0.342***
			(23.52)	(20.94)	(21.54)	(17.91)
Stock dummy	No	No	No	No	No	Yes
Belong dummy	No	No	No	No	No	Yes
Status dummy	No	No	No	No	No	Yes
Size dummy	No	No	No	No	No	Yes
Regitype dummy	No	No	No	No	No	Yes
Constant	1.436***	-1.184***	0.466	1.484***	1.755***	0.513
	(5.50)	(-3.54)	(1.88)	(4.25)	(4.95)	(1.04)
lnsig2u	2.160***	2.143***	2.101***	2.099***	2.099***	1.814***
	(81.12)	(80.77)	(79.99)	(79.93)	(79.86)	(72.10)

sigma_u	2.944	2.919	2.859	2.856	2.856	2.477
rho	.8965686	.8949679	.8909957	.8908045	.8907757	.8598558
N	91841	91841	91841	91841	91841	91738

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level monthly minimum wage, fiscal expenditure, city area and human capital per person, respectively, institute refers to the province-level institute and com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 13: **The effect of minimum wage on firms' exporting sales in industry 18 (Tobit estimation) (2004-2007)**

lnexport	(1)	(2)	(3)	(4)	(5)	(6)
lnmminiwage	0.0110	-0.00331	-0.0251	-0.0260	-0.00601	-0.0850**
	(0.49)	(-0.15)	(-1.14)	(-1.18)	(-0.26)	(-3.19)
lptfp	0.0609**	0.0602**	0.0748***	0.0721***	0.0475*	-0.000395
	(3.21)	(3.28)	(4.09)	(3.93)	(2.48)	(-0.02)
lncityarea	0.0294*	0.00647	0.0266*	0.0210	0.0197	0.0229
	(2.31)	(0.50)	(2.09)	(1.61)	(1.51)	(1.78)
lnfisexp	0.0920***	0.0668***	0.0625***	0.0591***	0.0459***	0.0365**
	(8.12)	(5.72)	(5.41)	(5.06)	(3.87)	(3.11)
lnhumcapital	-0.0512***	-0.0627***	-0.0569***	-0.0594***	-0.0694***	-0.0513***
	(-3.56)	(-4.34)	(-3.96)	(-4.11)	(-4.78)	(-3.51)
div					-1.142***	-1.138***
					(-6.13)	(-6.32)
com	0.00110				0.00215**	0.00113
	(1.39)				(2.69)	(1.41)
urb		0.116***		0.0302	0.0538***	0.0160
		(9.11)		(1.92)	(3.33)	(1.00)
loc			0.0940***	0.0837***	0.0771***	0.0893***
			(12.80)	(9.19)	(8.42)	(9.83)
Stock dummy	No	No	No	No	No	Yes
Belong dummy	No	No	No	No	No	Yes
Status dummy	No	No	No	No	No	Yes
Size dummy	No	No	No	No	No	Yes
Regitype dummy	No	No	No	No	No	Yes
Constant	6.839***	5.904***	6.480***	6.282***	6.267***	7.669***
	(67.65)	(43.16)	(65.60)	(44.00)	(43.47)	(32.64)
sigma_u	1.099***	1.098***	1.096***	1.096***	1.096***	1.024***
	(155.61)	(155.60)	(155.50)	(155.50)	(155.51)	(149.11)

sigma_e	0.643***	0.643***	0.642***	0.642***	0.642***	0.640***
	(273.22)	(273.22)	(273.20)	(273.18)	(273.18)	(270.47)
rho	.7449709	.7448765	.7443162	.7444202	.7445646	.7191529
N	54505	54505	54505	54505	54505	54441

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level monthly minimum wage, fiscal expenditure, city area and human capital per person, respectively, institute refers to the province-level institute and com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 14: **The effect of minimum wage on firms' exporting choices in industry 43 (2004-2007)**

exportdum	(1)	(2)	(3)	(4)	(5)	(6)
lnmminiwage	-0.121	-0.0855	-0.398**	-0.313*	-0.338*	-0.271
	(-0.69)	(-0.50)	(-2.82)	(-2.17)	(-2.27)	(-1.82)
lptfp	0.0738	0.0693	0.353***	0.451***	0.456***	0.483***
	(0.63)	(0.60)	(4.47)	(5.52)	(5.58)	(6.75)
lncityarea	-1.029***	-1.135***	-0.979***	-0.469***	-0.397***	-0.109
	(-8.51)	(-8.72)	(-10.15)	(-4.49)	(-3.74)	(-1.14)
lnfisexp	0.298***	0.281***	0.262***	0.358***	0.380***	0.189***
	(3.80)	(3.63)	(4.32)	(5.72)	(6.07)	(3.33)
lnhumcapital	0.0446	0.0505	-0.182*	-0.291***	-0.322***	-0.309***
	(0.43)	(0.49)	(-2.16)	(-3.37)	(-3.71)	(-3.92)
div					3.955***	2.204**
					(4.21)	(2.69)
com	0.0102				-0.00350	-0.00131
	(1.85)				(-0.65)	(-0.25)
urb		0.173*		-0.839***	-0.858***	-0.710***
		(2.50)		(-12.77)	(-13.00)	(-11.71)
loc			0.745***	0.908***	0.920***	0.686***
			(29.86)	(30.94)	(31.06)	(25.25)
Stock dummy	No	No	No	No	No	Yes
Belong dummy	No	No	No	No	No	Yes
Status dummy	No	No	No	No	No	Yes
Size dummy	No	No	No	No	No	Yes
Regitype dummy	No	No	No	No	No	Yes
Constant	1.668*	-0.104	-2.087**	3.762***	3.231***	2.499*
	(1.96)	(-0.10)	(-3.06)	(4.55)	(3.80)	(2.47)
lnsig2u	2.532***	2.514***	2.046***	2.116***	2.112***	1.735***
	(39.71)	(39.68)	(36.00)	(37.26)	(37.16)	(30.59)

sigma_u	3.547	3.516	2.782	2.880	2.875	2.381
rho	.9263523	.9251512	.8855496	.8924338	.8920526	.8500354
N	18493	18493	18493	18493	18493	18448

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level monthly minimum wage, fiscal expenditure, city area and human capital per person, respectively, institute refers to the province-level institute and com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 15: **The effect of minimum wage on firms' exporting sales in industry 43 (Tobit estimation) (2004-2007)**

lnexport	(1)	(2)	(3)	(4)	(5)	(6)
lnmminiwage	-0.00800	-0.0116	-0.0336	-0.0352	-0.0410	-0.0621
	(-0.13)	(-0.19)	(-0.55)	(-0.58)	(-0.66)	(-0.96)
lptfp	0.107**	0.106**	0.124***	0.119***	0.115***	0.123***
	(3.15)	(3.14)	(3.62)	(3.46)	(3.33)	(3.62)
lncityarea	-0.0979*	-0.148***	-0.110**	-0.140**	-0.153***	-0.104*
	(-2.49)	(-3.43)	(-2.79)	(-3.25)	(-3.47)	(-2.36)
lnfisexp	0.114***	0.111***	0.118***	0.115***	0.112***	0.0815**
	(4.40)	(4.30)	(4.55)	(4.44)	(4.30)	(3.12)
lnhumcapital	-0.0362	-0.0317	-0.0441	-0.0385	-0.0328	-0.0334
	(-1.05)	(-0.91)	(-1.27)	(-1.11)	(-0.94)	(-0.96)
div					-0.481	-0.821
					(-1.12)	(-1.96)
com	0.00242				0.00268	0.00262
	(1.30)				(1.42)	(1.38)
urb		0.0687**		0.0450	0.0503	0.0411
		(2.95)		(1.74)	(1.93)	(1.57)
loc			0.0374**	0.0275*	0.0254	0.0128
			(3.18)	(2.12)	(1.94)	(0.98)
Stock dummy	No	No	No	No	No	Yes
Belong dummy	No	No	No	No	No	Yes
Status dummy	No	No	No	No	No	Yes
Size dummy	No	No	No	No	No	Yes
Regitype dummy	No	No	No	No	No	Yes
Constant	6.963***	6.334***	6.801***	6.467***	6.566***	7.079***
	(23.14)	(18.34)	(23.15)	(18.43)	(18.41)	(15.43)
sigma_u	1.114***	1.114***	1.113***	1.113***	1.112***	1.066***
	(79.77)	(79.78)	(79.76)	(79.76)	(79.71)	(77.04)

sigma_e	0.620***	0.620***	0.620***	0.620***	0.620***	0.624***
	(106.06)	(106.08)	(106.08)	(106.08)	(106.05)	(104.83)
rho	.7635341	.7633677	.7630685	.763076	.7629767	.7446366
N	10322	10322	10322	10322	10322	10305

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corresponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level monthly minimum wage, fiscal expenditure, city area and human capital per person, respectively, institute refers to the province-level institute and com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration.

Table 16: **GMM estimation of minimum wage on firm-level export (2004-2007)**

lnexport	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.lnexport	0.814***	0.817***	0.820***	0.821***	0.792***	0.775***	0.797***	0.781***
	(320.00)	(311.86)	(317.60)	(307.02)	(308.29)	(288.72)	(311.65)	(289.99)
L2.lnexport	0.00824**	0.0162***	0.00599*	0.0130***	-0.0167***	-0.0189***	-0.0148***	-0.0171***
	(3.05)	(5.81)	(2.23)	(4.66)	(-6.30)	(-6.94)	(-5.63)	(-6.31)
lptfp	-0.220***	-0.234***	-0.383***	-0.428***	0.0762*	0.170***	-0.0254	0.0396
	(-7.36)	(-8.34)	(-14.00)	(-16.23)	(2.51)	(5.74)	(-0.88)	(1.40)
L.lptfp	-0.105***	-0.105***	0.109***	0.0965***	-0.0142	0.0435	0.0990***	0.153***
	(-3.57)	(-3.79)	(4.01)	(3.70)	(-0.49)	(1.49)	(3.59)	(5.50)
lnmminiwage	-0.783***	-0.767***	-0.766***	-0.737***	0.0641	0.119*	0.184***	0.208***
	(-34.97)	(-34.04)	(-33.88)	(-32.50)	(1.19)	(2.01)	(3.53)	(3.62)
L.lnmminiwage					-1.023***	-1.144***	-1.008***	-1.184***
					(-16.36)	(-16.71)	(-16.30)	(-17.46)
	(-3.57)	(-3.79)	(4.01)	(3.70)	(-0.49)	(1.49)	(3.59)	(5.50)
loc	0.260***	0.274***	0.0649	0.0966*	0.282***	0.474***	0.158**	0.344***
	(4.92)	(5.18)	(1.42)	(2.06)	(5.19)	(8.12)	(3.12)	(6.31)
L.loc	-0.144**	-0.169***	0.0561	0.0169	-0.0953	-0.264***	0.0150	-0.140**
	(-2.85)	(-3.34)	(1.30)	(0.38)	(-1.82)	(-4.68)	(0.31)	(-2.67)
urb	1.532***	1.466***	1.271***	1.184***	1.779***	1.579***	1.464***	1.293***
	(22.41)	(21.20)	(20.98)	(19.17)	(25.27)	(21.11)	(22.49)	(18.78)
L.urb	-1.215***	-1.163***	-0.861***	-0.797***	-1.457***	-1.235***	-1.211***	-0.948***
	(-18.55)	(-17.48)	(-15.05)	(-13.55)	(-21.89)	(-17.47)	(-19.83)	(-14.65)
div	-1.750*	-1.557	-0.338	-0.0854	-0.0836	0.866	-1.115	0.204
	(-2.17)	(-1.87)	(-0.44)	(-0.10)	(-0.11)	(1.11)	(-1.53)	(0.27)
L.div	1.623	1.475	0.347	0.00222	-0.147	-1.340	1.041	-0.513
	(1.91)	(1.69)	(0.42)	(0.00)	(-0.18)	(-1.66)	(1.37)	(-0.66)
com	0.00364***	0.00317***	0.00206*	0.00211**	0.00612***	0.00510***	0.00582***	0.00539***

	(4.15)	(3.84)	(2.44)	(2.61)	(6.78)	(5.61)	(6.52)	(5.97)
L.com	0.00833***	0.00782***	0.00612***	0.00586***	0.0115***	0.0105***	0.0109***	0.0100***
	(10.01)	(9.84)	(7.53)	(7.49)	(13.17)	(12.04)	(12.72)	(11.58)
lncityarea	-0.142***	-0.134***	-0.124***	-0.123***	-0.0393**	-0.0360**	-0.0258*	-0.0247
	(-11.08)	(-10.67)	(-10.05)	(-10.12)	(-3.08)	(-2.75)	(-2.06)	(-1.93)
lnfisexp	-0.0180	-0.00395	-0.0116	0.00382	0.0329**	0.0424***	0.0120	0.0528***
	(-1.80)	(-0.39)	(-1.21)	(0.39)	(3.02)	(3.95)	(1.12)	(4.90)
lnhumcapital	-0.00462	-0.0233	0.0421*	0.00968	-0.283***	-0.332***	-0.273***	-0.320***
	(-0.26)	(-1.34)	(2.40)	(0.56)	(-16.16)	(-18.82)	(-16.05)	(-18.51)
popurban		-0.0534		-0.108**		-0.466***		-0.509***
		(-1.36)		(-2.81)		(-12.33)		(-13.64)
lnharbor			0.534*	0.574*			0.442	0.725**
			(2.20)	(2.41)			(1.58)	(2.66)
L.lnharbor			-0.383	-0.444			-0.517	-0.693*
			(-1.58)	(-1.87)			(-1.85)	(-2.55)
Regitype dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.761***	0.831***	-1.845***	-1.496***	1.385***	1.683***	2.099***	1.003***
	(4.90)	(5.37)	(-5.79)	(-4.58)	(8.77)	(10.51)	(8.63)	(3.94)
AR(1)	-92.327	-89.854	-92.436	-90.09	-93.888	-90.698	-93.859	-91.417
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
AR(2)	-0.93171	-1.8249	-0.90054	-1.7104	4.0298	4.7685	3.6695	4.3289
	(0.3515)	(0.0680)	(0.3678)	(0.0872)	(0.0001)	(0.0000)	(0.0002)	(0.0000)
AR(3)	1.4043	1.2672	1.3058	1.1525	0.3144	0.00334	0.19814	-0.11702
	(0.1602)	(0.2051)	(0.1916)	(0.2491)	(0.7532)	(0.9973)	(0.8429)	(0.9068)
Sargan Test	12797.63	12559.83	13324.77	12971.87	14417.27	13677.6	14879.59	14135.01
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
N	964732	936357	959061	930686	959061	930686	959061	930686

Note: The value in "[]" is the "t-statistics" of the corresponding estimated value. "***", "**", "*" represent, respectively, that the corre-

sponding estimated value are significant at 1%, 5% and 10%, respectively. Lptfp is the firm-level total factor productivity estimated with the LP method, lnmminiwage, lnfisexp, lncityarea and lnhumcapital represent the logarithm of county-level monthly minimum wage, fiscal expenditure, city area and human capital per person, respectively, institute refers to the province-level institute, harbor is the distance of the city to the nearest harbor, popurban is the population in the city, and com, div, urb and loc represent for, respectively, the effect of competition, diversity, urban economy and local specialization caused by agglomeration. $L.x$ represents for the first-order lag of variable x.