
**IFPRI Discussion Paper 01558**

**September 2016**

# Have Chinese Firms Become Smaller?

## If So, Why?

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## INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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## ABSTRACT

Normally as an economy develops, firm sizes increase. However, as measured by the employment rate, the firm size in China declined from 2004 to 2008. In this paper, we develop a structural dynamic model with heterogeneous workers to study the relative contributions of three factors to declining firm size: rising real wages, implementation of minimum wages, and the introduction of a new national labor contract law. While rising wages make a sizeable contribution, we find that the new labor law plays a dominant role in solving the puzzle. In comparison, the impact of minimum wages is more muted.



**Keywords: firm size, rising wages, labor law, minimum wage, China**

## ACKNOWLEDGMENTS

We are thankful for the helpful comments of Pol Antras, Loren Brandt, Carsten A. Holz, Kjetil Storesletten, Robert M. Townsend, Shang-jin Wei, and seminar participants at Peking University. Financial supports from the Natural Science Foundation of China (Approval numbers 71441008, 71341002, and 71350002) and the key research base of China Ministry of Education (14JJD790027) are gratefully acknowledged.

# 1. INTRODUCTION

Large firms normally have innovation advantage in capital-intensive sectors (Acs and Audretsch 1987). As an economy develops, the share of capital-intensive industries goes up, providing an opportunity for large firms to thrive. Not surprisingly, firm size tends to increase with economic development. However, according to two economic censuses conducted in China in 2004 and 2008, firm size as measured by employment has declined, in contrast to the historical patterns of increasing size observed in developed countries (Cabral and Mata 2003). The question arises: why have firms in China become smaller?

There are at least three possible factors contributing to this trend. First, rising real wages have induced firms to invest more in capital to cope with increasing labor shortages. Second, China has implemented a minimum wage, which imposes a heavy burden on employers. This has made companies more hesitant about hiring unskilled workers. Third, in 2007 China enacted a seemingly rigid labor contract law in an attempt to more effectively protect workers' interests. This law may create additional costs to firms and prevent them from growing.

In this paper, we develop a structural dynamic model with heterogeneous workers to quantify the relative contributions of these three factors. We find that while rising wages contributed to 36 percent of the total decline in employment from 2004 to 2008, the new labor law accounted for roughly 57 percent of the decline in firm size. By comparison, the contribution of the minimum wage was more limited, explaining less than 7 percent of the decline.

Our paper contributes to several strands of the literature. First, it examines the relationship between the minimum wage and employment. Findings in this area of the literature are mixed. While some studies have shown that an increase in minimum wages reduces employment (van Soest 1994; Baker et al.1999; Alaniz, Gindling, and Terrell 2011; Fang and Lin 2013), others have found that rising minimum wages help to generate employment (Steward 2004; Dickens 2005; Draca 2006; Dube, Lester, and Reich 2010; Allegretto, Dube, and Reich 2011). Our paper finds only a minuscule impact of minimum wages on employment.

Second, our paper is associated with the literature evaluating the impact of labor market regulations, which yields inconclusive findings. Some (Timothy Besley and Robin Burgess 2004) found that rigid labor market regulations hinder the growth of middle-sized firms. Yet, another study shows that the impact is minimal thanks to the difficulty in implementing labor laws in developing countries (Betcherman 2014). Our results are more consistent with the findings of (Besely and Burges 2004)—namely, that labor market regulation inhibits growth in firm size. One key difference is that China's new labor contract law reduces employment regardless of firm size, while in India the effect of labor market regulations is more pronounced for micro and small enterprises.

Third, our paper contributes to the literature on the "missing middle" in developing countries. This term refers to the failure of microenterprises to grow into small and medium-sized enterprises (Tybout 2000). In the case of China, the problem of the "missing middle" is largely absent, consistent with Hsieh (2014).

Although a number of studies have investigated the impact of one or another of the three factors on firm size, none has simultaneously examined the relative importance of all three factors on firm size distributions. To our knowledge, our paper is the first to disentangle the three contributions in an integrated framework. In addition, we have distinguished firms by ownership (state-owned, private, and foreign) in our main analysis to consider ownership heterogeneity.

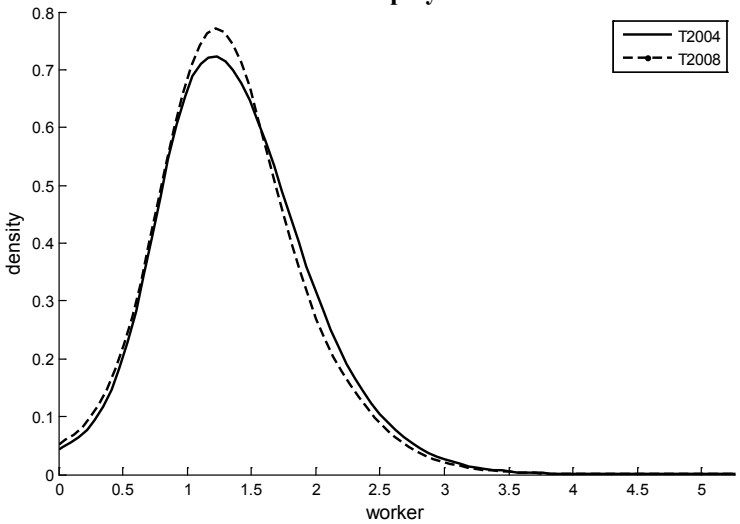
The paper is organized as follows. Section 2 begins by documenting the pattern of declining firm size in China and introduces background information on rising wages, minimum wages, and the new labor contract law. Section 3 develops a structural dynamic model that allows us to separate the effect of rising wages, minimum wages, and the new labor law. Section 4 reports the estimations of the structural model and quantifies the relative contributions of the three factors. Section 5 concludes the paper.

## 2. THE TREND OF DECLINING FIRM SIZE AND THREE POSSIBLE CAUSES

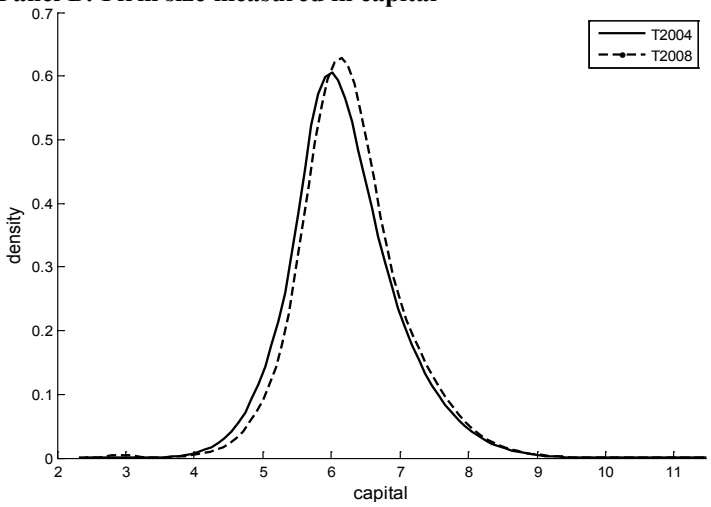
According to the China economic censuses of 2004 and 2008, firm sizes as measured by employment have declined, despite a remarkable annual growth rate of 9 percent in per capita GDP during the period. As shown in Figure 2.1, the curve of firm size distribution has systematically moved leftward from 2004 to 2008. In particular, larger firms have witnessed a more noticeable decline in size during this period. Moreover, the figure does not exhibit the "missing middle" phenomenon as discussed in Tybout (2000), in accordance with the more recent findings of (Chang-tai Hsieh 2014).

**Figure 2.1 Firm size distribution measured by employment and capital in 2004 and 2008**

**Panel A: Firm size measured in employment**




**Panel B: Firm size measured in capital**




Source: Authors.

Notes: Plotted by authors based on the China economic censuses conducted in 2004 and 2008. Capital stock in 2008 is deflated by the fixed-asset price index at the provincial level to the 2004 price level. The kernel density method is used to estimate the distribution curve with band width=0.2 and normal kernel. The K-S test indicates that the difference of firm-size distribution between the two periods is statistically significant with p=0.000.

Table 2.1 presents the average firm sizes as measured by employment and ownership capital, based on the China economic censuses of 2004 and 2008, respectively. State-owned enterprises (SOEs) enjoyed many subsidies from the government, such as low-interest loans from state banks, but they also had to provide more social-welfare services for employees than did private firms. Before the SOE reform in the late 1990s, SOEs rarely laid off workers. In addition, many SOEs provided employees with public housing and other fringe benefits, making workers reluctant to change jobs. After the reform, SOEs gained greater autonomy to lay off workers. But when doing so, many of them still faced pressure from the government. In general, SOEs are subject to less market competition than private and foreign-owned firms. Many foreign firms originated in developed economies. Their hiring decisions may be influenced by the labor laws of these countries. Compared to SOEs and foreign firms, private firms face more credit constraints. Given the large differences among the three types of firms, Table 2.1 presents the summary statistics by ownership.

**Table 2.1 Average firm employment and capital by type in 2004 and 2008**

| | Employment | | | | Capital | | | |
|---|---|---|---|---|---|---|---|---|
| **Firm type** | **2004** | **2008** | **Change from 2004 to 2008** | **p value of t-test for the difference** | **2004** | **2008** | **Change from 2004 to 2008** | **p value of t-test for the difference** |
| **Total** | 3.224 | 3.125 | -0.099 | 0.000 | 5.071 | 5.324 | 0.253 | 0.000 |
| Foreign firms | 4.355 | 4.352 | -0.004 | 0.660 | 7.078 | 7.401 | 0.323 | 0.000 |
| SOEs | 4.543 | 4.030 | -0.513 | 0.000 | 7.199 | 6.703 | -0.496 | 0.000 |
| Domestic private firms | 3.158 | 3.070 | -0.088 | 0.000 | 4.956 | 5.232 | 0.276 | 0.000 |
| Labor-intensive firms | 3.227 | 3.104 | -0.123 | 0.000 | 5.092 | 5.292 | 0.200 | 0.000 |
| Capital-intensive firms | 3.222 | 3.146 | -0.076 | 0.000 | 5.053 | 5.354 | 0.302 | 0.000 |
| **Firms established in the past two years** | | | | | | | | |
| Total | 3.012 | 2.873 | -0.138 | 0.000 | 4.707 | 4.867 | 0.160 | 0.000 |
| Foreign firms | 3.978 | 3.803 | -0.175 | 0.000 | 6.378 | 6.634 | 0.256 | 0.000 |
| SOEs | 4.315 | 4.189 | -0.126 | 0.199 | 6.828 | 6.909 | 0.082 | 0.571 |
| Domestic private firms | 2.973 | 2.850 | -0.123 | 0.000 | 4.640 | 4.823 | 0.182 | 0.000 |
| Labor-intensive firms | 2.986 | 2.821 | -0.165 | 0.000 | 4.606 | 4.735 | 0.129 | 0.000 |
| Capital-intensive firms | 3.036 | 2.934 | -0.102 | 0.000 | 4.802 | 5.020 | 0.218 | 0.000 |
| **Firms established more than two years ago** | | | | | | | | |
| Total | 3.294 | 3.176 | -0.118 | 0.000 | 5.190 | 5.417 | 0.227 | 0.000 |
| Foreign firms | 4.464 | 4.413 | -0.052 | 0.000 | 7.279 | 7.486 | 0.207 | 0.000 |
| SOEs | 4.551 | 4.023 | -0.528 | 0.000 | 7.212 | 6.693 | -0.518 | 0.000 |
| Domestic private firms | 3.220 | 3.116 | -0.104 | 0.000 | 5.062 | 5.318 | 0.256 | 0.000 |
| Labor-intensive firms | 3.313 | 3.168 | -0.145 | 0.000 | 5.266 | 5.419 | 0.153 | 0.000 |
| Capital-intensive firms | 3.279 | 3.185 | -0.095 | 0.000 | 5.129 | 5.416 | 0.286 | 0.000 |

Source: Authors.

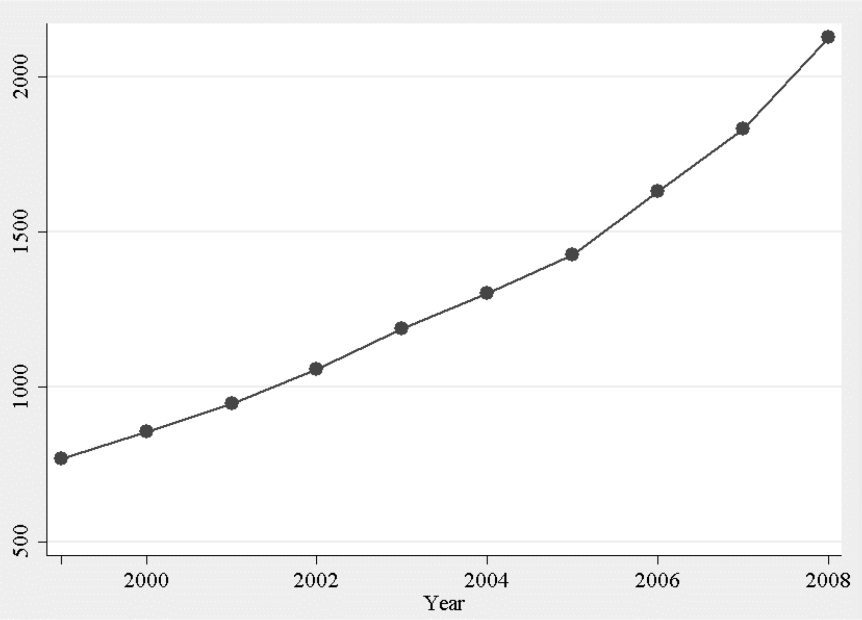
Notes: SOE = state-owned enterprises. Calculated by authors based on China economic censuses conducted in 2004 and 2008. Employment and capital are expressed in natural logarithm. For the labor- and capital-intensive firms, we focus only on the non- SOE firms, since the decision of inputs like capital and employment for SOE is largely influenced by the political factors in China.

As shown in the first row, the average number of workers per firm declined from 25 to 23 in the period. A *t*-test indicates that the average firm sizes in the two periods are statistically different. The drop in firm size varies across different types of firms. While domestic firms, particularly, SOEs, have cut the number of workers from 94 to 56, the average number of workers per foreign firm barely changed. Labor-intensive enterprises have reduced employment more dramatically than capital-intensive ones.

In contrast to the contraction of employment, the average capital per firm has increased by more than 25 percent. In 2004, on average, SOEs were larger than foreign firms in terms of capital stock. But by 2008, an average foreign firm was about 70 percent larger than a typical SOE. Apparently, foreign firms accumulated capital much faster than SOEs during this period. An examination of newly established firms in the past two years reveals that SOEs were actually bigger than foreign firms in both 2004 and 2008. However, within established firms, there was a sharp contrast. While the capital of foreign firms grew by more than 20 percent, the capital of an average SOE shrunk by more than 50 percent.

At least three factors contributed to declining firm size. First, rapidly rising real wages may have been a key driving force. Since 2003–2004, the annual growth rate of real wages has accelerated to more than 10 percent (Zhang, Yang, and Wang 2011). Figure 2.2 displays the trend of real wages from 1998 to 2008 based on the Annual Survey of Industrial Enterprises in China (ASIEC). This trend indicates that the growth of real wages has accelerated since the mid-2000s. As wages go up, firms are likely induced to invest in labor-saving technologies to substitute for labor (Tan and Zhang 2016).

**Figure 2.2 Real wages (yuan/month) from 1998 to 2008**

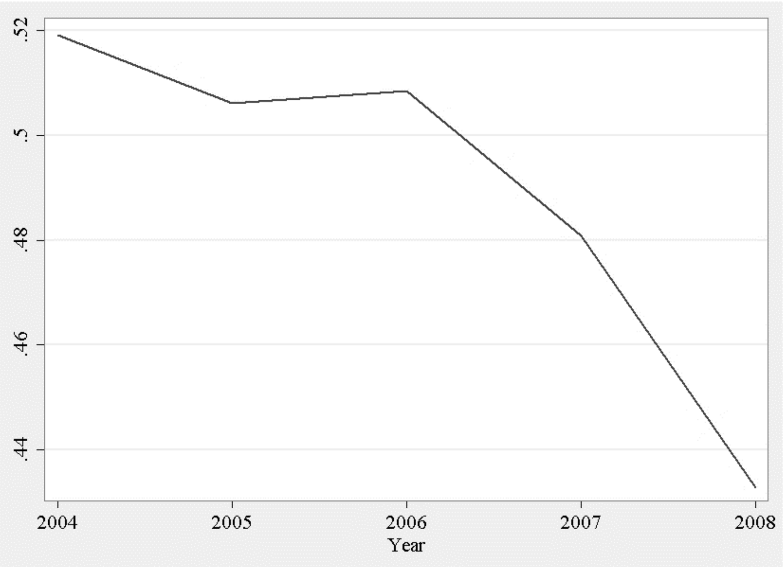



Source: Authors.

Notes: The real wage was calculated by the authors based on the price index from the National Bureau of Statistics using 1998 as the base year and the nominal wage from the Annual Survey of Industrial Enterprises in China.

The second contributing factor in the decrease of firm size is the implementation of minimum wages by local governments. Under the minimum wage regulation, firms are obligated to pay workers at or above the local minimum wage. This creates additional costs for firms that pay workers below the minimum wage. Figure 2.3 plots the ratio of minimum wages to market wages by year. The trend has steadily declined over time, suggesting that minimum wages have become less of a burden to firms over time.

**Figure 2.3 Ratio of minimum wage to market wage over time**




Source: Authors.

Notes: Plotted by the authors using the minimum wage from the CEIC database and the wages at firm level from the Annual Survey of Industrial Enterprises in China. Due to a lack of data on the minimum wage for earlier years, we plot the trend from 2004 to 2008 only.

Table 2.2 presents the distribution of firms according to the ratio of wages to minimum wages for all observations from 2004 to 2008. P10 refers to those firms whose average wages are higher than local minimum wages by less than 10 percent. P20 denotes firms in which the ratio of wages to minimum wages falls in the interval [1.1, 1.2]. P50, P100, P200, and P200+ are defined similarly. A total of 86 percent of foreign firms and 75 percent of domestic firms pay their workers at least twice the minimum wage. Table 2.2 and Figure 2.3 reveal that minimum wages affect only a small number of firms.

**Table 2.2 Distribution of firms by the ratio of market wages to minimum wages and by ownership**

| Market wages are higher than minimum wages by | | | | | | | |
|---|---|---|---|---|---|---|---|
| Variable | 10% (P10) | 20% (P20) | 50% (P50) | 100% (P100) | 200% (P200) | >200% P(200+) | Observations |
| SOEs | 9.78 | 2.51 | 9.12 | 15.38 | 23.5 | 39.7 | 73,603 |
| Private | 7.01 | 3.20 | 14.8 | 27.2 | 27.0 | 20.8 | 1,202,747 |
| Foreign | 4.18 | 1.76 | 8.57 | 20.5 | 31.4 | 33.7 | 316,641 |
| Overall | 6.57 | 2.88 | 13.3 | 25.3 | 27.7 | 24.2 | 1,593,487 |

Source: Authors.

Notes: SOE = state-owned enterprises. Calculated by authors based on Annual Survey of Industrial Enterprises in China (ASIEC) and CEIC database (web site: http://www.ceicdata.com/en) from 2004 to 2008; information on minimum wage before 2004 is unavailable.

The third likely factor in the drop in firm size is the enactment of the new labor contract law passed in 2007 and implemented in early 2008. Under the new law, a worker will automatically hold an open-end contract after working for a firm for more than two years. The new law mandates that if a firm lays off workers who hold open-end contracts, it must pay them additional compensation in proportion to their wages. Thus, the new labor law makes it more difficult for a firm to dismiss workers and makes it more cautious about hiring new employees. Intuitively, the extent to which a firm is subject to the new labor contract law depends largely on the likelihood of the firm laying off workers in the future and the strictness of local governments about enforcing the law.

## 3. DYNAMIC STRUCTURAL MODEL

### Basic Setup of the Model

We used the Bellman Equation to develop a structural dynamic model, enabling us to decompose the decline in firm size into three components: rapidly rising real wages, challenges in meeting the requirement of local minimum wages, and strictness of local governments about enforcing the new labor law.

Following the seminal work of Olley and Pakes (1996) and of Levinsohn and Petrin (2003), we assume that a firm faces three state variables $(a_t, k_t, \Omega_t)$, representing firm age, capital stock, and the firm-specific productivity shock observable to entrepreneurs but not econometricians. Given the state variables, at the beginning of each period, a firm faces two choices: exit the market for ever and sell its assets or stay in the market. If a firm decides to remain in business, it has to choose the desired level of variable inputs, such as labor and intermediate inputs, and the level of investment based on the current state variables, technology, and expectations.

While the traditional dynamic models normally assume that workers are homogeneous, in this paper we take workers' heterogeneity explicitly into account to identify the differential effects of minimum wages on workers with different sets of skills and abilities. Our model assumes that a firm employs a spectrum of workers with varying degree of abilities and skills in its production process. Specifically, a firm of type $z$ hires $l$ workers in production, we assume the number of workers with ability or skill $\tilde{z}$ to be $ldG(\tilde{z} \mid z)$, where $G(\tilde{z} \mid z)$ is a probability distribution function with respect to the skill $\tilde{z}$ conditional on firm type $z$.[1] We define a firm as type $z$ if $z \equiv \int \tilde{z} dG(\tilde{z} \mid z)$. It is essentially a firm's average skill.

A firm's effective labor use (skill-adjusted labor use) is:

$$zl \equiv l \int \tilde{z} dG(\tilde{z} \mid z) \tag{1}$$

We further assume that $G(\tilde{z} \mid z)$ depends only on the ratio $\tilde{z}/z$; that is, $G(\tilde{z} \mid z)$ is invariant to scaling or stretching transformation with respect to $(\tilde{z}, z)$.[2] Specifically, we also assume that $G(\tilde{z} \mid z = 1)$ has a support $\left[\underline{z}, \bar{z}\right]$.

We denote the wage paid to a worker with one unit of skill in the absence of minimum wage as $w$, minimum wage set up by government as $w_m$, and the ability of a worker who earns only the minimum wage in an unregulated market as

$$z_m = \frac{w_m}{w} \tag{2}$$

As a result, a firm hiring a worker with ability $\tilde{z}$ has to pay

[1] Here, if we simplify $dG(\tilde{z} \mid z)$ into a Dirac measure $\delta(\tilde{z} - z)$, then our assumption collapses into the usual one that firms hire only one type of worker with skill $z$. We can extend our model to include multiple dimensions of ability. However, due to data limitation, we focus on one dimension of ability—salary compensation.

[2] This assumption appears to be stringent. For example, a garment factory may pay all its workers slightly above the minimum wage, while another company, such as Google, pays high wages to programmers but low wages (below minimum) to janitors. In our empirical part, we allow for industry fixed effects. Within the same industry, the assumption is more plausible. Therefore, after controlling for industry fixed effects, the assumption is more reasonable.

$$w\tilde{z} + w\tilde{z}\max\left\{0, \frac{z_m}{\tilde{z}} - 1\right\}, \tag{3}$$

where $w\tilde{z}$ is the equilibrium wage rate for a worker with ability $\tilde{z}$ ; $\max\left\{0, \frac{z_m}{\tilde{z}} - 1\right\}$ is the proportion of additional wages paid by employers to satisfy the regulation of minimum wage.

The average wage paid by a firm with type $z$ can be written as

$$\bar{w} = w\int \tilde{z}\max\left\{1, \frac{z_m}{\tilde{z}}\right\} dG\left(\tilde{z} \mid z\right) = zw + zwh(z_m / z). \tag{4}$$

In the bracket of the last part of equation (4), the first part $zw$ stands for wages of homogeneous workers with skill $z$ in the absence of minimum wage regulations. The second part $zwh(z_m/z)$ captures the additional wage cost incurred to firms due to the introduction of minimum wages. $h(\bullet)$ is a monotonic function of the ratio $z_m/z$ . Conditional on the form of distribution G, firms with a larger proportion of workers paid at or below minimum wage, that is, at a higher value of $z_m/z$ , will bear higher wage costs when minimum wage regulations are introduced and enforced.

Once we allow for worker heterogeneity, the average wage per effective labor paid by a type-$z$ firm would be a function of $z_m/z$ , which in turn is a function of $w_m/\bar{w}$ .[3]

### Dynamic Programming

A firm's dynamic profit maximization can be written as

$$V\left(a_t, k_t, \Omega_t; \frac{z}{z_m}\right) = \max\left\{S_t, \max_{l_t, m_t, i_t} \pi_t - c(i_t) - p_{m,t}m_t + \beta E(V_{t+1}(a_{t+1}, k_{t+1}, \Omega_{t+1}; \frac{z}{z_m}) \middle| \mathsf{F}_t)\right\}$$

$$\pi_t = F(a_t, k_t, \Omega_t; zl_t, m_t) - zl_t w_t(1 + \bar{w}(z_m / z)), \tag{5}$$

Where $V(\bullet)$ is the value function, depending on the state variables $(a_t, k_t, \Omega_t; z/z_m)$ , and $c(i)$ and $p_{m,t}m_t$ are the costs of investment and intermediate input. $\pi_t$ refers to the net revenue after wages are paid, and $S_t$ stands for the benefit of exiting the market. To identify the effect of the new labor contract law passed in the middle of 2007, we need to take into account the expected

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[3] From equation (2), we have relationship

$$\frac{z_m}{z} = \frac{w_m}{zw}.$$

Combining equation (4) and canceling the term $zw$ , we can get an equation between the terms $z/z_m$ and $\bar{w}/w_m$ , that is,

$$\frac{\bar{w}}{w_m} = \frac{1 + h(z_m/z)}{z_m/z} = \frac{z}{z_m} + \frac{z}{z_m}h(z_m/z) \square \frac{z}{z_m} + M\left(\frac{z_m}{z}\right)$$

In the appendix, we also present a sufficient condition under which the unobservable term $z/z_m$ can be expressed as a function of the observable term $\bar{w}/w_m$ .

additional cost of laying off workers in the future by expanding the value function in the next period as

$$V_{t+1}(a_{t+1},k_{t+1},\Omega_{t+1};\frac{z}{z_m})=\max\left\{S_{t+1},\max_{l,m,i}\left(\pi_{t+1}-c_{nll}-c_m\left(m_{t+1}\right)+\beta E(V_{t+2}(a_{t+2},k_{t+2},\Omega_{t+2};\frac{z}{z_m})\middle|\mathsf{F}_{t+1}\right)\right)\right\}.$$

The additional cost to firms that need to lay off workers after the implementation of the new labor law is:

$$c_{nll}=\theta I_{nll}w_t(l_t-l_{t+1})I\left(l_t>l_{t+1}\right)\int\max\left\{1,{}^{z_m}\!/_{\tilde{z}}\right\}\tilde{z}dG(\tilde{z}\mid z) \quad (6)$$

$I(\bullet)$ is an indicator function, being 1 if the condition inside the bracket is true and 0 otherwise; $I_{nll}$ is an indicator variable with value 1 after the new labor law came into effect and 0 otherwise. In the subsequent empirical identifications, we set it at 1 for observations in 2007 and 2008 and 0 otherwise. Given the state variables($a_t$, $k_t$, $\Omega_t$) and the information set $\mathsf{F}_t$ by period *t*, a firm chooses the appropriate level of employment and intermediate inputs to maximize profit. The demand for workers can be written as:4

$$zl_t=\varphi\left(k_t,a_t,\Omega_t;w_t\left[1+\beta\theta I_{nll}P\left(l_t\prec l_{t+1}\mid\mathsf{F}_t\right)\right]\int\frac{\tilde{z}}{z}\max\left(1,{}^{z_m}\!/_{\tilde{z}}\right)dG(\tilde{z}\mid z)\right), \quad (7)$$

where parameter $\theta$ stands for the effectiveness of the new labor law.

For a Cobb-Douglas production function, after taking the log on both sides of equation (7), the following equation can be derived:

$$\log(l_t)=\beta_w\log(w_t)+\phi_{mw}\left(\frac{z}{z_m}\right)+\phi_{nll}+\varphi_0\left(a_t,k_t\right)-\log(z), \quad (8)$$

where

$$\phi_{mw}=\beta_{mw}\log(1+\int\frac{\tilde{z}}{z}\max\left(0,\frac{z_m}{\tilde{z}}-1\right)dG(\tilde{z}\mid z))$$

$$\phi_{nll}=\beta_{nll}\log(1+\beta\theta P\left(l_t\prec l_{t+1}\mid\mathsf{F}_t\right))$$

$$\varphi_0\left(a_t,k_t\right)=\beta_a a_t+\beta_k\log k_t+\tilde{\Omega}_t.$$

4 This is true if we assume there is some friction involved in hiring and firing workers, even without the implementation of the new labor law. For example, a firm may have to spend some time to find workers to replace the dismissed employee, which will create additional costs. As a result, the firm will take this additional cost into account when deciding to fire workers. If we assume this cost is proportional to the wage paid to workers, then the demand for labor will be slightly different. This can be written as

$$zl_t=\varphi\left(k_t,a_t,\Omega_t;w_t\left[1+\beta\left(\theta_0+\theta I_{nll}\right)P\left(l_t\prec l_{t+1}\mid\mathsf{F}_t\right)\right]\int\frac{\tilde{z}}{z}\max\left(1,{}^{z_m}\!/_{\tilde{z}}\right)dG(\tilde{z}\mid z)\right),$$

where $\theta_0$ is the cost of finding new employees or the friction that results from hiring and firing workers.

Based on equation (8), we can decompose the causes behind the decline in employment into three components: rising wages, minimum wages, and the introduction of the new labor law. These three components correspond to the first, second, and third items, respectively, in equation (8). Log (z) represents fixed effects at firm level, and $\tilde{\Omega}_t$ is equivalent to $\Omega_t$ because the only difference between them is a constant.

## Decomposition

### *Effects of the New Labor Law*

In equation (8), the effect of the new labor law depends on the probability of a firm laying off workers in the future. This can be written as a product of two terms: the chance of staying in business in the next period, which is conditional on the current information set, and the probability of cutting employment, which is conditional on the current information and survival in *t*+1. That is,

$$P\left(l_t \prec l_{t+1} \mid \mathsf{F}_t\right) = P\left(l_t \prec l_{t+1} \mid \mathsf{F}_t, \chi_{t+1} = 1\right) \mathrm{P}\left(\chi_{t+1} = 1 \mid \mathsf{F}_t\right) \tag{9}$$

where the sign "$\prec$" means smaller. The survival likelihood in period *t*+1 depends on the initial capital, age, and productivity shock $\Omega_{t+1}$, and $z/z_m$, which in turn relies on the current state variable and $\overline{w}/w_m$.[5] Similarly, employment size also depends on the state variables in the next period, which are shaped by the current state variables (Olley and Pakes 1996).

Following the equation, we can estimate the probability of exit, of staying in business, and of adjusting employment by using the polynomial expansion of $\left(a_t, k_t, m_t\right)$ and the ratio of average wages to minimum wages. In the subsequent empirical part, we adopted two estimate methods: expanding $\left(a_t, k_t, m_t\right)$ by neglecting labor heterogeneity and expanding $\left(a_t, k_t, m_t; \overline{w}/w_m\right)$ by taking into account worker heterogeneity, that is, $\overline{w}/w_m$. Based on the two estimates, the probability of laying off workers $\widehat{P}\left(l_t \prec l_{t+1} \mid \mathsf{F}_t\right)$ can be derived.

Since both parameters $\beta$ (discount rate of profit) and $\theta$ (the ratio of total wages paid to laid off workers) are less than 1, it is relatively accurate to use linear approximation to estimate the new labor term.

$$\beta_{nll} \log(1 + \beta\theta P\left(l_t \prec l_{t+1} \mid \mathsf{F}_t\right)) \approx \beta_{nll} P\left(l_t \prec l_{t+1} \mid \mathsf{F}_t\right) \tag{10}$$

Here, to simplify the notation of the coefficients, we still use $\beta_{nll}$ on the right to represent the multiplication $\beta_{nll}\beta\theta$.

### *Effects of the Minimum Wage*

It is obvious from equation (4) that the effect of minimum wage exists only if a firm pays workers below the minimum wage. The larger the proportion of workers eligible for the minimum wage is, the larger the burden for the firm to meet the minimum wage requirement.

[5] This ratio can be expressed as a function of $\overline{w}/w_m$ according to equations (1) and (2).

Given the assumption that $G(\tilde{z} \mid z)$ only depends on the ratio $\tilde{z}/z$, we have

$$\int \frac{z_m - \tilde{z}}{z} I_{(z_m > \tilde{z})} dG(\tilde{z} \mid z) = H\left(\frac{\overline{w}}{w_m}\right). \tag{11}$$

Here $\overline{w}$ is the average wage for each employee of the firm, and $H(\bullet)$ is a monotonic decreasing function, which is determined by the specific form of $G(\tilde{z} \mid z)$. We use a quantile regression to estimate the effects of the minimum wage. Specifically, we define a set of categorical variables to indicate the distance between a firm's average wage and the local minimum wage. The following equation is estimated:

$$\phi_{mw} = \beta_{mw,10} I_{p10} + \beta_{mw,20} I_{p20} + \beta_{mw,50} I_{p50} + \beta_{mw,100} I_{p100} + \beta_{mw,200} I_{p200}. \tag{12}$$

### Unobservable Shocks

Similarly to the pioneering work done by Olley and Pakes (1996) and Levinsohn and Petrin (2003), we assume that $\Omega_t$ follows a first-order Markov Process and uses material inputs as a proxy for the productivity shock. However, we should be cautious in that the choice of materials inputs also depends on ratio $z/z_m$, which captures the interaction between workers' heterogeneity and the minimum wage regulation, though the ratio becomes negligible when $z$ is much larger than $z_m$. Specifically,

$$m_t = m(\Omega_t; a_t, k_t, w/w_m).$$

If just using the material input $m_t$ as a proxy of the observable shock and using the polynomial expansion of $(m_t, a_t, k_t, w/w_m)$ to estimate $\Omega_t$, it is impossible to separate the effect of the minimum wage term using equation (8).

We use investment, another proxy variable, suggested by Olley and Pakes (1996), to cancel the term $w/w_m$. Accordingly, the productivity shock can be expressed as:

$$\Omega_t = \Omega(m_t, i_t; a_t, k_t).$$

In the empirical analyses, we also report the estimates using a polynomial expansion of $(m_t; a_t, k_t)$, which ignores the effect of workers' heterogeneity. The results are robust to the alternative specification.

## 4. EMPIRICAL ESTIMATIONS

Based on the structural model outlined in the last section, we use the following empirical specification:

$$\log(l_t) = \beta_w \log(w_t) + \phi_{mw} + \beta_{nll} P(l_t \prec l_{t+1} \mid \mathsf{F}_t) I_{nll} + \varphi_0(a_t, k_t, \Omega_t) + FE + \varepsilon_t, \quad (13)$$

where

$$\phi_{mw} = \beta_{mw,10} I_{p10} + \beta_{mw,20} I_{p20} + \beta_{mw,50} I_{p50} + \beta_{mw,100} I_{p100} + \beta_{mw,200} I_{p200},$$

$$P(l_t \prec l_{t+1} \mid \mathsf{F}_t) = P(l_t \prec l_{t+1} \mid \mathsf{F}_t, \text{survive in t+1}) P(\text{survive in t+1} \mid \mathsf{F}_t),$$

$$\varphi_0(a_t, k_t, \Omega_t) = \beta_a a_t + \beta_k k_t + \Omega_t,.$$

Here $I_{nll}$ is defined as 1 if the year is 2007 or 2008 and 0 otherwise. The first three terms in equation (13) stand for the contributions of rising wages, minimum wages, and the new labor law.

We present several alternative specifications to verify the robustness of our results. First, we neglect the effect of labor heterogeneity on the exit decision and material inputs of the firm. We estimate exit rates, probability of reducing labor force, and $\varphi_0(a_t, k_t, \Omega_t)$ using a polynomial expansion of $(a_t, k_t, m_t)$, similar to that used by Levinsohn and Petrin (2003). Second, we take worker heterogeneity into account by using the polynomial expansions of $(a_t, k_t, m_t; \overline{w}/w_m)$ to estimate the probability of exit and laying off workers.

After obtaining these estimates, we use the expansion of $(a_t, k_t, m_t; i_t)$ to estimate the term $\varphi_0(a_t, k_t, \Omega_t)$. Our results are robust regardless of whether we consider labor heterogeneity.

Finally, to reduce the measurement errors resulting from the use of the year dummy of 2008 to proxy the implementation of the new labor law, we also report our results based on different subsamples. We draw on two approaches to address the concern that the year dummy may capture the effect of the global financial crisis in 2008. First, we use a subsample of firms that did not export. Second, we drop year 2008 from the sample as a robustness check. In both cases, the main results hold.

We use three steps to estimate the contributions of the three factors related to the decline in firm size. The first step is to estimate the exit rate, or survival rate, of firms in each period using a probit model. Following Levinsohn and Petrin (2003), we take a second-order polynomial expansion of the triplets $(a_t, k_t; m_t)$ to approximate the probability of exit. Considering that firms' survival and performance are often closely tied to ownership, we estimate the exit rate separately for SOEs, foreign firms, and domestic private firms. We also control for year and industry fixed effects to partly capture factors that vary with time, such as the price of raw material, and industry-specific factors, such as the ratio of workers earning less than the minimum wage to those that earn more.

Table 4.1 reports the estimation results of exit for three types of firms.[6] High usage of materials (intermediate input) is normally associated with large productivity shocks. Therefore, firms are less likely to exit the market. This is particularly true for domestic private firms. A larger capital stock is often associated with greater profit, as suggested by Olley and Pakes (1996). Consequently, capital stock is found to have a strong negative effect on the chances of exit for all three types of firms. Compared with foreign and domestic private firms, SOEs are less sensitive to the amount of capital stock.

[6] In a previous study of firm exit (Brandt, van Biesehroeck, and Zhang 2014), a firm is identified as exiting from markets if it cannot be observed in the data set of the ASIEC in the following years. This criterion may lead to an upward bias toward the probability of exit because a firm may not show up in ASIEC. This occurs mainly because its sales falls below the threshold used to define large-scale firms. To overcome this bias, we link the ASIEC data set to the national firm registry database. The registry database provides exact information on the year of firm entry and exit.

**Table 4.1 Regressions on the probability of firm exit**

| Variables | (1) SOEs | (2) Foreign | (3) Private |
|---|---|---|---|
| Material | -0.213*** | -0.390*** | -0.408*** |
| | (0.016) | (0.018) | (0.010) |
| Capital | -0.101*** | -0.347*** | -0.327*** |
| | (0.016) | (0.016) | (0.007) |
| Age | 0.216 | 2.168*** | 2.050*** |
| | (0.195) | (0.459) | (0.135) |
| Age*Capital | -0.028 | 0.033 | 0.027* |
| | (0.024) | (0.051) | (0.016) |
| Material*Age | -0.061*** | -0.237*** | -0.223*** |
| | (0.022) | (0.059) | (0.018) |
| Capital*Material | 0.022*** | 0.026*** | 0.025*** |
| | (0.002) | (0.002) | (0.001) |
| Capital square | -0.005*** | 0.004*** | 0.003*** |
| | (0.001) | (0.001) | (0.000) |
| Material square | -0.009*** | 0.000 | 0.003*** |
| | (0.001) | (0.001) | (0.001) |
| Age square | 0.732*** | 0.849* | 0.057 |
| | (0.194) | (0.478) | (0.119) |
| Year FE | YES | YES | YES |
| Industry FE | YES | YES | YES |
| Pseudo $R^2$ | 0.116 | 0.120 | 0.094 |
| Observations | 66,234 | 303,454 | 1,140,295 |

Source: Authors.

Notes: FE = fixed effect; SOE = state-owned enterprises. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. A probit model is used following Olley and Pakes (1996) and Levinsohn and Petrin (2003). Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.01.

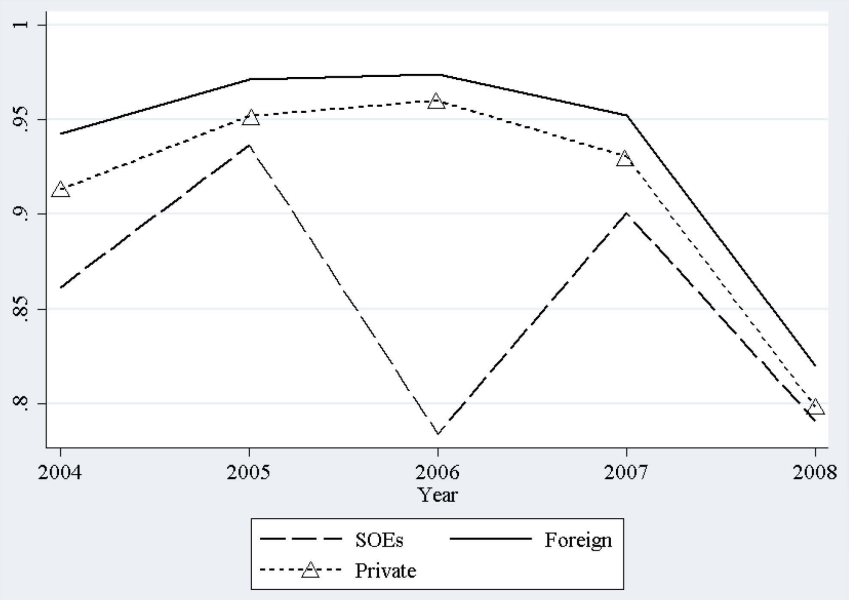
Figure 4.1 plots the survival rate (=1-exit rate) by firm ownership. Interestingly, SOEs perform the worst. They witness a sharp drop in survival rate in 2006. This is probably related to the policy calling for clear delineation of SOE shareholders, announced in August 2005 by the State Council. The decrease in survival rate is probably also due to change in the definition of SOEs by the National Bureau of Statistics. On the one hand, the delineation of shareholders may have diluted the state shares in SOEs. On the other hand, the National Bureau of Statistics reclassified SOEs based on whether the state share was 50 percent or above, reducing the number of SOEs. Foreign firms are consistently more likely to survive than SOEs and domestic private firms in all the years examined. All three types of firms experienced a dip in survival rate in 2008 likely due to the global financial crisis.

In Table A.1 in the Appendix, we present estimates of the exit rate using a polynomial expansion of four rather than three variables. One additional variable—the cost of meeting minimum wages—is a function of $\overline{w}/w_m$ ; the coefficients for age, capital, and materials remain largely the same. In terms of magnitude, the coefficient for the new term—the ratio of wage to minimum wage—is much smaller than that for material and capital, indicating that the minimum wage effect is minimal.

Next, we estimate the likelihood of laying off workers using an expansion of triplets $(a_t, k_t; m_t)$. Table 4.2 presents estimates of the probability of laying off workers in the next period. Input materials, capital, age, year, and industrial fixed effects are included. Considering inherent differences across firms with different ownerships, we also report the estimates by ownership. Normally, following a large positive shock of productivity in period t, the chance of receiving a consecutive large positive shock in the next period diminishes. Consequently, firms are likely to reduce their employment size in the next period. The impact is more pronounced for domestic private firms than for SOEs and foreign firms. SOEs with large capital stock in this period have a greater likelihood of laying off workers in the subsequent year.

This is probably due to the ongoing SOE reform in the sample period. In contrast, large capital stocks provide a buffer for foreign and private firms to retain their employees.

**Figure 4.1 Firm survival rate by ownership over time**




Source: Authors.
Notes: SOE = state-owned enterprises. The Y-axis is the estimated probability of surviving in the market.

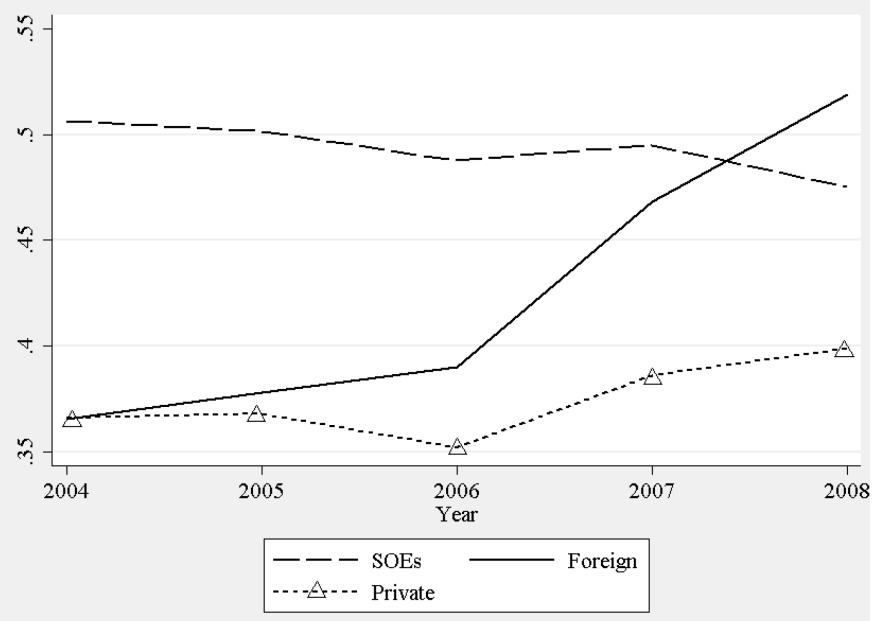
**Table 4.2 Regressions on the probability of laying off workers**

| Variables | (1) SOEs | (2) Foreign | (3) Private |
|---|---|---|---|
| Material | 0.073*** | 0.035** | 0.135*** |
| | (0.016) | (0.016) | (0.009) |
| Capital | 0.028* | -0.067*** | -0.116*** |
| | (0.016) | (0.012) | (0.006) |
| Age | 1.261*** | 4.415*** | 2.745*** |
| | (0.169) | (0.336) | (0.101) |
| Age*Capital | 0.051** | 0.499*** | 0.210*** |
| | (0.021) | (0.037) | (0.012) |
| Material*Age | -0.067*** | -0.498*** | -0.279*** |
| | (0.021) | (0.044) | (0.014) |
| Capital*Material | 0.004* | 0.010*** | 0.000 |
| | (0.002) | (0.002) | (0.001) |
| Capital square | -0.000 | -0.004*** | 0.008*** |
| | (0.001) | (0.001) | (0.000) |
| Material square | -0.007*** | -0.006*** | -0.008*** |
| | (0.001) | (0.001) | (0.001) |
| Age square | -0.612*** | -5.664*** | -1.309*** |
| | (0.156) | (0.332) | (0.085) |
| Year FE | YES | YES | YES |
| Industry FE | YES | YES | YES |
| Pseudo $R^2$ | 0.0259 | 0.0232 | 0.0102 |
| Observations | 52,548 | 270,189 | 988,561 |

Source: Authors.
Notes: FE = fixed effect; SOE = state-owned enterprises. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. A probit model is used following Olley and Pakes (1996) and Levinsohn and Petrin (2003). Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.01.

Figure 4.2 presents the predicted probability of laying off workers by year. Interestingly, SOEs have the highest layoff rate for the whole period except 2008, the last year of our sample, when foreign firms have the highest rate as a result of the global financial crisis. By comparison, private firms figure the lowest in terms of layoff rate during the period. Table A2 in the Appendix also reports the estimates on the probability of laying off workers using a polynomial of four variables $(a_t, k_t; m_t, \overline{w}/w_m)$. The results are robust to the alternative specification.

**Figure 4.2 The likelihood of laying off workers by firm ownership over time**




Source: Authors.

Table 4.3 presents the panel regressions on firm size for all the firms. Year, ownership, and ownership*year fixed effects are included in all the regressions. The first regression is the most parsimonious specification, as it includes only key variables of interest such as real wages. The coefficient for this variable is -0.165, significant at the 1 percent level. In the second regression, a dummy variable for introducing the labor contract law is added. The new variable is highly significant (-0.480). The coefficient for real wages drops slightly and remains statistically significant. On top of the first regression, regression (3) includes a set of dummy variables for minimum wages; it indicates the percentage of average wages paid above the minimum wage. All the dummy variables have negative coefficients, implying a negative impact of minimum wage on employment. Consistent with our model, the coefficients for the minimum wage term become smaller when the average wage paid by firms increases relative to minimum wages. The results are robust when taking worker heterogeneity into account (see Table A.3).

The year dummies not only capture the implementation of the labor contract law, but also many other factors. For example, the year 2008 probably reflects the effect of the global financial crisis. Therefore, the variable is not necessarily a precise measure of the labor contract law. To mitigate this concern, we first drop the year of 2008 from our sample as a robustness check. Table A.4 in the Appendix shows the results based on this reduced sample. The coefficients for wages and the new labor contract law barely change. Interestingly, the coefficients for minimum wages decline. For example, the coefficient for "minimum wage P10" decreases from -0.038 to -0.014 in column 4. One possible explanation is that, compared with normal years, during the crisis, firms had a stronger incentive to lay off workers receiving minimum wage due to a decline in demand for their products.

**Table 4.3 The impact of minimum wages, rising wages, and labor contract law on firm size (employment)**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log real wage | -0.165*** | -0.161*** | -0.186*** | -0.179*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Minimum wage P10 | | | -0.048*** | -0.038*** |
| | | | (0.003) | (0.003) |
| Minimum wage P20 | | | -0.044*** | -0.039*** |
| | | | (0.003) | (0.003) |
| Minimum wage P50 | | | -0.035*** | -0.033*** |
| | | | (0.002) | (0.002) |
| Minimum wage P100 | | | -0.023*** | -0.022*** |
| | | | (0.002) | (0.002) |
| Minimum wage P200 | | | -0.015*** | -0.015*** |
| | | | (0.001) | (0.001) |
| Labor law | | -0.480*** | | -0.484*** |
| | | (0.012) | | (0.012) |
| Capital | -0.015*** | -0.021*** | -0.015*** | -0.022*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Age | 0.769*** | 0.824*** | 0.759*** | 0.816*** |
| | (0.053) | (0.057) | (0.053) | (0.057) |
| Material | -0.104*** | -0.122*** | -0.104*** | -0.122*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Second order term of ($a_t$,$k_t$,$m_t$) | Yes | Yes | Yes | Yes |
| Year = 2005 | 0.017*** | 0.028*** | 0.020*** | 0.031*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Year = 2006 | 0.027*** | 0.050*** | 0.033*** | 0.055*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Year = 2007 | 0.030*** | 0.279*** | 0.036*** | 0.286*** |
| | (0.002) | (0.006) | (0.002) | (0.006) |
| Year = 2008 | 0.044*** | 0.294*** | 0.052*** | 0.302*** |
| | (0.002) | (0.006) | (0.002) | (0.006) |
| Ownership FE | Yes | Yes | Yes | Yes |
| Ownership*Year FE | Yes | Yes | Yes | Yes |
| Adjusted R-squared | 0.216 | 0.208 | 0.216 | 0.208 |
| Number of panel ID | 494,727 | 422,229 | 494,727 | 422,229 |
| Observations | 1,508,476 | 1,310,195 | 1,508,476 | 1,310,195 |

Source: Authors.

Notes: FE =fixed effect; ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

As a further robustness check, we use only those firms without any exports, which are supposedly less subject to the shock of the global crisis in 2008. Table A.5 in the Appendix replicate Table 4.3 using this restricted sample. The coefficient for rising wages in regression (4) changes slightly from -0.18 to -0.16. By comparison, the effect of the new labor law declines from -0.48 to -0.44. Facing global financial crises, local governments might have loosened the implementation of labor law to help local firms adjust to the new economic reality. Overall, the results remain robust.

Based on regression (4) in Table 4.3, we can compute the relative contributions of rising real wages, minimum wage regulations, and the new labor contract law on the drop in firm size as measured by employment. From 2004 to 2008, real wages rise by approximately 0.6 (measured by log), contributing to a decline in employment by 10.8 (=0.6*0.18*100) percent. After the implementation of the new labor contract law in 2007, the value "labor law" increases from 0 to 0.36. Consequently, the introduction of the law results in a decrease in employment by 17 (=0.36*0.48*100) percent. By

comparison, the effect of the minimum wage is more limited, at less than 2 percent.[7] In combination, the three forces contribute to the decline in firm size by, on average, 30 percent. In relative terms, the introduction of the new labor law, rising wages, and minimum wage regulations account for 57 percent (=(17.0/(10.8+17.4+2)*100%), 36 percent (=10.8/(10.8+17.3+2.0)*100%), and 7 percent (=2.0/(10.8+17.3+2.0)*100%), respectively, of the total decline in firm size.

Table 4.3 assumes firms with different ownership use the same process to generate data—the coefficients are the same for the three types of firms—except for the intercept term. This is a rather stringent assumption. Tables 4.4a, 4.4b, and 4.4c replicate Table 4.3 by running separate regressions on SOEs, private firms, and foreign firms. The three tables yield rather consistent results. Based on these findings, in Figure 4.3 we compute and plot the contributions of the three factors to the decline in firm size for SOEs, private firms, and foreign firms. The relative importance of the three factors ranks the same for the three types of firms. The introduction of the new labor contract law is the largest contributor to the decline in firm size; rising wages also make a sizeable contribution. By comparison, the effect of minimum wages is rather limited, particularly for foreign firms. It is probable that these firms rarely paid workers below the minimum wage even before the new law was enacted.

**Table 4.4a The impact of minimum wages, rising wages, and labor contract law on firm size (employment of SOE firms)**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log real wage | -0.237*** | -0.232*** | -0.262*** | -0.259*** |
| | (0.004) | (0.004) | (0.006) | (0.006) |
| Minimum wage P10 | | | -0.075*** | -0.080*** |
| | | | (0.012) | (0.013) |
| Minimum wage P20 | | | -0.035*** | -0.055*** |
| | | | (0.013) | (0.014) |
| Minimum wage P50 | | | -0.027*** | -0.037*** |
| | | | (0.010) | (0.010) |
| Minimum wage P100 | | | -0.030*** | -0.039*** |
| | | | (0.008) | (0.008) |
| Minimum wage P200 | | | -0.012** | -0.019*** |
| | | | (0.006) | (0.006) |
| Labor law | | -0.457*** | | -0.461*** |
| | | (0.043) | | (0.043) |
| Capital | -0.008 | -0.003 | -0.010 | -0.005 |
| | (0.012) | (0.014) | (0.012) | (0.014) |
| Age | -0.312** | -0.737*** | -0.312** | -0.733*** |
| | (0.145) | (0.158) | (0.145) | (0.158) |
| Material | 0.118*** | 0.138*** | 0.118*** | 0.138*** |
| | (0.009) | (0.011) | (0.009) | (0.011) |
| Second order terms of ($a_t$,$k_t$, $m_t$) | Yes | Yes | Yes | Yes |
| Year = 2005 | -0.031*** | -0.026*** | -0.028*** | -0.023*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Year = 2006 | -0.055*** | -0.036*** | -0.047*** | -0.028*** |
| | (0.004) | (0.005) | (0.004) | (0.005) |
| Year = 2007 | -0.057*** | 0.170*** | -0.047*** | 0.182*** |
| | (0.005) | (0.020) | (0.005) | (0.020) |
| Year = 2008 | -0.020*** | 0.174*** | -0.008 | 0.188*** |
| | (0.006) | (0.018) | (0.006) | (0.018) |
| Adjusted R-squared | -0.280 | -0.258 | -0.279 | -0.256 |
| Number of panel ID | 24,131 | 18,779 | 24,131 | 18,779 |
| Observations | 65,941 | 52,375 | 65,941 | 52,375 |

Source: Authors.

Notes: SOE = state-owned enterprises; ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

[7] (=6.57*0.038+2.88*0.039+13.3*0.033+25.3*0.022+27.7*0.015).

**Table 4.4b The impact of minimum wages, rising wages, and labor contract law on firm size (employment) of private firms**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log real wage | -0.147*** | -0.145*** | -0.166*** | -0.162*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Minimum wage P10 | | | -0.037*** | -0.029*** |
| | | | (0.003) | (0.003) |
| Minimum wage P20 | | | -0.041*** | -0.037*** |
| | | | (0.003) | (0.003) |
| Minimum wage P50 | | | -0.036*** | -0.034*** |
| | | | (0.002) | (0.002) |
| Minimum wage P100 | | | -0.029*** | -0.028*** |
| | | | (0.002) | (0.002) |
| Minimum wage P200 | | | -0.024*** | -0.023*** |
| | | | (0.002) | (0.002) |
| Labor law | | -0.424*** | | -0.424*** |
| | | (0.016) | | (0.016) |
| Capital | -0.006* | -0.014*** | -0.006* | -0.014*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Age | 1.020*** | 1.189*** | 1.023*** | 1.197*** |
| | (0.067) | (0.072) | (0.067) | (0.072) |
| Material | -0.111*** | -0.135*** | -0.110*** | -0.134*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Second order terms of ($a_t$,$k_t$, $m_t$) | -0.024*** | -0.056*** | -0.025*** | -0.058*** |
| Year = 2005 | 0.000 | 0.009*** | 0.003** | 0.010*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Year = 2006 | -0.017*** | 0.000 | -0.012*** | 0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Year = 2007 | -0.026*** | 0.155*** | -0.020*** | 0.160*** |
| | (0.001) | (0.006) | (0.001) | (0.006) |
| Year = 2008 | -0.012*** | 0.162*** | -0.005*** | 0.168*** |
| | (0.002) | (0.006) | (0.002) | (0.006) |
| Adjusted R-squared | -0.265 | -0.255 | -0.264 | -0.254 |
| Number of panel ID | 390,266 | 332,015 | 390,266 | 332,015 |
| Observations | 1,139,404 | 987,909 | 1,139,404 | 987,909 |

Source: Authors.

Notes: ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Table 4.4c The impact of minimum wages, rising wages, and labor contract law on firm size (employment) of foreign firms**

| Variables | (1) Employment | (2) Employment | (3) Employment | (4) Employment |
|---|---|---|---|---|
| Log real wage | -0.215*** | -0.206*** | -0.240*** | -0.225*** |
| | (0.002) | (0.002) | (0.003) | (0.003) |
| Minimum wage P10 | | | -0.093*** | -0.073*** |
| | | | (0.006) | (0.006) |
| Minimum wage P20 | | | -0.053*** | -0.043*** |
| | | | (0.007) | (0.007) |
| Minimum wage P50 | | | -0.032*** | -0.026*** |
| | | | (0.004) | (0.004) |
| Minimum wage P100 | | | 0.002 | 0.002 |
| | | | (0.003) | (0.003) |
| Minimum wage P200 | | | 0.010*** | 0.010*** |
| | | | (0.003) | (0.003) |
| Labor law | | -0.517*** | | -0.521*** |
| | | (0.024) | | (0.024) |
| Capital | -0.037*** | -0.042*** | -0.038*** | -0.044*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Age | -0.037 | 1.003*** | -0.217 | 0.836*** |
| | (0.217) | (0.227) | (0.216) | (0.227) |
| Material | -0.183*** | -0.203*** | -0.187*** | -0.205*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Second order terms of ($a_t$,$k_t$, $m_t$) | Yes | Yes | Yes | Yes |
| Year = 2005 | 0.015*** | 0.026*** | 0.018*** | 0.029*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Year = 2006 | 0.025*** | 0.047*** | 0.031*** | 0.052*** |
| | (0.002) | (0.002) | (0.003) | (0.003) |
| Year = 2007 | 0.027*** | 0.292*** | 0.035*** | 0.300*** |
| | (0.003) | (0.011) | (0.003) | (0.011) |
| Year = 2008 | 0.043*** | 0.308*** | 0.055*** | 0.318*** |
| | (0.004) | (0.011) | (0.004) | (0.011) |
| Adjusted R-squared | -0.116 | -0.118 | -0.113 | -0.116 |
| Number of Panel ID | 93,328 | 82,674 | 93,328 | 82,674 |
| Observations | 303,262 | 270,028 | 303,262 | 270,028 |

Source: Authors.

Notes: ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Figure 4.3 The impact of minimum wages, rising wages, and labor contract law on firm size by ownership**


Source: Authors.
Note: For minimum wage term, we plot only the coefficient for the group of P100 by ownership.

## 5. CONCLUSION

As measured by employment, the size of firms in China has declined despite its rapid economic growth. This pattern contradicts the situation in developed countries. Based on a structural model, we decompose the decline in firm size into three components: rising real wages, minimum wages, and the new labor contract law. We find a strong association between the enactment of the law and the decline in firm size. Rising wages also influence the drop in firm size; the impact of minimum wages on firm size is more muted. The effect is particularly small for firms whose market wages are much higher than the minimum, such as foreign firms.

Our analysis hinges upon the crucial assumption that firms seek to maximize their profit. However, the assumption may not fully apply for SOEs. In China, SOEs provides many social functions and are subject to less market competition than private firms. We urge caution in the interpretation of results concerning SOEs.

## APPENDIX: PROOF OF MONOTONICITY

It is impossible for us to directly observe the ability of a worker. However, we can observe the minimum and average wages paid by a firm to its workers. Combining equations 2 and 4, we obtain that

$$\frac{\overline{w}}{w_m} = \frac{z}{z_m} + \int_0^1 G(\lambda z_m \mid z) d\lambda \equiv \frac{z}{z_m} + M(\frac{z_m}{z}) \quad . \tag{A.1}$$

Based on our assumption that $G(z' \mid z)$ is a PDF and invariant in the stretching transformation, it is clear that $M(\bullet)$ is a monotonic increasing function. The term $M(z_m / z)$ is the additional cost due to minimum wages. If workers are not exposed to the minimum wage, the ratio becomes zero.

We define $x = z / z_m$ to check the monotonicity of equation (A.1)

$$\frac{d}{dx}\left(\frac{\overline{w}}{w_m}\right) = 1 - \frac{1}{x} G\left(\frac{1}{x}\right) + \int_0^{1/x} G(\lambda) d\lambda \quad . \tag{A.2}$$

Here, $\lambda$ is the integral variable. If we assume that the average worker in a firm can obtain the minimum wage in the market, then obviously monotonically increases with respect to $z / z_m$, since $x$ is not less than 1 and G is a PDF. If the average worker in the firm receives a wage below the minimum in an unregulated market, to guarantee the monotonicity, we require that

$$\min_{\underline{z} \le x z_m \le \overline{z}} \left[ 1 - \frac{1}{x} G\left(\frac{1}{x}\right) + \int_0^{1/x} G(\lambda) d\lambda \right] \ge 0 \quad . \tag{A.3}$$

In our paper, we always assume that the condition A.3 holds to guarantee the monotonicity.

**Table A.1 Regressions on firm exit: Taking into account worker heterogeneity**

| Variable | (1) SOEs | (2) Foreign | (3) Private |
|---|---|---|---|
| Material | -0.210*** | -0.396*** | -0.412*** |
| | (0.016) | (0.019) | (0.010) |
| Capital | -0.084*** | -0.353*** | -0.319*** |
| | (0.016) | (0.016) | (0.008) |
| Age | 0.111 | 2.522*** | 2.058*** |
| | (0.198) | (0.474) | (0.137) |
| Wage/Minimum wage | -0.051*** | -0.013* | -0.056*** |
| | (0.010) | (0.008) | (0.005) |
| Year = 2005 | -0.388*** | -0.301*** | -0.280*** |
| | (0.021) | (0.014) | (0.006) |
| Year = 2006 | 0.467*** | -0.332*** | -0.359*** |
| | (0.018) | (0.014) | (0.006) |
| Year = 2007 | 0.143*** | -0.030** | -0.055*** |
| | (0.023) | (0.012) | (0.006) |
| Year = 2008 | 0.692*** | 0.763*** | 0.612*** |
| | (0.022) | (0.011) | (0.005) |
| Second order interaction terms | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.118 | 0.126 | 0.0951 |
| Observations | 65,136 | 294,055 | 1,124,960 |

Source: Authors.

Notes: SOE = state-owned enterprises; FE = fixed effect. We include the second order interaction terms of capital, age, materials, and wage/minimum wage. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Table A.2 Regressions on the probability of laying off workers: Taking into account worker heterogeneity**

| Variables | (1) SOEs | (2) Foreign | (3) Private |
|---|---|---|---|
| Material | 0.066*** | 0.024 | 0.114*** |
| | (0.017) | (0.016) | (0.009) |
| Capital | 0.018 | -0.065*** | -0.112*** |
| | (0.016) | (0.013) | (0.007) |
| Age | 1.171*** | 4.201*** | 2.640*** |
| | (0.174) | (0.347) | (0.102) |
| Wage/Minimum wage | -0.077*** | -0.151*** | -0.114*** |
| | (0.010) | (0.006) | (0.004) |
| Year = 2005 | -0.011 | 0.019** | 0.008* |
| | (0.015) | (0.008) | (0.004) |
| Year = 2006 | -0.061*** | 0.049*** | -0.030*** |
| | (0.017) | (0.008) | (0.004) |
| Year = 2007 | -0.023 | 0.267*** | 0.074*** |
| | (0.018) | (0.008) | (0.004) |
| Year = 2008 | -0.057*** | 0.383*** | 0.122*** |
| | (0.020) | (0.008) | (0.004) |
| Second order interaction terms | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.0332 | 0.0304 | 0.0140 |
| Observations | 51,668 | 261,918 | 975,232 |

Source: Authors.

Notes: SOE = state-owned enterprises; FE =fixed effect. We include the second order interaction terms of capital, age, materials and wage/minimum wage. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Table A.3 Regression of firm size on minimum wages, rising wages, and labor law: Taking into account worker heterogeneity**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log real wage | -0.160*** | -0.174*** | -0.175*** | -0.181*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Minimum wage P10 | | | -0.036*** | -0.015*** |
| | | | (0.004) | (0.004) |
| Minimum wage P 20 | | | -0.032*** | -0.014*** |
| | | | (0.004) | (0.004) |
| Minimum wage P 50 | | | -0.026*** | -0.013*** |
| | | | (0.003) | (0.003) |
| Minimum wage P 100 | | | -0.020*** | -0.007*** |
| | | | (0.002) | (0.003) |
| Minimum wage P 200 | | | -0.016*** | -0.006*** |
| | | | (0.002) | (0.002) |
| Labor Law | | -0.462*** | | -0.467*** |
| | | (0.013) | | (0.013) |
| Capital | 0.002 | -0.012* | 0.002 | -0.012** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Age | 1.247*** | 1.122*** | 1.241*** | 1.117*** |
| | (0.084) | (0.091) | (0.084) | (0.091) |
| Material | -0.124*** | -0.120*** | -0.124*** | -0.120*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Log investment | -0.003 | -0.006** | -0.003 | -0.006** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Second order term of ($a_t$,$k_t$,$m_t$,$i_t$) | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Ownership FE | Yes | Yes | Yes | Yes |
| Ownership*year FE | Yes | Yes | Yes | Yes |
| R-squared | 0.150 | 0.153 | 0.150 | 0.153 |
| Number of panel ID | 319,096 | 287,143 | 319,096 | 287,143 |
| Observations | 715,091 | 630,060 | 715,091 | 630,060 |

Source: Authors.

Note: FE = fixed effect; ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Table A.4 Robustness checks: Dropping the year 2008**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| log wage | -0.194*** | -0.187*** | -0.201*** | -0.193*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Minimum wage P10 | | | -0.020*** | -0.014*** |
| | | | (0.003) | (0.003) |
| Minimum wage P 20 | | | -0.015*** | -0.014*** |
| | | | (0.003) | (0.003) |
| Minimum wage P 50 | | | -0.007*** | -0.007*** |
| | | | (0.002) | (0.002) |
| Minimum wage P 100 | | | 0.007*** | 0.005** |
| | | | (0.002) | (0.002) |
| Minimum wage P 200 | | | 0.008*** | 0.006*** |
| | | | (0.001) | (0.001) |
| Labor law | | -0.486*** | | -0.488*** |
| | | (0.014) | | (0.014) |
| Capital | -0.016*** | -0.021*** | -0.016*** | -0.022*** |
| | (0.003) | (0.004) | (0.003) | (0.004) |
| Age | 0.589*** | 0.530*** | 0.577*** | 0.516*** |
| | (0.065) | (0.069) | (0.065) | (0.069) |
| Material | -0.108*** | -0.135*** | -0.109*** | -0.136*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Second order term of ($a_t$,$k_t$,$m_t$) | Yes | Yes | Yes | Yes |
| Year = 2005 | 0.019*** | 0.031*** | 0.020*** | 0.032*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Year = 2006 | 0.034*** | 0.057*** | 0.036*** | 0.058*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Year = 2007 | 0.041*** | 0.295*** | 0.044*** | 0.298*** |
| | (0.002) | (0.007) | (0.002) | (0.007) |
| Ownership FE | Yes | Yes | Yes | Yes |
| Ownership*Year FE | Yes | Yes | Yes | Yes |
| Observations | 1,170,250 | 1,050,345 | 1,170,250 | 1,050,345 |
| Number of Panel ID | 414,064 | 366,264 | 414,064 | 366,264 |
| Adjusted R-squared | 0.253 | 0.246 | 0.252 | 0.246 |

Source: Authors.

Note: FE = fixed effect; ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

**Table A.5 Robustness checks: Excluding export firms**

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| log wage | -0.145*** | -0.142*** | -0.164*** | -0.158*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Minimum wage P10 | | | -0.037*** | -0.030*** |
| | | | (0.003) | (0.003) |
| Minimum wage P 20 | | | -0.039*** | -0.037*** |
| | | | (0.003) | (0.003) |
| Minimum wage P 50 | | | -0.037*** | -0.035*** |
| | | | (0.002) | (0.003) |
| Minimum wage P 100 | | | -0.028*** | -0.028*** |
| | | | (0.002) | (0.002) |
| Minimum wage P 200 | | | -0.022*** | -0.022*** |
| | | | (0.002) | (0.002) |
| Labor law | | -0.440*** | | -0.440*** |
| | | (0.016) | | (0.016) |
| Capital | 0.006 | 0.002 | 0.006 | 0.002 |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Age | 0.928*** | 0.873*** | 0.927*** | 0.878*** |
| | (0.064) | (0.069) | (0.064) | (0.069) |
| Material | -0.045*** | -0.063*** | -0.044*** | -0.062*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Second order term of ($a_t$,$k_t$,$m_t$) | Yes | Yes | Yes | Yes |
| Year = 2005 | 0.014*** | 0.025*** | 0.016*** | 0.027*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Year = 2006 | 0.014*** | 0.038*** | 0.019*** | 0.043*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Year = 2007 | 0.026*** | 0.249*** | 0.033*** | 0.254*** |
| | (0.004) | (0.008) | (0.004) | (0.008) |
| Year = 2008 | 0.041*** | 0.268*** | 0.049*** | 0.274*** |
| | (0.004) | (0.008) | (0.004) | (0.008) |
| Ownership FE | Yes | Yes | Yes | Yes |
| Ownership*Year FE | Yes | Yes | Yes | Yes |
| Adjusted R-squared | 0.326 | 0.315 | 0.326 | 0.314 |
| Number of Panel ID | 411,671 | 347,625 | 411,671 | 347,625 |
| Observations | 1,118,141 | 959,567 | 1,118,141 | 959,567 |

Source: Authors.

Note: FE = fixed effect; ID = firm identity. The variables of capital and materials are in logarithmic form. The age variable is divided by 100. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.01.

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