Have Chinese Firms Become Smaller?

And Why?

Qiming Yang, National School of Development, Peking University

Xiaobo Zhang, NSD, Peking University and
International Food Policy Research Institute (IFPRI)

Wu Zhu, NSD, Peking University

This draft: August 24, 2014

Abstract

Normally as an economy develops, firm sizes go up. However, firm sizes measured in employment in China have declined from 2004 to 2008. There are at least two potential explanations. First, rising real wages induce firms to invest more in capital to substitute for labor. Second, under the newly introduced labor contract law, firms are reluctant to hire workers because it is difficult to dismiss them once they sign formal contracts. In this paper, we developed an analytical framework to directly test the two hypotheses. We found that rising wages are the major driver behind the decline in firm sizes in China.

Keywords: Firm entry, selection, exit, Lewis turning point, and labor contract law.

1. Introduction

After more than three decades of rapid growth, China has become the "world factory." The emergence and growth of massive number of enterprises have played a key role in driving's China's industrialization process (Wei and Zhang, 2011). Despite the importance, the studies on the extensive growth of Chinese firms are rather scant. There are a few studies testing whether the large or publically listed Chinese firms follow the distribution of Gibrate law (Shi, 2010) or the Zipf law (Yang, et al., 2010； Fang and Nie, 2010； Gao and Mao, 2012； Zhang, et al., 2009). One limitati oof these studies is that they focus on large firms but neglect the birth, growth, and exit of small firms. In order to fill the knowledge gap, we examine the evolutions of firm size distribution by including both large and small firms based on two recent economic censuses in China.

There are two major strands of the literature on firm size distribution, one focusing on developing countries and one on developed countries. A salient feature on firm size distribution in developing countries is the lack of middle sized firms, the so called "missing middle" phenomenon (Tybout, 2000; Garcia-Santana and Ramos, 2012; Dasgupta, 2012). Yet, we do not observe such a "missing middle" problem in China as in other developing countries.

A large body of the literature on developed countries test whether firm size distribution follows a certain distribution, such as lognormal distribution (Cabral and Mata, 2003; Angelini, 2008) or Zipf distribution (Axtell, 2001; Luttmer, 2007), and explore the underlying mechanisms behind the observed patterns. Most studies examine firm size distribution (shortened as FSD) using cross-sectional data. To a large extent, the analysis is static. Cabral and Mata (2003)[1] divert from the previous literature by focusing on firm dynamics. Using employment as a measure of firm size, they find that FSD in Portugal is mainly determined by the growth effect of existing firms, while the exit effect plays a trivial role. In developed countries, firm size distribution probably has probably reached a stable equilibrium state and therefore changes slowly over time. For example, according to Cabral and Mata (2003), the distribution of firm size was almost identical between 1984 and 1991 in Portugal. Will the findings inferred from developed countries apply to a country with rapid transformation, such as China?

Based on China Economic Censuses in 2004 and 2008, we found that Chinese firm sizes with respect to employment have declined. Yet, if measured in capital, Chinese firm sizes have significantly expanded. How do we reconcile the conflicting results based on two different measures?

In order to answer this question, we first developed a framework to decompose the evolution of aggregate FSD into three components—entry effect, growth effect, and selection effect (exit effect). Most studies (Pashigian, 1962; David, 1987) on FSD employ parametric methods such as regressions. As an exception, Cabral and Mata (2003) develop a non-parametric framework to decompose FSD into different effects. Previous works (Pashigian, 1962; Jovanovic, 1982; Evans, 1987; David, 1987; Dixit, 1989; Jovanovic, 1989; Holtz-Eakin, et al., 1994; Cooley, 2001; Aghion, et al., 2007) often focus only on one or two of the three effects (entry, growth, and exit) and rarely study the three effects together. We made a methodological contribution to study the three effects in an integrated framework.

We found that existing firms have barely grown in terms of employment, the newly entered enterprises hire fewer workers than before, and smaller firms are more likely to die out. In combination, firm sizes in employment have declined. However, if looking at FSD from the prism of capital, the story is different. The existing firms have accumulated asset in a great rate. Small enterprises have a higher likelihood of exit and entry than binger ones. On balance, the average capital size has risen significantly. The sharp contrast between the two different measures of firm sizes indicates that it may be misleading to use only employment as a measure of firm sizes in a fast transforming economy, like China.

The decline in employment-based firm sizes in China is contrary to the observed patterns in many of the developed countries where firm sizes generally increase over time. Why have firms employed fewer workers China despite its rapid growth?

There are two possible explanations to the puzzle. One explanation has something to do with the enactment of new labor contract law in January, 2008. Under the new labor law, firms have to sign long-term labor contracts after workers stay in the current position for a significant period of time. In order to circumvent the law, some firms hire workers from temp companies or use piece rates instead of fixed wages as the main contract arrangement (labor outsourcing).

In doing so, the number of formal employment on the company payroll naturally would appear smaller. However, we find that such an effect, if existing at all, is minimal.

The second explanation posits that rising real wages as a result of the arrival of the Lewis turning point (the running out of seemingly abundant laborers) in China induce firms to substitute increasingly more expensive workers for relatively cheap capital. Consequently, firm sizes measured in employment shift leftward, but move rightward when measured in capital.

We use several methods to test the two hypotheses. First, we exploited the difference in the cost of implementing the new labor contract law between domestic private enterprise and foreign firms. Generally speaking, most foreign firms have modern cooperate governance and high-standard labor practice in their home territories. So when they move to China, it is rather easy for them to meet the new labor law requirements. The impact of implementing the new labor standards is likely minimal for them. However, the impact may be more serious for domestic firms. Many domestic private firms had a lax labor standard prior to the enactment of the new labor law, thereby likely facing a great challenge in implementing the more stringent law after it took effect. We run a difference-in-differences (DID) regression on the newly established foreign and domestic private firms in the past two years observed in the 2004 and 2008 economic censuses and found that the newly established foreign firms are becoming smaller at a rate faster than domestic private ones, contrary to the prediction of the law-abiding-cost hypothesis. The evidence suggests that the introduction of labor contract law is not a major factor contributing to the declining firm sizes.

Next, we further divided the sample into two subsamples of labor-intensive and capital-intensive firms and run a DID across the two groups between the two censuses. We found that the passage of labor law reduces employment more significantly in labor-intensive firms than capital-intensive ones, lending support to the capital-for-labor substitution hypothesis.

Moreover, we also constructed a simple structural model to estimate parameters related to substitution effect and found that it accounts for a large part of the reduction in employment-based firm sizes from 2004 to 2008. In a fast growing economy like China, using only employment as a measure of firm sizes may mask firms' substitution of labor for capital in

response to rising real wages.

The paper is organized as follows. Section 2 develops a general decomposition framework to analyze the evolution of aggregate FSD. The decomposition results are presented in Section 3. Section 4 provides potential explanations to the drop in firm sizes. Section 5 concludes.

2. Change in Firm Size Distribution from 2004 to 2008

In this section, we use data from China Economic Censuses in 2004 and 2008 to study the evolution of China's firm size distribution. The economic census is one of the most comprehensive firm datasets in China as of now. Panels A and B of Figure 1 plots the density of firm sizes measured in employment and capital, respectively. Both the employment and capital are measured in natural logarithm.[2] As shown in Panel A of Figure 1, the FSD measured in employment slightly shifts leftward. In comparison, FSD measured in capital has noticeably moved rightward as indicated in Panel B, signaling an increase in firm size.

Table 1 presents the average firm sizes measured in employment and capital in 2004 and 2008, respectively. As shown in the first row, the average number of workers per firm reduced from 25 to 23. A t-test indicates that the average firm sizes in the two periods are statistically different. The drop in firm size was not the same for all types of firms. The average number of workers per foreign firm barely changed in the period, whereas the domestic firms, in particularly the state-owned enterprises (SOEs), have cut the number of workers from 94 to 56. The labor-intensive enterprises have reduced employment more dramatically than capital-intensive ones. On average, the firm sizes between labor-intensive and capital-intensive firms were similar.

In contrast to the contraction of employment, the average capital per firm has increased by more than 25%. 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% larger than a typical SOE. Apparently foreign firms have accumulated capital much faster than SOEs in the period. If looking at the

[2] The capital is comparable across the two years. We divided the asset of firms into fixed asset and non-fixed asset, constructed separate price indexes for them, and generated the composite capital price index using weighted averages.

newly established firms in the past two years prior to the surveys, SOEs were actually bigger than foreign firms in both 2004 and 2008. However, within the established firms, we observe a sharp contrast — foreign firms' capital has grown by more than 20%, while the capital of an average SOE has shrunk by over 50%.

Overall, we found that the evolution of firm sizes differs depending upon whether employment or capital is used as a measure of firm size.

3. Decomposition framework

This section, we develop a framework to decompose the change in firm sizes into different components to uncover the underlying mechanisms. Intuitively, the evolution of the aggregate FSD, from period *t* to *t*+1, can be attributed to three components: the exit of firms, the growth in size of the surviving firms, and the entry of new firms. We call the three components exiting, growth, and entry effects, respectively.

Denote $N(s,t)$ as the cumulative frequency in period *t*, that is the number of firms with size smaller than *s* in period *t*. Denote $D(s,t)$ as the average death rate of firms smaller than *s*. Denote $E(s,t)$ as the average transition rate, that is, the proportion of firms initially smaller than *s* have grown larger than *s*. Finally, we denote $F(s,t+1)$ as the cumulative frequency of new firms between period *t* and *t*+1. We can write the following identity based on our definition:

$$N(s,t+1) = N(s,t)(1-D(s,t))(1-E(s,t)) + F(s,t+1) \quad (1)$$

Firms smaller than *s* in period *t*+1 include two groups: firms newly entering the market between *t* and *t*+1; survival firms from *t* to *t*+1 with size smaller than *s* in both periods.

Based on the above definition, we can define the exit effect,[3] growth effect, and the entry effect. The *selection* (*exit*) *effect* can be written as the change from $N(s,t)$ to $N^s(s,t)$,

$$N(s,t) \to N(s,t)(1-D(s,t)) \equiv N^s(s,t) \quad (2)$$

The superscript *s* denotes survivors in period *t*. Because both $N(s,t)$ and $N^s(s,t)$ are

[3] In this paper, we use exit effect and selection effect interchangeably.

observable, the average death rate for firms smaller than *s* can be written as,[4]

$$D(s,t) \equiv 1 - \frac{N^s(s,t)}{N(s,t)} \tag{3}$$

By comparing the firms existing in both periods, we can compute the contribution of *growth effect* to the evolution of FSDI as:

$$N(s,t)(1-D(s,t)) \equiv N^s(s,t) \ \rightarrow N^s(s,t+1) = N^s(s,t)\ (1-E(s,t)) \tag{4}$$

Where $N^s(s,t+1)$ is the cumulative frequency distribution of the survivors in period *t*+1.

Next, we define the *entry effect* as the number of firms newly entering the market between periods *t* and *t*+1:

$$N^s(s,t)\ (1-E(s,t)) = N^s(s,t+1) \rightarrow N(s,t+1) = N^s(s,t+1) + F(s,t+1) \tag{5}$$

F(s, t+1) is the *entry effect*. We define the entry rate as $\frac{F(s,t+1)}{N(s,t+1)}$.

Based on equations (3), (4), and (5), the evolution of FSD for the whole sample from period *t* and *t*+1 can be decomposed into three components—selection, growth and entry effects.

4. Decomposition Results

This section presents the decomposition results based on the above decomposition framework. Because of the large sample, it is not informative to show the effect for firms in all the size. In order to better visualize the effect, we classify the sample into 20 quantiles either according to employment or capital. Under each quantile, we compute the average selection, growth and entry effect based on equations 3-5. Figures 2-4 plot the three effects, separately.

The average firm death rates (selection effect) measured in employment and capital moved in sync over the 20 quantiles. The downward slope of the two lines in Figure 2 means that smaller firms face a larger likelihood of failure than bigger ones. The chance of exit over the

---

[4] The death rate for any given size *s* can be derived from the average death rate up to size *s*. Based on the definition of $D(s,t)$, if we define $n(s,t) = \frac{\partial N(s,t)}{\partial s}$, then the death rate $d(s,t)$, for any given size, can be expressed as $d(s,t) = \frac{1}{n(s,t)} \frac{\partial}{\partial s}\left(N(s,t)D(s,t)\right)$, using the identity $D(s,t) = \frac{1}{N(s,t)} \int_{[0,s]} n(x,t)d(x,t)dx$.

period of 2004-2008 for firms at the bottom decile exceeded 50%. In comparison, the likelihood was lower than 30% for firms on the top decile.

The difference in growth effect between the employment and capital measure is more pronounced as shown in Figure 3. The horizontal axis measure firm sizes by quantile in 2004. The vertical axis stands for the average growth rate of the firms survived from 2004 to 2008 in each quantile. The line representing capital always lies above the employment line, indicating that firm capital has grown faster than employment across the broad. This implies that firms have generally become more capital intensive from 2004 to 2008. Yet the growth rate varied by firm size. On average, smaller firms have expanded more rapidly than their large counterparts. For example, the smallest one-third of the survival firms has added more workers. In contrast, other two-thirds of the firms have seen a contraction in labor force.

The pattern of entry effect revealed in Figure 4 resembles that of selection effect in Figure 2. Small firms experienced higher entry rates than large ones. The employment-based and capital-based entry rates in relation to firm size largely move in tandem. A comparison of Figures 4 and 2 indicates the entry rate is mostly greater than the death rate. For instance, a median firm (at the point 0.5 on the X axis) in 2004 faced a 45% likelihood of death over the subsequent period of 2004-2008. By comparison, the entry rate for a median firm surpassed 60%.

The three figures demonstrate that the effects of growth, entry and exit vary by firm size. Table 2 reports the average contributions of the three components to the change in firm size for the whole sample between 2004 and 2008. In addition, the table displays the decompositions for firms at different sizes — the top 25% percentile, median, and bottom 25% percentile in the table. Panel A presents the decompositions according to employment. The growth effect is negligible in all the four decompositions independent of firm size. On overage, the entry effect, which drives down the average firm size, overshadowed the exit effect, which pushes up the average size of survival firms, leading to a net reduction in firm size. However, the difference between entry and exit effects is rather muted for firms among the top 25%. The gap is more noticeable for smaller firms as shown in the last column for firms at the bottom 25th percentile (26.24 for selection and -39.2 for entry). The relative higher entry and death rates for small

firms mean that they are more dynamic.

Panel B in Table 2 reports the decomposition results based on firm capital. The major difference from the Panel A is the grow effect. In contrast to the stagnant growth in employment, the survival firms have accrued capital at a rapid pace. The average growth rate in capital among the survival firms was 36.94%. Similar to the patterns revealed in Panel A on employment, we observe a stronger entry effect compared to the exit effect, in particular for small firms. The entry effect averaged at -46.29%, larger than the selection effect of 34.68% in terms of magnitude. For the firms on the peck order of bottom 25th percentile, the entry effect was as high as -64.46%, compared to 39.57% for the selection effect. The relatively higher entry rate compared to the death rate among small firms dilutes the strong growth effect of the existing firms. Consequently, the capital size for firms at the bottom 25th percentile grew by 16.89% from 2004 to 2008, below the average for the sample as a whole (25.32%).

4. Reconcile the Firm Size Puzzle

Having shown that firm sizes have moved in opposite directions in the period of 2004-2008 depending upon whether they are measured in employment or capital, in this section we aim to reconcile the puzzle. There are at least two potential explanations to the conflicting directions of firm size. The first is related to the new labor contract law introduced in the early 2008. The second explanation has something to do with rising real wages. We used two ways to test the two alternative hypotheses. The first is a reduced-form parametric DID analysis which takes advantage of the cost difference in implementing the labor contract law by foreign and domestic firms. The second is a non-parametric approach based on the comparison of simulated and actual distributions.

4.1. DID Test of Two Alternative Hypotheses

China had a labor contract law on the book but was rarely enforced. After more than one year's deliberations, China's People's Congress passed a new Labor Contract Law on June 19, 2007and the law took effect in January 2008. Compared to the old labor law, the new law granted workers more rights to protect them. For example, once working for a company for

more than one year, a worker is entitled to sign a formal contract with the company. After that, it is much more difficult for the company to dismiss the worker.

It is widely regarded the new labor law increases the cost of doing business. However, the impact may differ greatly across firms. Prior to coming to China, the multinational firms from developed countries had already meet labor laws in their countries of origin, which often are more stringent than the new Chinese labor law. When they set up a subsidiary or joint venture in China, they largely followed their previous labor practice and signed formal contracts with workers. Since they had pretty much meet the labor standards prescribed by the new labor law, it is expected that the introduction of the law matters little to them.

However, domestic private firms had operated in an environment where the labor law was just on the paper. Many of them did not meet the high labor standards as stipulated by the new law. After the new law was passed, they have to make concerted efforts to meet the high bar of standards. So implementing the law likely imposes additional burdens on them.

Since the law was passed in 2007, we could run a DID analysis by comparing the changes in firm size between foreign and domestic private firms over the period of 2004-2008 using the following specification:

$$\ln(L_{it}) = a + bT + c * Foreign + d * T * Foreign + eX + \varepsilon_{it} \ , \qquad (6)$$

where *i* stands for firm *i*; t represents the year of census (0 for 2004 and 1 for 2008); L_{it} is firm *i*'s size in year *t*; *Foreign* is a dummy variable indicating a firm is registered as a foreign firm; *d* is the DID coefficient; X is a vector of control variables, such as years of establishment, regional or industry fixed effects.

Table 3 presents the DID estimations for firm sizes measured in employment (log) in six different specifications. In the first basic specification, we do not control for any regional or industrial fixed effects. The second specification adds industry fixed effects at the SIC 4-digit level. The third specification includes only the province fixed effects. Column (4) replaces the province fixed effects with more disaggregate county fixed effects. In column (5), both province and industry fixed effects are included. Regression in Column (6) repeats the specification in

Column (5) by replacing the province fixed effects with county fixed effects. Adjusted R squared and AIC listed in the last two rows of the table measure the degree of fitness of the different specifications. The smallest AIC, the better fit a model.

The dummy variable for year 2008 is negative and significant across the six specifications, indicating a declining trend of firm size. The coefficient for the dummy indicating foreign firms is positive and highly significant. On average, foreign firm employed more workers than domestic firms, in consistent with the findings revealed in Table 1. The DID coefficient is the interaction term between year dummy of 2008 and foreign firm dummy. It is positive and statistically significant in all the six regressions. The magnitude varies from 0.037 to 0.051 across the specifications, meaning that foreign firms have grown faster than domestic private firms by 3.7%-5.1% from 2004 to 2008. This seems to lend some support of the law-abiding cost hypothesis. Enjoying lower cost of implementing the new law, foreign firms can hire workers more easily than domestic enterprises.

However, the finding does not nullify the alternative rising-wage hypothesis. Real wages have increased by more than 10% a year since 2003. Some scholars have argued that the Lewis Point where the seemingly unlimited labor is exhausted has arrived in China (Cai, 2007; Zhang, et al, 2011). The rapid increase in wage might have induced firms, in particular those labor-intensive ones, to substitute labor with capital. Since foreign firms are more capital intensive than domestic firms, they face less wage pressure to downsize their workforce. Thus, the rising wage hypothesis offers the same prediction as the new labor law hypothesis — the drop in employment is more pronounced in foreign firms than domestic ones.

The above analysis is based on the whole sample encompassing both new and established firms. The large heterogeneity between the two types prevents us from drawing a precise inference. We next tested the two hypotheses using two separate subsamples, newly established firms in the past two years and established firms present in both waves of censuses. Our first subsample includes all the enterprises established in the past two years at the time of survey. We repeated the same excises of Table 3 on this subsample. Table 4 provides the results, which are robust to the six different specifications. The dummy variable for the year of 2008 is negative and statistically significant, revealing a general trend of decline in firm size. The

positive coefficient for the dummy variable of foreign firms means that on average the newly established foreign enterprises employ more workers than domestic enterprises. Interestingly, the coefficient for the interaction term (DID coefficient) is negative across the six regressions. In contrast to the prediction of the law-abiding cost hypothesis, the newly entries of foreign firms have reduced their number of employees at a faster rate than their domestic counterparts. If the cost of meeting the new labor law is a major hindrance to new entries, we would expect that foreign firms enjoy a competitive edge because they had already followed modern labor practices in their home countries. Consequently their reactions to the law in terms of hiring workers should have been less radical. However, we observe the opposite.

Of course, the new entries constitute only a small proportion of the firm sample. The findings on the new entries may not apply to the existing firms. It is likely that the established firms respond to the new labor law differently from the new entries. To investigate the impact of the new labor law on established firms, we extracted a subsample of panel firms which appear in both the 2004 and 2008 economic censuses. This is the second subsample for testing the two hypotheses. This time we used the following DID specification which can be derived from equation 6 by taking a difference between 2008 and 2004 on both dependent and independent variables:

$$g_i = b + d * Foreign + \varepsilon_i \ , \qquad (7)$$

Where *i* stands for firm *i*; *g* is growth rate in employment from 2004 to 2008; *Foreign* is a dummy variable indicating a firm is registered as a foreign firm; *d* is the DID coefficient.

The first column of Table 5 displays the above DID estimation results. The coefficient for the variable indicating foreign firms is 0.024, yet not statistically significant. The established foreign firms have not performed much differently from domestic private ones in terms of employment growth. Of course, there are potential other factors influencing the firm growth differently for the two types of firms. For example, the government may provide some special favorable terms, such as tax breaks, to foreign firms in certain sectors. To remedy these concerns, we included county fixed effects in Column (2) and additional industry fixed effects in

Column (3). The foreign variable becomes statistically significant after controlling for these fixed effects. The result is consistent with the DID analysis for the whole sample in Table 3. The problem of this specification is that the two hypotheses cannot be distinguished.

To overcome this challenge, we added the capital-labor ratio in logarithm form in 2004. If rising wages are a major driver behind the decline in firm size, we would expect to see a positive and significant coefficient for this variable. As labor becomes more costly, capital-intensive firms enjoy a comparative advantage and thereby are more likely to expand than labor-intensive firms.[5] If the law-abiding cost hypothesis dominates, the DID coefficient should remain positive and significant after controlling for the initial firm endowment. Columns (4)-(6) are identical to Columns (1)-(3) except for the new term of the capital-labor ratio. The DID term turns from positive to negative and is statistically significant in all the three regressions. The coefficient for the initial capital-labor ratio variable is positive and highly significant, providing a strong support in favor of the rising wage hypothesis. The observed change in employment in established firms is not due to their cost advantage of abiding the new labor law. Rather their labor hiring decisions primarily hinge upon China's changing factor endowment in the past decade.

Next we provide more evidence in support of the rising wage hypothesis by examining the difference in employment growth between labor-intensive and capital-intensive industries. We follow the method outlined in Qu et al. (2013) to categorize Chinese industries into two groups, labor-intensive and capital intensive. Their classification is based on the capital-labor ratio in the US industries, largely avoiding the potential endogeneity problem of classification based on Chinese data. Table 5 follows the specifications in Table 3 except that we replaced the ownership-based group variable with a dummy variable for labor-intensive industries. Since the dummy variable is at the industry level, we cannot include both the dummy variable and industry fixed effects at the same time. So in Columns (2), (5), and (6), it only shows up in the interaction term but not as an independent variable.

The estimation results are presented in Table 6. The dummy variable for year 2008 is negative, consistent with Tables 3-5. The labor-intensive variable is insignificant. The result is not surprising given that the average firm size differed little between labor-intensive and

[5] Please see the technical details for this claim.

capital-intensive firms as shown in Table 1. The negative and significant coefficient for the interaction term means that labor-intensive firms have become smaller relative to capital-intensive firms over time. This is consistent with our story that in the face of rising wages, labor-intensive firms have been induced to invest more in capital to substitute labor.

The response to rising wags may differ by firms according to the initial capital-labor ratio. Figure 5 is drawn to gauge the substitution effect of capital for labor by the level of initial capital-labor ratio. Similar to Figures 2-4, we grouped firms which were present in both 2004 and 2008 economic censuses into 20 quantiles, this time according to their capital-labor ratios in 2004. The vertical axis displays the average growth rate in employment and capital from 2004 to 2008 at each quantile. The difference between the growth rate in capital and in labor (the gap between the two lines in the figure) measures the substitution effect of capital for labor. The lower the initial capital-labor ratio, the larger is the substitution effect in the subsequent period of 2004-2008, as shown by the corresponding wider gap between the two lines marked on the vertical axis. The substitution effect of capital for labor declines as the initial capita-labor ratio increases until it reaches the 80^{th} percentile. For firms with capital-labor ratio in the top 20 percentile, we observe a substitution of labor for capital. In a word, Figure 5 suggests the degree of substitution of capital for labor is proportional to the initial firm endowment (capital-labor ratio). Because of the initial low capital-labor ratio for most labor-intensive manufacturing enterprises, the substitution effect of capital for labor is naturally more evident among the labor-intensive firms. This is exactly what we observed in Table 6.

4.2 A Structural Approach

In this section, we constructed a simple static model to quantify the substitution effect of capital for labor in response to rising wages.

Assume that the production function of firm i in period t is $y_{i,t} = A\left(\varepsilon_{i,t}\right) g\left(f\left(k_{i,t}, l_{i,t}\right)\right)$ (Lucas, 1978; Jovanovic, 1982). Where f is homogeneous of degree one with respect to capital and labor; *g* is strictly increasing and concave.

For simplicity, we assume that a firm's production follows the Cobb-Douglas form, i.e.,

$y_{i,t} = A(\varepsilon_{i,t}) k_{i,t}^{\alpha} l_{i,t}^{\beta}$[6], where $\alpha + \beta \in (0,1)$. Similar results can be derived when using a more general functional form.[7] Facing the price of capital $r_{i,t}$ and labor $w_{i,t}$, a firm's profit maximization implies:

$$\ln l_{i,t} = \frac{1}{\alpha+\beta} \ln\left(\frac{y_{i,t}}{A(\varepsilon_{i,t})}\right) + \frac{\alpha}{\alpha+\beta} \ln\left(\frac{\beta r_{i,t}}{\alpha w_{i,t}}\right) \quad (8)$$

$$\ln k_{i,t} = \frac{1}{\alpha+\beta} \ln\left(\frac{y_{i,t}}{A(\varepsilon_{i,t})}\right) + \frac{\beta}{\alpha+\beta} \ln\left(\frac{\alpha w_{i,t}}{\beta r_{i,t}}\right) \quad (9)$$

According to the above equations, changes in capital or labor can be decomposed into two parts: substitution effect due to the change in relative prices from period *t* to *t*+1; the growth effect as represented by the change in output $y_{i,t}/A(\varepsilon_{i,t})$ from period *t* to *t*+1.

Based on the first-order condition of profit maximization, we have:

$$\ln\left(\frac{\alpha w_{i,t}}{\beta r_{i,t}}\right) = \ln k_{i,t}/l_{i,t} \quad (10)$$

By substituting (10) into (8) and (9), we can estimate the substitute effect due to changes in the relative price from 2004 to 2008 as:

$$\ln k_{i,t+1}^{v} - \ln k_{i,t} = (1-\lambda) * \left(\ln(k_{i,t+1}/l_{i,t+1}) - \ln(k_{i,t}/l_{i,t})\right) \quad (11)$$

$$\ln l_{i,t+1}^{v} - \ln l_{i,t} = -\lambda * \left(\ln(k_{i,t+1}/l_{i,t+1}) - \ln(k_{i,t}/l_{i,t})\right) \quad (12)$$

Where $\ln k_{i,t+1}^{v}$ and $\ln l_{i,t+1}^{v}$ represent the amount of capital and labor purely resulting from the substitute effect; λ is defined as the ratio of $\alpha/\alpha+\beta$.

In order to estimate the substitute effect using equations (11) and (12), we must know the term $\ln(k_{i,t+1}/l_{i,t+1}) - \ln(k_{i,t}/l_{i,t})$ and the undetermined parameter λ, which stands for the

---

[6] This can be obtained by assume $g(x) = x^{\theta}$ and $f(k,l) = k^{\chi} l^{1-\chi}$ with $\theta \in (0,1)$, $A(\varepsilon_{i,t})$ corresponding to the managerial ability .

[7] The economic intuition is that given the output fixed (corresponding to constant of f value), optimal choice implies $w/r = f_l / f_k$, the right hand term of the equation is monotonically increasing with respect to k/l.

share of labor income in total income. The key is to estimate λ. We use a non-parametric approach to estimate λ using the panel firms existing in both periods 2004 and 2008. The evolution of labor and capital can be written as:[8]

$$\tilde{\ln} l^{08} = g + \ln l^{04} - \lambda\left(\ln\left(k^{08}/l^{08}\right) - \ln\left(k^{04}/l^{04}\right)\right) \quad (13)$$

$$\tilde{\ln} k^{08} = g + \ln k^{04} + (1-\lambda)\left(\ln\left(k^{08}/l^{08}\right) - \ln\left(k^{04}/l^{04}\right)\right) \quad (14)$$

Where g is the net growth effect to be estimated, $\ln l^{04}$ and $\ln k^{04}$ stand for initial labor and capital in year 2004; $\tilde{\ln} l^{08}$ and $\tilde{\ln} k^{08}$ stand for the predicted labor and capital in year 2008 due to the substitute effect provided that firms follow a homogenous growth rate g.

Based on parameters (λ, g) and equations (13) and (14), we can predict the firm size in 2008, $\tilde{\ln} k^{08}$ for capital and $\tilde{\ln} l^{08}$ for labor of the same firm, since all the information on labor and capital for the survivors in 2004 and 2008 are available. The parameter pairs (λ, g) can be determined by fitting FSD of $\ln k^{08}$ and FSD of the panel firm's capital in 2008, and fitting the FSD of $\ln l^{08}$ and the FSD of panel firm's labor according to the following fitness index.

$$fitness = \frac{\sum_{i=1}^{N}\left|f_{08}(s_i) - \tilde{f}_{08}(s_i)\right| + \sum_{i=1}^{N}\left|h_{08}(s_i) - \tilde{h}_{08}(s_i)\right|}{\sum_{i=1}^{N}\left|f_{04}(s_i) - f_{08}(s_i)\right| + \sum_{i=1}^{N}\left|h_{04}(s_i) - h_{08}(s_i)\right|}$$

$f_{04}(s)$, $f_{08}(s)$, and $\tilde{f}_{08}(s)$ are the actual observed density functions in 2004, 2008, and the predicted one based on model of capital, while h corresponds to density of labor. We estimated the parameters (λ, g) so as to minimize the value of "fitness". In specific, we tried to estimate the parameters so that the predicted distributions $\tilde{f}_{08}(s_i)$, $\tilde{h}_{08}(s_i)$ are as close to the observed ones $f_{08}(s_i)$, $h_{08}(s_i)$ as possible.

The fitness is about 0.45. This means that 55% of the difference in the distributions between $f_{04}(s)$ and $f_{08}(s)$ can be explained by our model.

[8] The implicit assumption is that the net growth rate is independent of the firm size, equivalent to the Gibrate Law. Even under this simple assumption, we can fit distribution curve well after including the substitution effect.

The estimated values are $\hat{\lambda} = 0.38$ and $\hat{g} = 0.115$. The simulated density curves based on the two parameters are displayed in Figure 6. It is apparent the simulated density function for the survivors firms closely resembles the actual distribution.

Based on the simulated density curve, we calculated the substitution effect for labor and capital based on equations 11 and 12. We found that the substitution effect due to relative price change accounts for about 13% of the actual increase in employment, while it explains 25% of the increase in capital. Clearly enterprises adjust both capital and labor in response to rising wages.

5. Conclusion

Using two recent economic censuses in China, we found that firm sizes measured in employment have declined, while average firm sizes in capital have increased. There are at least two possible explanations to the observed pattern. One is related to the enactment of the new labor law in China. In face of tougher labor standards, firms may be more reluctant to hire workers. The second hypothesis stipulates that firms are induced to invest more on capital to substitute the increasingly more expensive workers. To test the two hypotheses, we compared the growth rate in foreign and domestic private firms in the period of 2004-2008. The foreign firms have not increased their labor force any faster than domestic private enterprises despite their relatively low cost of meeting the new labor law. This evidence largely refutes the labor-law hypothesis. Firm's initial capital-labor ratio is strongly positively correlated with its subsequent employment growth in consistent with the prediction of the rising wage hypothesis.

In addition, we developed a framework to decompose the change in firm size into several components — exit, growth and entry effects. By looking at the three effects in relation to firm size, we found that the small firms are more dynamic in both exits and entries. The survival firms have mainly maintained their growth through capital input rather than labor input. Given the imminent pressure of rising wages in China, it is expected the trend of substitution of capital for labor will continue in the foreseeable future.

Reference

[1]. Angelini, P. & Generale, A., 2008, On the evolution of firm size distributions. The American Economic Review, 98(1): pp. 426-438.

[2]. Aghion, P., Fally, T. & Scarpetta, S., 2007, Credit Constraints as a Barrier to the Entry and Post Entry Growth of Firms, Economic Policy, 22(52): pp. 731-779.

[3]. Axtell, R. L., Zipf distribution of US firm sizes. Science, 2001. 293(5536): pp. 1818-1820.

[4]. Jovanovic, B., 1982, Selection and the Evolution of Industry. Econometrica, 50(3): pp. 649-670.

[5]. Cabral, L.M. & Mata J., On the evolution of the firm size distribution: Facts and theory. American Economic Review, 2003: 98(1): pp. 1075-1090.

[6]. Chen, Y. Y., Tian, G. F. & Wang, L., Industry Life-cycle Evolution and Firm Size Distribution: An Empirical Research Based on China's Manufacturing Industry. Review of Industrial Economics, 2013(2): pp. 100-116.

[7]. Cooley, T. F. & Quadrini, V. 2001, Financial Markets and Firm Dynamics. The American Economic Review, 91(5): pp. 1286-1310.

[8]. Dasgupta, K., 2010, The Missing Middle in Developing Countries Revisited. http://www.economics.utoronto.ca/kdasgupta/draft_mm.pdf

[9]. David, S., 1987, Tests of Alternative Theories of Firm Growth. Journal of Political Economy, 95(4): pp. 657-674.

[10]. Dixit, A., 1989, Entry and Exit Decision under Uncertainty. Journal of Political Economy, 97(3): pp. 620-638.

[11]. Guimaraes, P. and P. Portugal, A simple feasible procedure to fit models with high-dimensional fixed effects. Stata Journal, 2010. 10(4): p. 628.

[12]. Holtz-Eakin, D., Joulfaian D. & Rosen, H. S., 1994, Sticking it out: Entrepreneurial Survival and Liquidity Constraints, Journal of Political Economy, 102(1): pp. 53-75.

[13]. Evans, D. S. 1987, The Relationship between Firm Growth, Size, and Age: Estimates for 100 manufacturing Industries. The Journal of Industrial Economics, 35(4), pp. 567-581.

[14]. Fang，M.Y., Nie, H. H., The Stylized Facts of Size Distribution of China Manufacturing Industries: A Perspective of Zipf's Law. Review of Industrial Economics, 2010(02): pp.1-17.

[15]. Garcia-Santana, M. and R. Ramos, Dissecting the size distribution of establishments across countries, in CEMFI Working Paper. 2012.

[16]. Gao, B. J. & Mao, H. Y., Size Distribution of Chinese Listed Companies—Based on the data of 2000-2011, Luojia Management Review, 2011(1): 125-134.

[17]. Jovanovic, D. S.,1989, An Estimated Model of Entrepreneurial Choice under Liquidity Constraints. Journal of Political Economy , 97(4): pp. 808-827.

[18]. Robert E.Lucas, J. 1978, On the Size Distribution of Bussiness. The Bell Journal of Economics, 9(2): pp. 508-523 .

[19]. Luttmer, E.G.J., 2007, Selection, Growth, and the Size Distribution of Firms. The Quarterly Journal of Economics, 122 (3): p. 1103-1144.

[20]. Pashigian, S. H., 1962, Firm Size and Rate of Growth. Journal of Political Economy, 70(6): pp. 556-569.

[21]. Shi, J., 2010, Character and Shape of te Chinese Firm Size Distribution. East China Economic Management, 24(12): pp. 51-55.

[22]. Tybout, J.R., 2000, Manufacturing firms in developing countries: How well do they do, and why? Journal of Economic literature, 38(1): p. 11-44.

[23]. Yang, Qijing, Li, Xiaobin & Fang, Mingyue, 2010, Market, Government and Firm Size Distribution: An Empirical Study, World Economic Papers, 1: 1: 15.

[24]. Zhang, J. H., Chen, Q. H. & Wang, Y. G., 2009, Zipf distribution in top Chinese firms and an economic explanation. Physica A: statistical Mechanics and its applications, 388(10): pp. 2020-2024.

[25]. Zhang, X. B., Yang, J. & Wang, S. L., China has reached the Lewis Turning Point. China Economic Review, 22(4): pp. 542-554.

[26]. Wei, Shang-jin and Xiaobo Zhang, 2011. "Sex Ratios, Entrepreneurship, and Economic Growth in the People's Republic of China." National Bureau of Economic Research Working Paper No. 16800.

Appendix Technical Note
Capital-Labor Substitution in the Face of Rising Wages

Firm *i*'s production function in time *t* can be written as:

$$y_{i,t} = A(\varepsilon_{i,t})\left(aK_{i,t}{}^{\sigma_i} + (1-a)L_{i,t}{}^{\sigma_i}\right)^{\frac{\theta}{\sigma_i}}$$

where $\theta \in (0,1)$ is a parameter to ensure the existence of optimal firm size; $A(\varepsilon_{i,t})$ is total factor productivity in response to exogenous shock $\varepsilon_{i,t}$. Parameter $\sigma \in (0,1)$. $e = \frac{1}{1-\sigma}$ stands for the capital-labor substitution elasticity between capital and labor.

If writing the interest rate of capital and wage rate as $r_{i,t}$, $w_{i,t}$, a firm maximizes its profit:

$$\max A(\varepsilon_{i,t})\left(aK_{i,t}{}^{\sigma_i} + (1-a)L_{i,t}{}^{\sigma_i}\right)^{\frac{\theta}{\sigma_i}} - r_{i,t}K_{i.t} - wL_{i,t}$$

The first-order conditions imply:

$$\frac{a\theta K_{i,t}{}^{\sigma_i-1}}{aK_{i,t}{}^{\sigma_i} + (1-a)L_{i,t}{}^{\sigma_i}} y_{i,t} = r_{i,t} \qquad 1$$

$$\frac{(1-a)\theta L_{i,t}{}^{\sigma_i-1}}{aK_{i,t}{}^{\sigma_i} + (1-a)L_{i,t}{}^{\sigma_i}} y_{i,t} = w_{i,t} \qquad 2$$

Total capital income is $\theta y_{i,t}$, while $(1-\theta) y_{i,t}$ is the proportion of income by firm owners. Based on (1) and (2), we can derive the following:

$$\frac{a}{(1-a)} \frac{K_{i,t}{}^{\sigma_i-1}}{L_{i,t}{}^{\sigma_i-1}} = \frac{r_{i,t}}{w_{i,t}} \qquad 3$$

That is,

$$\frac{d\ln\left(L_{i,t}/K_{i,t}\right)}{d\ln\left(w_{i,t}/r_{i,t}\right)} = -\frac{1}{1-\sigma_i} = -e_i$$

Where $e_i = \frac{1}{1-\sigma_i}$ represents the technology elasticity of substitution between labor and capital.

We can write the change in capital-labor ratio as:

$$\ln\left(L_{i,t+1}/L_{i,t}\right) - \ln\left(K_{i,t+1}/K_{i,t}\right) = -e_i\left[\ln w_{i,t+1}/r_{i,t+1} - \ln w_{i,t}/r_{i,t}\right] \qquad 4$$

The term $\ln w_{i,t+1}/r_{i,t+1} - \ln w_{i,t}/r_{i,t}$ stands for the change in the relative price from periods t to t+1.

It is apparent the change is proportion to e_i. Given the same wage escalation, the substitution effect will greater among firms with a larger e_i. Normally labor intensive industries have larger e_i than capital-intensive industries. Therefore, the substitution effect of capital for labor is more evident in labor-intensive industries than capital-intensive ones in the face of rising wages.

Even without assuming that e_i is related to the degree of capital intensity in an industry, we can also reach the same finding as above. We write equation (3) as:

$$\frac{L_{i,t}}{K_{i,t}} = \left(\frac{(1-\alpha) r_{i,t}}{a w_{i,t}} \right)^{e_i} \qquad 5$$

Let's further rewrite above equation 5 as:

$$e_i = \frac{\ln(L_{i,t}/K_{i,t})}{\ln(1-\alpha) r_{i,t}/a w_{i,t}} \qquad 6$$

Putting equation 6 back into equation 4, we obtain the following equation:

$$\ln\left(L_{i,t+1}/L_{i,t}\right) - \ln\left(K_{i,t+1}/K_{i,t}\right) = \ln(L_{i,t}/K_{i,t}) \left[\frac{\ln a w_{i,t+1}/(1-\alpha) r_{i,t+1}}{\ln a w_{i,t}/(1-\alpha) r_{i,t}} - 1 \right] \qquad 7$$

Because $\ln a w_{i,t+1}/(1-\alpha) r_{i,t+1} > \ln a w_{i,t}/(1-\alpha) r_{i,t}$, $\frac{\ln a w_{i,t+1}/(1-\alpha) r_{i,t+1}}{\ln a w_{i,t}/(1-\alpha) r_{i,t}} \prec 1$. Thus the direction of change in the above equation depends solely upon the initial capital-labor ratio.

1）For labor-intensive industries, $\ln(L_{i,t}/K_{i,t}) \succ 0$， the change in labor will be slower than change in capital.

2) For capital-intensive industries, $\ln(L_{i,t}/K_{i,t}) \prec 0$， we will observe a more rapid change in labor than in capital.

The patterns on the changes in capital and labor in relation to initial capital-labor ratio shown in Figure 5 confirm the above predictions.

Table 1 Average Firm Employment and Capital by Type in 2004 and 2008

Firm type	Employment				Capital			
	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								
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

Note: Calculated by authors based on China Economic Censuses in 2004 and 2008. Employment and capital are in expressed in natural logarithm. All the labor-intensive and capital intensive firms are domestic private firms.

Table 2 Decomposition of the Changes in Firm Size from 2004 to 2008

	Mean	Top 25th percentile	Median	Bottom 25th percentile
Panel A: Employment				
Change in 2004-2008 (%)	-9.90	0	-4.88	-12.78
Selection	19.01	18.23	21.36	26.24
Growth	-1.22	0	0	0
Entry	-27.68	-18.23	-26.24	-39.02
Panel B: Capital				
Change in 2004-2008 (%)	25.32	28.85	25.77	16.89
Selection	34.68	26.75	30.41	39.57
Growth	36.94	34.59	35.61	41.78
Entry	-46.29	-32.49	-40.25	-64.46

Note: Calculated by authors based on China Economic Censuses in 2004 and 2008. Employment and capital are in expressed in natural logarithm.

Table 3 DID Estimations for Employment: Foreign vs. Private Enterprises

	(1)	(2)	(3)	(4)	(5)	(6)
Year(=2008)	-0.076***	-0.058***	-0.081***	-0.091***	-0.068***	-0.085***
	(0.017)	(0.015)	(0.017)	(0.017)	(0.014)	(0.014)
Foreign	1.338***	1.247***	1.370***	1.412***	1.260***	1.294***
	(0.046)	(0.025)	(0.037)	(0.031)	(0.023)	(0.022)
Year*foreign	0.037*	0.040**	0.044**	0.040**	0.051***	0.045***
	(0.020)	(0.016)	(0.021)	(0.020)	(0.015)	(0.015)
Age fixed effect	yes	yes	yes	yes	yes	yes
Regional fixed effect			province	county	province	county
4-digit industry fixed effect		yes			yes	yes
Observations	2,159,353	2,159,353	2,159,353	2,159,353	2,159,353	2,159,353
adjusted R2	0.087	0.179	0.108	0.165	0.198	0.246
AIC	634,3951	6,114,438	6,291,798	6,146,299	6,064,127	5,930,033

Notes: Robust standard error in parentheses; * p<0.1, ** p<0.05, *** p<0.01. In order to reduce the computation time, for firms over 30 years old, we set its age to 30. Since very few firms are older than 30 years, such a restriction should have minimal effect on our results. The results remain hold when we drop the fixed effects of firm age.

Table 4 DID estimation for Employment:

Newly Established Foreign vs. Private Enterprises

	(1)	(2)	(3)	(4)	(5)	(6)
Year(=2008)	-0.089***	-0.067***	-0.108***	-0.124***	-0.087***	-0.117***
	[0.015]	[0.014]	[0.015]	[0.015]	[0.013]	[0.012]
Foreign	1.102***	1.057***	1.130***	1.184***	1.055***	1.089***
	[0.046]	[0.027]	[0.038]	[0.030]	[0.024]	[0.021]
Year*foreign	-0.092***	-0.070***	-0.085***	-0.077**	-0.062**	-0.057**
	[0.032]	[0.026]	[0.032]	[0.032]	[0.026]	[0.026]
Age fixed effect	yes	yes	Yes	yes	yes	yes
Regional fixed effect			province	county	province	county
4-digit industry fixed effect		yes			yes	yes
Observations	478,042	478,042	478,042	478,042	478,042	478,042
adjusted R2	0.041	0.139	0.085	0.169	0.175	0.25
AIC	1,350,986	1,298,698	1,328,406	1,279,510	1,279,090	1,233,287

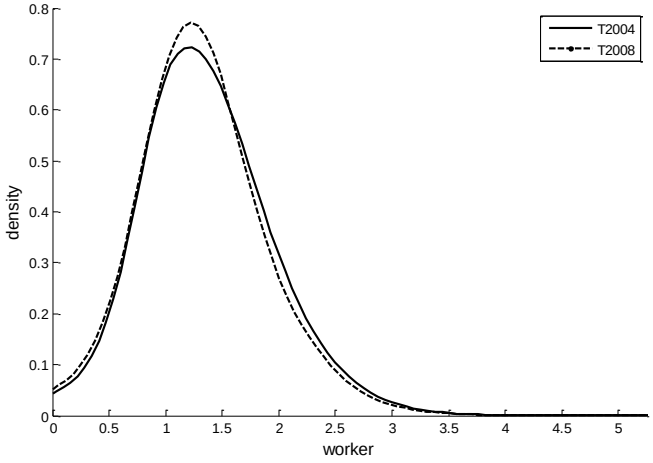
Notes: Robust standard error in parentheses; * p<0.1, ** p<0.05, *** p<0.01. In order to reduce the computation time, for firms over 30 years old, we set its age to 30. Since very few firms are older than 30 years, such a restriction should have minimal effect on our results. The results remain hold when we drop the fixed effects of firm age.

Table 5 Growth in Employment:

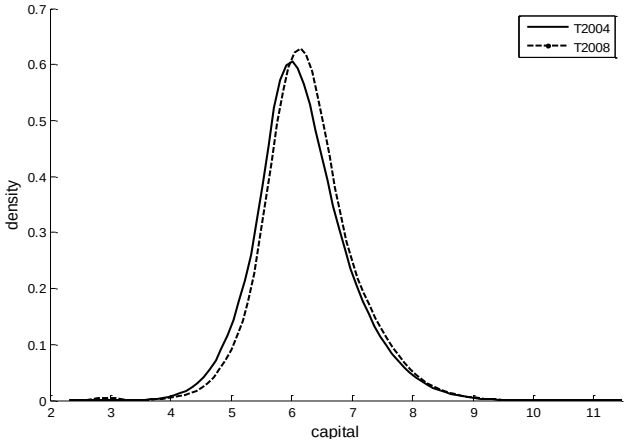
Survival Foreign vs. Private Enterprises

	(1)	(2)	(3)	(4)	(5)	(6)
Foreign	0.024	0.062***	0.072***	-0.121***	-0.101***	-0.075***
	（0.018）	（0.015）	（0.012）	（0.010）	（0.009）	（0.008）
Ln(capital/labor) in 04				0.159***	0.197***	0.157***
				（0.005）	（0.004）	（0.004）
Age fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effect		Yes	Yes		Yes	Yes
SIC4 ind. fixed effect			Yes			Yes
Observations	456,645	456,645	456,645	456,645	456,645	456,645
Adjusted R2	0.006	0.055	0.074	0.052	0.115	0.114
AIC	1,079,653	1,053,828	1,047,360	1,058,203	1,024,107	1,027,059

Notes: Robust standard error in parentheses; * p<0.1, ** p<0.05, *** p<0.01. In order to reduce the computation time, for firms over 30 years old, we set its age to 30. Since very few firms are older than 30 years, such a restriction should have minimal effect on our results. The definition of labor-intensive industries is drawn from Qu et al. (2013).



Panel A: Firm Size Measured in Employment



Panel B: Firm Size Measured in Capital

Figure 1 Firm Size Distribution Measured by Employment and Capital in 2004 and 2008

Note: Plotted by authors based on China Economic Censuses in 2004 and 2008. Capital stock in 2008 is deflated by 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.

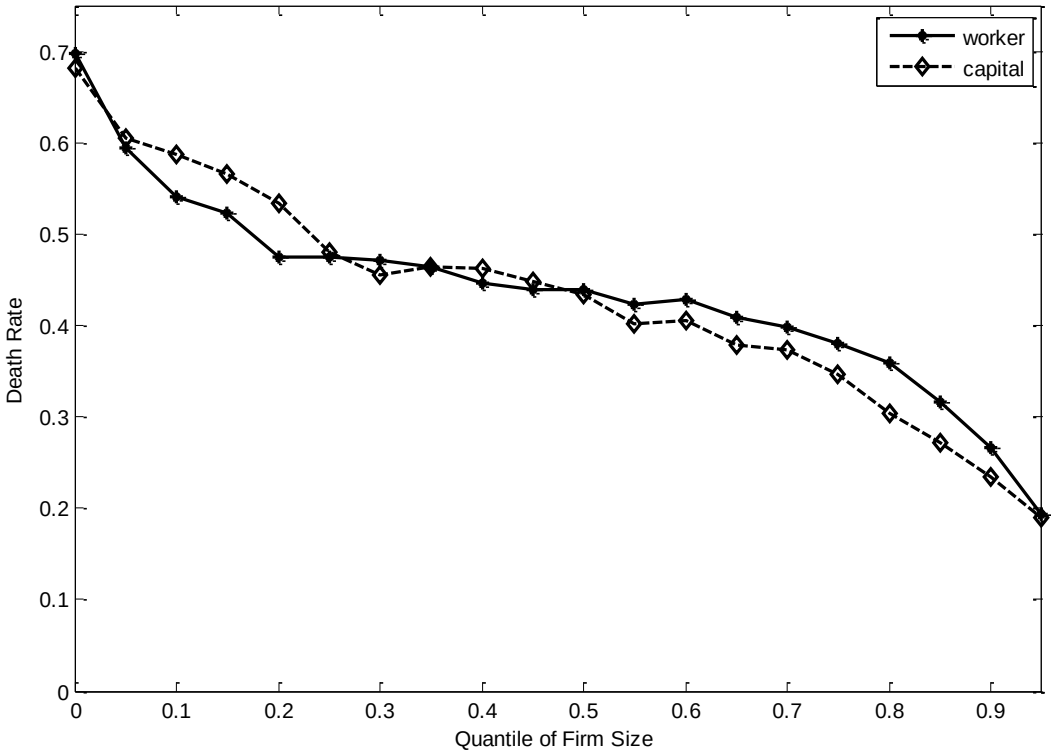


Figure 2 Firm Death Rates by Size

Note: Firms are divided into 20 quantiles with equal size either according to employment or capital. The x-axis stands for the 20 quantiles in ascending order. The y-axis displays the average death rate at each quantile.

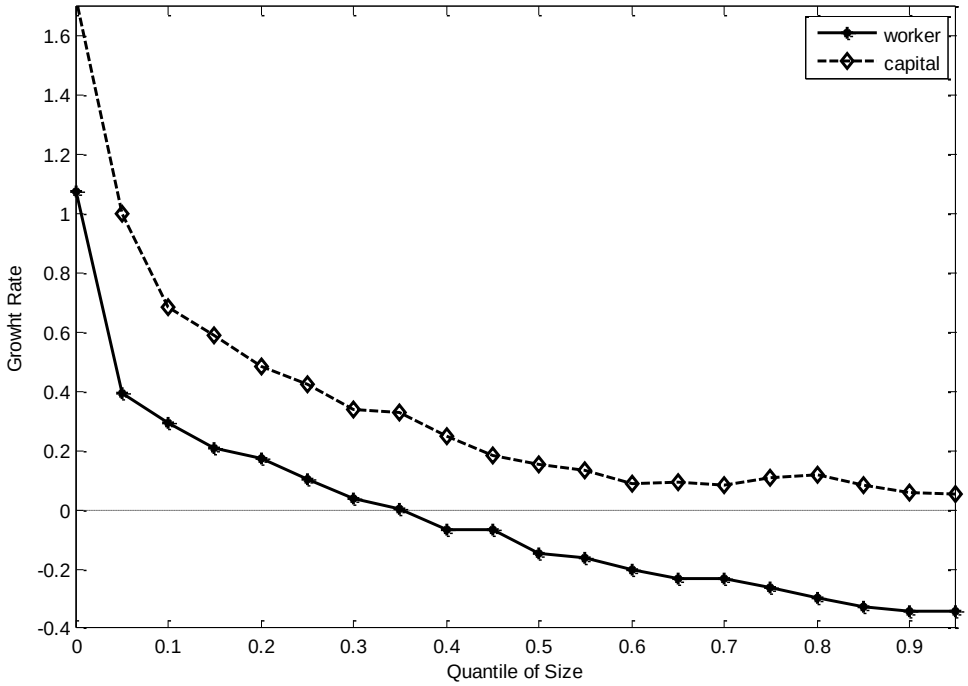


Figure 3 Firm Growth Rates by Size

Note: Firms are divided into 20 quantiles with equal size either according to employment or capital. The x-axis stands for the 20 quantiles in ascending order. The y-axis displays the average growth rate at each quantile.

Figure 4 Firm Entry Rate by Size

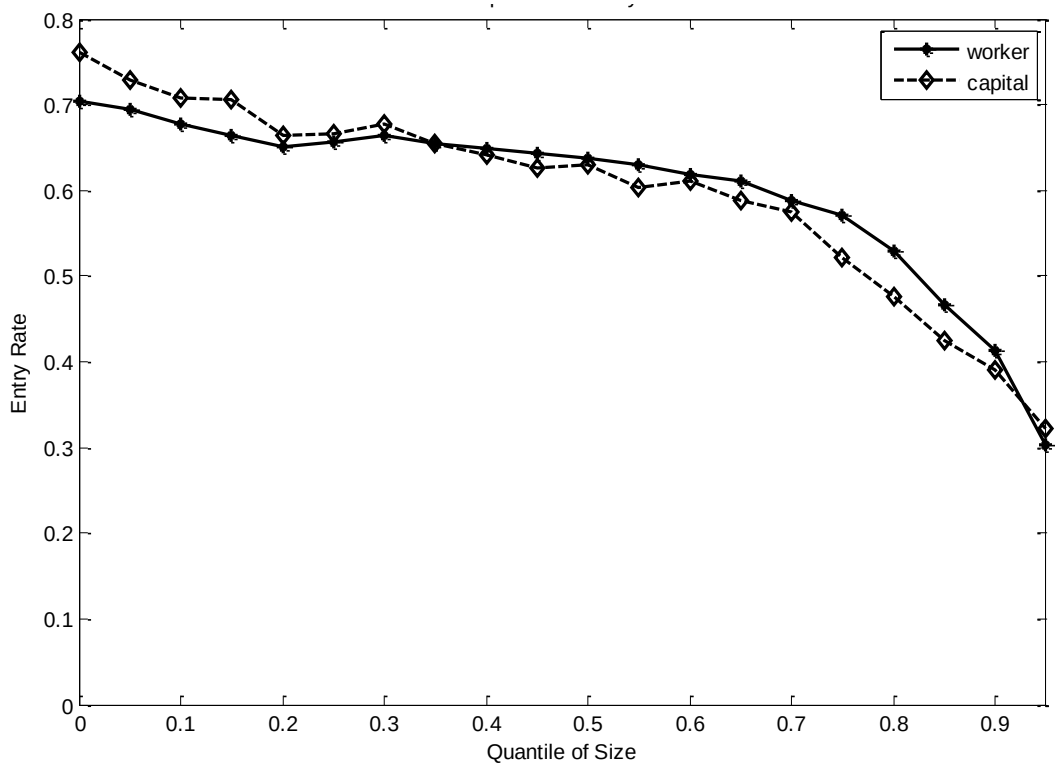


Figure 4 Firm Entry Rates by Size

Note: Firms are divided into 20 quantiles with equal size. The x-axis stands for the 20 quantiles in ascending order. The y-axis displays the average entry rate at each quantile.

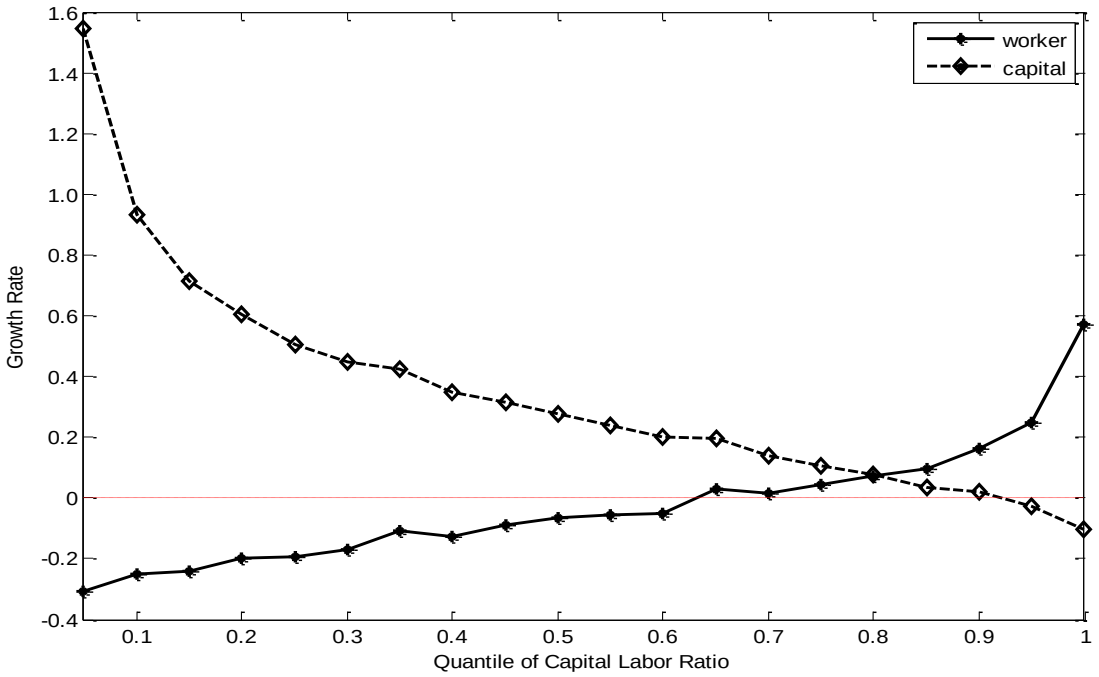
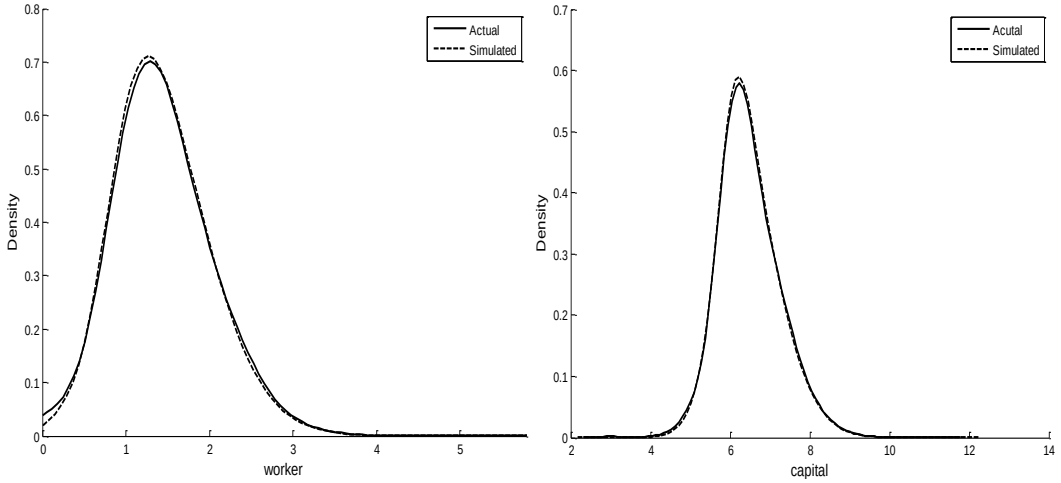


Figure 5 Growth Rates by Capital Labor Ratio

Note: Firms are divided into 20 quantiles with equal size. The x-axis stands for the 20 quantiles in ascending order. The y-axis displays the average growth rate measured in employment or capital at each quantile.



Panel A. Simulations for the Survivors (capital) Panel B. Simulations for Survivors (labor)

Figure 6 Simulated and Actual Firm Size Distributions in 2008

Note: The sample includes surviving firms from 2004 to 2008. The dash line represents the simulated FSD in 2008, while the bold line stands for the actual FSD in 2008 of the survivors.