

Trade Liberalisation, Increased Competition and Skilled-Unskilled Wage Gap in China's Manufacturing Sector

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Abstract

Economic reforms of the late 1980s have contributed to rapid economic growth in China. While the overall standard of living has improved, economic growth has also resulted in an increase in income inequality. Rising income inequality can increase social tensions that can impede further economic growth. By making use of firm level panel data, this paper focuses on the impact of increased market competition and trade liberalisation on skilled-unskilled wage gap in China. A theoretical model is used to argue that trade liberalisation and market competition can affect skilled-unskilled wage gap. Based on this result, an econometric model is specified. The empirical analysis presented in this paper shows that increased trade liberalisation has contributed to an increase in skilled-unskilled wage gap in China. However, increased market competition has the opposite effect.

Key Words: Wage inequality, Trade liberalisation, China

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1. Introduction

The current period of openness and global integration has witnessed rapid economic growth accompanied by massive inflow of foreign investment in China.¹ The structure of the Chinese economy has significantly changed – the contribution of the private sector to GDP is now more than 70%. It is widely believed that economic reforms have reduced the overall level of poverty in China and the standard of living of millions of Chinese workers has also improved.² However, economic growth has resulted in rising income inequality. Income inequality in China can be viewed from a number of perspectives – inequality in different regions (e.g., coastal versus inland areas or eastern versus western provinces), urban-rural wage gap, skilled-unskilled wage gap, etc.³

This paper focuses on skilled-unskilled wage gap in China's manufacturing sector. Specifically, we consider the role of trade liberalisation and increased market competition. A number of existing studies have attempted to identify various determinants of skilled-unskilled wage gap. However, none of the existing studies have empirically examined the impact of these factors on skilled-unskilled wage gap in China's manufacturing sector.

The empirical analysis, which is the main contribution of this paper, is based on a theoretical model. The theoretical model, which is based on existing studies, shows that trade liberalisation and market competition can affect the skilled-unskilled wage gap. Based on the theoretical model, an econometric model is specified. The econometric model is estimated by making use of a dataset that covers a large number of Chinese firms in 2000, 2003 and 2006.

¹ Starting from 1949, the Chinese economic history can be divided into six periods: (1) Revolution and Land Reforms period of 1949-56, (2) the Great Leap Forward and the Great Famine of 1957-61, (3) post Famine Recovery period of 1962-65, (4) Cultural Revolution and transition to reform period of 1966-78, (5) rural reform period of 1979-84, and (6) Openness and Global Integration period that started in 1985.

² The per-capita income of China increased from US\$1,740 in 2006 to US\$3,556 in 2009.

³ For example, Fleisher et al. (2010) consider the impact of FDI and investment in human capital on regional income inequality in China. They conclude that investment in human capital in less-developed areas can reduce regional income inequality. Ramasamy and Yeung (2010) suggest that FDI through increase in productivity has contributed to increase in wages in China - the coastal areas due to better quality infrastructure and the availability of better trained workers have witnessed a large increase in wages. The coastal areas account for a major proportion of the GDP. The Pearl River delta, located on the southeast coast, is believed to be home to some of China's richest people. While the Eastern provinces are experiencing strong growth, the central (excluding Hunan, Hubei and Jiangxi) and western provinces are lagging behind (see Ramstetter *et al.*, 2009). Ma (2006) considers regional economic inequality in China arising from trade flows associated with foreign direct investment.

A number of recent theoretical and empirical studies have attempted to examine the impact of globalisation and trade liberalisation on wage inequality between the skilled and unskilled workers in developed as well as developing countries. By making use of a standard Heckscher-Ohlin model, Kremer and Maskin (2003) argue that trade liberalisation increases wage inequality in developed countries but its effect on wage inequality in developing countries is the opposite. Marjit and Kar (2005) show that, contrary to the general belief, emigration of both skilled and unskilled workers from a developing economy can increase wage inequality. Chaudhuri and Yabuuchi (2007) suggest that in the presence of labour market imperfections, a reduction in import tariff on low-skilled manufacturing sector can contribute to wage inequality.

As far as empirical studies are concerned, Taylor and Driffield (2005) consider the link between wage inequality and foreign direct investment (FDI) in the UK. They argue that on the average approximately 11% of wage inequality in the UK can be attributed to FDI. Chung and Kin (2007) argue that the growing wage inequality in the US can be attributed to skill-biased technological change. Verhoogen (2008) argues that firms that are attempting to produce higher quality products tend to hire highly skilled workers. These workers are paid higher wages which can account for rising wage inequality. The empirical analysis presented in this paper is based on data from Mexico. Breau and Rigby (2010) consider the issue of skilled-unskilled wage inequality in Canada. They argue that import competition from low-income countries has contributed to increased wage inequality in Canada. Bustos (2011) argues that trade liberalisation can induce productive firms to utilise skilled-biased technologies which has contributed to wage inequality in Brazil.⁴

Studies that consider the determinants of skilled-unskilled wage gap in China include Wu (2001). By making use of a general equilibrium model involving imperfect competition, Wu argues that foreign investment in China's differentiated sectors tends to increase the skilled-unskilled wage gap. Wu further argues that increase in the wage gap will be smaller if China

⁴ Other important studies that consider the issue of wage inequality include Beyer, Rojas and Vergara (1999), Das (2002), Feenstra and Hanson (2003), Marjit, Beladi and Chakrabarty (2003), Das (2005), Chamarbagwala (2006), Long, Riezman and Soubeyran (2007), Yabuuchi and Chaudhuri (2007), Chaudhuri (2008), Gupta and Dutta (2010), Beladi and Chao (2010) and Chaudhuri and Banerjee (2010). Some of these studies argue that globalisation has resulted in increased competition which along with trade liberalisation has contributed to rising wage inequality between skilled and unskilled workers. It is suggested that technological improvement and technology transfer arising from foreign investment in host countries is skill-biased and hence foreign investment and the associated spillovers boost productivity thereby increasing wages. As the skilled workers are relatively more productive, foreign investment is likely to increase the wage gap.

enforces stricter protection of intellectual property rights. However, Wu's empirical work is not based on any rigorous statistical methods. Zhao (2001) argues that foreign firms operating in China tend to pay higher wages to skilled workers as compared to the wages paid by local firms including the state owned enterprises. By making use of household survey data from 1988 and 1995, Knight and Song (2003) consider the impact of labour market reforms on urban wage inequality in China. By making use of panel data from 1986 to 2001, Owen and Yu (2003) argue that export oriented FDI has contributed to wage inequality in China. Li (2008) suggests that proximity to large markets can account for wage inequality in China. Liu *et al.* (2010) utilise data on 2,884 Chinese firms over the period 1993-1996 to consider the effect of FDI on wages. They argue that the relationship is affected by the degree of skill intensity of FDI. By making use of a general equilibrium model, Mitchener and Yan (2010) examine the skilled-unskilled wage gap in China during the 20th century. They argue that during the early part of the 20th century, Chinese exports became more unskilled labour intensive and hence during the 1920s, the wage gap between the skilled and unskilled workers in China fell by approximate 8%.

The empirical methodology used in this paper is not very different from the existing studies. For example, Taylor and Driffield (2005) use a cost function as a basis for their econometric model. The cost of production in their model depends on the wage rate, stock of capital, output and technology. Verhoogen (2008) used a general equilibrium model to establish a link between the variables of interest. Based on the equilibrium conditions, an econometric model is specified. As compared to the existing empirical studies, the theoretical framework presented in this paper is a little more general and factor market equilibrium conditions are also specified. The cost/profit conditions that are also used by other studies determine the output market equilibrium. Combining these conditions with factor market clearing conditions allows one to derive a general reduced form solution for the equilibrium wage gap, which is used as a basis for specification of an econometric model in this paper.

The rest of this paper is organised as follows. Section 2 contains a theoretical model which is used to argue that trade liberalisation and market competition can affect skilled-unskilled wage gap. Based on the theoretical framework, an econometric model is specified in Section 3. This section also contains data description. Empirical results are presented in Section 4 whereas Section 5 contains some concluding remarks.

2. Determinants of Skilled-Unskilled Wage Gap: A Theoretical Framework

By making use of the existing theoretical literature, such as Anwar (2010) and Anwar and Rice (2009), the purpose of this section is to provide a theoretical foundation for the econometric model that will be estimated in section 3.⁵ Consider an economy that produces two traded goods (Z and Y). Z is an importable whereas Y is an exportable good. Z is produced by means of capital and unskilled labour, whereas Y is produced by means of capital, skilled labour and a large number of varieties of producer services. Examples of such services include consulting, auditing, engineering and legal services. These services are primarily utilised by sector Y and therefore they do not enter as input into the production of the imported good. A number of existing studies such as Redding and Venables (2004) have highlighted the role played by the services sector in real economies. Each variety of the non-traded producer services is produced by means of capital and skilled labour. Following the existing studies, inter-sector differences in factor intensities are captured in an extreme manner, namely sector Y is skilled labour intensive whereas sector Z is unskilled labour intensive. The production functions are as follows:

$$Y = (L_y^{1-\beta} K_y^\beta)^{1-\alpha} \left(\sum_{i=1}^n x_i^\delta \right)^{\frac{\alpha}{\delta}}$$
$$Z = L_z^{1-\theta} K_z^\theta$$

where α , β , θ and δ are parameters in the range $[0,1]$; x_i is the output of the i th variety of producer services sector; n is the number of varieties produced by the services sector and L and K are labour and capital inputs used in the production of the final goods.

The production of both final goods is subject to constant returns to scale. On the other hand, production of each variety of producer services is subject to internal economies of scale. Accordingly, each firm specialises in the production of a single variety. The cost function of the i th variety is as follows:

$$c(w_s, r, x_i) = r\mu + w_s(\lambda x_i)$$

where r and w_s respectively are the price of capital and the skilled wage rate; λ is a positive constant and μ is the amount of capital used by each firm in the services sector.

⁵ We use a minimalist model to establish a link between (i) trade liberalisation and skilled-unskilled wage gap and (ii) market competition and skilled-unskilled wage gap. We do not claim that this model adequately captures all aspects of the Chinese economy.

The above specification implies that the fixed cost involves capital and the variable cost involves skilled labour. Similar cost function has been used by other studies such as Marrewijk, Sitobra, Vaal and Viaene (1997). It is well-known that the production function corresponding to the above cost function is non-homogenous. Following the existing literature, we consider a symmetric equilibrium so that this paper focuses on a symmetric equilibrium where the price elasticity of demand for each variety is fixed. Varieties of producer services are produced under conditions of monopolistic competition. The following condition determines the equilibrium output of the exportable good industry, where p is the price of producer services and $\Theta = \alpha^{-\alpha} \beta^{-\beta(1-\alpha)} (1-\alpha)^{-(1-\alpha)} (1-\beta)^{-(1-\alpha)(1-\beta)} > 0$.

$$1 = \Theta \left[w_s^{1-\alpha-\beta(1-\alpha)} \right] \left[r^{\beta(1-\alpha)} \right] \left[\frac{p^\alpha}{n^{\frac{\alpha(1-\delta)}{\delta}}} \right] \quad (1)$$

The right-hand side of equation (1) is the unit cost of production whereas the left-hand side is the price of the exportable good and all prices are measured in the units of the final good Y . An increase in the number of varieties decreases the effective price of producer services and hence average cost of the exportable good decreases. If the services sector is active in equilibrium then the following first order condition must hold

$$\delta p = \lambda w_s^{1-\theta} r^\theta \quad (2)$$

Equation (2) is the usual profit maximisation condition which shows that marginal revenue equals marginal cost. The optimal output of sector Z is determined by the following zero profit condition, where q is price of Z which is determined in the international market and t is the amount of import duty.

$$q(1+t) = \left[\theta^{-\theta} (1-\theta)^{-(1-\theta)} \right] w_u^{1-\theta} r^\theta \quad (3)$$

The market clearing condition for skilled labour, which is assumed to be in fixed supply (L_s), is as follows:

$$n \left[\lambda x \right] + \Theta (1-\alpha)(1-\beta) \left[\frac{w_s}{r} \right]^{-\beta(1-\alpha)} \left[\frac{w_s}{p} \right]^{-\alpha} \left[\frac{Y}{n^{\frac{\alpha(1-\delta)}{\delta}}} \right] = L_s \quad (4)$$

The first and the second terms on the left-hand side of equation (4), respectively, are the demand for skilled labour in the services and exportable good sector.

The market clearing condition for unskilled labour, which is assumed to be in fixed supply (L_u) is as follows, where the left hand side is the demand for unskilled labour in the sector Z .

$$\left[\frac{\theta}{1-\theta} \right]^{-\theta} \left[\frac{w_u}{r} \right]^{-\theta} Z = L_u \quad (5)$$

The market clearing condition for capital, which is assumed to be in fixed supply (K) is as follows, where the left-hand side of equation (6) is demand for capital.

$$n\mu + \left[\frac{\theta}{1-\theta} \right]^{1-\theta} \left[\frac{w_u}{r} \right]^{1-\gamma} Z + \Theta [\beta(1-\alpha)] \left[\frac{w_s}{r} \right]^{1-\beta(1-\alpha)} \left[\frac{w_s}{p} \right]^{-\alpha} \left[\frac{Y}{n \frac{\alpha(1-\delta)}{\delta}} \right] = K \quad (6)$$

The first, the second and the third terms on the left hand side of equation (6) respectively are demand for capital in the services sector (nK_x), sector Z (K_z) and the exportable good sector (K_y).

The market clearing condition for the output of the services sector is as follows, where the left-hand side of equation (7) is the demand for producer services and the right hand side is the aggregate supply.

$$(\Theta\alpha) \left[\frac{w_s}{r} \right]^{-\beta(1-\alpha)} \left[\frac{w_s}{p} \right]^{1-\alpha} \left[\frac{Y}{n \frac{\alpha(1-\delta)}{\delta}} \right] = nx \quad (7)$$

This completes the description of the shortrun equilibrium where equations (1) to (7) are seven equations in seven endogenous variables; Y , Z , x , r , w_s , w_u , and p . t , q , n , K , L_s and L_u are exogenous variables. In other words, a number of factors such as the tariff rates and the number of firms in the industry can affect skilled and unskilled wage and hence the wage gap between skilled and unskilled workers in the shortrun. Following the existing literature, the wage gap is measured by skilled-unskilled wage ratio.

Within the context of the shortrun equilibrium, the impact of an increase in competition in the domestic market can be examined in two ways: (a) an exogenous increase in the number of firms in the services sector and (b) an exogenous decrease in services sector's fixed cost. The impact of trade liberalisation can be examined by means of a decrease in the amount of import duty on the importable good Z . It is clear that an increase in the level of competition and trade liberalisation can affect the skilled and unskilled wage rate and hence the wage gap in the shortrun. For example, by making use of equations (1) to (7), the

impact of an increase in the competition (i.e., an increase in the number of firms) on wage inequality can be examined by equation (9) as follows, where a circumflex is used to denote proportional changes.

$$[\hat{w}_s - w_u] = \left\{ \frac{\left[\frac{\alpha(1-\delta)}{\delta} \right] (K_z + K_y) + [\theta - \beta(1-\alpha)](nK_x)}{[1 - \beta(1-\alpha)]K_z + (1-\theta)K_y} \right\} \hat{n} \quad (9)$$

The above equation shows that an increase in competition leads to an unambiguous increase in wage inequality as long as $\theta \geq \beta(1-\alpha)$. $\beta(1-\alpha)$ and θ respectively are exportable and importable good sectors. An increase in the number of firms in the services sector increases the demand for capital which leads to an increase in the price of capital and owing to the substitution effect the unskilled wage rate falls. The overall impact on skilled wage rate consists of two effects: a negative effect due to increase in the price of capital and a positive effect due to the presence of external economies in exportable good sector. The overall effect on skilled wage rate is ambiguous but wage inequality rises as long as the negative effect on skilled wage rate is smaller than or equal to the negative effect on unskilled wage rate. The impact of a decrease in the fixed cost (which can also be attributed to increased competition) in the services sector on wage inequality can be examined by means of equation (10) as follows:

$$[\hat{w}_s - w_u] = \left\{ \frac{[\theta - \beta(1-\alpha)](nK_x)}{[1 - \beta(1-\alpha)]K_z + (1-\theta)K_y} \right\} \hat{\mu} \quad (10)$$

Equation (10) shows that a decrease in services sector's fixed cost increases (decreases) wages inequality as long as the income share of capital in the sector Z is larger (smaller) than the income share of capital in exportable good sector. This follows from the fact that a decrease in the fixed cost releases capital which leads to a decrease in the price of capital results in an unambiguous increase in both skilled and unskilled wages. The impact of a decrease in import duty on the imported good on wage inequality can be examined by means of equation (11) as follows:

$$[\hat{w}_s - w_u] = \left\{ \frac{-(K_y + K_z)}{[1 - \beta(1-\alpha)]K_z + (1-\theta)K_y} \right\} \hat{t} \quad (11)$$

Equation (11) shows that a decrease in the amount of import duty on the importable good increases wage inequality in the shortrun. This result follows from Stolper-Samuelson

theorem which shows that a decrease in the price of a good decreases the reward of the factor that is used intensively in its production.

Based on the analysis of the theoretical model presented in this section, it is clear that trade liberalisation and increased competition affect the skilled-unskilled wage gap. However, whether or not increased competition for example would increase or decrease the wage gap depends on assumptions regarding relative factor intensities.⁶ Since the theoretical analysis produces mixed results (i.e., results that depend on assumptions which may be hard to validate in practice), it makes sense to conduct empirical analysis using data from real economies.

3. Econometric Specification and the Data

Based on the theoretical model presented in section 2, it can be argued that skilled-unskilled wage gap depends on the level of market competition and the degree of trade liberalisation. Of course, other factors also affect skilled-unskilled wage gap and hence the following general relationship can be specified.

$$wg = f(\text{herfindahl}, \text{eintensity}, \mathbf{X})^7$$

where wg is the wage gap, *herfindahl* index is a measure of the level of market competition, *eintensity* (i.e., the average export intensity) is a measure of the degree of trade liberalisation and X is a vector of control variables.

The vector of control variables includes other important factors including firm characteristics that can also affect the skilled-unskilled wage gap.⁸ The firm characteristics include the size, labour productivity, age, capital intensity, state versus private ownership and domestic versus foreign invested firms, and geographical location.⁹ Based on the general specification, we specify the following econometric relationship, where industry and year dummies have been added as additional control variables.

⁶ It is perhaps worth mentioning that the theoretical model is used here mainly to justify the empirical model. The theoretical model can also be used to examine the impact of foreign investment on skilled-unskilled wage gap. An increase in the stock of capital can be attributed to foreign investment which affects the wage gap through its impact on productivity of skilled and unskilled workers (see Anwar, 2010 and Anwar and Rice, 2009).

⁷ Later we use a log-linear functional form. The log-linear functional form has been widely used in similar studies, for example Hering and Poncet (2010).

⁸ Note that later in this section, we closely examine the distribution of the average wage and find that it varies significantly across firm characteristics that are included in the vector of control variables.

⁹ The empirical work of Hering and Poncet (2010) suggests that economic geography can also affect wages.

$$\ln(\text{wg}) = \beta_0 + \beta_1 \text{herfindahl} + \beta_2 \text{eintensity} + \beta_3 X + \beta_4 \text{dindustry} + \beta_5 \text{dyear} + \varepsilon \quad (12)$$

where *dindustry* is a vector of two-digit industry classification dummies to control for the industry fixed effect; *dyear* is a vector of year dummies to control for the time variant effect;¹⁰ and ε_{it} is the error term which is assumed to be *i.i.d.* normal.

Measurement of the Wage Gap

In order to measure the wage gap between the skilled and unskilled workers, we compute the mean of average wage (total wage bill divided by the number of employees) within the four-digit industry classification and then divide it by the minimum of this mean within the same industry classification as follows:

$$\text{wage gap} = \frac{\text{mean}\left(\frac{\text{total salary}}{\text{number of employees}}\right)}{\min\left(\text{mean}\left(\frac{\text{total salary}}{\text{number of employees}}\right)\right)}$$

The minimum of the mean of firm average wage bill within the 4-digit industry classification is assumed to be the wage that is paid to unskilled workers and hence the ratio measures the wage gap between the skilled and unskilled workers.¹¹

Measurement of Market Competition

We use Herfindahl index as a measure of the level of market competition, which is a common practice in the empirical literature. The Herfindahl index is the sum of squared market share of firms, which ranges between 0 and 1 and a higher value indicates a less competitive market. Herfindahl index is calculated within the 4-digit industry classification.

Measurement of Trade Liberalisation

The level of trade liberalisation is measured by the mean of the firm export intensity within the 4-digit industry classification. It is well known that trade liberalisation tends to increase the average export intensity.

Measurement of the Control Variables

These factors include firm characteristics. The firm size is measured by the number of employees. On the one hand, large firms are likely to hire a larger proportion of skilled

¹⁰ The year dummies also capture the impact of a change in the minimum wage policy in 2005.

¹¹ It can be argued that the skilled and unskilled workers can be distinguished based on their level of education. However, data on worker education are not available.

worker and they can also afford to pay higher wages, which can contribute to an increase in the wage gap. On the other hand, large firms tend to have more power in the wage bargaining process. Using this market power, large firms can also restrict skilled wage increases, which can potentially reduce the skilled-unskilled wage gap.

The theoretical literature shows that the wage gap is affected by the productivity of workers. A firm where workers are relatively more productive is likely to pay higher average wage, which increases the wage gap. As far as the impact of firm age is concerned, younger firms are more likely to pay lower wages due to their relatively weak financial position, which can potentially reduce the wage gap. Some older firms might also pay lower wages due to their good reputation (they offer well sought after jobs with actual or perceived job security) and hence the overall impact of age on the wage gap can be negative. The impact of capital intensity on wage gap is expected to be positive, as the marginal productivity of workers employed by relatively capital intensive firms is likely to be higher. The geographical location of firms can also affect the wage gap, as suggested by Hering and Poncet (2010). Eastern China is more developed than Western and Central China, and therefore firms located in Eastern China are more likely to pay higher wages as compared to firms located in Central and Western China, which increases the wage gap.

A firm's ownership structure also affects the wage gap. The state and collectively owned firms in China tend to be relatively less productive. These firms receive some financial assistance from the government to survive (Zheng et al., 2003; Zhang et al., 2002) and hence such firms are less likely to pay higher wages, which tends to reduce the wage gap. On the other hand, some state and collectively owned firms may have monopoly power in the goods market, which enables them to pay higher wages. Therefore it is also possible that firm ownership status positively affects the wage gap. Whether or not a firm has received foreign direct investment (FDI) can also affect the wage gap. An FDI invested firm is likely to expect more from their employees. Such firms, for example may require their employees to be able to speak a foreign language and hence the average wage paid to skilled workers is likely to be higher, which is likely to increase the wage gap.

Description of the Data Set

This paper utilises firm level data on Chinese firms in 2000, 2003, and 2006. The firms included in the dataset account for more than 85 per cent of China's total industrial output. Existing studies such as Jefferson et al. (2008) and Sun (2009) have utilised the same

data set but these studies do not consider the issue of skilled-unskilled wage gap. We follow Jefferson et al. (2008) to clean the dataset, namely the following firms are excluded from the sample: firms that (i) employed less than eight workers as they may not have reliable accounting systems; (ii) reported negative net values of fixed assets and working capital, and non-positive output, wage, and value-added; (iii) were located in the upper and lower tail of labour productivity distribution¹².

In relation to (iii), we computed VA/L , L/VA , VA/K , K/VA ; where VA , L and K respectively are the firms value-added, number of employees and net value of fixed assets. Firms that sit more than four standard deviations away from their means were not included in our sample. All industry level variables (for example the Herfindahl index) were calculated after dataset was cleaned. A balanced panel data set was extracted from the original dataset, which helps to avoid the impact of panel attrition (e.g., the entry and exit of firms can also influence the wage gap). The panel dataset we extracted covers 37,391 firms in 2000, 2003, and 2006.

There has been a change in the minimum wage legislation in China in 2004. In 2003, the Chinese firms were operating under the previous minimum wage legislation. The impact of a change in the minimum wage legislation is captured by the year dummies. In addition, the legislation stipulates that the minimum wage must take into account factors such as the urban residents' average living expenses and region's unemployment rate. Accordingly, the minimum wage in China varies from region to region. The geographical location dummies capture this effect.

Table 1 presents the descriptive statistics of the cleaned dataset. Information presented in Table 1 suggests that all variables take reasonable values and there exists significant variation within the variables. For example, consider the firm size - on the average a firm employs 480 workers and the corresponding standard deviation is 1,770, which is more than three times that of the mean; the largest firm employs over 161 thousand workers while in contrast the smallest firm employs only 8 workers. Since the ownership structure, geographical location, and whether or not a firm is foreign invested are dummy variables, we only report the average values that merely indicates the percentage of firms that were assigned a value of 1. Hence, 57 per cent of the firms included in our empirical analysis are privately owned and 31 per cent of the firms are foreign invested. The average value of the

¹² Note that excluding these firms avoids the undesirable impacts of outliers in the data.

Herfindahl index is as low as 0.02 indicating that some industries are highly competitive. It is interesting to note that the agriculture, forestry, animal husbandry and fishery-specific instrument manufacturing industry (4124) consisted of only one firm in 2003. The export activities are quite significant with an average of 0.16 (indicating that on average, firms export 17 per cent of their total sales) and a maximum of 0.86.

Table 1: Descriptive Statistics

Variables	Sample Size	Mean	Std. Dev.	Min	Max
ln(wage gap)	112173	0.98	0.66	0	3.93
firm size	112173	0.48	1.77	0.008	161.65
labour productivity	112173	82.24	127.39	0.11	3232.76
firm age	112173	15.51	13.31	1	407
capital intensity	112173	83.62	158.48	0.01	12681
Herfindahl index	112173	0.02	0.04	0.00	1
average export intensity	112173	0.17	0.17	0	0.86
ownership	112173	0.53			
whetherfdi	112173	0.32			
western	112173	0.10			
middle	112173	0.12			

Note: ownership is a dummy variable that takes a value of 1 if a firm is privately owned; whetherfdi is a dummy variable that takes a value of 1 if a firm is foreign invested. Two firms that produce traditional Chinese medicine reported a history dated back to the 15th century, which makes their age over 400 years.

Distribution of the Average Wage

Before we present the empirical results, we first discuss the distribution of average wage and explore its relationship with firm characteristics. This will help us to further justify the inclusion of firm characteristics as control variables in our empirical model. The main characteristics of the wage distribution are summarised in Table 2, which shows considerable variation in the average wage across firms. The average wage per employee is 13.23 thousand RMB with a standard deviation of 11.27 thousand. The highest average wage per employee is 478.11 thousand RMB and in contrast the lowest average wage per employee is 0.01 thousand RMB. The firms that pay a very low average wage (i.e., an average wage of less than 1 thousand RMB) account for a very small proportion of the total firms. In 2000, 2003 and 2006 respectively there were 379, 204 and 4 such firms. These firms respectively account for 1 per cent, 0.5 per cent and 0.01 per cent of the total firms. While the mean of the average wage bill has increased over time, the standard deviation, which is a measure of dispersion, has also increased.

Table 2: Distribution of the Average Wage

Year	Sample Size	Mean	Standard Deviation	Min	Max
All	112173	13.23	11.27	0.01	478.11
2000	37931	10.68	9.48	0.01	344.50
2003	37931	13.09	10.76	0.07	478.11
2006	37931	15.93	12.73	0.35	178.35

Note: the average wage is deflated to 2000 prices; Unit: thousand RMB/employee.

Will the distribution of average wage be affected by firm characteristics, such as the firm size, labour productivity, age, capital intensity, ownership structure, and whether or not a firm is foreign invested? To answer this question, we examine the differences in the distribution of the average wage across firm characteristics. Since the firm size, labour productivity, age, and capital intensity are continuous variables, we first define four dummy variables that take a value of 1, if a firm is (i) big (i.e., its size is bigger than the mean firm size), (ii) productive (i.e., its labour productivity is higher than the average labour productivity), (iii) old (i.e., its age is bigger than the mean of firm age) and (iv) capital intensive (i.e., its capital intensity is higher than the average capital intensity). We then consider whether or not the distribution of the average wage varies significantly across these six variables. For example, we consider whether or not the distribution of average wage for foreign invested firms is significantly different from that of the firms that have not attracted any foreign investment (i.e., the firms that are purely domestic owned and operated).

The figure presented in Appendix 1 shows the distribution of the average wage by firm size. It appears that as compared to the small firms, the average wage distribution of the large firms is biased more to the right, indicating that on average large firms do pay higher wages. The Kolmogorov-Smirnov test (Kolmogorov, 1933, and Smirnov, 1933) for equality of two distributions also rejects the null hypothesis of equal distribution with a test statistic of 0.0774 and a *p*-value of 0.000. Similar patterns can also be observed from figures presented in Appendix 2-6. The average wage distributions of the productive, old, capital intensive, privately owned and foreign invested firms are biased to the right as compared to less productive, young, less capital intensive, state and collectively owned, and domestic firms respectively. The Kolmogorov-Smirnov test is also used to test the equality of all of these distributions. Based on the results of this test, we were able to reject the null hypothesis of

equality. In summary, we observe that a significant variation exists in the average wage across the selected firm characteristics, which justifies the inclusion of these characteristics as control variables in our econometric model.

4. Empirical Results

In Equation (12), we have included a set of control variables that conceptually affect the wage gap between skilled and unskilled labour. Nevertheless to what extent does this specification fit the population from which the data were sampled? Based on Equation (12), we use a number of information criteria to search for the best specification. We utilize a variable selection procedure provided by Lindsey and Sheather (2010), where a leaps-and-bounds algorithm is used. The leaps-and-bounds algorithm identifies the optimal model as the one with the smallest value of Akaike's information criterion (AIC), Akaike's corrected information criterion (AICC), and Bayesian information criterion (BIC), the one with the largest adjusted R^2 , and the one with a Mallows's C_p being the smallest or being close to the number of variables in the models plus 1. Our search process finds that the full specification (namely Equation 12) is the optimal model with an adjust R^2 , Mallows's C_p , AIC, AICC, and BIC being 0.9237, 45, -206931.4, 429371.8, and -206466.9 respectively. Thus in our later empirical exercises, we use the specification of Equation (12).

Labour productivity and the wage rate are positively related. For a given labour force, as the firms become more capital intensive, productivity of labour increases (since marginal product of capital is non-negative). Therefore, labour productivity variable may be endogenous, since we are simultaneously using capital intensity as a determinant skilled-unskilled wage gap. In other words, it can be argued that labour productivity, which appears as one of the independent variables in our econometric model, is an endogenous variable. Nevertheless, in our empirical exercise, we first assume that labour productivity is exogenous and then account for possible endogeneity by making use of an instrumental variable (IV) estimator. Before estimating the econometric model, we first check for the presence of outliers in our sample. Based on the results of Grubbs test (Grubbs, 1969 and Stefansky, 1972), we conclude that outliers are not present in our dataset. Using Wooldridge test (Wooldrige, 2002), we test whether or not the error terms are serially correlated. The Wooldridge test is also robust to conditional heteroskedasticity. Drukker (2003) has shown that for a reasonable sample size, this test has good size and power properties. Our sample consists of 112,173 observations and hence the Wooldridge test is applicable in our context.

The estimated value of the test is 3138.422 with a p -value of 0.000. Thus we reject the null hypothesis of no first order autocorrelation at less than 1 per cent significance level. Since the mean average wage differs substantially across the four-digit industry classification within the manufacturing sector, it is reasonable to suspect that dependent variable in our econometric model is heteroskedastic. Thus we conduct a modified Wald test for groupwise heteroskedasticity. The estimated test statistic of 2×10^{32} with a p -value of 0.000 allows us to reject the null hypothesis of homoskedasticity at less than 1 per cent level of significance. Since there is evidence of significant autocorrelation and heteroskedasticity, we correct for these problems by calculating the heteroskedasticity and autocorrelation robust standard errors. Specifically, we utilise the procedure suggested by Schaffer (2007).

To address the endogeneity problem identified in the above, we employ the instrumental variable (IV) estimator, using the one-period lagged labour productivity as the instrument.¹³ The IV estimation is carried out using Schaffer (2007) procedure. As we find evidence of significant heteroskedasticity and autocorrelation when labour productivity is assumed to be exogenous, we suspect that IV estimation will also be affected by heteroskedasticity and autocorrelation. Accordingly, the IV estimation is based on heteroskedasticity and autocorrelation robust standard errors. We conduct a feasible efficient two-step generalised method of moments (GMM) estimation, which is more efficient than the two-step least square (2SLS) IV estimation when significant heteroskedasticity and autocorrelation are present (Baum *et al.* 2007). While using IV/GMM estimation technique, we first test for the relevance of the selected instruments – i.e., we closely examine the fit of the first stage regression. In the first stage regression, Bound *et al.* (1995) partial R-square and the Shea (1997) partial R-square are both 0.29, and the F -statistic for the significance of the lagged labour productivity is 17672.41 with a p -value of 0.000, which suggests that the instrument is relevant. The last step involves the choice of estimation technique - the IV/GMM estimation versus the estimation technique that assumes that labour productivity is exogenous. In order to make an informed choice, we carry out an endogeneity test based on the C -statistic (see Eichenbaum *et al.*, 1988 and Hayashi, 2000). The estimated value of the C -statistic can be used to test for orthogonality of the endogenous variables. In the present case, the estimated value of the C -statistic is 323.87 with a corresponding p -value of 0.000,

¹³ It has been argued that lagged variables do not always serve as good instruments and the estimated results may be sensitive to the choice of instruments. Accordingly, one should try to use other suitable instrumental variables. Unfortunately, lack of data prevented us from using other instrumental variables. Recent studies such as Barbosa and Eiriz (2009) and Suyanto *et al.* (2009) have also highlighted this problem but following other studies involving developing economies, they have also used lagged variables as instruments.

which allows us to reject the null hypothesis of orthogonality of labour productivity at a very low level of significance. Accordingly, it is possible to argue that IV/GMM estimation results are more reliable. The empirical results are presented in Table 3.

Column (1) of Table 3 contains the estimated coefficients and standard errors when labour productivity is treated as an exogenous variable, whereas column (2) contains the estimated results when one period lag of the labour productivity is used as an instrument. However, by making use of the *C*-statistic, we have already determined that the estimated results presented in column (2) are more reliable. The discussion that follows is based on the estimated results presented in column (2).

Table 3: Estimation Results

Variables	(1)			(2)		
	Estimated Coefficient	Standard Error	<i>P</i> value	Estimated Coefficient	Standard Error	<i>P</i> value
ln(firm size)	-0.0043	0.0006	0.00	-0.0021	0.0006	0.00
ln(labour productivity)	0.0177	0.0007	0.00	0.0321	0.0013	0.00
firm age	-0.0004	0.0000	0.00	0.00001	0.0001	0.84
ln(capital intensity)	0.0064	0.0005	0.00	0.00004	0.0007	0.95
ownership	-0.0024	0.0014	0.07	-0.0076	0.0014	0.00
whether FDI invested	0.0311	0.0015	0.00	0.0273	0.0014	0.00
western	-0.0272	0.0022	0.00	-0.0241	0.0024	0.00
middle	-0.0286	0.0019	0.00	-0.0270	0.0021	0.00
Herfindahl index	0.7789	0.0296	0.00	0.8005	0.0359	0.00
average export intensity (4-digit industry classification)	0.0956	0.0051	0.00	0.0486	0.0055	0.00
constant	1.5194	0.0045	0.00	0.0977	0.0058	0.00
industry dummies	yes			yes		
year dummies	yes			yes		
Number of observations	112125			74781		
<i>F</i> -value	42335.57			2664.66		
Centered R^2	0.93			0.59		

Note: (i) Column (1) is the pooled OLS estimation without the instrument whereas column (2) is the IV/GMM fixed effect estimation with the one year lagged labour productivity as the instrument; (ii) Both estimations employ the feasible efficient two-step GMM estimator; (iii) The standard errors are heteroskedasticity and autocorrelation robust; (iv) A 2SLS IV estimation produces results that are similar to the results presented in column (2); (v) the impact of minimum wage policy is captured by the year dummies.

The two variables of interest are the Herfindahl index, which captures the extent of market competition, and the average export intensity, which captures the level of trade

liberalisation. The coefficient of the Herfindahl index is 0.8 with a standard error of 0.03, indicating that a 1 unit increase in Herfindahl index results in 0.8 per cent increase in skilled-unskilled wage gap in China's manufacturing sector. An increase in Herfindahl index reflects a decrease in market competition. Hence increase in market competition appears to reduce the wage gap. In a competitive goods market, high level of competition forces firms to employ more skilled workers as skilled workers are relatively more productive. In a competitive labour market, workers are paid based on their value of marginal productivity. However, due to the law of diminishing marginal returns, as more skilled workers are utilised, the marginal productivity declines, which results in a decrease in the wage gap. The estimated coefficient of the average export intensity as reported in Table 2 is positive and significant. It can therefore be argued that a one unit increase in the average export intensity (i.e., trade liberalisation) leads to 0.05 per cent increase in the wage gap.

Most firm characteristics included in our econometric model appear to have significant impact on the wage gap. The firm size, as measured by the number of employees, exerts a significantly negative impact - a 1 per cent increase in the firm size leads to a 0.0021 per cent decrease in the wage gap, which is surprising but it can occur if large firms are able to exert strong pressure during wage bargaining process. The labour productivity has a significant and positive impact on the wage gap, which is not surprising as firms with higher labour productivity tend to pay a higher average wage. The impact of capital intensity is found to be insignificant. This can be attributed to the fact that although firms with higher capital intensity tend to have more productive workers, which in turn leads to higher wages thereby increasing the wage gap, we have already controlled for the impact of labour productivity. Accordingly, it is not surprising that the impact of capital intensity on the wage gap in our empirical model is insignificant.

The results presented in Table 2 suggest that firm ownership structure also has a significant impact on the wage gap. Being state and collectively owned positively contributes to the wage gap, which suggests that an increase in the proportion of private firms in China is likely to have a negative impact on the wage gap. Whether or not a firm is FDI invested has a significant and positive impact on the wage gap as the foreign firms tend to pay higher wages. Firm age is found to exert an insignificant impact on the wage gap, which is consistent with our expectations. Younger firms might pay lower wages due to their relatively weak financial position, which is likely to have a negative effect on the wage gap. Some older firms might also pay lower wages as they attract many good workers and offer relatively

secure jobs with additional benefits. But many older firms and almost all foreign invested firms pay higher wage, which increases the wage gap. Accordingly, the overall impact of firm age on the wage gap can be insignificant as the positive and negative effects may cancel each other. The coefficients of *western* and *middle* are significantly negative, which confirms that firms in Western and Central China pay lower wages than their Coastal counterparts.

In order to test for the robustness of our empirical results, the econometric model was also estimated without the firm characteristics (i.e., only Herfindahl index, industry export intensity, and industry and year dummies were included as independent variables). The estimated equation is: $\ln(wg) = 1.6135 + 0.7904herfindahl + 0.1115industry_eintensity$. The estimated coefficients were found to be significant at the 1 per cent level and the coefficients of industry and year dummies are not reported here. Although, the size of the estimated coefficients has changed, the signs are unaffected. In other words, our main results concerning the impact of market competition and trade liberalisation on the wage gap remain unaffected.

Note that we measured the wage gap as the mean of average wage within the four-digit industry classification divided by the minimum of this mean within the same industry classification. We also measured trade liberalisation as the mean of the firm export intensity within the 4-digit industry classification. However, since the mean is sensitive to the existence of outliers, we re-constructed the trade liberalisation variable as the median of firm export intensity within the 4-digit industries. We also re-estimated, the wage gap as follows:

$$wage\ gap = \frac{\text{median}\left(\frac{\text{total salary}}{\text{number of employees}}\right)}{\min\left(\text{median}\left(\frac{\text{total salary}}{\text{number of employees}}\right)\right)}$$

By making use of the new values of trade liberalisation and the skilled-unskilled wage gap, the econometric model was re-estimated. The estimated model is as follows:

$$\begin{aligned} \ln(wg) = & 0.1042 + 0.0229\ln(labour\ productivity) - 0.0002\ln(firm\ size) - \\ & 0.00005age + 0.0004\ln(capital\ intensity) - 0.0044ownership + \\ & 0.0239whetherfdi - 0.0245western - 0.0313middle + \\ & 0.6026herfindahl + 0.0685eintensity \end{aligned}$$

where *whetherfdi* is a dummy variable that takes a value of 1 if a firm is FDI invested; *western* and *middle* are two dummies that take a value of 1 if a firm is located in Western and Central China respectively.

The estimated coefficients of the firm size, age, and capital intensity are not significant at the 5 per cent level (the coefficients of industry and year dummies are not reported). Again we observe some variation in the magnitude of the estimated coefficients of Herfindahl index and trade liberalisation. However, there is no change in any of the signs. It can therefore be argued that the results presented in this paper are robust to the different measures of wage gap and trade liberalisation.

5. Conclusions

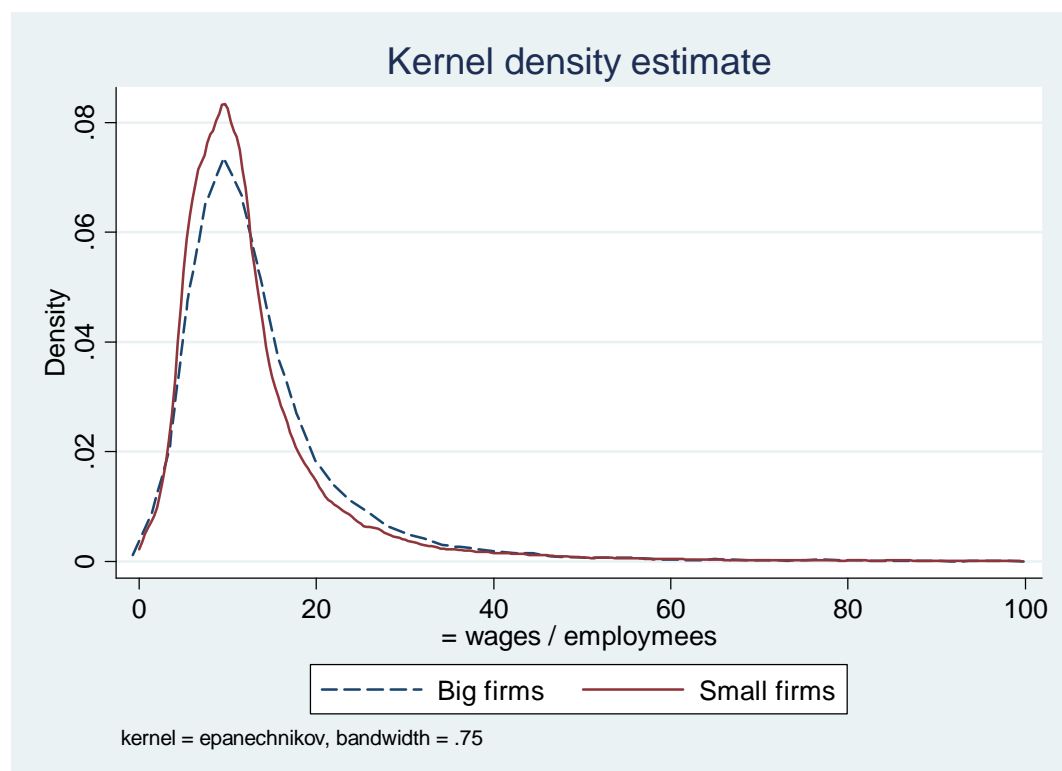
Since the introduction of market oriented reforms in the late 1980s, the Chinese economy has consistently registered strong economic growth. While the overall standard of living as measured by real per-capita income has improved, the benefits of economic growth are not equally shared by all. There is strong evidence of rising income inequality in China. A number of studies have considered the issue of income inequality in different regions of China. It has been argued that rising income inequality is a concern because it can increase social tensions that can stifle economic growth.

This paper attempts to extend the existing literature by focusing on the determinants of the skilled-unskilled wage gap in China's manufacturing sector. We use a theoretical model to argue that trade liberalisation and market competition can affect skilled-unskilled wage gap. Based on this result, an econometric model is specified. The econometric model is estimated by making use of firm level data for 2000, 2003 and 2006. The empirical analysis suggests that trade liberalisation has contributed to an increase in skilled-unskilled wage gap in China and increased market competition has contributed to a decrease in the wage gap. Our empirical analysis also suggests that the impact of firm characteristics on wage gap in China is significant. For example the labour productivity positively affects the wage gap and an increase in foreign invested firms is contributing to rising wage gap. We also found that an increase in the number of private firms (i.e., a decrease in state owned or collectively owned firms) is likely to reduce the skilled-unskilled wage gap.

Given the worldwide push for further trade liberalisation, it is not in China's overall economic interest to reverse or even slowdown the pace of trade liberalisation. However, the Chinese government can take steps that are likely to increase market competition thereby slowing down the rate of increase in skilled-unskilled wage gap. As a result of rapid economic growth, the Chinese government is facing additional internal as well as external challenges. Internal challenges include uneven regional economic development and rising income inequality, while the rising trade surplus with the US and the European Union is

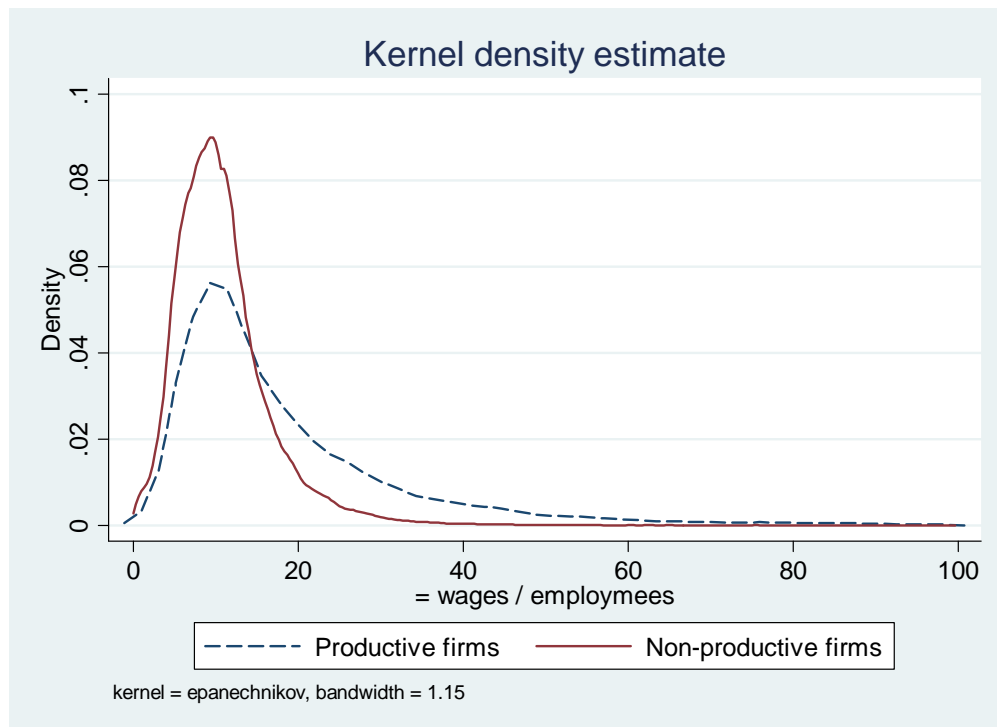
contributing to external pressures in the form of demands for revaluation of the Chinese currency. In order to ensure a minimum standard of living for all workers, the minimum wage in China is regularly adjusted upwards. By increasing investment in education and training, the Chinese government can help reduce the wage gap between the skilled and unskilled workers. Careful government planning and increased spending on infrastructure in relatively less developed regions can also help reduce regional income disparity. Increased integration with the world economy has several benefits such as increased foreign investment. However, the size of direct as well as indirect benefits of foreign investment crucially depends on the availability of appropriate production infrastructure and human capital in the form of highly skilled workers. The rising standard of living in China is encouraging an increased number of Chinese parents to send their children for education in foreign countries which is likely to contribute to the problem of brain drain - an area of research that has not been explored so far.

Appendix 1: Distribution of the Average Wage by Size



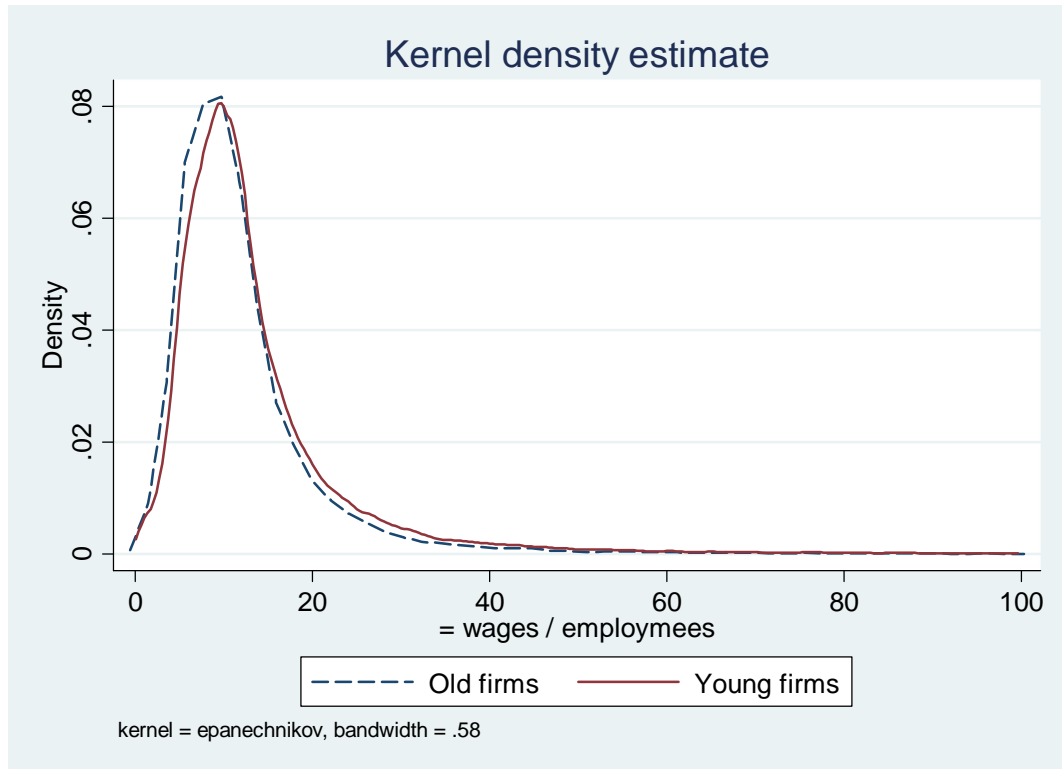
Source: Enterprise Data, NBS, Beijing, 2003-2006

Appendix 2: Distribution of the Average Wage by Labour Productivity



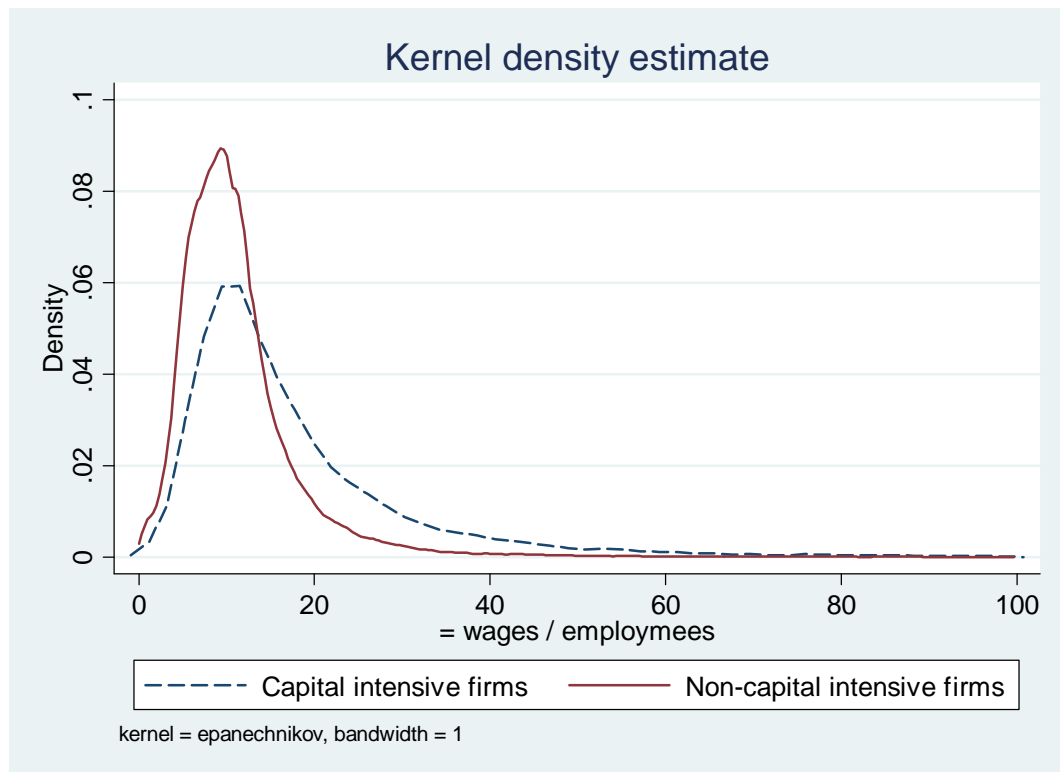
Source: Enterprise Data, NBS, Beijing, 2003-2006

Appendix 3: Distribution of the Average Wage by Firm Age



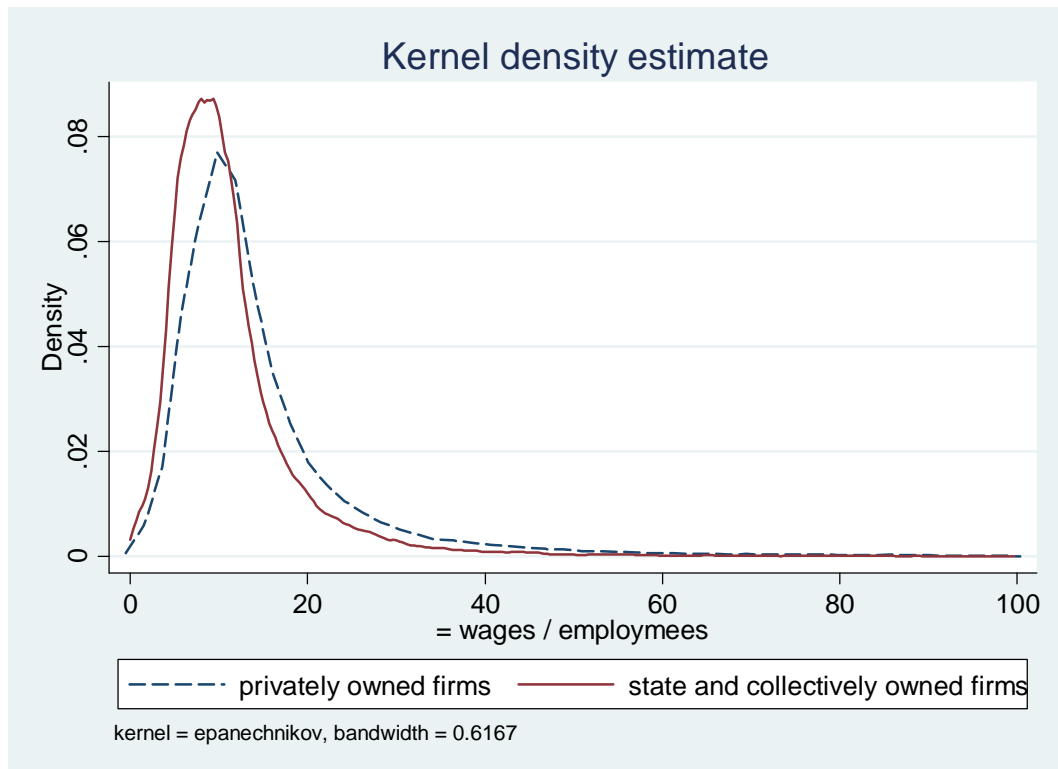
Source: Enterprise Data, NBS, Beijing, 2003-2006

Appendix 4: Distribution of the Average Wage by Capital Intensity



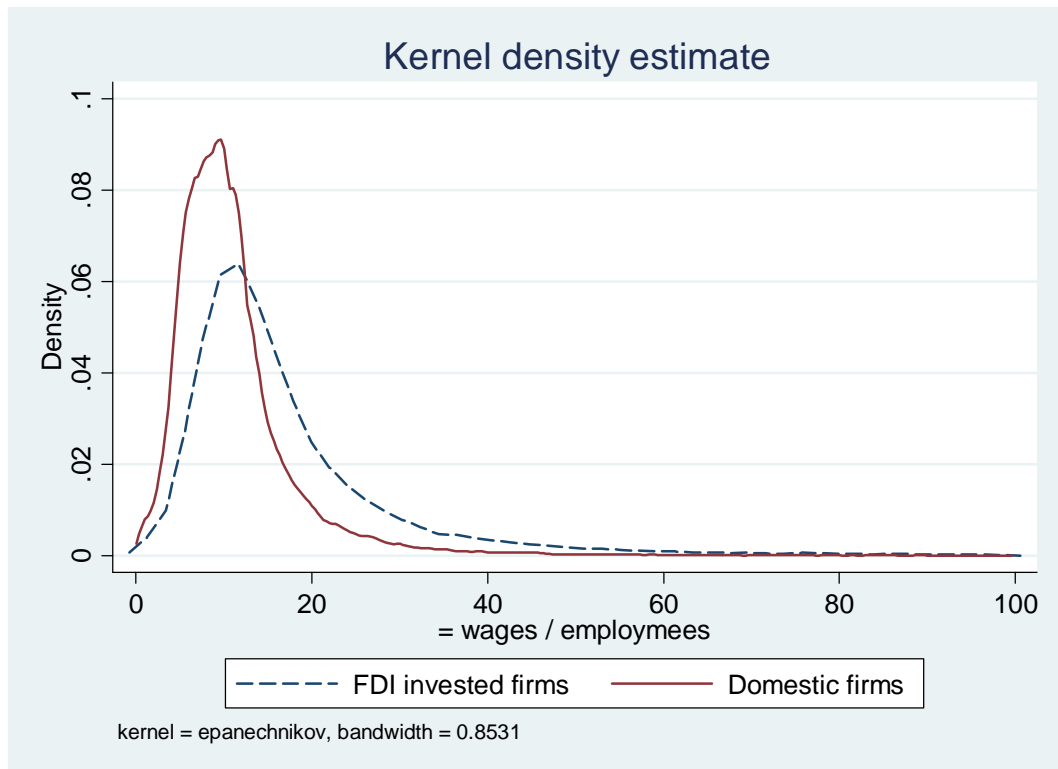
Source: Enterprise Data, NBS, Beijing, 2003-2006

Appendix 5: Distribution of the Average Wage by Ownership



Source: Enterprise Data, NBS, Beijing, 2003-2006

Appendix 6: Distribution of the Average Wage by FDI Ownership



Source: Enterprise Data, NBS, Beijing, 2003-2006

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