Skilled-Unskilled Wage Gap in China

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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 liberalization 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 in the shortrun as well as the longrun. 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.

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1. Introduction

A number of recent studies have attempted to examine the impact of globalization 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) have argued 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) have shown that, contrary to the general belief, emigration of both skilled and unskilled workers from a developing economy can increase wage inequality. Bertán, Ferri and Pons (2007) have argued that unlike the globalisation that took place during 1880-1913, the present day globalisation has resulted in an increase in the wage gap between the skilled and unskilled workers. Chaudhuri and Yabuuchi (2007) have shown that in the presence of labour market imperfections, a reduction in import tariff on low-skilled manufacturing sector can contribute to wage inequality. By making use of a panel data set, Taylor and Driffield (2005) have considered the link between wage inequality and FDI in the UK. Taylor and Driffield have argued that on the average approximately 11% of wage inequality in the UK can be attributed to FDI. Chung and Kin (2007) have argued that the growing wage inequality in the US can be attributed to skill-biased technological change. It is well known that FDI can contribute to skill-biased technological change. Breau and Rigby (2010) have considered the issue of skilled-unskilled wage inequality in Canada. They have argued that import competition from low-income countries has contributed to increased wage inequality in Canada.

Other studies that consider the issue of wage inequality include Wood (1997), Beyer, Rojas and Vergara (1999), Das (2002), Feenstra and Hanson (2003), Marjit and Acharyya (2003), Marjit, Beladi and Chakrabarty (2003), Das (2005), Chamarbagwala (2006), Long, Riezman and Soubeyran (2007), Yabuuchi and Chaudhuri (2007). Some of these studies have argued that globalisation has resulted in increased competition which along with trade liberalisation has contributed to rising wage inequality or wage gap between skilled and unskilled workers. In fact it has been argued that technological improvement and technology transfer arising from foreign investment in host countries is skill-biased. Foreign investment and the associated spillovers boost productivity thereby increasing wages. The skilled workers are more productive so foreign investment is likely to increase wage inequality.
Most studies involving China are mainly concerned with income inequality across regions of China whereas some studies are concerned with the historical evolution of wage and income inequality in China. Kanbur and Zhang (2005) have considered the evolution of regional income inequality in China starting from the Revolution of 1949. They have considered three distinct periods in the Chinese history – the Great Famine of the late 1950s, the Cultural Revolution that started in the late 1960s and the current period of openness and global integration that started from the late 1980s. Kanbur and Zhang have argued income inequality in China has peaked during each of these three periods. They argue that rise in urban-rural income inequality during the pre-reform period (i.e., before the current period of openness) can be attributed to heavy industry development strategy. Kanbur and Zhang further argue that the present day rising income inequality between coastal and inland areas can be attributed to openness and decentralisation. Park, Song, Zhang and Zhao (2003) have shown that increases in wage inequality are greatest from 1992 to 1994 and from 1997 to 1999. They have considered labour market and broader economic factors to try to explain wage inequality from 1988 to 1999.

By making use of a general equilibrium model involving imperfect competition, Wu (2000) argues that free trade and FDI in China is likely to increase the wage gap between skilled and unskilled labour. Wu has shown that foreign investment has resulted in increase in both skilled and unskilled wages but its effect of unskilled wages is relatively small. Zhao (2001) has argued 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. Knight and Song (2003) have considered changes in Chinese urban wage structure. Their analysis is based on surveys conducted in 1988 and 1995. The Gini coefficient of earnings increased by 8% over the eight year period considered and the average wage increased over 52%. These surveys highlight the impact of labour market reforms in China. Ma (2006) considers regional economic inequality in China arising from trade flows associated with foreign direct investment. The author utilises a gravity model to consider state-owned enterprises (SOEs) as well as collective-owned enterprises. The author argues that at least one third of the wage inequality between coastal and inland provinces can be attributed to geography: i.e., access to export market and access of the suppliers to the intermediate inputs plays a vital role in determining the size of wage inequality. Wan and Zhou (2005) have argued that while geography is an important factor in determining income inequality in China it is becoming less important over time. Li (2008) has suggested that proximity to large
markets can account for wage inequality in China. By making use of panel data from 1986 to 2001, Owen and Yu (2003) have argued that export oriented FDI has contributed to wage inequality in China.

Fleisher, Li and Zhao (2010) have considered the determinants of the observed uneven economic growth experienced by different regions of China. The main focus of this study is on the role of FDI and investment in human capital. The authors have made use of production functions at province level. They have argued that investment in human capital in less developed regions of China has contributed to a reduction in regional inequality. As indicated by Fleisher, Li and Zhao, China’s spending on education as a percentage of GDP which is a crude measure of human capital is well below the developed countries. However, the proportion of population with some college education in China is continuously rising (from 0.60% in 1982 to 5.17% in 2003). At the same time, there is a significant increase in new college enrolment overtime. Ramasamy and Yeung (2010) have suggested 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.

Liu, Lovely and Ondrich (2010) have utilised data on 2,884 Chinese firms over the period 1993-1996 to consider the effect of FDI on wages. They have argued that the relationship is affected by the degree of skill intensity of FDI, competition in the market and the level of economic development of the source country. Specifically, investors from OECD countries are more responsive to wage differences in China. These investors are less likely to invest in regions of China that have already attracted significant FDI. By making use of a general equilibrium model, Mitchener and Yan (2010) have examined 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%.

Based on the studies reviewed in the above it is clear that inequality can be viewed from a number of perspectives – income inequality in different regions (e.g., coastal versus inland areas or eastern versus western provinces), urban-rural wage gap, skilled-unskilled wage gap, etc. This paper focuses on skilled-unskilled wage gap in China’s manufacturing sector. We focus on the determinants of the wage gap – specifically on the role of trade liberalisation and increased market competition. A theoretical model is utilized to show that trade liberalisation and market competition can affect skilled-unskilled wage gap. Empirical analysis presented
in this paper is conducted by making use of a dataset that covers a large number of Chinese firms in 2003, 2006 and 2007.

The rest of this paper is organised as follows. Section 2 contains a theoretical model. 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. FDI and Wage Inequality – A Theoretical Model

By making use of a simple general equilibrium model, the main aim of this section is to demonstrate that increased competition and trade liberalisation can affect the skilled-unskilled wage gap in the shortrun as well as in the longrun.\(^1\) 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 agricultural good. A number of existing studies such as Markusen (1989), Marrewijk, Sitobra, Vaal and Viaene (1997), Markusen and Venables (1999), Eswaran and Kotwal (2002) and Rivera-Batiz and Oliva (2003), Reddings 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. For simplicity, 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:

\[
Y = \left( L_y^{-\beta} K_y^\beta \right)^{1-\alpha} \left( \sum_{i=1}^{\sigma} x_i^\delta \right)^{\frac{\delta}{\sigma}}
\]

\[
Z = L_z^{-\alpha} K_z^{\alpha}
\]

\(^1\) 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.
where $\alpha$, $\beta$, $\theta$ and $\delta$ 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.

Production of both final goods is subject to constant returns to scale, which implies that the average cost equals the marginal cost. 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; $\lambda$ is a positive constant and $\mu$ is the amount of capital used by each firm in the services sector.

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 Rivera-Batiz and Rivera-Batiz (1991) and 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. It is well-known that the presence of internal economies in the services sector gives rise to external economies in the industrial sector which in increases productivity.

The following condition determines the equilibrium output of the industrial good industry where $p$ is the price of producer services.

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

where $\Theta = \alpha^{-\alpha} \beta^{-\beta(1-\alpha)} (1-\alpha)^{-(1-a)} (1-\beta)^{-(1-a)(1-\beta)} > 0$

The right-hand side of equation (1) is the unit cost of production whereas the left-hand side is the price of the industrial good. The industrial good is the numéraire and hence its price has been set equal to unity. An increase in the number of varieties decreases the effective price of producer services and hence average cost of the industrial good decreases. If the services sector is active in equilibrium then the following first order condition must hold
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.

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

(3)

where $q$ is price of $Z$ which is determined in the international market and $t$ is the amount of import duty.

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

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

(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 industrial 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 $Z$.

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

(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.

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

(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 ($nK_s$), sector $Z$ ($K_z$) and the industrial 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.

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

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. The longrun equilibrium is characterised by free entry and exit of firms in the services sector where monopolistic competition prevails. Because of free entry and exit, the price of each variety of producer services will just cover average cost. By making use of equation (2), the zero profit condition, which determines the equilibrium number of firms \( n \) in the services sector can be written as follows:

\[
(1 - \delta) px = r \mu
\]

The longrun equilibrium is characterised by equations (1)-(8) where the number of firms in the services sector is endogenous.\(^2\)

**Wage Inequality in the Shortrun**

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 wage 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

\(^2\) It has been argued that globalization has resulted in competitive pressures that have contributed to cost cutting and downsizing (see Hill, 2009 and Wälde and Weiβ, 2007). Most existing studies have not explicitly considered the impact of cost cutting and increased competition on wage inequality. In addition, most studies have only considered the longrun effect on wage inequality. It is well-known that the shortrun effect can be substantially different from the longrun effect (see Chao and Yu, 1997; Das, 2002).
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.

\[
\left[ \hat{w}_s - \hat{w}_u \right] = \left[ \frac{\alpha(1 - \delta)}{\delta} \left( K_z + K_y \right) + \left[ \theta - \beta(1 - \alpha) \right] (nK_y) \right] \hat{n}
\]

(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 \( \theta \) 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 industrial 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 in the shortrun can be examined by means of equation (10) as follows:

\[
\left[ \hat{w}_s - \hat{w}_u \right] = \left[ \frac{\theta - \beta(1 - \alpha)}{1 - \beta(1 - \alpha)} \left( K_z + (1 - \theta)K_y \right) \right] \hat{n}
\]

(10)

Equation (10) shows that a decrease in services sector’s fixed cost has no effect on wage inequality as long as the income shares of capital in the sectors Y and Z are identical. On the other hand, 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 industrial sector. This follows from the fact that a decrease in the fixed cost releases capital which leads to a decrease the price of capital which leads to an unambiguous increase in both skilled and unskilled wages. The positive effect on unskilled wage rate is relatively small if the income share of capital in agricultural sector is large and hence wage inequality rises.

The impact of a decrease in import duty on the imported good on wage inequality in the shortrun can be examined by means of equation (11) as follows:
Equation (11) shows that a decrease in the amount of import duty on the importable good increases wage inequality in the short run. 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. The good Z is unskilled labour intensive and hence the unskilled wage decreases. On the other hand, due to Stolper-Samuelson theorem, a decrease in the amount of import duty on the agricultural good increases the skilled wage rate.

\[
\left[ \hat{w}_s - \hat{w}_u \right] = \left\{ \frac{-(K_x + K_y)}{[1-\beta(1-\alpha)]K_z + (1-\theta)K_y} \right\} \hat{t}
\]  

(11)

Wage Inequality in the Longrun

In the longrun, due to free entry and exit, the number of firms in the services sector is endogenous. The impact of a decrease in competition on wage inequality in the longrun can be examined by means of equation (12) as follows:

\[
\left[ \hat{w}_s - \hat{w}_u \right] = -\left\{ \frac{\alpha(1-\delta)}{\delta} \left[ \frac{\Delta}{\alpha(1-\delta)} \right] \right\} \hat{\mu}
\]  

(12)

Where \( \Delta = -\left[ \frac{\alpha(1-\delta)}{\delta} \right] K_z + \theta[1-\beta(1-\alpha)]K_z + (1-\theta)(nK_x + K_y) \)

The sign of equation (12) depends on the sign of \( \Delta \). By making use of the dynamic stability condition, it can be easily confirmed that \( \Delta \) is positive as long as the equilibrium is stable which means that the size of external economies in the industrial sector (i.e., \( \frac{\alpha(1-\delta)}{\delta} \)) is not very large. An excellent discussion of the stability condition can be found in Wong (1995).

Equation (12) shows that in the longrun, the impact of a decrease in services sector’s fixed cost on wage inequality depends on the size of external economies in industrial sector. In the presence of external economies, a decrease in the fixed cost increases wage inequality. This follows from the fact that a decrease in services sector’s fixed cost decreases the price of capital which increases the unskilled wage rate. A decrease in services sector’s fixed cost increases the skilled wage through two channels: (i) a decrease in the price of capital and (ii) an increase in the number of firms in the services sector and hence there is a larger increase in skilled wage rate. The impact of further trade liberalisation (i.e., a decrease in the amount of import duty on
the imported good) on wage inequality in the longrun can be examined by means of equation (13) as follows:

\[
\left[ \hat{\omega}_s - \hat{\omega}_u \right] = -\left\{ \left[ \frac{\alpha(1-\delta)}{\delta} \right] + \beta(1-\alpha) \right\}K_s + nK_s + K_y \left[ 1 \right] \hat{\Delta}
\]

Equation (13) shows that a decrease in the amount of import duty on the agricultural good increases wage inequality in the longrun. It is interesting to note that unlike the shortrun, the longrun impact on wage inequality depends on the size of external economies in the industrial sector. The longrun effect is larger due to the presence of external economies. This result is consistent with Long, Riezman and Soubeyran (2007). By making use of a model that includes human capital, they have shown that trade liberalisation increases wage inequality in a country that exports high-tech goods.

Based on the analysis of the theoretical model presented in this section, it is clear that trade liberalisation and increased competition do affect the skilled-unskilled wage gap both in the shortrun as well as in the longrun. However, whether or not increased competition for example would increase or decrease the wage gap depends on assumptions regarding relative factor intensities. 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 theoretical model presented in section 2, it is possible to specify the following general relationship.

\[
WG = f(HERFINDAHL, EINTENSITY, X)
\]

Where WG is the wage gap, HERFINDAL index is a measure of the level of market competition, EINTENSITY (i.e., the average export intensity and its standard deviation) is a

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3 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 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).
measure of the degree of trade liberalisation and $X$ is a vector of control variables (i.e., other important variables that can affect the wage gap).

The control variables include firm characteristics such as the size, labour productivity, age, capital intensity, state versus private ownership and domestic versus foreign invested firms, and the effect of change in government minimum wage policy. Based on the general specification, we estimate the following econometric relationship where industry and year dummies have been added as additional control variables.

\[
\ln(WG_{it}) = \beta_0 + \beta_1 \text{HERFINDAHL}_{it} + \beta_2 \text{EINTENSITY}_{it} + \beta_3 X_{it} + \\
\beta_4 \text{dINDUSTRY}_i + \beta_5 \text{dYEAR}_t + \alpha_i + \varepsilon_{it} \tag{14}
\]

where $WG$ is the wage gap; $HERFINDAHL$ is the Herfindahl index; $EINTENSITY$ is the average export intensity, which is equal to exports divided by total sales within the four-digit industry; $X$ is a vector of firm characteristics and includes the firm size, labour productivity, age, capital intensity, a dummy variable that denotes the ownership structure, and a dummy variable that denotes whether a firm is a foreign owned or not; $dMINWAGE$ is a dummy variable that captures a change in the minimum wage policy and takes a value of 1 if a firm is in year 2005, 2006 and 2007; $dINDUSTRY$ is a vector of two-digit industry classification dummies; $dYEAR$ is a vector of year dummies; $\alpha_i$ is the firm fixed effect; and $\varepsilon_{it}$ 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 four-digit industry classification as follows:

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

\[4\] The recent empirical work of Hering and Poncet (2010) suggests that economic geography can also affect wages.
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.

*Measurement of Market Competition*

It is common in the empirical literature to use the Herfindahl index as a measure of the level of market competition. 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. The Herfindahl index is calculated at the 4-digit industry classification level.

*Measurement of Trade Liberalization*

The level of trade liberalization is measured by the mean of the firm export intensity within the 4-digit industry classification. It is well known that trade liberalization tends to increase the average export intensity.\(^5\)

*Measurement of the Control Variables*

While the main aim of this paper is to examine the impact of trade liberalization and market competition on wage inequality, we also control for other factors that can affect wage inequality. These factors include firm characteristics such as the firm size, labour productivity, firm age, capital intensity, the ownership structure and whether or not a firm is privately owned and whether or not the firm is foreign invested. The firm size is measured by the number of employees and large firms are likely to have a large proportion of skilled worker as they are more likely to be able to afford to pay higher wages which can contribute to an increase in the wage gap.

The wage rate is significantly affected by the productivity of workers. A firm where workers are relatively more productive is likely to pay higher average wage and thus contributes positively to the wage gap. As far as the impact of the firm age is concerned, the average wage paid by younger firms is likely to be lower as compared to the average wage paid by older firms that are likely to be well established. Owing to the experience curve effect, the older firms are likely to pay relatively higher wages. Hence the net impact of the firm age on wage inequality is unclear. The impact of capital intensity on wage gap is

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\(^{5}\) Equation (14) was also estimated after including the standard deviation of the average export intensity as an additional independent variable. However, the estimated coefficient was highly insignificant and hence this variable was excluded from the empirical model.
expected to be positive, as the marginal productivity of workers employed by relatively capital intensive firms is likely to be higher.

A firm’s ownership structure also affects the wage gap. It has been found that the state and collectively owned firms in China tend to be less productive and require certain levels of assistance from the government to survive (Zheng et al., 2003; Zhang et al., 2002) and hence these firms are less likely to pay higher wages which subsequently contributes negatively to 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 have a higher requirement on its employee. Such firms for example may require their employees to be able to speak a foreign language and hence the average wage paid to the skilled workers is likely to be higher which is likely to contribute positively to the wage gap.

Description of the Data Set

This paper utilizes firm level data on Chinese firms in 2003, 2006, and 2007. The firms included in the dataset account for more than 85 per cent of China’s total industrial output. Similar data have been used by Jefferson et al. (2008) to study productivity growth in the Chinese industrial economy and Sun (2009) to examine the FDI linked export spillovers. We followed Jefferson et al. (2008) to clean the data set, namely the following firms are excluded in 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 tails of the labour productivity distribution.

In relation to (iii), we computed VA/L, L/VA, VA/K, K/VA; where VA, L and K respectively are the firm’s value added, number of employees and net value of fixed assets. Firms that lay more than four standard deviations from their means were not included in our sample. All industry level variables (for example the Herfindahl index) were calculated after data set was cleaned up. A balanced panel data set was extracted from the original dataset, which helps to avoid the impact of the panel attrition (e.g., the entry and exit of firms can also influence the wage gap). The panel data set we extracted covers 37,391 firms in 2003, 2006, and 2007.

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. In order to
take this into account, we use a dummy variable. In addition, it is stipulated in the legislation that the minimum wage is calculated as a function of such factors as the urban residents’ average living expense and unemployment rate in the region. Accordingly, the minimum wage in China varies from region to region. The fixed effect estimation takes such factors into account. Besides, the legislation also requires that the minimum wage shall be adjusted at least once every two years. Such impact is controlled by the year dummies that were included in our estimation.

Table 1 presents the descriptive statistics of the data used for empirical analysis. It appears from Table 1 that all variables take reasonable values and there exists significant variation in these variables. For example, regarding the firm size, on the average a firm employs 490 workers and the corresponding standard deviation is 1,750, which is more than three times that of the mean; the biggest firm employs over 151 thousand workers while in contrast the smallest firm employs only 10 workers. Since the ownership structure and whether or not a firm is foreign invested are dummy variables, we only report the average values that merely indicate the percentage of firms that were assigned a value of 1. Hence, 57 per cent of the firms included in the empirical analysis are privately owned and 31 per cent of firms are foreign invested. The average value of the 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) consists of only one firm in 2003. The export activities are quite significant with an average of 0.16 (indicating that on the average, firms export 16 per cent of their total sales) and a maximum of 0.86.

Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(wage gap)</td>
<td>112173</td>
<td>0.48</td>
<td>0.22</td>
<td>0</td>
<td>1.62</td>
</tr>
<tr>
<td>firm size</td>
<td>112173</td>
<td>0.49</td>
<td>1.75</td>
<td>0.01</td>
<td>151.01</td>
</tr>
<tr>
<td>lagged labour productivity</td>
<td>112173</td>
<td>91.97</td>
<td>143.40</td>
<td>0.09</td>
<td>3465.27</td>
</tr>
<tr>
<td>firm age</td>
<td>112173</td>
<td>17.11</td>
<td>12.93</td>
<td>1</td>
<td>408</td>
</tr>
<tr>
<td>capital intensity</td>
<td>112173</td>
<td>90.35</td>
<td>159.52</td>
<td>0.02</td>
<td>12681</td>
</tr>
</tbody>
</table>
The Distribution of the Average Wage

Before we present the estimation 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 a control variable in our empirical model. The main characteristics of the wage distribution are summarized in Table 2. Table 2 shows considerable variation in the average wage across firms. The average wage per employee is 14.61 thousand RMB with a standard deviation of 12.19 thousand. The highest average wage per employee is 782.06 thousand RMB and in contrast the lowest average wage per employee is 0.003 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 2003, 2006 and 2007 respectively there were 1474, 64 and 18 such firms. These firms respectively account for 1.2 per cent, 0.03 per cent and 0.01 per cent of the total firms. While the mean of the average wage bill has increased overtime, the standard deviation which is a measure of dispersion has also increased.

Table 2. The Distribution of Average Wage

<table>
<thead>
<tr>
<th>Year</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>582077</td>
<td>14.61</td>
<td>12.19</td>
<td>0.003</td>
<td>782.06</td>
</tr>
<tr>
<td>2003</td>
<td>122323</td>
<td>11.37</td>
<td>9.74</td>
<td>0.003</td>
<td>782.06</td>
</tr>
<tr>
<td>2006</td>
<td>215977</td>
<td>14.38</td>
<td>11.59</td>
<td>0.12</td>
<td>658.36</td>
</tr>
<tr>
<td>2007</td>
<td>243777</td>
<td>16.44</td>
<td>13.40</td>
<td>0.25</td>
<td>721.32</td>
</tr>
</tbody>
</table>

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 median 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 four variables. For example, we check whether or not the distribution of the 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).  

4. Empirical Results

Since the wage rate is affected by the productivity of labour, it can be argued that labour productivity which is one of the control variables in our empirical model is endogenous. Nevertheless, we first assume that labour productivity is exogenous and utilise the fixed effect (FE) estimator and then account for the possible endogeneity of labour productivity by applying an instrumental variable (IV) estimator. In the fixed effect estimation while assuming labour productivity to be exogenous, it is possible that the idiosyncratic error terms in equation (14) are serially correlated. Therefore we utilise the Wooldridge (2002) test, which is also robust to conditional heteroskedasticity, involves regressing the residuals obtained from the regression of the first-differenced variables against their one-period lag to test for AR(1) process. 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 1101.52 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 in the manufacturing

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6 Preliminary statistical testing shows significant variation in the average wage across the selected firm characteristics which justifies the inclusion of these characteristics as control variables in our empirical model.
sector, it is reasonable to suspect the dependent variable in equation (14) is heteroskedastic. Thus we conduct a modified Wald test for groupwise heteroskedasticity, and obtain a test statistic of $3.2 \times 10^7$ with a $p$-value of 0.000. Accordingly, we reject the null hypothesis of homoskedasticity at less than 1% 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 utilize the procedure suggested by Schaffer (2007).

As the firm labour productivity can be endogenous, it is possible that the above FE estimation is biased and inconsistent. To address the endogeneity problem, we employ the instrumental variable (IV) estimator, using the one-period lagged labour productivity as the instrument.\(^7\) The IV estimation is carried out using Schaffer (2007) procedure. As we find evidence of heteroskedasticity and autocorrelation in the estimation assuming the exogeneity of labour productivity, we suspect the heteroskedasticity and autocorrelation also exist in the IV estimation. Therefore, the heteroskedasticity and autocorrelation robust standard errors are computed in the IV estimation. We conduct a feasible efficient two-step generalized method of moments (GMM) estimation, which is more efficient than the two-step least square (2SLS) IV estimation when significant heteroskedasticity and autocorrelation is present (Baum et al. 2007). In the IV/GMM estimations, we first test the relevance of instruments, namely to examine the fit of the first stage regression. In the first stage regression, the Bound, Jaeger, and Baker (1995) partial R-square and the Shea (1997) partial R-square are both 0.08, and the $F$-statistic for the significance of the lagged labour productivity is 2547.9 with a $p$-value of 0, which suggests that the instrument is relevant.

The last step involves the choice of the estimation technique - the IV/GMM estimation versus the estimation 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 & 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 93.5 with a corresponding $p$-value of 0.00 which allows one to reject the null hypothesis of orthogonality of labour productivity at a very low level of significance.

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\(^7\) 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, Salim and Bloch (2009) have also highlighted this problem but following other studies involving developing economies, they have also used lagged variables as instruments.
Accordingly, it is possible to argue that the 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. It is clear from Table 3 that the estimated results presented in columns (1) and (2) are not identical. However, by making use of the C-statistic, we have already determined that the estimated resulted presented in column (2) are more appropriate. The discussion that follows is based on the estimated results presented in column (2).

Table 3. Estimation Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
<th>P value</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>ln(firm size)</td>
<td>-0.006</td>
<td>0.0008</td>
<td>0.00</td>
<td>0.0023</td>
<td>0.0011</td>
<td>0.044</td>
</tr>
<tr>
<td>ln(labour productivity)</td>
<td>0.0084</td>
<td>0.0005</td>
<td>0.00</td>
<td>0.0232</td>
<td>0.0019</td>
<td>0.00</td>
</tr>
<tr>
<td>firm age</td>
<td>-0.0005</td>
<td>0.00004</td>
<td>0.00</td>
<td>-0.0002</td>
<td>0.0001</td>
<td>0.001</td>
</tr>
<tr>
<td>ln(capital intensity)</td>
<td>0.0005</td>
<td>0.0005</td>
<td>0.32</td>
<td>-0.0020</td>
<td>0.0007</td>
<td>0.002</td>
</tr>
<tr>
<td>ownership</td>
<td>0.0057</td>
<td>0.0010</td>
<td>0.00</td>
<td>0.0054</td>
<td>0.0013</td>
<td>0.000</td>
</tr>
<tr>
<td>whether FDI invested</td>
<td>0.0028</td>
<td>0.0016</td>
<td>0.09</td>
<td>-0.0005</td>
<td>0.0019</td>
<td>0.804</td>
</tr>
<tr>
<td>dminwage</td>
<td>-1.4809</td>
<td>0.0010</td>
<td>0.00</td>
<td>-0.2680</td>
<td>0.0008</td>
<td>0.00</td>
</tr>
<tr>
<td>Herfindahl index</td>
<td>0.3797</td>
<td>0.0211</td>
<td>0.00</td>
<td>0.3607</td>
<td>0.0315</td>
<td>0.000</td>
</tr>
<tr>
<td>average export intensity (4-digit industry classification)</td>
<td>0.1207</td>
<td>0.0072</td>
<td>0.00</td>
<td>0.0453</td>
<td>0.0100</td>
<td>0.000</td>
</tr>
<tr>
<td>industry dummies</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>year dummies</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Number of obs</td>
<td>224218</td>
<td>112172</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-value</td>
<td>94742.94</td>
<td>6025.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centered R²</td>
<td>0.97</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (i) Column (1) is the FE estimation without the instrument whereas column (2) is the FE estimation with instrument, using 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) dminwage is the dummy variable that captures the change in minimum wage policy.

The two variables of interest are the Herfindahl index, which captures the market competition and the average export intensity which captures the level of trade liberalisation. The coefficient of the Herfindahl index is 0.36 with a standard error of 0.03, indicating that a 1 per cent increase in the Herfindahl index will result in 0.36 per cent increase in the wage gap between skilled and unskilled labour. An increase in the Herfindahl index indicates a
decrease in the market competition. Hence the market competition appears to alleviate the wage gap between the skilled and unskilled labour. In a more competitive goods market, the competition forces firms to employ more productive workers, namely the skilled labour that have higher productivity. Since in a competitive labour market workers are paid at the value of their marginal product, the wage of skilled labour will decline as the employment of skilled labour increases, given the law of diminishing marginal product, which results in the decrease of the wage gap. The coefficient of the average export intensity is also significant and positive. It can be argued that a 1 per cent increase in the average export intensity leads to 0.12 per cent increase in the wage gap.

The firm characteristics appear to have a significant impact on the wage gap. The firm size, measured by the number of employees, exerts a significantly positive impact, with a 1 per cent increase in the firm size leading to a 0.0023 per cent increase in the wage gap, confirming that bigger firms can afford to pay a higher wage to employ more skilled workers. Similarly 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 significantly negative, which is surprising but can occur. A firm’s ownership structure also has significant impact on the wage gap. Being state and collectively owned negatively contributes to the wage gap, consistent with our prior expectation. In contrast, whether a firm is FDI invested or not appears not to significantly affect the wage gap. The change of minimum wage policy significantly and negatively affects the wage gap.
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 the Chinese manufacturing sector. We use a theoretical model to argue that trade liberalisation and market competition can affect skilled-unskilled wage gap in the shortrun as well as the longrun. In stage two, we use firm level data for 2003, 2006 and 2007 to estimate an empirical model. The empirical analysis suggests that trade liberalisation has contributed to an increase in skilled-unskilled wage gap in China. On the other hand, 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. Given the worldwide push for further trade liberalisation, it is not in China’s overall economic interest to reverse or even slow down 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.

References


