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HAPPIER UPPER CLASSES? – DO THE INTRA-FIRM COMPENSATION GAP AND GENDER WAGE DISCRIMINATION EXIST: EVIDENCE FROM A CHINESE COMPANY UNDER A TWO-TIER FRONTIER MODEL[1]

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Abstract

We examine the intra-firm compensation gap and gender wage discrimination in a listed company in China. We argue that the difference in bargaining ability of different level of employee can bring intra-firm compensation gap and we know that gender wage discrimination does exist at the bottom levels of employee. The bottom levels of employee have less bargaining ability than the firm, then get negative net surplus on wage that shows the existence of wage discrimination. While the upper levels of employee have stronger bargaining ability than the firm and will get positive net surplus on wage, which proves that the intra-firm compensation do really exist and the firm will pay more for upper levels. For bottom levels, female has relatively less bargaining ability than male and gets less wage, showing the existence of gender wage discrimination. Upper levels have almost the same bargaining ability as the firm and can get small amount of positive net surplus and there is no gender wage discrimination.

Keywords: Two-tier frontier, Bargaining ability, Gender wage discrimination, Intra-firm compensation.

JEL Classification: D31, J24, J31.

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1. Introduction

Wage distribution efficiency is always in highlights of important issues as it affects not only the consumption in macroeconomics but decides the long-term growth. Also, distribution fairness is an important way to guarantee social welfare. It also is an important way to enhance initiative and effectiveness of employee and improve income distribution of the whole society. The distribution of wage shows the bargaining result of the firm and the employee as well as the efficiency and equity. Theoretically, in the labor market, the labor price, wage, is decided by two factors, supply and demand. The firm considers the factor endowment it faces and decides how much to spend on hiring while the employees consider their own endowment and decide how much they will accept for a certain job. Under the direction of the "invisible hand" in the labor market, the firm and employees reach an agreement in bargaining and the equilibrium wage is decided. However, the market arrangement inefficiency, information asymmetry and heterogeneity etc. make it hard to reach the market-clearing level. And it is hard to live without wage discrimination.

After four decades of reform and opening up, China has become the 2nd largest economy in the world and starts to concentrating on building an efficient market system. However, there is a long way to go to build a paradise for all. The injustice in distribution is still waiting to be brought down. Focusing on the bargaining ability of both firm and employees, we try to find out what is it that lead to the wage discrimination.

We believe that the labor market is not perfect. The wage distribution shows the real result after bargaining of firm and employees though bargaining ability that is decided by many factors as human capital endowments and others personal characteristics, while a large amount of studies have been discussing this problem. Machin (1997) found that the labor agency plays an important part in workers' income equity by the survey of British employment and unemployment during 1980-1990, which suggested that the fainted union power or the failure of minimum wage intensify the inequity of wage distribution. Martins and Pereira (2004) found that the higher education level and better quality of schooling and major had a positive effect on wage. Using quantile regression, Arulampalam and Booth (2010) studied the relationship between education level and income distribution in private enterprises in 10 EU countries and found in a certain country, there was no strong relationship between job training and wage distribution but in different countries it showed a strong relationship between job training and wage distribution. We find that the difference in endowment plays an important role in wage distribution so we will introduce variables that describe the endowments of employees into our model.

As we all know, the upper classes of employee enjoy quite a high level of income that shows they capture stronger bargaining ability than the firm and will

get large surplus. However, whether the upper classes should get more is still controversial, a number of studies worked on the reason why the upper class of employees could get net positive surplus and the effect that it bought to the firm management. Early literatures believed that the higher wage level could ensure larger firm value. Coughlan Schmidt (1985) said higher wage for manager was an incentive to work hard to improve firm value and was good for the increase of shareholder value. After the study of 153 randomly selected manufacturing corporations, Mehran (1995) found it could raise the incentive of manager to improve firm value by offering more shareholdings than offering high wage. Chung and Pruitt (1996) discovered the inner relationship among the executive shareholding, firm value and executive income, that gave the executive high income and large shareholding could help improving firm value. They also found that the firm scale and the experience of executive did affect the wage level. After the financial crisis, an increasing number of scholars doubted the positive relationship between the executive wage level and firm value. Bebchuk and Cohen (2010) studied the compensation management of Bear Stearns and Lehman Brothers and found the high compensation might not have a positive effect on company management, but increased the executive risk-taking behaviors instead, which would bring financial crisis. Bolton and Mehran (2011) had come to a similar conclusion by studying the compensation management of some financial institutions. They believed that the shareholding as an incentive could increase the executive risk-taking behaviors. By using the representative small businesses data during 1993-2003, Cole and Mehran (2016) found that the executive compensation level had positive relation with firm scale and their age, education, background and gender.

Gender wage discrimination is always in highlight of academia. Female has less bargaining ability than male in labor market and always gets lower wage than male for the same work. By early year data of Russia, Newell and Reilly (1996) found about 30% of the wage differential came from gender. Jurajda (2003) studied the gender wage differential in transition countries and found by all the series of policies to fight against gender wage discrimination, two-thirds of the wage differential was attributed by gender, but public sector and state-owned enterprises were excepted. Oostendorp (2009) worked on data from International Labor Organization aiming at the influence of global factor on gender wage differential and found gender wage differential decreased with the economic development level, scale of foreign trade and investment. From the view of individual character diversity, Nyhus and Pons (2012) found 11.5% of gender wage differential came from individual character diversity. Mussida and Picchio (2014) used the ECHP panel data from 1994-2001 to study the influence of education on gender wage differential and found female with less education was easier to encounter with wage unfairness. Magnusson (2015) took doctors as a case to analysis the high-reputed careers and found gender wage differential still existed as the female doctors got lower wage than the male. By empirical

studies, Shouwei Qi and Zhiqiang Liu (2009) compared the gender wage differential in state-owned departments and non-state-owned departments and found the main reason of gender wage differential was gender discrimination while the discrimination in state-owned departments were more serious. Fengming Guo and Shiwei Zhang (2010) got similar result like Qi and Liu. Yuhao Ge and Xiangquan Zeng (2011) found two reasons to explain gender wage differential. On one hand, the firm had monopoly and so did the information asymmetry exist in the labor market, which allow the firm offered lower wage to female. On the other hand, the gender discrimination did really exist.

Besides the reason of gender wage differential, an increasing number of researchers start to work on the degree of gender wage differential under certain income level. Comparing the gender wage differential in the US and Denmark, Nabanita Datta Gupta et al. (2005) found, with the increase in income, the gender wage differential became large in Denmark which showed the ceiling effect. But the opposite phenomenon was found in the US. Using the ECHP panel data to test ceiling effect in wage distribution, Arulampalam and Booth (2007) found gender wage differential was significant in both state-owned and non-state-owned department. And at the upper class, the wage difference of female and male became more significant. After investigation and analysis about the wage distribution of 1.1 million employees in Sweden, Bihagen and Ohls (2007) found the floor effect that the lower class faced large wage discrimination while the upper class faced no obvious discrimination. Using quantile regression to analysis the wage discrimination in state-owned and non-state-owned enterprises, Shouwei Qi and Zhiqiang Liu (2009) found the floor effect existed in both lower and upper class while the lower class was faced with a big gender wage differential. By the analysis of urban worker gender wage differential, Shi Li et al. (2014) found the female employee who was inadequate and in bad condition would face more serious wage discrimination.

Throughout all the literature on wage distribution and gender wage discrimination, numbers of scholar have been working on the reason and effect of wage differential, but obstacles like the limitation of data and the lack of proper model make it hard to come to a certain conclusion. Because of the heterogeneity of subjects and bad data quality, like lack of real microcosmic data of firm and employee, empirical results and conclusions contradicted each other. At the same time, many scholars concentrated on the difference among firms, countries and cultures but the difference in different classes within a firm was still waiting to be explored. As we know, different classes of employee have quite huge gulf in endowments like education, experience, skills, etc., this paper is trying to find out the income distribution caused by the bargaining ability in different classes in one firm, and to reveal the reason of intra-firm compensation

gap and the influence of gender on bargaining ability in certain class of employee and find evidence for the gender wage discrimination.

The rest of paper is organized as follows: Section 2 builds up the bargaining model for both firm and employee. Section 3 describes the data and the empirical results. We conclude in Section 4.

2. The Bargaining model

2.1 Set up the mathematical model

Neoclassical theory believes that the firm pays at the equilibrium price of labor market and the market clears at the point where demand meets supply, at which maximizes both the firm and employee utilities. For the firm, the lower labor price it pays, the less operating cost it suffers and higher profit it gains. For employees, the higher labor price is, the more they earn. So, we consider the real wage point, which shows bargaining result of the firm and the employee. Also, we can take the real wage as an implementation of bargaining ability of both sides. Based on the argument above, we can describe the real wage (w) as follow:

$$w = \underline{w} + \eta(\overline{w} - \underline{w}) \tag{1}$$

where $\underline{w}$ is the lowest wage employee can accept, $\underline{w}$ is the highest wage the firm is willing to offer, η $(0 \le \eta \le 1)$ is the bargaining strength within the firm and employee, $\eta(\overline{w} - \underline{w})$ is the bargaining surplus firm gets. Future, we define $g(x)$ as the market clearing wage of employee who characterized as x, and $\underline{w} \le g(x) \le \overline{w}$. So, $(\overline{w} - g(x))$ is the largest surplus the firm can get. Correspondingly, $(g(x) - \underline{w})$ is the largest surplus employee can get. Finally, the surplus firm or employee gets depends on the bargaining ability firm and employee have. Then, we transform formula (1) into:

$$w = g(x) + \underline{w} - g(x) + \eta(\overline{w} - g(x)) - \eta(\underline{w} - g(x))$$

$$= g(x) + \eta(\overline{w} - g(x)) - (1 - \eta)(g(x) - \underline{w}) \tag{2}$$

Formula (2) can be divided into 3 parts, $g(x)$is the market clearing wage characterized by individual factor x, $\eta(\overline{w} - g(x))$ is the real bargaining surplus the firm get, and $(1 - \eta)(g(x) - \underline{w})$ is the real bargaining surplus of the employee, and $\eta(\overline{w} - g(x)) - (1 - \eta)(g(x) - \underline{w})$ is the net surplus represents the result of bargaining.

We can see from the above formula that the firm has the negative affect and turns to lower the wage while the employee has positive affect and tries to raise

the wage, and these two effects are both one-sided effect. We follow the two-tier frontier model of Kumbhakar and Parmeter (2009), and describe the bargaining action of the firm and the employee as follow:

$$y_i = \mathrm{g}(x_i) + \varepsilon_i \ , \varepsilon_i = v_i - \mu_i + \omega_i \quad (3)$$

y_i is the real wage after bargaining, $\mathrm{g}(x_i) = x_i'\beta$ is the equilibrium wage which stands for the market clearing price under certain individual characteristic. β is the corresponding parameter vector, x_i is the characteristic vector of employee. v_i is the residual error term, $\mu_i \geq 0$ and $\omega_i \geq 0$ stand for the non-negative random error terms with one-sided effect. μ_i represents the firm's bargaining ability which brings the firm more surplus by lowering the wage. ω_i represents the employee's bargaining ability which brings the employee surplus by raising the wage. Since μ_i and ω_i are both one-sided, E(ε_i) may not be zero and the OLS estimator of the parameters would be unbiased. So, we estimate the model using the maximum likelihood (MLE) method based on the following distributional assumptions of the error components. Following the work of Kumbhakar and Parmeter (2009), Hongyou Lu and Yujun Lian (2011) and Chunking Li et.al (2014), we assume that: $v_i \sim i.i.d.N(0, \sigma^2)$, μ_i and ω_i have the single-tier stochastic frontier and follow exponential distribution, viz., $\mu_i \sim i.i.d.Exp(\sigma_u, \sigma_u^2)$, $\omega_i \sim i.i.d.Exp(\sigma_\omega, \sigma_\omega^2)$.

And the 3 error components are distributed independently with each other and from the regressor, $\mathrm{x_i}$.

Based on the distributional assumptions above, the probability density function of ε_i is as follow:

$$\mathrm{f}(\varepsilon_\mathrm{i}) = \frac{\exp(\mathrm{a_i})}{\sigma_\mathrm{u}+\sigma_\omega}\Phi(\mathrm{c_i}) + \frac{\exp(\mathrm{b_i})}{\sigma_\mathrm{u}+\sigma_\omega}\int_{-\mathrm{d_i}}^{+\infty}\phi(\mathrm{z})\mathrm{dz} = \frac{\exp(\mathrm{a_i})}{\sigma_\mathrm{u}+\sigma_\omega}\Phi(\mathrm{c_i}) + \frac{\exp(\mathrm{b_i})}{\sigma_\mathrm{u}+\sigma_\omega}\phi(\mathrm{d_i}) \quad (4)$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the probability density function and cumulative distribution function of standardized normal distribution. a_i、b_i、c_i、d_i is defined as follow, respectively:

$$a_i = \frac{\varepsilon_i}{\sigma_i} + \frac{\sigma_v^2}{2\sigma_u^2} \quad ; \quad b_i = -\frac{\varepsilon_i}{\sigma_\omega} + \frac{\sigma_v^2}{2\sigma_\omega^2} \quad ; \quad c_i = -\frac{\varepsilon_i}{\sigma_v} - \frac{\sigma_v}{\sigma_u} \quad ; d_i = \frac{\varepsilon_i}{\sigma_i} - \frac{\sigma_v}{\sigma_\omega} \quad (5)$$

The log likelihood function for observations can be set up as:

$$lnL(x_i;\theta) = -ln(\sigma_u + \sigma_\omega) + \sum_{i=1}^{n} ln\left[exp(a_i)\,\Phi(c_i) + exp(b_i)\,\Phi(d_i)\right] \quad (6)$$

where $\theta = \{\beta, \sigma_v, \sigma_u, \sigma_\omega\}$ is the estimated parameters, and all the parameters can be estimated by maximizing the above log likelihood function. We pay more attention to the bargaining ability of both firm side and employee side, in other

words, the surplus of each side. So we need the conditional distributions of one-sided error terms μ_i and ω_i as follow:

$$f(\mu_i|\varepsilon_i) = \frac{\lambda exp\,(-\lambda\mu_i)\Phi(\mu_i/\sigma_v+d_i)}{X_{1i}} \quad (7a)$$

$$f(\omega_i|\varepsilon_i) = \frac{\lambda exp\,(-\lambda\omega_i)\Phi(\omega_i/\sigma_v+c_i)}{X_{2i}} \quad (7b)$$

where $\lambda = (1/\sigma_u) + (1/\sigma_\omega)$, $X_{1i} = \Phi(d_i) + exp\,(a_i - b_i)\Phi(c_i)$, $X_{2i} = exp(b_i - a_i)\,X_{1i}$.

With (7a) and (7b), we derive the conditional expectation of μ_i and $\omega_i$as follow:

$$E(\mu_i|\varepsilon_i) = \frac{1}{\lambda} + \frac{exp(a_i-b_i)\sigma_v[\Phi(-c_i)+c_i\Phi(c_i)]}{X_{1i}} \quad (8a)$$

$$E(\omega_i|\varepsilon_i) = \frac{1}{\lambda} + \frac{\sigma_v[\Phi(-d_i)+d_i\Phi(d_i)]}{X_{2i}} \quad (8b)$$

By (8a) and (8b) we can get the absolute variation of the degree which shows the distance where real wage is from the market clearing wage. We divide the employee into upper class and lower class, which, by using the absolute variation, may impose limits on our analysis as the absolute value of individual characters varied. Instead, we use relative variation, which has a better analysis effect, defined as follow:

$$E(1 - e^{-\mu_i}|\varepsilon_i) = 1 - \frac{\lambda}{1+\lambda}\frac{1}{X_{1i}}[\Phi(d_i) + exp(a_i - b_i) * exp\,(\frac{\sigma_v^2}{2} - \sigma_v c_i)\Phi(c_i - \sigma v] \quad (9a)$$

$$E(1 - e^{-\omega_i}|\varepsilon_i) = 1 - \frac{\lambda}{1+\lambda}\frac{1}{X_{2i}}[\Phi(c_i) + exp(b_i - a_i) * exp\,(\frac{\sigma_v^2}{2} - \sigma_v d_i)\Phi(d_i - \sigma v] \quad (9b)$$

Using (9a) and (9b), we can calculate the net surplus (NS) after bargaining, which means, employee holds an advantage due to bargaining ability if NS turns out to be positive, while the opposite is true if NS is negative. NS is given as follow:

$$NS = E(1 - e^{-\mu_i}|\varepsilon_i) - E(1 - e^{-\omega_i}|\varepsilon_i) \quad (10)$$

2.2 Set up the Empirical model

The difference in bargaining ability mainly comes in two ways. On the individual property side, we call it individual endowments. Compared with lower class, the employees in upper class are usually equipped with better education, better ability, abundant experience. Usually, the firm is willing to hire these kinds of employee even it has to pay more. On the social property side, we consider about the firm culture and working environment etc. Dependently, we choose the explanatory variables which are mainly from the individual and social property side of employee while considering the availability, viz., age gender, education etc. Considering the regional difference, we add a dummy variable, province, into the regression and build up the two-tier frontier model as follow:

$$\begin{aligned} Lnwage_i = \beta_0 + \beta_1 Lnage_i + \beta_2 Gender_i + \beta_3 Marriage_i + \beta_4 Edu_i \\ + \beta_5 Native_i + \beta_6 Seniority_i + \beta_7 Level_i + \beta_8 Punish_i \\ + \beta_9 Award_i + \beta_{10} Training_i + \sum Province + v_i - \mu_i + \omega_i \end{aligned}$$

where $Lnwage_i$, $Lnage_i$, $Gender_i$, $Marriage_i$, Edu_i, $Native_i$, $Seniority_i$, $Level_i$, $Punish_i$, $Award_i$, $Training_i$ represents log wage, log age, gender, marriage, education, whether native employee or not, working experience, rank of position, the number of punishment, the number of reward, the number of training, respectively. $\sum Province$ is the dummy variable which includes Guangdong, Guangxi, Yunnan, Guizhou, Hainan, Fujian, Shanxi, and we set Yunnan as the benchmark.

3. Data and Empirical results

3.1. Data and Variables

Our data is the original full copy data from the human resources management data base of a listed company in mainland China whose subsidiaries spread over several provinces. The data starts at 1996 and end at 2015. We take it as a typical case and consider it as a good representative. In order to improve the data quality, we do treatments as follow:

To classify the employees into upper and lower class, we put frontline worker, primary manager, primary professional staff, unskilled worker, back-man, workman etc. into the lower class, while put middle manager, senior manager, middle professional staff, senior professional staff, duty engineer, etc. into the upper class. To guarantee the sample representativeness we drop the data of whose age under 18, which is under the consider of the regulation of Labor Law. We drop the samples whose observed value is default or exceptional.

After the treatments above, we get 23815 observations, while the observation of lower class is 19384 and upper class is 4431.

When choosing dependent variable, we consider the wage grade rather than the observed wage. As the observed wage is quite a complicated matter which contain foundational wage, merit pay, post wage, etc. which is quite hard to be summed up directly, while the wage of lower class always depends on firm current performance which is characterized by the violent fluctuation and hard to get efficient statistics. The higher the wage grade is, the higher salary worker gets, and the umber of wage grade range from 40 to 56. At the same time, to make the data better to describe the reality, we assign specific amount to stand for the wage grade. We take the lowest grade 40 as the benchmark, assign it with the amount 3500 RMB and one grade higher, 500 RMB increases.

The outcome variable is log wage and the explanatory variable in the regression are: age, gender, education, seniority, level, the number of punishment, the number of reward, the number of training and dummy variables for marriage, whether native or not and province. Detailed as follow:

Age: considering about the regulation of Labor Law, we drop the simples of those who are under 18, and others take the actual value of age and then take the log of the value.

Gender: We assign male as 1, and assign female as 0.

Marriage: Marriage may have a positive influence on working, we use the dummy variable of marriage and assign married employee as 1, single employee as 0.

Education level: We assign the education level into 4 grades. Below high school level as grade 1, junior college as grade 2, undergraduate as grade 3, graduate as grade 4 and evaluate them as 1,2,3,4 respective.

Native: By matching the employee's working location and household register location (province level), we assign the same as native as 1, otherwise 0. For those sample without household register data, we use their house address (province level) instead.

Seniority: We calculate the number of year from the employee joined the company until the year 2015.

Level: Considering the tiered standard of the listed company, and rank the position as 7 grades and evaluate them.

The number of punishment, the number of reward and the number of training are all take the original data.

In order to reduce the heteroscedasticity, we take the log of wage level and age. All the variables name and sign we referred are displayed on table 1. We can see

from the table that the average of gender is 0.285 which means the firm has much more male employees; the average of education is 1.405 which means most of the employees are not well educated; the average of rank of position is 2.544 which means most of the employees are lower classes.

Table 1. Statistics description

Variable	Average	Maximum	Minimum	Standard Error
Lnwage	8.583	9.35	8.16	0.170
Lnage	3.505	4.32	2.89	0.236
Gender	0.825	1	0	0.380
Marriage	0.686	1	0	0.464
Edu	1.405	4	1	0.688
Native	0.877	1	0	0.328
Seniority	5.019	20	1	2.833
Level	2.544	7	1	1.453
Punish	0.011	5	0	0.130
Award	0.015	5	0	0.137
Training	13.78	129	0	16.75

Source: Human resources management data base from a certain listed company

3.2. Model estimation

We estimate the difference of bargaining ability among lower class and upper class to analyze the wage discrimination, the results are presented on Table 2 and regression is ran dividedly in different group of all employees, lower class and upper class, respectively. Model (1), model (3) and model (5) is estimated by the two-tier frontier model using MLE (maximum likelihood estimation), while mode (2), model (4) and model (6) are OLS (ordinary least squares). All the results get a high R^2, which confirms all the explanatory variables has a strong interpretability with wage. By comparing the results and t value of OLS and MLE, we find a strong consistency between two methods which confirms the method MLE we use won't lead to biased estimations. The results are almost significant at 1% level, with few exceptions, and the sign of explanatory variables are all in line with expectation. From table 2, the education level, rank, seniority, etc. have a significant positive influence on wage, regardless of upper or lower class. The well-educated, longtime working and highly rank employees get higher wage and have stronger bargaining ability. This result is consistent with the literatures. Notice that the gender has a significant positive influence on lower class but not on the upper class, which confirms the existence of gender wage discrimination appearance in lower class.

Table 2. Estimates of regression

Variable	All employees		Lower class		Upper class	
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model(5)**	**Model(6)**
Lnage	-0.015***	-0.015***	-0.029***	-0.041***	0.068***	0.067***
	(-5.515)	(-5.203)	(-12.068)	(-15.582)	(10.307)	(10.138)
Gender	0.061***	0.067***	0.06***	0.082***	-0.004	-0.003
	(40.301)	(48.405)	(47.772)	(65.881)	(-1.221)	(-0.914)
Marriage	0.004***	0.003**	-0.0003	0.001	0.001	0.001
	(2.715)	(2.409)	(-0.269)	(0.831)	(0.275)	(0.445)
Edu	0.035***	0.036***	0.017***	0.017***	0.022***	0.021***
	(37.169)	(39.877)	(20.885)	(18.652)	(14.354)	(14.131)
Native	-0.017***	-0.018***	-0.007***	-0.007***	-0.008***	-0.007***
	(-9.98)	(-10.808)	(-4.579)	(-4.026)	(-2.841)	(-2.776)
Seniority	0.003***	0.003***	0.002***	0.002***	0.005***	0.005***
	(14.883)	(12.609)	(13.021)	(11.127)	(11.814)	(11.76)
Level	0.085***	0.091***	0.066***	0.069***	0.101***	0.101***
	(155.697)	(214.783)	(156.942)	(163.157)	(86.627)	(90.177)
Punish	0.002	0.005	-0.003	0.001	-0.004	-0.004
	(0.659)	(1.177)	(-0.987)	(0.274)	(-0.676)	(-0.682)
Award	0.015***	0.013***	0.010***	0.006	0.027***	0.028***
	(4.028)	(3.524)	(3.014)	(1.556)	(4.742)	(4.803)
Training	-0.00026***	-0.00029***	0.00001	0.00005	-0.00044***	-0.00044***
	(-8.177)	(-8.562)	(0.702)	(1.588)	(-6.456)	(-6.523)
Province	–	–	–	–	–	–
Constant	8.332***	8.316***	8.440***	8.437***	8.115***	8.127***
	(876.656)	(832.54)	(1028.363)	(925.159)	(356.043)	(367.662)
σ_u	0.0479	–	0.0475	–	0.0176	–
σ_w	0.0511	–	0.0277	–	0.0280	–
σ_v	0.0374	–	0.0315	–	0.0632	–
N	23815	23815	19384	19384	4431	4431
Adj.R^2	–	0.787	–	0.691	–	0.784
ll	27184.46	–	26758.891	–	5417.275	–

*, ** and *** denote significance at 10, 5 and 1 percent levels, respectively.
t values are in parenthesis.
The results of Province are not display on table in consideration of table format.
Source: Human resources management data base from a certain listed company

We can see from the results that there is an obvious difference between the upper and lower class that may come from great difference in individual endowment, which encourages us to carry on the test with divided group. Our analyses below are all based on the results from model (3) and model (5).

3.3. Variance decomposition: Bargaining ability measurement

Using the two-tier frontier approach will give us deeper insight on the effect of bargaining on wage from both firm side and employee side. The surplus from bargaining is revealed by wage, while the firm wants better employee with lower

wage, showing the negative effect on wage, while the employee wants higher wage at the given individual endowment level, showing the positive effect on wage. The wrestle on wage is perfectly explained by variance decomposition.

From the estimation results of σ_u, σ_w and σ_v in table 2, we can calculate the results of bargaining ability of the firm and the employee in table 3.

Table 3. Variance decomposition of bargaining ability on both side

Variable	Expression	Lower	Upper
Total variance of stochastic term	$\sigma_{,,}^2+\sigma_{,,}^2+\sigma_{,,}^2$	0.004	0.0051
Share of bargaining ability in total	$(\sigma_{,,}^2+\sigma_{,,}^2)/(\sigma_{,,}^2+\sigma_{,,}^2+\sigma_{,,}^2)$	0.753	0.215
Share of firm in bargaining	$\sigma_{,,}^2/(\sigma_{,,}^2+\sigma_{,,}^2)$	0.747	0.284
Share of employee in bargaining	$\sigma_{,,}^2/(\sigma_{,,}^2+\sigma_{,,}^2)$	0.253	0.716

Source: Calculated by the results from table 2

We can see from the results in table 3, column 3, for the lower class, the employee' effect on wage is about 25.3% while the firm's effect on wage is about 74.7%, which means the firm has absolute advantage on wage bargaining and the bargaining significantly reduce the wage and discriminates the lower class. However, the upper class in column 4, is almost reverse, the employee' effect on wage is about 73.4% while the firm's effect on wage is about 26.6% which means the upper class has stronger bargaining ability than the firm and can ensure higher wage by efficient bargaining with the firm. The upper class usually receives more and is not afraid of discrimination. The intra-firm compensation gap does really exist!

3.4. Estimate the intra-firm gap of the wage

It seems that we are reading the Matthew's story. The upper class is happier than the lower class. They have stronger bargaining ability than the firm and never suffers from any discriminations. However, the lower class seems not lives in such a happy world and suffers a lot from the negative net surplus brought by the poor bargaining ability. There is a big gap between the upper and lower class. But, how many surpluses are exploited? We are now trying to find the details on surplus extraction using one-side estimation based on the $E(1-e^{-\mu_i}|\varepsilon_i)$ and $E(1-e^{-\omega_i}|\varepsilon_i)$ from (9a) and (9b), respectively. These formulas describe the the percentage change which the firm and the employee gets, relative to the average wage. The net surplus (NS) is from function (10). Results are showed on table 4.

Table 4. The net surplus from bargaining

	Variable	Average	Standard	P25	P50	P75
Lower class	Surplus of employee	2.69	1.61	1.79	2.06	3.19
	Surplus of firm	4.53	3.71	2.14	3.45	5.31
	NS	-1.83	4.58	-3.52	-1.39	1.05
Upper class	Surplus of employee	2.72	1.14	2	2.48	3.06
	Surplus of firm	1.73	0.45	1.43	1.61	1.92
	NS	0.99	1.5	0.08	0.87	1.63

Source: Calculated by the results from table 2

We can see from table 4: on average, lower class is able to raise wage from the average up to about 2.69%, while the firm lowers the wage down for about 4.53%. The result of bargaining ability, names, the net surplus, is negative -1.83%, which means lower the wage down from the average wage for 1.83%. For lower class, the employees have less bargaining ability than the firm. In reality, the lower class can only accept the wage decided by the firm and have disadvantages on income distribution, which means, there does really exist of wage discrimination on lower class. The last 3 columns in Table 4 shows the net surplus of upper and lower class at first quartile, second quartile and third quartile, respectively. Overall, we can see the lower class is in disadvantage, but on the third quartile we get 1.05% in net surplus which means the upper quartile in lower class can get positive net surplus, but just only for the upper quartile, which proofs that even in the lower class, the intra-firm compensation gap also exists. One possible story is that, because of the existence of asymmetric information, the upper 25% of the employees in lower class who have inadequate personal characteristics than expected, still get more than average wage they deserve at their characteristics level.

However, on average, the upper classes have stronger bargaining ability than the firm with the surplus of 2.72%, larger than the surplus of firm, 1.73%, and get a net positive surplus and raise their wage. Even at different quartiles of upper class, the net surplus is positive, which reveals the advantage of the upper class in bargaining and income distribution.

3.5. Estimate the effect of gender in wage distribution

The gender problem in wage distribution is always in highlight, we follow the formula (9a), (9b) and (10) to do the one-side estimation with dummy variable, gender, and get the the net surplus analysis of lower and upper class in table 5.

Table 5. The net surplus from bargaining under different gender

		Variable	Average	Standard	P25	P50 (%)	P75
Lower class	Female	Surplus of employee	2.91	2.24	1.72	2.19	3.18
		Surplus of firm	6.39	6.1	2.15	3.09	9.1
		NS	-3.48	7.26	-7.38	-0.9	1.03
	Male	Surplus of employee	2.64	1.43	1.83	2.04	3.19
		Surplus of firm	4.11	2.77	2.14	3.49	4.83
		NS	-1.47	3.64	-3	-1.44	1.05
Upper class	Female	Surplus of employee	2.63	0.83	2.11	2.48	3.04
		Surplus of firm	1.73	0.48	1.44	1.62	1.83
		NS	0.9	1.23	0.28	0.86	1.61
	Male	Surplus of employee	2.74	1.19	1.98	2.48	3.06
		Surplus of firm	1.73	0.45	1.43	1.61	1.94
		NS	1.01	1.54	0.03	0.87	1.63

Source: Calculated by the results from table 2

We can see from the table 5 that, on average, for the lower class, the female can raise the wage for 2.91% while the firm lowers the wage for 6.39%, the male can raise the wage for 2.64% while the firm lowers the wage for 4.11%. Even though, the net surplus for both female and male is negative, but the male can get more net surplus than the female, which tells the bargaining ability of male is stronger than female in lower class. The last 3 columns in table 5 show the net surplus for both male and female in different quartile. We can see a lower net surplus of female than male on average. But on the third quartile, the difference between male and female shrinks to 0.02%. By contrast, we also calculate the surplus of upper class. On average, the net surplus of female is 0.9% while the net surplus of male is 1.01%, and the difference on different quartile is just about to tell in upper class the gender has little influence on wage and the female and male has the similar bargaining ability and there is no gender wage discrimination exist in upper class. The result is consistent with the former result in table 2, that the gender variable is not significant in upper class model but significant in lower class.

4. Conclusions

We use the database of a certain listed company in mainland China and the two-tier frontier model to estimate the surplus from the bargaining of both firm and employee in different classes and also calculate the net surplus to explore the wage discrimination during this process. We find a strong evidence for intra-firm wage gap and gender wage discrimination. While, we also get some useful statements as follow:

The lower class has less bargaining ability than the firm and gets less wage than average level. By the results of variance decomposition, the lower class has an upside power of 0.253 while the firm has a downside power of 0.747, and the

lower class gets negative net surplus, which means they can not get all the wage they deserve and suffer from the wage discrimination.

The upper class of has stronger bargaining ability than the firm and gets more wage than the average level. By the results of variance decomposition, the upper class has an upside power of 0.716 while the firm's bargaining ability is about 0.284. The upper class makes the firm pays more for them and gets a positive net surplus.

The wage discrimination exists among the lower class rather than the upper class. For lower class, the female has less bargaining ability than the male, which shows the exist of gender wage discrimination. However, for the upper class the net surplus of both the female and male is indifference and they enjoy an equality in wage distribution.

Till now, we find some facts in wage distribution, that the intra-firm compensation gap does exist, the upper class can always get more than the lower class, which make the lower class suffers more. At the same time, the female in lower class experience the cruelest unfairness in wage distribution, which reveals the gender wage discrimination. There is still a long way to go in order to build a fair and efficient labor market.

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