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# Are Firms Stronger than Employees in Terms of Salary Bargaining Power? Evidence from China

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**Abstract:** This paper aimed to analyze the salary bargaining power of employees and firms. Based on two-tier stochastic frontier model, this paper constructed a model to measure the bargaining power of employees and firms in the salary formation process. Taking Chinese A-share listed companies from 2017 to 2021 in the China Stock Market & Accounting Research Database (CSMAR) of GTA as samples, this paper conducted an empirical measurement of the bargaining power of both parties and the impact on employee salary. The results showed that: (1) The bargaining power of both employees and firms had a very important impact on the final salary, and employees had stronger bargaining power compared with firms; (2) About 75% employees made their salary higher than “Benchmark” salary through bargaining. The employee salary was 8.46% higher than "Benchmark" salary on average. With the increase of salary level, employees had stronger bargaining power in the process of salary formation. (3) The bargaining power of employees and firms was heterogeneous in firms with different ownership in different years, but the bargaining power of employees was generally stronger than that of firms.

**Keywords:** Employee salary; Bargaining power; Two-tier stochastic frontier model; “Benchmark” salary

## 1. Introduction

Fairness is the basic principle and value norm of reasonable social order, therefore, it is an important subject in ethics, sociology, political science, economics and law. In recent years, the Chinese public has been very concerned about the high salary of employees in several monopoly industries and the income gap between industries. The 20$^{th}$ Communist Party of China (CPC) National Congress emphasized to "increase the income of low-income people and expand the middle-income group", which shows the great attention paid to the issue of income distribution. Reasonable income distribution is an important embodiment of social fairness. Distribution of labor salary, as the initial distribution of society, is one of the important sources affecting the income gap and social stability (Wang, 2010). Elements of equity theory include work input and output. An important part of work output is salary, especially in developing countries like China, where salary reasonableness is used to measure the fairness of work output. As an important part of employees' labor income, salary is not only the main component of residents' income, but also directly affects employees' enthusiasm for work and enterprises' value creation (Blackburn & Neumark, 1992).

The existing literature has conducted in-depth research on the labor income of employees, which can be divided into two types: calculation and reason analysis of labor income share, as well as analysis of the income gap. However, there are relatively few studies on how to determine labor income and whether it is reasonable, especially measurement of the deviation degree of employee salary in Chinese listed companies. Although the public generally believes "strong capital and weak labor" in recent years, with the improvement of information transparency and the increase of various feedback platforms, the salary bargaining power of employees may not be as bad as imagined. As for employee salary in Chinese listed companies, is there any difference in the bargaining power between employees and firms? How has bargaining power changed over time? It's interesting to study these questions. Understanding the salary bargaining power of both parties helps form a fairer environment to promote social equity and improve economic efficiency. Therefore, based on two-tier stochastic frontier model, this paper constructed a game model of salary bargaining between employees and firms in Chinese listed companies,

empirically measured their bargaining power as well as the salary formation mechanism of employees, thus providing some reference for related research.

The following structure of this paper was as follows: the second part constructed a measurement model based on literature review; the third part was sample selection; the fourth part was empirical analysis; the fifth part was conclusions of the paper.

## 2. Literature Review and Model Construction

Income distribution has an impact on social stability, economic development and improvement of people's livelihood. China's labor income share has long been lower than the 55%-65% level in many countries of the world. China's income distribution shows a trend toward capital, forming a situation of "strong capital and weak labor", which has led to a series of social problems, such as unfair distribution, intensified labor conflicts and widening income gap (Guo & Lü, 2012). Employees' labor income directly affects their enthusiasm for work and enterprises' value creation (Lu et al., 2012). Therefore, it is of great significance to study the labor income of employees.

Most of existing studies on labor income focus on two types, and the first is the study of labor income share. The study of Qian & Fang (2021) has shown that when the uncertainty of economic policies increases, firms increase the proportion of labor income by reducing the size of employees and increasing the average employee salary. Bai & Luo (2022) studied A-share listed Chinese manufacturing companies from 1998 to 2018 and empirically tested the positive correlation between labor income share and corporate performance. Lv & Guo (2012) calculated the distribution of pre-tax and after-tax factor income in China since the reform and opening up based on financial factors. Some scholars have explained the decline of labor income share through empirical analysis, and several representative views include return on capital (Li et al., 2009), industrial structure (Luo & Zhang, 2009), state-owned enterprise restructuring and monopoly (Bai & Qian, 2009), system or power allocation (Liu et al., 2013). The second type is the research on income gap, which focuses on the causes of income gap. Guo & Luo (2021) argued that biased technological progress within an industry affected the skill intensity and income gap of the overall economy. Chang & Zhao (2016) believed that income gap was mainly caused by the household registration system. Ye et al. (2011) found through empirical research that industrial monopoly and ownership were the main factors of income gap.

Few studies have investigated the bargaining power of labor and capital for the formation of employees' labor income in China. However, with the increase of information transparency, the bargaining power of employees also increased. The existing research data on employees' bargaining power are relatively old, and there are generally no research samples on Chinese listed companies.

What exactly causes employee salary to deviate from "Benchmark" salary? Neoclassical economics emphasizes complete market competition, and employees can get the "benchmark" salary spontaneously formed by the market in the long run. However, due to transaction costs (Williamson, 1985), heterogeneity (Coase, 1937; Hart & Moore, 1988), bargaining and other problems (Gibbons & Katz, 1992) in reality, on the one hand, firms try to keep employee salary as low as possible, which leads to the problem of profits encroaching on salary; on the other hand, employees use their information to maximize their salary. As a result, the true labor income of employees must deviate from "Benchmark" salary, which is largely caused by the power allocation control. On the premise of certain internal power, firms and employees jointly distribute various powers. If the power allocation control of firms is higher than that of employees, the internal income distribution is biased toward the capital side, and firms save costs by lowering employee salary, resulting in the salary lower than "Benchmark" salary. If the power allocation control of employees is higher than that of firms, the internal income distribution is biased to employees, which enables them to have stronger bargaining power and obtain higher labor income than "Benchmark" salary.

In view of the importance of right allocation and control for employee salary, it is necessary to deeply discuss this issue. Based on the studies of Gaynor & Polachek (1994), Polachek & Yoon (1996), Kumbhakar & Parmeter (2009), this paper established a model to measure the salary bargaining power of employees. The core mechanism of this model was: under the premise of "Benchmark" salary with given sample characteristics, due to the difference in power allocation and control, on the one hand, employees increased their salary by obtaining the expected surplus of firms; on the other hand, firms reduced employee salary by earning the expected surplus of employees. The final salary was the result of the two-tier effect between firms and employees. The bargaining power of both parties was measured by calculating the strength of their control right.

Assuming that there are many labor supply parties (employees) and labor demand parties (firms) in the labor market, and both parties have certain control rights of power allocation. Employee salary in the labor market is expressed as follows:

$$salary = \underline{salary} + \eta(\overline{salary} - \underline{salary}) \quad (1)$$

where, $\underline{salary}$ is the minimum salary accepted by employees, $\overline{salary}$ is the highest salary that firms are willing to pay. $\eta(0 \leq \eta \leq 1)$ is used to measure the bargaining power of employees in salary formation (i.e., it measures the

strength of power allocation and control of employees.). The stronger the bargaining power, the closer $\eta$ is to 1. Therefore, $\eta(\overline{salary}\text{-}\underline{salary})$ reflects the surplus in the formation process of employee salary.

In order to reflect the role of employees and firms in salary formation simultaneously in the model, Eq. (1) needs to be decomposed. Assuming that when the basic characteristics $x$ of the sample are pre-defined, the market spontaneously forms the "Benchmark" salary for $\mu(x)=E(\theta|x)$, in which $\theta$ actually exists but cannot be known (Many studies have analyzed this effective matching price problem (such as Acemoglu & Shimer, 2000; Flinn, 2006), but they are generally set to know or obey some distribution. Since it is difficult to find a "Benchmark" salary a priori, this paper sets it as unknowable in advance but objectively existing.), and there are always $\underline{salary}\leq\mu(x)\leq\overline{salary}$. Therefore, $[\mu(x)\text{-}\underline{salary}]$ represents the expected surplus that the employees receive, and $[\overline{salary}\text{-}\mu(x)]$ represents the expected surplus obtained by the firms. Which party can get more surplus depends on how much control they have over power allocation and their bargaining power based on it (Osborne & Rubinstein, 1990). This paper used these surplus definitions to restate Eq. (1) as:

$$salary=\mu(x)+[\underline{salary}\text{-}\mu(x)]+\eta[\overline{salary}\text{-}\mu(x)]-\eta[\underline{salary}\text{-}\mu(x)] =\mu(x)+ \eta[\overline{salary}\text{-}\mu(x)]-(1\text{-}\eta)[\mu(x)\text{-}\underline{salary}] \quad (2)$$

It can be seen from Eq. (2) that employees increase their salary by obtaining part of the expected surplus of the firms, and the range obtained is $\eta[\overline{salary}\text{-}\mu(x)]$. Similarly, firms reduce employee salary by capturing part of the expected surplus of employees, and the range obtained is $(1\text{-}\eta)[\mu(x)\text{-}\underline{salary}]$. The expected surplus that employees obtain depends on the bargaining power $\eta$ of employees and the expected surplus $[\overline{salary}\text{-}\mu(x)]$ obtained by firms in the process of salary formation; and the expected surplus that firms obtain depends on the bargaining power $(1\text{-}\eta)$ of firms and the expected surplus $[\mu(x)\text{-}\underline{salary}]$ obtained by employees in the process of salary formation.

Eq. (2) shows that the salary consists of three parts: the first is $\mu(x)$, which represents the "Benchmark" salary level formed by the market when the sample characteristic $x$ is given; the second is $\eta[\overline{salary}\text{-}\mu(x)]$, which indicates that employees obtain the expected surplus of firms through salary bargaining; the third is $(1\text{-}\eta)[\mu(x)\text{-}\underline{salary}]$, which indicates that firms obtain the expected surplus of employees through salary bargaining. The final net surplus is:

$$NS=\eta[\overline{salary}-\mu(x)]-(1-\eta)[\mu(\mathrm{x})-\underline{salary}] \quad (3)$$

Eq. (3) can be used to reflect the comprehensive effect in the formation of employee salary. If $NS<0$, it indicates that firms have stronger bargaining power than employees, and reduce employee salary by obtaining their expected surplus; If $NS>0$, it means that employees have stronger bargaining power than firms, and increase their salary by obtaining the expected surplus of firms.

Under the analytical framework of Eq. (3), the bargaining power of firms has a negative effect on employee salary, while that of employees has a positive effect. The final formation of employee salary is the result of the joint action of both parties, which is a typical two-tier stochastic frontier model. The model can be written as:

$$salary_i=\mu(x_i)+\xi_i, \quad \xi_i=w_i-u_i+v_i \quad (4)$$

where, $\mu(x_i)=x_i'\delta$, $x_i$ is the sample's characteristics vector, $\delta$ is the parameter vector to be estimated, $w_i$ represents the salary that employees increase by obtaining firms' surplus, and $w_i=\eta_i[\overline{salary}_i\text{-}\mu(x_i)]\geq 0$, $u$ represents the salary that firms reduce by obtaining employees' surplus, and $u_i=(1\text{-}\eta_i)[\mu(x_i)\text{-}\underline{salary}_i]\geq 0$, $v_i$ is a random disturbance term in the general sense.

In order to simultaneously estimate the parameter vector $\delta$ in the model and the expected surplus obtained by employees and firms in the process of employee salary formation, this paper adopt the maximum likelihood estimation (MLE) method to estimate the value of Model (4). According to the above analysis and the setting of Model (4), the interference terms $w_i$ and $u_i$ both have the characteristics of one-sided distribution, therefore, this paper assumes that both of them follow the exponential distribution, i.e. $u_i\sim i.i.d.\ Exp(\sigma_u, \sigma^2_u)$, $w_i\sim i.i.d.\ Exp(\sigma_w, \sigma^2_w)$ (The study by Kumbhakar & Lovell (2003) showed that the adoption of different distribution assumptions had no substantial impact on the outcome, therefore, this paper uses the simplest form of the exponential distribution.). For the disturbance term $v_i$, it is assumed to follow a normal distribution, i.e. $v_i\sim i.i.d.\ N(0, \sigma^2_v)$. At the same time, it is assumed that $v_i$, $u_i$ and $w_i$ are independent of each other and independent of sample characteristics $x_i$. Based on the above settings, the probability density function of the composite interference term $\xi_i$ can be derived as follows (See Kumbhakar & Parmeter (2009) for a detailed derivation.):

$$f(\xi_i)=\frac{\exp(a_i)}{\sigma_u+\sigma_w}\Phi(c_i)+\frac{\exp(b_i)}{\sigma_u+\sigma_w}\int_{-h_i}^{\infty}\phi(z)dz=\frac{\exp(a_i)}{\sigma_u+\sigma_w}\Phi(c_i)+\frac{\exp(b_i)}{\sigma_u+\sigma_w}\phi(h_i) \quad (5)$$

where, $\phi(\bullet)$ and $\Phi(\bullet)$ are the probability density function and cumulative distribution function of standard normal distribution respectively, and other parameters are set as follows:

$$a_i = \frac{\sigma_v^2}{2\sigma_u^2} + \frac{\xi_i}{\sigma_u}; b_i = \frac{\sigma_v^2}{2\sigma_w^2} - \frac{\xi_i}{\sigma_w}; h_i = \frac{\xi_i}{\sigma_v} - \frac{\sigma_v}{\sigma_w}; c_i = -\frac{\xi_i}{\sigma_v} - \frac{\sigma_v}{\sigma_u}$$

For a sample containing *n* observations, the log-likelihood function can be expressed as follows:

$$\ln L(X;\theta) = -n\ln(\sigma_u + \sigma_w) + \sum_{i=1}^{n} \ln[e^{a_i}\Phi(c_i) + e^{b_i}\Phi(h_i)] \tag{6}$$

where, $\theta=[\beta, \sigma_v, \sigma_u, \sigma_w]'$. Maximum likelihood estimates of all parameters can be obtained by maximizing the log-likelihood function.

This paper focused on the surplus obtained by employees and firms through bargaining, therefore, it is necessary to further derive the conditional distribution of and $u_i$ and $w_i$, denoted as $f(u_i|\xi_i)$ and $f(w_i|\xi_i)$ respectively, then:

$$f\left(u_i|\xi_i\right) = \frac{\lambda\exp(-\lambda u_i)\Phi(u_i/\sigma_v + h_i)}{\Phi\left(h_i\right) + \exp\left(a_i - b_i\right)\Phi\left(c_i\right)} \tag{7a}$$

$$f\left(w_i|\xi_i\right) = \frac{\lambda\exp\left(-\lambda w_i\right)\Phi\left(w_i/\sigma_v + c_i\right)}{\exp\left(b_i - a_i\right)\left[\Phi\left(h_i\right) + \exp\left(a_i - b_i\right)\Phi\left(c_i\right)\right]} \tag{7b}$$

where, $\lambda=1/\sigma_u+1/\sigma_w$. Based on the conditional distributions determined by Eqns. (7a) and (7b), the conditional expectations of $u_i$ and $w_i$ in the process of employee salary formation can be obtained respectively, the estimation equations for both are as follows:

$$E\left(1-e^{-u_i}|\xi_i\right) = 1 - \frac{\lambda}{1+\lambda}\frac{\left[\Phi\left(h_i\right) + \exp\left(a_i - b_i\right)\exp\left(\sigma_v^2/2 - \sigma_v c_i\right)\Phi\left(c_i - \sigma_v\right)\right]}{\Phi\left(h_i\right) + \exp\left(a_i - b_i\right)\Phi\left(c_i\right)} \tag{8}$$

$$E\left(1-e^{-w_i}|\xi_i\right) = 1 - \frac{\lambda}{1+\lambda}\frac{\left[\Phi\left(c_i\right) + \exp\left(b_i - a_i\right)\exp\left(\sigma_v^2/2 - \sigma_v h_i\right)\Phi\left(h_i - \sigma_v\right)\right]}{\exp\left(b_i - a_i\right)\left[\Phi\left(h_i\right) + \exp\left(a_i - b_i\right)\Phi\left(c_i\right)\right]} \tag{9}$$

Furthermore, the net surplus *NS* in the employee salary bargaining process can be expressed as:

$$NS = E\left(1-e^{-w_i}|\xi_i\right) - E\left(1-e^{-u_i}|\xi_i\right) = E\left(e^{-u_i} - e^{-w_i}|\xi_i\right) \tag{10}$$

It should be emphasized here that since the parameter $\sigma_u$ appears only in $a_i$ and $c_i$, and parameter $\sigma_w$ appears only in $b_i$ and $d_i$, therefore, the two parameters can be identified. In the subsequent inspection process, there is no need to assume the relative size of the bargaining power of employees and firms in advance, because it is completely determined by the estimation results of the model (Lu et al., 2011), which is also the fundamental advantage of this analysis method different from the traditional regression method.

### 3. Sample Selection and Data Sources

This paper took following steps to select the data, obtained from the CSMAR database of GTA from 2017 to 2021: (1) remove listed financial companies; (2) remove Special Treatment (ST) and Particular Transfer (PT) listed companies; (3) remove companies with asset-liability ratio greater than 100%; (4) remove companies with total assets less than 0; (5) remove companies with main business income below 0; (6) remove companies with owner's equity less than 0; (7) remove companies with listing time below 0; (8) remove samples with missing values for the primary variable. In this paper, the main financial variables were winsorized by 1%. Finally, 13,994 observations were obtained in this paper.

This paper explained the variable salary, which was calculated by *ln[(ending balance of employee compensation payable - beginning balance of employee compensation payable + cash paid to and for employees) / number of employees]*. In terms of sample characteristic variables, this paper selected the listing time of firms (list), natural

logarithm of earnings per employee (ln_prof), the excess employee rate (Hu & Jin, 2018; Liao & Shen, 2014), and employee density (staff_den), and the calculation method was: *the ratio of the number of employees at the end of the year to the current year's operating income*. This paper also selected male share of management (male_r), natural log of average age of management (ln_age), board size (boardisze), the proportion of independent directors (independent), and equity balance degree (shares_b), and the calculation method was: *the shareholding ratio of the 2-5 largest shareholders / the shareholding ratio of the largest shareholders*. For herfindahl index (hhi5), the calculation method was: *the square sum of the top five shareholders' shares*. In addition, this paper selected the shareholding ratio of the largest shareholder (topone), and concurrent positions of chairman and general manager (duality). If the chairman concurrently serves as the general manager, the value is 1; otherwise, the value is 0. The return on total assets (ROA) was calculated as: *net profit / average balance of total assets.* The return on equity (ROE) was calculated as: *net profit / average balance of shareholders' equity*. This paper also selected total asset growth rate (asset_grow), operating profit growth rate (profit_grow), revenue growth rate (income_grow), growth rate of owners' equity (equity_grow), and asset-liability ratio (lev), calculated as: *total liabilities / total assets*. The main characteristic variables and salary variable used in this paper are shown in Table 1.

**Table 1.** Descriptive statistics of main characteristic variables and salary variable

| Variable | Mean | Standard | Min | p50 | Max |
|---|---|---|---|---|---|
| list | 10.749 | 8.289 | 0 | 9 | 34 |
| ln_prof | 11.447 | 1.165 | 5.348 | 11.468 | 16.114 |
| excess | -0.095 | 1.704 | -48.62 | 0.31 | 1 |
| staff_den | 1.524 | 39.674 | 0.007 | 0.94 | 4657.382 |
| male_r | 79.486 | 11.713 | 20 | 80.95 | 100 |
| ln_age | 3.904 | 0.065 | 3.573 | 3.908 | 4.141 |
| boardsize | 8.388 | 1.625 | 4 | 9 | 18 |
| independent | 37.783 | 5.597 | 14.29 | 36.36 | 80 |
| shares_b | 0.782 | 0.619 | 0.008 | 0.626 | 4 |
| hhi5 | 0.16 | 0.113 | 0.002 | 0.131 | 0.81 |
| topone | 34.191 | 14.593 | 2.431 | 31.964 | 89.991 |
| duality | 0.305 | 0.46 | 0 | 0 | 1 |
| roa | 0.05 | 0.048 | -0.099 | 0.043 | 0.201 |
| roe | 0.083 | 0.08 | -0.229 | 0.079 | 0.319 |
| asset_grow | 0.154 | 0.244 | -0.225 | 0.095 | 1.614 |
| profit_grow | -0.386 | 6.552 | -37.847 | -0.146 | 29.397 |
| income_grow | 0.271 | 0.607 | -0.667 | 0.126 | 3.959 |
| equity_grow | 0.144 | 0.285 | -0.252 | 0.072 | 2.11 |
| lev | 0.409 | 0.19 | 0.054 | 0.402 | 0.854 |
| salary | 11.818 | 0.444 | 10.484 | 11.769 | 13.083 |

Note: The detailed calculation process of indicators can refer to the indicator description of CSMAR database.

## 4. Empirical Analysis

This paper made regression analysis of the factors affecting employee salary, decomposed the total variance on the basis of regression, measured the expected surplus range obtained by employees and firms through bargaining in the salary formation process, and further analyzed the differences in the influence of various factors.

### 4.1 Analysis of Influencing Factors of Employee Salary

Based on the above employee salary formation mechanism and quantitative measurement method, this paper analyzed the bargaining power between employees and firms, and used the two-tier stochastic frontier model for measurement. The regression results are shown in Table 2, which also reports the regression results of ordinary least squares (OLS) and maximum likelihood estimate (MLE).

In Table 2, Model 1 was estimated by OLS, Model 2 by MLE, and Models 3-6 all by MLE under the two-tier stochastic frontier. Model 4 eliminated the insignificant variables *topone* and *duality* on the basis of Model 3. Model 5 added year dummy variables based on Model 4. Model 6 eliminated insignificant variables *roa* and *profit_grow* on the basis of Model 5. Considering the log likelihood function and the significance of variables comprehensively, this paper used Model 6 as the benchmark model for subsequent variance decomposition.

The estimation results of Model 6 showed several variables had significant positive effects on employee salary, namely, the listing time of firms (list), natural logarithm of earnings per employee (ln_prof), the excess employee rate (excess ), employee density (staff_den), male share of management (male_r), natural log of average age of management (ln_age), board size (boardisze), the proportion of independent directors (indenpendent), equity balance degree (shares_b), herfindahl index (hhi5), return on equity (roe), total asset growth rate (asset_grow), revenue growth rate (income_grow), growth rate of owners' equity (equity_grow), and asset-liability ratio (lev).

**Table 2.** Regression analysis of influencing factors of employee salary

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| list | 0.003*** | 0.004*** | 0.003*** | 0.003*** | 0.003*** | 0.003*** |
| ln_prof | 0.209*** | 0.207*** | 0.207*** | 0.207*** | 0.199*** | 0.199*** |
| excess | -0.029*** | -0.033*** | -0.027*** | -0.027*** | -0.029*** | -0.029*** |
| staff_den | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| male_r | 0.000* | 0.000* | 0.000* | 0.000* | 0.001*** | 0.001*** |
| ln_age | 0.249*** | 0.298*** | 0.293*** | 0.297*** | 0.152*** | 0.154*** |
| boardsize | 0.011*** | 0.013*** | 0.012*** | 0.013*** | 0.017*** | 0.017*** |
| independent | 0.004*** | 0.004*** | 0.004*** | 0.004*** | 0.004*** | 0.004*** |
| shares_b | 0.042*** | 0.051*** | 0.039*** | 0.045*** | 0.043*** | 0.043*** |
| hhi5 | 0.379** | 0.382*** | 0.398*** | 0.322*** | 0.348*** | 0.347*** |
| topone | -0.001 | 0 | -0.001 | — | — | — |
| duality | -0.005 | -0.006 | -0.006 | — | — | — |
| roa | 0.45 | 0.516** | 0.488* | 0.490* | 0.424 | — |
| roe | -1.867*** | -2.031*** | -1.925*** | -1.929*** | -1.895*** | -1.655*** |
| asset_grow | -0.148*** | -0.141*** | -0.152*** | -0.153*** | -0.149*** | -0.148*** |
| profit_grow | -0.001 | -0.001 | -0.002* | -0.002* | -0.001 | - |
| income_grow | 0.047*** | 0.056*** | 0.047*** | 0.047*** | 0.052*** | 0.049*** |
| equity_grow | 0.033* | 0.041*** | 0.034** | 0.035** | 0.037** | 0.035** |
| lev | 0.365*** | 0.394*** | 0.369*** | 0.370*** | 0.351*** | 0.314*** |
| year | — | — | — | — | control | control |
| _cons | 8.075*** | 7.856*** | 7.809*** | 7.771*** | 8.190*** | 8.193*** |
| adj-$R^2$ | 0.317 | — | — | — | — | — |
| Log likelihood | — | -12977.1 | -5331.7 | -5332.2 | -4931.6 | -4933.4 |

Note: ***, ** and * indicate that the t-test is significant at the levels of 1%, 5% and 10%, respectively.

### 4.2 Variance Decomposition: Analysis of the Effect of Bargaining Power on Employee Salary

This paper measured the expected surplus range of bargaining power obtained by employees and firms, and the results are shown in Table 3.

The results in Table 3 showed that the bargaining power of employees and firms significantly affected the employee salary. In addition, employees had stronger bargaining power compared with firms, which led to a positive comprehensive impact on salary. $E(w\text{-}u)=\sigma_w\text{-}\sigma_v=0.2381\text{-}0.1212=0.1169$, which showed that the bargaining between employees and firms generally formed a higher salary compared with "Benchmark" salary. Meanwhile, the unexplained part of the total variance ($\sigma_v^2+\sigma_u^2+\sigma_w^2$) of salary was 0.1286, 55.52% of which was contributed by the bargaining power of both parties. In the total impact of bargaining power on employee salary, the bargaining power of employees accounted for 79.43%, while that of firms 20.57%. The results of variance decomposition showed that both parties had certain bargaining power, but employees had relatively stronger power. In order to analyze the surplus and net surplus obtained by specific "employee-firm" in salary bargaining, this paper further estimated their unilateral effect on both firms and employees.

**Table 3.** Analysis of the effect of bargaining power of employees and firms on salary

| | Meaning of variable | Symbol | Coefficient |
|---|---|---|---|
| Bargaining mechanism | Random error term | $\sigma_v$ | 0.2391 |
| | Bargaining power of employees | $\sigma_w$ | 0.2381 |
| | Bargaining power of firms | $\sigma_u$ | 0.1212 |
| Decomposition of variance | Total variance of the random term | $\sigma_v^2+\sigma_u^2+\sigma_w^2$ | 0.1286 |
| | Proportion of bargaining factors in total variance | $(\sigma_u^2+\sigma_w^2)/(\sigma_v^2+\sigma_u^2+\sigma_w^2)$ | 55.52% |
| | Proportion of employees' bargaining power | $\sigma_w^2/(\sigma_u^2+\sigma_w^2)$ | 79.43% |
| | Proportion of firms' bargaining power | $\sigma_u^2/(\sigma_u^2+\sigma_w^2)$ | 20.57% |

### 4.3 Estimation of Expected Surplus of Employees and Firms

This part focused on estimating the surplus obtained by both employees and firms through bargaining, i.e. $E(u|\xi)$ and $E(w|\xi)$. The corresponding estimation equations were (8) and (9), which represented the percentage of the surplus obtained by employees and firms through bargaining compared with "Benchmark" salary $\widehat{salary} = x_i'\hat{\beta}$. The estimation results are shown in Table 4.

The estimated results in Table 4 showed that the bargaining power of employees made their salary 19.27% higher than "Benchmark" salary on average, while the bargaining power of firms resulted in the salary 10.81% lower than "Benchmark" salary, thus causing the employee salary 8.46% higher than "Benchmark" salary. In other

words, if "Benchmark" salary is CNY 100, due to the different bargaining power of both parties, employees finally get a salary of CNY 108.46, of which CNY 8.46 is the net surplus obtained by employees through bargaining.

The last three columns of Table 4 (Q1-Q3) present the distribution characteristics of the surplus of firms and employees in more detail, indicating that the bargaining power of both parties has obvious heterogeneity in the process of employee salary formation. In the first quarter (Q1), employees received a salary, 0.16% less than "Benchmark" salary, and received a salary, 14.74% more than "Benchmark" salary in the third quarter (Q3). This means that with the increase of salary level, employees had stronger bargaining power in the salary formation process.

In this paper, the surplus extracted by employees and firms and their net surplus were plotted into histograms, as shown in Figure 1, Figure 2 and Figure 3.

Figures 1-3 more intuitively presents the surplus extracted by both parties and their net surplus. According to Figure 1 and Figure 2, the surplus distribution of either side presents the feature of rightward trailing, which means that only a few employees or firms are definitely predominant in employee salary bargaining. It is worth noting that employees still have tailing around 60%, but the tailing of firms almost disappears near 30%, which indicates that employees have higher bargaining power than firms. As can be seen from the distribution characteristics of net surplus in Figure 3, not all employees are in fact in a strong position in the bargaining process. Statistical analysis suggested that about 25% net surplus was less than zero, meaning that these firms reduced employee salary through negotiation. This also means that about 75% employees were able to negotiate a higher salary than "Benchmark" salary. On the whole, the analysis in this paper showed that "strong capital and weak labor" eased in recent years, and employees obtained relatively high salaries through bargaining.

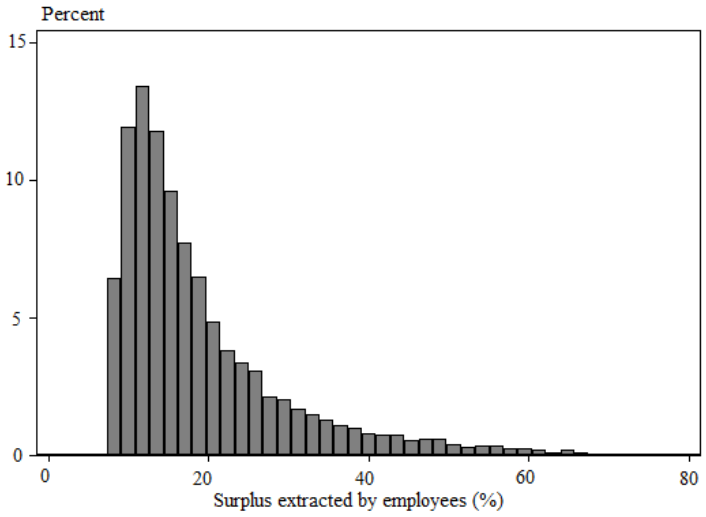


**Figure 1.** Residual frequency distribution of surplus extracted by employees

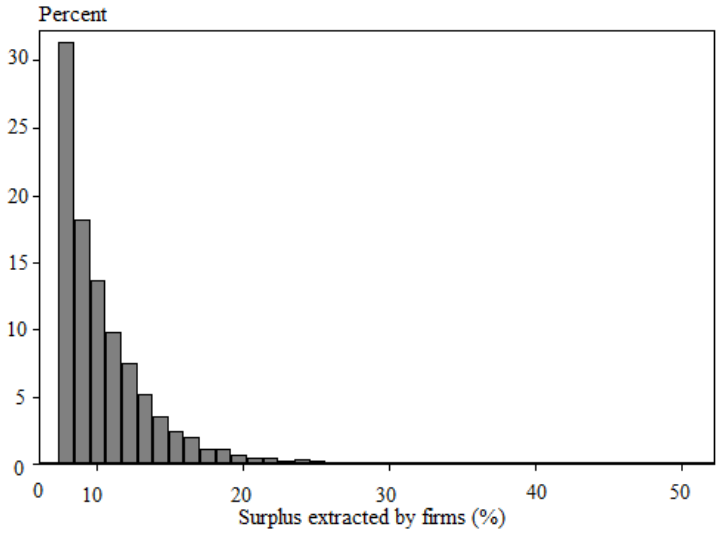


**Figure 2.** Residual frequency distribution of surplus extracted by firms

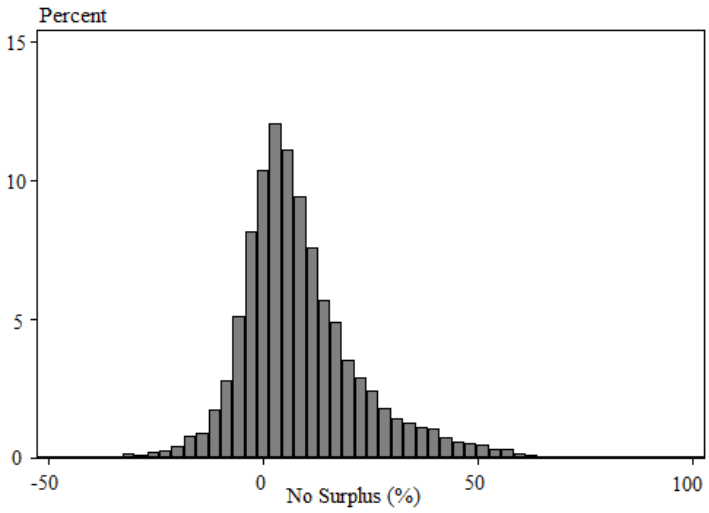


**Figure 3.** Residual frequency distribution of net surplus

**Table 4.** Total surplus obtained by employees and firms in bargaining

| Variable | Mean (%) | Standard (%) | Q1 (%) | Q2 (%) | Q3 (%) |
|---|---|---|---|---|---|
| Employees: $\hat{E}(1-e^{-w}\|\xi)$ | 19.27 | 10.96 | 11.81 | 15.64 | 22.91 |
| Firms: $\hat{E}=(1-e^{-u}\|\xi)$ | 10.81 | 4.02 | 8.18 | 9.62 | 11.97 |
| Net surplus: $\hat{E}=(e^{-w}-e^{-u}\|\xi)$ | 8.46 | 13.7 | -0.16 | 6.02 | 14.74 |

Note: Q1, Q2 and Q3 represent the 1st, 2nd and 3rd quarters respectively, i.e. the 25th, 50th and 75th percentiles (the same below).

### 4.4 Robustness Test

4.4.1 Estimation test with ordinary employee salary as salary variable

Since management salary is usually higher than that of ordinary employees, in order to exclude the influence of excessive management salary on the analysis results, this paper used the salary of ordinary employees as salary variable (salary_ord) to re-estimate Model 6. The total surplus obtained by ordinary employees and firms in bargaining is shown in Table 5.

The estimated results in Table 5 show that, the bargaining power of ordinary employees makes their salary higher than "Benchmark" salary by 19.54% on average, while the bargaining power of firms makes employee salary 11.22% lower, thus ultimately leading to employee salary higher than "Benchmark" salary by 8.32%. In the first quarter (Q1), ordinary employees received a salary, 0.5% less than "Benchmark" salary, and received a salary, 14.86% more than "Benchmark" salary, in the third quarter (Q3). This is generally similar to the empirical results in Table 4, indicating that the empirical results of this paper are relatively robust.

**Table 5.** Total surplus obtained by ordinary employees and firms in bargaining

| Variable | Mean (%) | Standard (%) | Q1 (%) | Q2 (%) | Q3 (%) |
|---|---|---|---|---|---|
| Ordinary employees: $\hat{E}(1-e^{-w}\|\xi)$ | 19.54 | 11.15 | 11.93 | 15.84 | 23.28 |
| Firms: $\hat{E}=(1-e^{-u}\|\xi)$ | 11.22 | 4.3 | 8.42 | 9.93 | 12.43 |
| Net surplus: $\hat{E}=(e^{-w}-e^{-u}\|\xi)$ | 8.32 | 14.07 | -0.5 | 5.91 | 14.86 |

Note: The calculation method of *salary_ord* for ordinary employees is ln [(balance of employee compensation payable at the end of the year - balance of employee compensation payable at the beginning of the year + cash paid to and for employees - total management compensation) / (number of employees - number of management)]

4.4.2 Expected surplus effect test of employees and firms with different ownership

Due to the heterogeneity of firms with different ownership, in order to compare the expected surplus obtained by those firms and their employees, this paper estimated state-owned and non-state-owned firms respectively, and the results are shown in Table 6.

The estimated results in Table 6 showed that in both state-owned and non-state-owned firms, employees had stronger bargaining power than firms. With the increase of income level, the bargaining power of employees improved. This was consistent with the main empirical results of this paper, indicating that the empirical results of this paper were relatively robust.

**Table 6.** Expected surplus effects of employees and firms with different ownership

| | Variable | Mean (%) | Standard (%) | Q1 (%) | Q2 (%) | Q3 (%) |
|---|---|---|---|---|---|---|
| State-owned | employees: $\hat{E}(1-e^{-w}\|\xi)$ | 18.4 | 10.88 | 11.04 | 14.77 | 21.9 |
| | firms: $\hat{E}=(1-e^{-u}\|\xi)$ | 9.45 | 3.41 | 7.24 | 8.44 | 10.41 |
| | net surplus: $\hat{E}=(e^{-w}-e^{-u}\|\xi)$ | 8.95 | 13.13 | 0.63 | 6.33 | 14.66 |
| Non-state-owned | employees: $\hat{E}(1-e^{-w}\|\xi)$ | 20.59 | 12.33 | 12.02 | 16.3 | 24.95 |
| | firms: $\hat{E}=(1-e^{-u}\|\xi)$ | 10.26 | 3.78 | 7.81 | 9.09 | 11.25 |
| | net surplus: $\hat{E}=(e^{-w}-e^{-u}\|\xi)$ | 10.33 | 14.8 | 0.77 | 7.22 | 17.13 |

4.4.3 Net surplus effect test of employees and firms in different years

Due to the heterogeneity of firms in different years, in order to compare the net surplus obtained by employees and firms in different years, this paper estimated Model 6 each year respectively. The net residual effects in different years are shown in Table 7.

**Table 7.** Net surplus effects of employees and firms in different years

| Year | Mean (%) | Standard (%) | Q1 (%) | Q2 (%) | Q3 (%) |
|---|---|---|---|---|---|
| 2017 | 7.7 | 16.12 | -2.17 | 5.21 | 15.58 |
| 2018 | 9.3 | 14.17 | 0.37 | 6.53 | 15.79 |
| 2019 | 8.65 | 15.08 | -0.56 | 6.11 | 15.7 |
| 2020 | 17.88 | 10.26 | 11 | 14.68 | 21.58 |
| 2021 | 11.75 | 9.22 | 5.7 | 9.36 | 15.11 |

The estimation results in Table 7 showed that the net surplus of employees and firms in salary bargaining was heterogeneous in different years between 2017 and 2021. Employees had less bargaining power in 2017, and earned 7.7% more than "Benchmark" salary on average. Employees had the most bargaining power in 2020, earning 17.88% more than "Benchmark" salary on average. In general, employees had more bargaining power than firms in any given year. In addition, as the income level increased, the bargaining power of employees also increased. This showed that the phenomenon of "strong capital and weak labor" alleviated in listed companies in recent years, which was consistent with the main empirical results of this paper, indicating that the empirical results of this paper were relatively robust.

## 5. Conclusions

Based on two-tier stochastic frontier model, this paper constructed a measurement model of bargaining power of employees and firms in the process of employee salary formation. This paper conducted empirical measurement using the five- year data of listed companies in CSMAR database. The research results showed as follows:

(1) In the process of employee salary formation, the bargaining power of employees and firms had a very important impact on the final salary. Employees had stronger bargaining power compared with firms, which led to a positive impact of 0.1169 on the salary, indicating that the bargaining formed a higher employee salary compared with "Benchmark" salary.

(2) Through the analysis of unilateral effects on both employees and firms, it was found that the bargaining power of employees increased their salary by 19.27% compared with "Benchmark" salary on average, while the bargaining power of firms resulted in the employee salary 10.81% lower. The combined two effects resulted in employees receiving a salary 8.46% more than "Benchmark" salary. Statistical analysis showed that about 75% employees were able to negotiate a salary higher than "Benchmark" salary. The quarterly analysis further showed that employees had relatively stronger bargaining power as income level increased.

(3) The robustness test showed that: first, the stronger bargaining power of employees was not caused by the higher management salary. Even if the management salary was excluded, the estimated results still showed that the salary of ordinary employees was 8.32% higher than "Benchmark" salary when the salary of ordinary employees was used as salary variable; second, in both state-owned and non-state-owned firms, employees had stronger bargaining power than firms, and their bargaining power improved with the increase of income level; third, the net surplus of employees and firms in salary bargaining was heterogeneous in different years between 2017 and 2021. But employees generally had more bargaining power than firms in any given year.

The conclusion of this paper showed that the phenomenon of "strong capital and weak labor" alleviated in listed companies in recent years, and employees obtained relatively high salaries through bargaining. Since the bargaining behavior is largely determined by the information asymmetry of both sides, it is necessary to continue to improve the transparency of employment information in the market and enhance the information management mechanism of the market, thus ensuring the authority and timeliness of information transmission and improving the efficiency of labor allocation.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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