

Research on the Impact of Product Quality Upgrading on Relative Wage Gap from the Perspective of Enterprise Heterogeneity

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ABSTRACT

The article defines the connotation and constructs the evaluation index of product quality upgrading, and reveals the influence mechanism of product quality upgrading on relative wage gap. Based on the perspective of enterprise heterogeneity, this article empirically tests the impact of product quality upgrading on relative wage gap by using the micro data of China's industrial enterprise database and customs database from 2000 to 2013. The research results show that: (1) Product quality upgrading have a significant positive impact on the relative wage gap, and the impact of different levels of product quality upgrading on the relative wage gap is different. (2) Enterprise heterogeneity has a significant impact on the relative wage gap. Among them, the better the enterprise performance, the stronger the innovation ability, the higher the total factor productivity and capital intensity, the greater the export subsidies, the higher the degree of foreign participation and monopoly, and the bigger the relative wage gap. There is a large relative wage gap between export enterprises and in-system enterprises. On this basis, it puts forward some policy suggestions with certain reference value. The results of the article provide important policy implications.

Keywords: Product quality upgrading, relative wage gap, enterprise heterogeneity

1. INTRODUCTION

Since the reform and opening up, China's economy has developed rapidly, foreign trade has made remarkable achievements, and the quality of Chinese enterprises' products has gradually upgraded in the fierce international competition [1-2]. However, with the deepening of economic globalization, the impact of international trade, especially export trade, on China's labor market has gradually become prominent. Export expansion aggravates the inequality of income distribution in China, which not only leads to the wage difference between export enterprises and non-export enterprises, but also significantly enlarges the wage gap among export enterprises, thus aggravating the overall wage inequality. Focusing on the problem of relative wage gap, the existing literature is mainly based on the H-O-S theoretical framework to explore the formation of trade mechanism from the price mechanism [3], technology spillover mechanism [4-5] and technology innovation mechanism [6-7], ignoring the role of product quality heterogeneity. How to define product quality upgrading? Does product quality upgrading have a significant impact on relative wage gap? Existing related research is rarely involved. Based on the heterogeneous trade theory of enterprises, this article discusses the impact of product quality upgrading on relative wage gap from both theoretical

analysis and empirical research. It has certain theoretical and practical significance to understand the relationship between product quality upgrading and relative wage gap, to explore the driving force of product quality upgrading, and to formulate scientific and reasonable policies and measures to adjust wage inequality.

2. RESEARCH PROGRESS AT HOME AND ABROAD

The relative wage gap generally refers to the wage gap between high-skilled labor and low-skilled labor. Most of the existing literature on the relative wage gap is on the industry level, while the research on the enterprise level is relatively less. With the development of heterogeneous enterprise trade theory and the promotion of product quality related research, the international economic field has gradually begun to pay attention to the impact of product quality upgrading on the relative wage gap at the micro level.

2.1. Enterprise Heterogeneity and Relative Wage Gap

For the heterogeneous trade theory of enterprises, scholars generally believe that Melitz (2003) model is the first work of heterogeneous enterprise trade theory [8-9].

Enterprise heterogeneity mainly refers to the differences among enterprises, including the differences in enterprise performance, capital intensity, enterprise scale, enterprise productivity and innovation ability. A large number of facts have proved that after controlling the individual characteristics of the labor, the employees will get different wages because of the different business performance of the enterprise. The better the enterprise performance is, the more capable it is to introduce high-skilled employees and pay higher wages for them [10-11]. Hallak (2009) research showed that under the premise of fixed scale, the higher the capital intensity of enterprises, the higher the wages paid to workers [12]. Rhokeyun (2012) also proved this point [13]. Munch (2008) research result showed that the technology intensity of enterprises is directly proportional to the wage level of employees [14]. Some scholars believe that the scale of enterprises is also an important factor affecting the wage gap [15]. Riley (2017) showed that the increase of total factor productivity would increase the demand for high-skilled workers, and for the development of enterprises, it was the wisest choice to improve the salary of high-skilled workers [16]. Some research by scholars suggested that the innovation ability and technological progress of enterprises also affect the relative wage gap. The increase in the demand for technical talents with professional knowledge will improve the innovation ability of enterprises, which will further increase the relative wage gap between high and low skilled workers [17-19].

2.2. Product Quality Upgrading and Relative Wage Gap

As for product quality upgrading, scholars generally use unit value method, product complexity index and regression backward method to measure, and some domestic scholars mostly use unit value method to measure the product quality upgrading of China's industrial enterprises [20-21]. However, the product quality upgrading involved still refers to the change of product quality, not the real upgrading. How to define and evaluate product quality upgrading? There are few related researches. Under the background of enterprise heterogeneity, generally speaking, product quality upgrading can be regarded as product quality heterogeneity, that is, the quality difference of different products represented by vertical product difference. Verhoogen (2008) thought that the demand of export enterprises for high quality products led to the demand for high-skilled labor, that is, the product quality upgrading increased the use of high-skilled labor and paid higher wages for them [22]. Other scholars' studies also proved this point of view [23]. Hallak et al. (2013) found that exporters sell higher quality products and charge higher prices, thus paying higher input prices and wages [24]. In addition, some scholars took the global value chain (GVC) as an intermediary variable, proving that the product

quality upgrading indirectly widened (narrowed) the wage gap through the positive (negative) GVC climbing effect [25].

In summary, domestic and foreign scholars have carried out in-depth research on product quality upgrading and relative wage gap, and achieved a series of research results, but there are still some unsolved problems: First, most scholars' research on product quality upgrading is based on product quality measurement results. The meaning of product quality upgrading is still unclear, and has not yet formed a unified evaluation index. How to define and establish the evaluation index system of product quality upgrading need further discussion. Second, the existing literature research on the impact of product quality upgrading on relative wage gap is mainly from the national level or industry level, rarely involving empirical tests at the enterprise level, thus the number of samples will be greatly limited. How to study the impact of product quality upgrading on the relative wage gap from a micro perspective remains to be further explored. Third, enterprise heterogeneity has a significant impact on enterprise performance, but in the establishment of econometric model, which enterprise heterogeneity characteristic variables can better explain the actual situation in China, this is also a question that needs to be further explored in this article.

Compared with existing related research, the main contributions of this article are as follows: First, this article defines the connotation of product quality upgrading, divides product quality upgrading levels according to quality standards, and designs evaluation index for product quality upgrading. It is not involved in existing related research. Second, based on the existing literature and the theoretical framework of heterogeneous enterprise trade, a theoretical model of product quality upgrading and relative wage gap is constructed, and the mechanism of the impact of product quality upgrading on relative wage gap is systematically revealed. Third, this article introduces enterprise heterogeneity characteristic variables such as enterprise performance, innovation ability, total factor productivity, capital intensity, export and export subsidy, the degree of foreign participation and industry competition, and empirically studies the impact of product quality upgrading on relative wage gap and draws a distinctive conclusion. This is also rare in existing related research.

3. THE THEORETICAL MODEL

Based on the basic framework of the Melitz (2003) model, this article deduces the theoretical model of the effect of enterprise heterogeneity and product quality upgrading on relative wage gap. Referring to the research of Murphy (1998) [26] and Sun Jingshui (2019) [27], assuming that full employment and returns to scale remain constant, manufacturers use high-skilled labor (H), low-skilled labor (L) and capital (K) for production. At this time, the production technology meets the CES function form of constant substitution elasticity, and the CES production

function includes capital K , high-skilled labor H and low-skilled labor L . We assume that the CES function is:

$$Y = F(K, H, L) = AK^\alpha [\lambda(A_H H)^\rho + (1 - \lambda)(A_L L)^\rho]^{\beta/\rho} \quad (1)$$

Among them, $\alpha > 0$, $\beta > 0$, $\rho < 1$, $0 < \lambda < 1$, $A > 0$ represents technological progress. Based on the upgrading of product quality, A_H and A_L respectively represent the production efficiency parameter of high-skilled and low-skilled labor. α and β represent the output elasticity of capital and labor respectively. ρ is a substitute parameter between H and L . λ and $1 - \lambda$ represent high and low-skilled labor intensity respectively, which are reflected in the distribution share of capital return and labor income in the final output. The substitution elasticity of H and L is $\sigma = 1/(1 - \rho)$. In general, $\sigma > 1$, H and L can replace each other.

According to the theory of perfect competition market, the maximum profit is the criterion for the business behavior of manufacturers. In production, enterprises will continue to input factors until the market equilibrium price of factors equals to marginal output. If the factor prices of H and L are ω_H and ω_L respectively, then under the condition of complete competition in labor market, according to the labor remuneration equal to its marginal output, it can be obtained

$$\omega_H = (\partial Y / \partial H) = \lambda \beta A K^\alpha [\lambda(A_H H)^\rho + (1 - \lambda)(A_L L)^\rho]^{\beta/\rho - 1} A_H^\rho H^{\rho - 1} \quad (2)$$

$$\omega_L = (\partial Y / \partial L) = (1 - \lambda) \beta A K^\alpha [\lambda(A_H H)^\rho + (1 - \lambda)(A_L L)^\rho]^{\beta/\rho - 1} A_L^\rho L^{\rho - 1} \quad (3)$$

Divide formula (2) by formula (3), and take the logarithm of both sides at the same time to obtain

$$\ln\left(\frac{\omega_H}{\omega_L}\right) = \ln\frac{\lambda}{1 - \lambda} + \rho \ln\frac{A_H}{A_L} - (1 - \rho) \ln\frac{H}{L} \quad (4)$$

Where $\ln(\omega_H/\omega_L)$ represents the difference between ω_H and ω_L , that is, the relative wage gap of employees with different skill levels.

Based on the derivation and construction of the above theoretical model, referring to the practices of Yu Donghua et al (2017) [28] and Sun Jingshui (2019), we add product quality upgrading, enterprise performance, capital intensity, innovation ability, export, foreign-funded enterprise and ownership structure into the CES production function. Since the skill bias of technological innovation will affect the relative wage gap [29-30], this article sets the technological progress function A as follows:

$$A_i = QU^{a_i} ROA^{b_i} TFP^{c_i} DIF^{d_i} EX^{e_i} FOR^{f_i} STA^{g_i}, i \in \{H, L\} \quad (5)$$

Among them, QU , ROA , TFP , DIF , EX , FOR , and STA respectively represent product quality upgrading, enterprise performance, enterprise productivity, innovation ability, export, foreign-funded enterprise, and ownership structure. Taking the logarithms of both sides of formula

(5) by H and L and subtracting them, the following equation can be obtained:

$$\begin{aligned} \ln(A_H/A_L) &= (\tau_{1H} - \tau_{1L}) \ln QU + (\tau_{2H} - \tau_{2L}) \ln ROA \\ &+ (\tau_{3H} - \tau_{3L}) \ln TFP + (\tau_{4H} - \tau_{4L}) \ln DIF \\ &+ (\tau_{5H} - \tau_{5L}) \ln EX + (\tau_{6H} - \tau_{6L}) \ln FOR \\ &+ (\tau_{7H} - \tau_{7L}) \ln STA \end{aligned} \quad (6)$$

Substituting formula (6) into formula (4) and simplifying, we get

$$\begin{aligned} \ln(\omega_H/\omega_L) &= \alpha_0 + \alpha_1 \ln QU + \alpha_2 \ln ROA + \alpha_3 \ln TFP \\ &+ \alpha_4 \ln DIF + \alpha_5 \ln EX + \alpha_6 \ln FOR + \alpha_7 \ln STA + \alpha_8 \ln\left(\frac{H}{L}\right) \end{aligned} \quad (7)$$

Among them, $\alpha_0 = \ln(\lambda/(1 - \lambda))$, $\alpha_i = \rho(\tau_{iH} - \tau_{iL})$, $i = 1, 2, \dots, 8$, $\alpha_9 = \rho - 1$. According to this formula, we can see that product quality upgrading, enterprise performance, enterprise productivity, innovation ability, export and foreign-funded enterprise have an impact on the relative wage gap. Based on the model of formula (7), the empirical model of this article is constructed as follows

$$\begin{aligned} \ln W_{it} &= \beta_0 + \beta_1 QU_{it} + \beta_2 ROA_{it} + \beta_3 CAP_{it} + \beta_4 EX_{it} \\ &+ \beta_5 DIF_{it} + \beta_6 TFP_{it} + \beta_7 AGE_{it} + \beta_8 AGE_{it}^2 \\ &+ \beta_9 SCALE_{it} + \beta_{10} FOR_{it} + \beta_{11} FIL_{it} + \beta_{12} SUB_{it} \\ &+ \beta_{13} SI_{it} + \beta_{14} HHI_{it} + \beta_{15} MS_{it} + \beta_{16} CEN_{it} + \varepsilon_{it} \end{aligned} \quad (8)$$

Where the subscripts i and t represent the enterprise and year respectively, $\ln W$ represents the relative wage gap, which is the logarithm of the ratio between the average wage of enterprise and that of the industry. The product quality upgrading index QU is the core explanatory variable, which is obtained by the new evaluation index proposed in this article. β is the regression coefficient of each explanatory variable, ε is the random error term. The other variables, symbols and meanings in model (8) are shown in Table 1.

Product quality upgrading means that the enterprise has won international and domestic quality certification or quality awards. The higher the level of quality certification or award, the higher the level of product quality upgrading. The development of enterprises' foreign trade is inseparable from its reputation and international market position. The higher the level of product quality upgrading, the higher the enterprise's popularity and market share, and the higher the productivity and profit level. The upgrading of product quality is accompanied by technological innovation, and the first variable added in the above-mentioned technological progress function (5) is the product quality upgrading, which stimulates and demands technological progress. Under this circumstance, the effect of skill-biased technological progress increases the demand for high-skilled labor and changes the skill structure in employment, thereby widening the relative wage gap and aggravating the income inequality. A large number of studies have shown that if the individual characteristics of the labor are fixed, the enterprise performance and productivity, capital intensity, innovation ability, export, industry competition, foreign-funded enterprise, and enterprise age will all affect the wage level

of employees. Moreover, in model (8), the variables of enterprise heterogeneity are introduced to reflect the impact of enterprise heterogeneity on relative wage gap.

4. EMPIRICAL ANALYSIS RESULTS

The product quality upgrading in this article refers to that in a certain time and space, the enterprise's product quality reaches or exceeds a certain specific standard (such as national or international quality certification), or obtains a recognized quality reputation or honor (such as obtaining national or international well-known trademarks, famous brand products and quality awards), which is called product quality upgrading. Otherwise, the product quality is not upgraded.

4.1. Variables, Symbols and Meanings in the Model

According to the above research hypothesis and theoretical analysis, the explained variable in this empirical model is the logarithm of the ratio between the average wage of enterprise and that of the industry, which is the relative wage gap ($\ln W$). The explanatory variables are: The core explanatory variable is product quality upgrading (QU), which represents the impact of product quality upgrading on relative wage gap under the heterogeneity of enterprises. The variables of enterprise heterogeneity are enterprise performance, capital intensity, enterprise productivity, export, innovation ability, enterprise scale, and enterprise age, etc. The control variables include foreign participation degree, absolute control of enterprises, whether directly under the central government, and the degree of industry competition. The symbols and meanings of the variables in the model are shown in Table 1.

Table 1 Variable, Symbol and Meaning in the Model

Variable	Symbol	Meaning
Explained variable: Relative wage gap	$\ln W$	$\ln(\text{Average wage of enterprise} / \text{Average wage of industry})$
Explanatory variables: Product quality upgrading ^a	QU	See note (1)
High-level upgrading	HQU	See note (2)
Middle-level upgrading	MQU	See note (2)
Low-level upgrading	LQU	See note (2)
Enterprise heterogeneity characteristic variables: Enterprise scale	SCALE	Expressed by the number of employees
Enterprise performance: Profit margin of total assets	ROA	Total profit / Total assets
Innovation ability: Product differentiation degree	DIF	Advertising expenses / Total sales
Total factor productivity	TFP	Obtained by OP method
Capital intensity	CAP	Net value of fixed assets / Number of employees
Duration of enterprise	AGE	Statistical year - Year of establishment
Subsidy: Subsidy status	SUB	If the export subsidy value is greater than 0, SUB=1, otherwise 0
Subsidy intensity	SI	Export subsidy value / Total sales
Export	EX	The logarithm of the export delivery value of the enterprise
Foreign and domestic: Foreign-funded enterprise ^b	FOR	If the enterprise is a foreign-funded enterprise, FOR=1, otherwise 0
Foreign participation degree	FIL	Proportion of foreign capital in enterprise capital
In-system enterprise: State-owned enterprise ^c	MS	If the enterprise is a state-owned absolute holding enterprise, MS=1, otherwise 0
Enterprises directly under the central government ^d	CEN	If the enterprise is directly under the central government, CEN=1, otherwise 0
degree of industry competition	HHI	Herfindahl-Hirschman Index ($(\text{Enterprise sales} / \text{Industry sales})^2$)

Referential standard: a Product quality has not been upgraded; b Domestic enterprises; c Non-state-owned enterprises; d Local enterprises.

Note: (1) If the enterprise has obtained the provincial well-known trademark (provincial famous brand product), then QU=1, and won the provincial government quality award, QU=2; if the enterprise has obtained China well-known trademark (China famous brand product) QU=3, obtained China world famous brand product QU=4, obtained China product quality certification QU=5, and obtained China government quality award QU=6; if the enterprise has obtained the world famous trademark (world famous brand product) QU=7, obtained international product quality certification QU=8, and won the world's three major quality awards QU=9. (2) If the enterprise has obtained the provincial well-known trademark (provincial famous brand product) or the provincial government quality award, LQU =1, otherwise LQU=0; if the enterprise has obtained China well-known trademark (China famous brand product, China world famous brand product) or China product quality certification or China government quality award MQU=1, otherwise MQU=0; if the enterprise has obtained the world famous trademark or international product quality certification or the world's three major quality awards, HQU =1, otherwise HQU=0.

4.2. Data Sources and Processing

The empirical part of this article uses the customs data and industrial enterprise data from 2000 to 2013, and refers to the data processing methods used by Yu miaojie et al. (2013) and Fan Haichao et al. (2015), processes the two databases, and then obtains the data used in this article by matching the enterprise name and telephone postcode. Specifically, to ensure the validity of the data, for customs data, we first removed samples with keywords "import and export", "trade", "logistics", "industry and trade" and "economic trade" in the enterprises name. Secondly, we eliminated samples with missing company names and corporate codes, samples with a single trade volume of less than US\$50, and samples with 0 or missing trade quantities. In addition, we converted the HS1996 codes in 2000 and 2001 to HS2002 codes. For industrial enterprise data, we first excluded the missing values of total assets, number of employees, total industrial output value and sales volume, as well as the sample of enterprises with negative wage level. Secondly, we deleted enterprises with total fixed assets of less than 100,000, number of employees of less than 8, and industrial output value of less than 5 million. Moreover, the international quality certifications, well-known trademarks and quality awards, used to measure product quality upgrading, are based on the detailed enterprise information obtained after the matching of the above two databases, which are obtained through the software Python and the manual query of the enterprise official website, and we assigned values to them.

4.3. Regression Analysis

Based on the matched data of customs and industrial enterprises from 2000 to 2013, this article uses stata15.0 to

conduct stepwise regression on model (8). In order to ensure the accuracy of model estimation, this article eliminates heteroscedasticity and autocorrelation of model (8) when solving parameter estimates, and finally obtains the regression results in Table 2 and Table 3.

1.The impact of product quality upgrading on relative wage gap. Model 1 in Table 2 reflects the impact of product quality upgrading and different levels of upgrading on the relative wage gap. The regression results of Model 1-1 show that product quality upgrading has a significant positive impact on the relative wage gap. The upgrading of enterprise product quality means that its product quality has been recognized by consumers and the market, its sales income and profit level have been greatly improved, and the corresponding wage level of enterprise employees has also been greatly improved, which leads to the widening of the wage gap between enterprises with product quality upgrading and those without upgrading. From Model 1-2 to Model 1-4, the regression results of the impact of low, middle, and high-level product quality upgrading on the relative wage gap are in turn. The empirical results show that the low-level product quality upgrading has a significant negative impact on the relative wage gap, which means that the demand of low-level upgrading enterprises for low-level employees is greater than that for high-level employees, thus narrowing the wage gap. The regression results of Model 1-3 and Model 1-4 showed that the middle-level and high-level product quality upgrading has a significant positive impact on the relative wage gap. The higher the product quality upgrading of the middle-level and high-level, the larger the relative wage gap, and the impact of the middle-level product quality upgrading on the relative wage gap is greater than that of the high-level upgrading.

Table 2. Regression Results 1

Explanatory variables	Model 1-1 (Basic model)	Model 1-2 (Low-level upgrading)	Model 1-3 (Middle-level upgrading)	Model 1-4 (High-level upgrading)	Model 2-1 (Foreign-funded enterprise)	Model 2-2 (Participation of foreign capital)
QU	1.4702E-03** (2.42)				1.4806E-03** (2.44)	1.4716E-03** (2.42)
LQU		-0.0331*** (-3.48)				
MQU			0.0168* (1.86)			
HQU				0.0119** (2.54)		
ROA	0.0371*** (4.09)	0.0444*** (4.99)	0.0445*** (4.99)	0.0445*** (4.99)	0.0375*** (4.13)	0.0374*** (4.12)
CAP	1.5302E-03** (148.27)	1.3084E-03*** (129.38)	1.3079E-03*** (129.34)	1.3081E-03*** (129.36)	1.53E-03*** (148.26)	1.5298E-03*** (148.23)
EX	0.0046** (13.03)	0.0046** (13.31)	0.0046** (13.28)	0.0046** (13.23)	0.0045** (12.85)	0.0045** (12.88)

DIF	0.6143*** (3.43)	0.4211** (2.40)	0.4106** (2.34)	0.4133** (2.36)	0.6162*** (3.44)	0.6173*** (3.45)
TFP	0.3196*** (140.26)	0.2994*** (134.07)	0.2992*** (134.00)	0.2992*** (134.03)	0.3196*** (140.26)	0.3197*** (140.28)
AGE	1.5298E-03*** (5.17)	1.3019E-03*** (4.31)	1.3142E-03*** (4.35)	1.3156E-03*** (4.36)	1.636E-03*** (5.30)	1.6202E-03*** (5.25)
AGE ²	-8.09E-07*** (-4.70)	-6.67E-07*** (-3.96)	-6.74E-07*** (-4.00)	-6.63E-07*** (-3.99)	-8.32E-07*** (-4.83)	-8.24E-07*** (-4.78)
SCALE	-0.2336*** (-81.40)	-0.2118*** (-75.37)	-0.2120*** (-75.46)	-0.2122*** (-75.49)	-0.2336*** (-81.42)	-0.2336*** (-81.43)
FOR					0.0215*** (5.08)	
FIL						0.0246*** (4.79)
C	-1.3075*** (-100.79)	-1.2500*** (-98.33)	-1.2485*** (-98.22)	-1.2491*** (-98.28)	-1.3190*** (-100.17)	-1.3180*** (-100.17)
F	6631.0781	6349.4375	6348.7413	6348.9831	6301.4976	6301.2767
R ²	0.3545	0.3447	0.3447	0.3447	0.3546	0.3546

Note:***, ** and * respectively signify that the regression coefficients are momentous at the level of 1%, 5% and 10%, the value in brackets under the estimated regression coefficient is the corresponding T-statistic.

2.The impact of enterprise heterogeneity on relative wage gap. Model 1-1 and Model 2 in Table 2, and Model 3 to Model 5 in Table 3 reflect the impact of enterprise heterogeneity on relative wage gap. The regression results of Model 1-1 in Table 2 show that enterprise performance has a significant positive impact on the relative wage gap. Due to the efficiency and profit sharing wage theory, the better the enterprise performance, the higher the wage level of its employees will be, thus making the relative wage gap larger. According to the results of Model 1-1, capital intensity has a significant positive impact on the relative wage gap. Enterprises with higher capital intensiveness have more capital strength, possess advanced production equipment and technology, hire high-skilled labor, and pay them higher wages, which leads to an increase in the wage gap. The results of Model 1-1 also show that exports have a significant positive impact on the relative wage gap. Due to the self-selection and export-learning effect, export enterprises independently choose innovative technology, increase innovation and pursue product quality upgrading, and resulting in the increase of relative wage gap. The results of Model 1-1 also reflect the significant positive impact of enterprise productivity and innovation abilities on the relative wage gap, and their regression coefficients are obviously larger than other variables, indicating that enterprise productivity and innovation abilities have a greater impact on the relative wage gap. The relationship between enterprise age (Duration of enterprise) and relative wage gap is inverted U-shaped, and the increase of enterprise age makes the wage gap increase first and then decrease. The scale of the enterprise has a significant negative impact on the relative wage gap,

indicating that the larger the number of employees, the smaller the relative wage gap. The regression results of Model 2-1 and Model 2-2 show that foreign-funded enterprise and foreign participation degree have a significant positive impact on the relative wage gap. The enterprises with higher degree of foreign participation will have higher level of scientific and technological innovation and management. These enterprises often employ high-skilled labor to participate in production and pay higher wages, which leads to the widening of the relative wage gap. The regression results of Model 3-1 and Model 3-2 in Table 3 show that export subsidies and subsidy intensity have a significant positive impact on the relative wage gap, the higher the subsidy intensity, the larger the relative wage gap. The regression results of Model 4-1 and Model 4-2 show that in-system enterprises (state-owned enterprises, enterprises directly under the central government) have a significant positive impact on the relative wage gap. Compared with enterprises outside the system, in-system enterprises enjoy special government policies, have a monopoly position due to the characteristics of the industry, thus obtain excessive monopoly profits. Their employees often enjoy higher wages and benefits, and the relative wage gap is larger. The regression results of Model 5 show that the degree of industry competition (Herfindahl-Hirschman Index) has a significant positive impact on the relative wage gap. The higher the Herfindahl index, the higher the degree of monopoly, therefore, enterprises can obtain higher monopoly profits, leading to the further expansion of the relative wage gap.

Table 3. Regression Results 2

Explanatory variables	Model 3-1 (Subsidy status)	Model 3-2 (Subsidy intensity)	Model 4-1 (state-owned enterprise)	Model 4-2 (Enterprises directly under the central government)	Model 5 (Degree of industry competition)
QU	1.3853E-03** (2.28)	1.4796E-03** (2.44)	1.4978E-03** (2.47)	1.4768E-03** (2.43)	1.5715E-03** (2.53)
ROA	0.0383*** (4.21)	0.0373*** (4.10)	0.0373*** (4.10)	0.0372*** (4.09)	0.0335*** (3.59)
CAP	1.5295E-03*** (148.23)	1.5302E-03*** (148.27)	1.531E-03*** (148.31)	1.530E-03*** (148.22)	1.548E-03*** (146.53)
EX	0.0044*** (12.58)	0.0046*** (13.03)	0.0046*** (13.01)	0.0046*** (13.02)	0.0045*** (12.52)
DIF	0.6011*** (3.36)	0.6126*** (3.42)	0.6104*** (3.41)	0.6147*** (3.43)	0.6217*** (3.42)
TFP	0.3194*** (140.16)	0.3198*** (140.30)	0.3197*** (140.28)	0.3197*** (140.26)	0.3254*** (138.04)
AGE	1.5804E-03*** (5.13)	1.593E-03*** (5.17)	1.506E-03*** (4.88)	1.579E-03*** (5.12)	1.465E-03*** (4.35)
AGE ²	-8.02E-07*** (-4.66)	-8.09E-07*** (-4.70)	-7.65E-07*** (-4.44)	-8.02E-07*** (-4.66)	-7.47E-07*** (-3.70)
SCALE	-0.2343*** (-81.65)	-0.2335*** (-81.37)	-0.2337*** (-81.46)	-0.2336*** (-81.40)	-0.2392*** (-80.72)
SUB	0.0278*** (9.83)				
SI		0.1426*** (3.51)			
MS			0.0425*** (5.11)		
CEN				0.0524** (2.53)	
HHI					0.4124*** (3.35)
C	-1.3074*** (-100.81)	-1.3084*** (-100.84)	-1.3098*** (-100.91)	-1.3081*** (-100.82)	-1.3207*** (-99.48)
F	6306.9853	6300.4518	6301.5231	6299.9935	6570.8133
R ²	0.3548	0.3546	0.3546	0.3546	0.3656

Note:***, ** and * respectively signify that the regression coefficients are momentous at the level of 1%, 5% and 10%, the value in brackets under the estimated regression coefficient is the corresponding T-statistic.

5. CONCLUSIONS

This article defines the connotation and constructs the evaluation index of product quality upgrading, and reveals the influence mechanism of product quality upgrading on relative wage gap. Based on the perspective of enterprise heterogeneity, this article empirically studies the impact of product quality upgrading on relative wage gap by using the data of China industrial enterprise database and China customs database from 2000 to 2013, and obtains the following research conclusions and policy implications.

5.1. Research Conclusions

Conclusion 1: Product quality upgrading has a significant positive impact on the relative wage gap, and the impact of different levels of product quality upgrading on the relative wage gap is different. The results show that the higher the product quality upgrading, the larger the relative wage gap. Product quality upgrading means that the product quality of an enterprise reaches or exceeds a certain specific standard (such as national or international quality certification), or obtains a recognized quality reputation or honor (such as obtaining national or international well-known trademarks, famous brand products and quality awards), which indicates that the product quality of

the enterprise has been recognized by consumers and the market, and its sales revenue and profits have been greatly improved, and the corresponding wage level of enterprise employees has also been improved, which has led to a widening of the relative wage gap between enterprises with product quality upgrading and those without upgrading. The results show that the low-level product quality upgrading has a significant negative impact on the relative wage gap, indicating that the demand of low-level upgrading enterprises for low-level employees is greater than that for high-level employees, thus narrowing the wage gap. We found that the higher the level of product quality upgrading is, the larger the relative wage gap is, and the impact of middle-level product quality upgrading on relative wage gap is greater than that of high-level upgrading.

Conclusion 2: Enterprise heterogeneity characteristics have a significant impact on the relative wage gap. Enterprise performance, innovation ability, total factor productivity, capital intensity, export and export subsidy intensity have significant positive effects on the relative wage gap; the number of employees has a significant negative impact on the relative wage gap; the relationship between enterprise age and relative wage gap is inverted U-shaped; foreign-funded enterprise and the degree of foreign participation, the degree of industry competition (Herfindahl index) and in-system enterprises (state-owned enterprises, enterprises directly under the central government) have significant positive effects on the relative wage gap. The research results show that the better the enterprise performance, the stronger the innovation ability, the higher the total factor productivity and capital intensity, the greater the intensity of export and export subsidy, and the larger the relative wage gap. The more employees in an enterprise, the smaller the relative wage gap. Foreign-funded enterprises and enterprises with a high degree of foreign participation have relatively high levels of technological innovation and management. Enterprises often employ high-skilled labor and pay higher wages, which leads to a widening of the relative wage gap. In-system enterprises often enjoy special government policies, have a certain monopoly position due to the characteristics of the industry, and can obtain excess monopoly profits. Their employees often enjoy higher wages, and the wage gap is larger than that of enterprises outside the system. The larger the Herfindahl index is, the higher the degree of monopoly is, and the more monopoly profits the enterprise obtains, thus the relative wage gap is further increased.

5.2. Policy Implications

The relative wage gap has double effects on economic development and social stability. On the one hand, if the wage gap is too small, the income distribution of workers tends to be egalitarian, which reduces the enthusiasm of high-skilled workers to innovate and create. In the long run, this will lead to low productivity and even hinder economic development. On the other hand, if the wage gap

is too large and the income imbalance is aggravated, the public's sense of injustice will be deepened and conflicts will be triggered, which will affect social stability. Therefore, the smaller the wage gap is not the better, nor is the bigger the better, and the key lies in moderation. In this regard, we put forward the following policy implications.

First, improve the quality of products, raise the wage of skilled workers, stimulate their innovation potential, and promote the positive effect of relative wage gap on the sustainable development of enterprises. The results show that product quality upgrading will make the enterprise recognized by consumers and the market, so it has higher sales revenue and profit, and the higher the corresponding wage level. The relative wage gap thus widened is a reasonable wage gap, which is conducive to the sustainable development of enterprises. Innovation ability and enterprise productivity have a positive impact on the relative wage gap, and the impact is greater. Improving the innovation ability and enterprise productivity depends on highly skilled talents. For those who master advanced knowledge and technology, have rich work experience and professional knowledge and skills, they should be given higher wages and improve the value of human capital. Appropriate wage gap can not only guarantee the skill income, but also fully stimulate the innovation and creation enthusiasm of skilled workers, and promote the sustainable development of enterprises.

Second, pay attention to the cultivation of low-skilled workers, increase the supply of skilled workers, and narrow the wage gap between skilled workers. The results show that product quality upgrading leads to the increase in the use of high-skilled workers and widens the relative wage gap. When the high-skilled workers are in short supply, the increase in the wages of high-skilled workers has further widened the relative wage gap. In response to this phenomenon, the government should strengthen the training and broaden the supply channels of skilled talents. There are usually two ways to increase the supply of skilled labor: First, through the development of higher education, especially higher vocational skills education, we should increase the training and improve the level of skilled talents, and directly increase the effective supply of skilled labor, so as to improve the production efficiency and wage level of skilled workers. The second is to establish a multi-channel and multi-level vocational skills training system. Through vocational skills training and talent exchange, we should strive to transform low-skilled workers into high-skilled workers, and indirectly increase the effective supply of skilled labor. This can not only increase the wage level of low-skilled workers, but also narrow the relative wage gap.

Third, breaking monopoly, abolishing preferential treatment and strengthening the regulation of enterprise salary within the system are of great practical significance to narrow the relative wage gap. The results show that in-system enterprises, foreign-funded enterprises foreign participation degree have a significant positive impact on the relative wage gap. The reason is that enterprises in the system are mainly concentrated in financial, tobacco, oil, aviation, railway, electricity, gas and other monopoly

industries. They obtain high monopoly profits by virtue of their monopoly status. In terms of income distribution, they get more salaries than competitive enterprises. In order to attract foreign investors, some local governments not only promise to reduce or exempt taxes, but also give more preferential treatment to foreign-funded enterprises, and their employees' wages were relatively high. Therefore, the government's policy orientation should be to break monopoly, deregulate, cancel preferential treatment, give full play to the decisive role of the market in the allocation of resources, and create a fair competitive market environment. This is of great practical significance to narrow the relative wage gap and promote the fairness of enterprise income distribution.

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