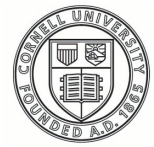

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Foreign Direct Investment and Wage Inequality: Evidence from the People's Republic of China

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Keywords

foreign direct investment, wage inequality, Theil index, Sharpley value decomposition

Comments

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FOREIGN DIRECT INVESTMENT AND WAGE INEQUALITY: EVIDENCE FROM THE PEOPLE'S REPUBLIC OF CHINA

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Keywords: Foreign Direct Investment, wage inequality, Theil index, Sharpley value decomposition

JEL Classification: F23, J31, O15

Contents

1. INTRODUCTION

The wage gap caused by the FDI between foreign firms and domestic firms in the host country has been a hot topic for labor economic research and development economic research. A lot of theories have explained this (Feenstra and Hanson, 1997; Markusen and Venables, 1997). Some of them show that foreign firms attract many high-skilled workers because of their high technological level, advanced management system, and high wage level. This widens the wage gap between foreign firms and domestic firms in the host country (Feenstra and Hanson, 1997; Figini and Görg, 1999). Some other research shows that the technology spillover effect of foreign firms can improve the technological level for domestic firms, which narrows the wage gap (Xu, Qi, and Li, 2009). We think foreign firms in the host country would have dynamic effects on the wage gap, following expansion of the FDI scale and FDI market. The effect of foreign firms could be different in different stages. Regretfully, there is no theoretical framework up to now under which we can analyze the affecting mechanism of FDI on the wage gap between foreign firms and domestic firms in the host country. This fact leads to divergence of explaining the effect of FDI on the wage gap in the host country. Moreover, many empirical studies have estimated the effect of FDI on the wage gap, but less research work focuses on the contribution of FDI to the wage gap and the development tendency of the effect of FDI.

The People's Republic of China (PRC) has attracted a large number of foreign direct investments since the early 1980s. Foreign firms usually pay higher wages than the domestic firms in order to attract the highly qualified labor force. According to Chinese official statistics, the average wage of foreign firms was 14.45% higher than that of domestic firms from 1998 to 2013. Using Chinese Manufacturing Enterprises Database, we find that foreign firms paid about 5.76% higher wages than domestic firms after controlling for enterprise scale, productivity, profits, per capital investment, industry, and location. Therefore, we wonder what the effect of entry of such a large number of FDI is. What is the tendency of this effect in the future? Through this study, we hope to give some suggestions for improving income inequality and decreasing risk of falling into the "middle income trap" in the PRC.

The objective of this paper is to investigate effects of FDI on the wage gap in the host country. We first make a theoretical model, attempting to describe effects of FDI on the wage gap between domestic firms and foreign firms. Then we use the Shapley value decomposition method to compute contributions of the observed factors, including FDI to Gini coefficient and Theil index. Theoretical results show that the overall effect of foreign investment leads first to expansion of the wage gap and then to narrowing of it. This implies that contribution of FDI to the wage gap in the host country follows an inverted U-shaped track. Empirical results show that contributions of FDI on wage inequality of enterprises tend to fall obviously during the observed period.

The paper proceeds as follows. In Section 2, we demonstrate research background for wage effects of FDI in the host country. In Section 3, we construct a two-sector model to calculate effects of FDI on the wage gap between domestic firms and foreign firms. In Section 4, we describe data and the estimation method. We then discuss our main findings in Section 5, and Section 6 concludes the paper.

2. LITERATURE REVIEW

There is a large amount of research on impact of FDI on the economy in the host country, both theoretically and empirically. Regarding the affecting mechanism of FDI on the wage gap, most work reveals that FDI affects the wage level and wage gap in the host country through two ways: labor transfer effect and technology spillover effect. On one hand, foreign firms entering the host country increase demand of labor. The labor force prefers to transfer from lower-wage domestic firms to higher-wage foreign firms. This inevitably leads to wage increase in the host country. However, using the competition model of the labor market for analysis, the wage gap would not be sustained forever (Brown et al., 2003; Lipsey and Sjoholm, 2004; Driffield and Taylor, 2006). On the other hand, domestic firms can benefit from the presence of foreign multinationals through positive spillovers. This allows them to improve their productivity through technology transfer, labor mobility, and products mobility. The extent of horizontal spillover depends on R&D activities of foreign firms and absorption capacity of domestic firms (Todo and Miyamoto, 2006). The extent of vertical spillover depends on participation of domestic firms in the supply chain of foreign firms (Saggi, 2002). But there are contrary opinions suggesting that when the economic development level and technological level in the host country are low, the negative crowding-out effect of FDI on domestic firms may be greater than the positive spillover effect. This even hurts the technological development of domestic firms (Wang, 2009).

Studies of the impact of FDI on the wage gap can be classified as two types. The first type is that inflow of FDI enlarges the wage gap between domestic firms and foreign firms. Foreign firms have the higher technological level and managerial level. This increases relative demand for skilled workers. In order to prevent loss of highly skilled workers, foreign firms often pay the higher wage. Therefore, foreign investment enlarges the wage gap between low-skilled workers and high-skilled workers (Lipsey and Sjoholm, 2004; Lipse, 2004). There is a lot of empirical evidence supporting this point. Feenstra and Hanson (1997) argue that multinationals from the developed countries always outsource production to developing countries, such as Mexico. This leads to an increase of relative demand for skilled workers and relative wage of skilled workers in developing country increases as well. Chen et al. (2011) investigates the wage premium and wage spillover effect of foreign firms in the PRC's manufacture sector. The results indicate that expansion of foreign investment increases inter-firm wage inequality.

The second type is that the direction of FDI influence on the wage gap is uncertain. Wu (2001) argues that this impact depends on whether the technology transfer effect caused by FDI is skill oriented or labor oriented, and this is irrelevant to which sector receives FDI. Analysis shows that FDI with relatively labor-oriented technology will decrease the wage gap, while relatively skill-oriented technology will increase the profit margin of exports and then the wage gap in the host country. Das (2002) finds that there are short-run effects of FDI entering skilled-labor intensive sectors. Faced with the wage gap between foreign firms and domestic firms, domestic firms would be encouraged to sustain increased demand for skilled labor. This raises the relative wage of domestic firms. In the long run, more FDI activities would increase the supply of skilled labor and would reduce relative wage. Dritfield and Taylor (2006) use industrial- and regional-level panel data for the UK to conclude that foreign firms have significant wage spillover effects on domestic firms. Such wage spillover effects are more widespread for skilled workers than for unskilled workers, and it is lower in sectors with high unemployment.

Using the PRC as an example, there are numerous studies about effects of FDI on wage disparities across different industries and regions. Bao and Shao (2008) argue that wage spillover effects of FDI are closely related to industrial characteristics. They set up the simultaneous equations model and use the PRC's manufactured industrial data and find that FDI enlarges the wage gap within the industry through the wage spillover effect. However, researchers obtain different conclusions about the impact of foreign investment on the wage gap between industries. This is because of different industrial characteristics.

The industry that can absorb more foreign investment has a higher wage level. So foreign investment enlarges the wage gap between industries (Chen and Xie, 2004). Some researchers (Xu, Xuan and Zhao, 2005) also found that the region where foreign investments gather has the ability to offer higher wages. Imbalanced distribution of foreign investments across different regions is the main reason for the wage gap between regions.

To sum up, research on effects of FDI on the wage gap between domestic firms and foreign firms in the host country does not have a dominant conclusion. Empirical results even go against the theoretical conclusion. There is no study yet setting up a theoretical framework to analyze the affecting mechanism of FDI on the wage gap in the host country. Actually, the affecting mechanism of FDI on the wage gap is a relatively complicated process, which includes both labor transfer effect and technology spillover effects. The direction and extent of effect could be different in different stages. This paper attempts to improve existing research, both theoretically and empirically, in order to obtain more-convincing results.

3. MODEL

We incorporate two affecting mechanisms of FDI on the wage gap into a theoretical model. Specifically, by analyzing the change of Theil index caused by labor transfer effect and technology spillover effect, we construct a two-sector model to calculate the effect of FDI on wage inequality between domestic firms and foreign firms. First, workers employed in domestic firms will surely be attracted to higher wages paid by foreign firms. Then, we calculate the change of Theil index caused by the labor transfer effect. Second, the relative wage between foreign firms and domestic firms can be derived from the technology spillover model. We then introduce this relative wage into the Theil index. The variation of inequality along with the increase of FDI technology spillover can be calculated. Finally, based on an overall analysis of two affecting mechanisms, we give the final theoretical results.

The model follows Acemoglu (1998, 2002) and is developed based on the two-sector model used by Robinson (1976), Glomm and Ravikumar (1992), and Zhou (2009).

Assumption 1: There are two sectors, Y_d (domestic sector) and Y_f (foreign sector), that use capital (K) and labor (L); Y is the total output of society with the expression as follows:

$$Y = \left(Y_d^{\rho} + \gamma Y_f^{\rho} \right)^{\frac{1}{\rho}}.$$

where the elasticity of substitution between Y_d and Y_f is $1/(1-\rho)$; γ is the importance of Y_f to Y.

Assumption 2: The production functions of two sectors are given as follows:

$$Y_f = A_f K_f^{\alpha} L_f^{\beta}$$

$$Y_d = A_d K_d^{\alpha} L_d^{\beta}$$

where A_f and A_d denote technology parameter. The labor market is competitive and clear, and people can move across the sector. $L_d + L_f = L$, labor's shares of domestic sector and foreign sector, are $1\text{-}\eta$ and η, respectively.

Assumption 3: W_d and W_f represent wages of domestic sector and foreign sector, respectively. The average wage of the whole country can be expressed as $(1\text{-}\eta)W_d + \eta W_f$. The wage of two sectors depends on the technical level and also is an increasing function of it. The expression is as follows:

$$w_f = f(A_f),\ \frac{\partial w_f}{\partial A_f} > 0$$

$$w_d = f(A_d),\ \frac{\partial w_d}{\partial A_d} > 0,$$

The level of technology in the foreign sector is higher than the domestic sector, so $w_f > w_d$, $w = \frac{w_f}{w_d} > 1$.

Assumption 4: There is no wage gap within each sector.

3.1 Effect of Labor Transfer on Wage Inequality

In this section, we ignore the effect of technology spillover and only analyze the effect of labor transfer on the wage gap. Assumption 5 is given as follows:

Assumption 5: There is no technology spillover existing between two sectors; thus, the wage gap, depending on technical level, is a constant.

Theil index is selected as the analyzing tool, due to the reason that it is more sensitive to income difference between groups.[1] The formula of Theil index is as follows:

$$T = \sum \left(\frac{I_i}{I} Ln \frac{I_i / I}{N_i / N} \right) \quad (1)$$

where I_i denotes total income of group i, N_i denotes number of individuals of group i, and I and N are gross income and total number of individuals, respectively. The expression of Theil index between domestic sector and foreign sector can be calculated as follows:

[1] Theil index is sensitive to transfers of income from poor to rich.

$$T=\frac{L_d w_d}{L((1-\eta)w_d+\eta w_f)}\ln\frac{L_d w_d \Big/ L((1-\eta)w_d+\eta w_f)}{1-\eta}+\frac{L_f w_f}{L((1-\eta)w_d+\eta w_f)}\ln\frac{L_f w_f \Big/ L((1-\eta)w_d+\eta w_f)}{\eta} \quad (2)$$
$$=\frac{(1-\eta)w_d \ln w_d+\eta w_f \ln w_f}{(1-\eta)w_d+\eta w_f}-\ln((1-\eta)w_d+\eta w_f)$$

In order to find out the effect of labor transfer on wage inequality, the first derivative of equation (2) on η is as follows:

$$\frac{\partial T}{\partial \eta}=\frac{(w_f \ln w_f - w_f \ln w_d)((1-\eta)w_d+\eta w_f)-(w_d-w_f)\left((1-\eta)w_d \ln w_d+\eta w_f \ln w_f-((1-\eta)w_d+\eta w_f)\right)}{((1-\eta)w_d+\eta w_f)^2} \quad (3)$$
$$=\frac{-\eta(w_d-w_f)^2+w_d w_f(\ln w_f-\ln w_d)+w_d(w_d-w_f)}{((1-\eta)w_d+\eta w_f)^2}$$

η^* is obtained to make the value of equation (3) zero.

$$\eta^*=\frac{w_d w_f(\ln w_f-\ln w_d)+w_d(w_d-w_f)}{(w_d-w_f)^2} \quad (4)$$
$$=\frac{\frac{w_f}{w_d}\ln\frac{w_f}{w_d}-\frac{w_f}{w_d}+1}{\left(1-\frac{w_f}{w_d}\right)^2}$$

Hence, if $\eta=\eta^*$, then $\frac{\partial T}{\partial \eta}=0$

Since $\frac{w_f}{w_d}>1$, it is easy to find out $\eta^*\in(0,1)$ [2].

Workers who are employed in domestic firms will surely be attracted by higher wages paid in foreign firms. So labor will transfer from the domestic sector to the foreign sector. This means η will increase. According to derivation result, if $0<\eta<\eta^*$, then $\frac{\partial T}{\partial \eta}>0$, which means the wage gap between two sectors will increase gradually, along with labor transfer, before η arrives at the critical point $\eta*$. While $\eta^*<\eta<1$, then $\frac{\partial T}{\partial \eta}<0$. This means labor transfer from domestic sector to foreign sector will narrow the gap after η exceeds the critical point $\eta*$. In summary, the wage gap between two

[2] let $f\left(\frac{w_f}{w_d}\right)=\frac{w_f}{w_d}\ln\frac{w_f}{w_d}-\frac{w_f}{w_d}+1$, $f_{\frac{w_f}{w_d}}{}'=\ln\frac{w_f}{w_d}>0$, $f(1)=0$, so $f\left(\frac{w_f}{w_d}\right)>0$; let $g\left(\frac{w_f}{w_d}\right)=1-\frac{w_f}{w_d}+\ln\frac{w_f}{w_d}$, $g_{\frac{w_f}{w_d}}{}'=\frac{w_d}{w_f}-1<0$, $g(1)=0$, so $g\left(\frac{w_f}{w_d}\right)<0$, $\frac{w_f}{w_d}\left(1-\frac{w_f}{w_d}+\ln\frac{w_f}{w_d}\right)<0$, that is $\eta^*<1$.

sectors increases first and then decreases with labor transfer, which is an inverted U-shaped variation.

To find out the specific feature and shape of the U-shaped curve, the second derivative of equation (2) on η is given as follows:

$$\frac{\partial^2 T}{\partial \eta^2} = \frac{\left(\frac{w_f}{w_d}-1\right)\left(\left(1-\frac{w_f}{w_d}\right)\left(1-\eta+\eta\frac{w_f}{w_d}\right)+2\eta\left(1-\frac{w_f}{w_d}\right)^2-2\left(\frac{w_f}{w_d}\ln\frac{w_f}{w_d}-\frac{w_f}{w_d}+1\right)\right)}{\left(1-\eta+\eta\frac{w_f}{w_d}\right)^3}$$
$$= \frac{\left(\frac{w_f}{w_d}-1\right)\left(\left(2\frac{w_f}{w_d}-2\right)\eta-2\ln\frac{w_f}{w_d}-1\right)}{\left(1-\eta+\eta\frac{w_f}{w_d}\right)^3} \quad (5)$$

η^{**} is obtained to make the value of equation (5) zero:

$$\eta^{**} = \frac{2\ln\frac{w_f}{w_d}+1}{2\left(\frac{w_f}{w_d}-1\right)} \quad (6)$$

Since,

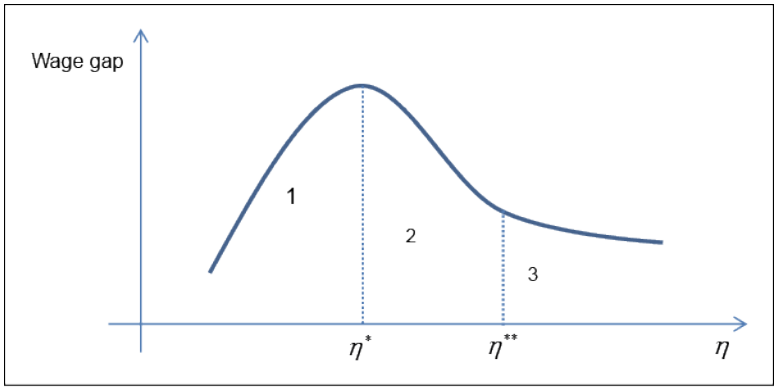
$$\eta^{**}-\eta^{*} = \frac{2\ln\frac{w_f}{w_d}+1}{2\left(\frac{w_f}{w_d}-1\right)} - \frac{\frac{w_f}{w_d}\ln\frac{w_f}{w_d}-\frac{w_f}{w_d}+1}{\left(1-\frac{w_f}{w_d}\right)^2} > 0^{\,3} \quad (7)$$

Namely, $\eta^{*} < \eta^{**}$

Figure 1 depicts a process occurring when the wage gap moves along with labor transfer from the domestic sector to the foreign sector. At the beginning, the wage gap between two sectors gradually expands following the increase of the labor's share of the foreign sector (Stage 1). More and more labor moving into the foreign sector reduces the wage gap (Stage 2). Once η exceeds η^{**}, the wage gap decrease starts to slow down (Stage 3). According to equation (4) and equation (6), the values of η^{*}. and η depend on $\frac{w_f}{w_d}$.

[3] let $h\left(\frac{w_f}{w_d}\right) = 3\frac{w_f}{w_d} - 2\ln\frac{w_f}{w_d} - 3$, $h(1)=0$, $h'_{\frac{w_f}{w_d}}\left(\frac{w_f}{w_d}\right) = 3-2\frac{w_d}{w_f} > 0$ so $h\left(\frac{w_f}{w_d}\right) > 0$, that is $\eta^{**}-\eta^{*} > 0$.

Figure 1: Effect of Labor Transfer on the Wage Gap



3.2 Effect of Technology Spillover on Wage Inequality

All descriptions in the above section about the effect of labor transfer from the domestic sector to the foreign-invested sector on the wage gap are under the condition that no technology spillover exists. In order to figure out the effect of technology spillover on wage inequality, there is a need to relax Assumptions 5 and 6.

Assumption 6: Foreign sector could affect the productivity of domestic sector by technology spillover. The level of technology in the domestic sector will increase with higher foreign-invested capital, due to possible technology spillovers (Saglam and Sayek, 2011), $A_d = AK_f^{\delta}$, where K_f denotes foreign-invested capital. A denotes the net of the foreign-invested sector's technology spillovers on domestic sector's productivity; σ denotes the extent of technology spillovers from K_f, and σ is an increase function of K_f, $\frac{\partial \delta}{\partial K_f} > 0$. Normalize the price of the final good Y to 1.

According to Assumption 1, competitive pricing gives a standard relative demand equation for domestic sector and foreign sector:

$$\frac{P_f}{P_d} = \gamma \left(\frac{Y_d}{Y_f} \right)^{1-\rho}$$

where P_d and P_f denote the prices of the two sectors. The wage premium between domestic sector and foreign is w:

$$w = \frac{W_f}{W_d} = \frac{K_f^{\rho(\alpha-\delta)}}{\gamma K_d^{\alpha\rho}} \left(\frac{A_f}{A} \right)^{\rho} \left(\frac{L_f}{L_d} \right)^{\beta\rho-1} \tag{8}$$

Equation (2) can be converted as follows:

$$T = \frac{\eta \frac{W_1}{W_2}\left[\ln \frac{W_1}{W_2} - \ln\left(1-\eta+\eta\frac{W_1}{W_2}\right)\right] - (1-\eta)\ln\left(1-\eta+\eta\frac{W_1}{W_2}\right)}{1-\eta+\eta\frac{W_1}{W_2}} \tag{9}$$

To simplify the process of the deduction, let $J = \frac{1}{\gamma}\left(\frac{K_f}{K_d}\right)^{\alpha\rho}\left(\frac{A_f}{A}\right)^{\rho}\left(\frac{L_f}{L_d}\right)^{\beta\rho-1}$, $\frac{W_f}{W_d} = JK_f^{-\rho\delta}$ substitute $\frac{W_f}{W_d}$ in equation (9),

$$T = \frac{\eta JK_f^{-\rho\delta}\left[\ln JK_f^{-\rho\delta} - \ln(1-\eta+\eta JK_f^{-\rho\delta})\right] - (1-\eta)\ln(1-\eta+\eta JK_f^{-\rho\delta})}{1-\eta+\eta JK_f^{-\rho\delta}} \tag{10}$$

In order to figure out the technology spillover effect of foreign sector on wage inequality, the first derivative of equation (10) on δ is given as follows:

$$\frac{\partial T}{\partial \delta} = \frac{-(1-\eta)\rho\eta JK_f^{-\rho\delta}\ln K_f \ln JK_f^{-\rho\delta}}{(1-\eta+\eta JK_f^{-\rho\delta})^2} \tag{11}$$

Since $\frac{\partial T}{\partial \delta} < 0$, improvements in the extent of technology spillovers will reduce the wage gap between two sectors, which accords with conventional wisdom.

Similarly, to find out the specific feature and shape of the curve, the second derivative of equation (10) on δ is given as follows:

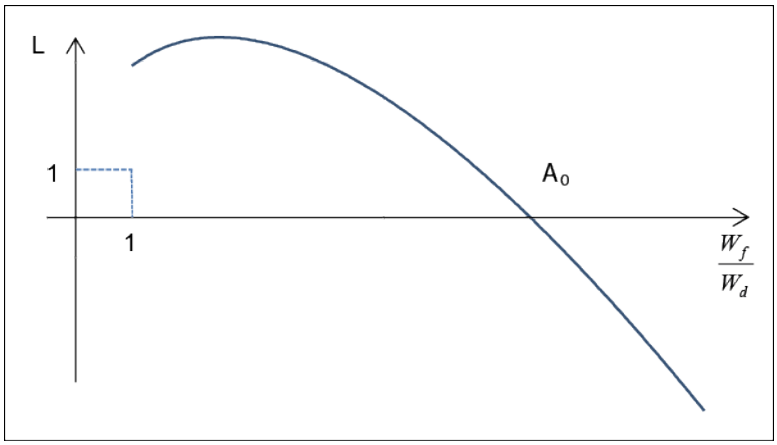
$$\begin{aligned}\frac{\partial^2 T}{\partial \delta^2} &= \frac{(1-\eta)\rho^2\eta JK_f^{-\rho\delta}(\ln K_f)^2\left[(1-\eta)(\ln JK_f^{-\rho\delta}+1) - \eta JK_f^{-\rho\delta}\ln JK_f^{-\rho\delta} + \eta JK_f^{-\rho\delta}\right]}{(1-\eta+\eta JK_f^{-\rho\delta})^3} \\ &= \frac{(1-\eta)\rho^2\eta(\ln K_f)^2\frac{W_f}{W_d}\left[(1-\eta)\left(\ln\frac{W_f}{W_d}+1\right) - \eta\frac{W_f}{W_d}\ln\frac{W_f}{W_d} + \eta\frac{W_f}{W_d}\right]}{\left(1-\eta+\eta\frac{W_f}{W_d}\right)^3}\end{aligned} \tag{12}$$

The sign of equation (12) depends on the function as follows:

$$L\left(\frac{W_f}{W_d}\right) = (1-\eta)\left(\ln\frac{W_f}{W_d}+1\right) - \eta\frac{W_f}{W_d}\ln\frac{W_f}{W_d} + \eta\frac{W_f}{W_d}$$

The image of $L\left(\frac{W_f}{W_d}\right)$ is shown as Figure 2.

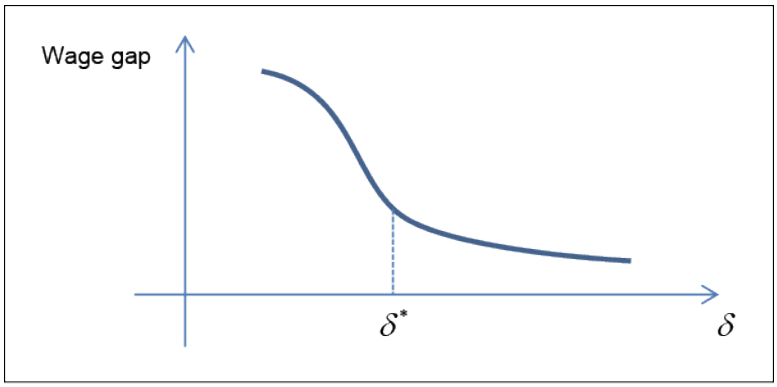
Figure 2: Image of $L\left(\frac{W_f}{W_d}\right)$



In Figure 2, If $\frac{W_f}{W_d} = A_0$ [4], $L\left(\frac{W_f}{W_d}\right) = 0$, $\delta = \delta^* = \frac{\ln(J/A_0)}{\rho \ln K_f}$, then $\frac{\partial^2 T}{\partial \delta^2} = 0$. If $1 < \frac{W_f}{W_d} < A_0$, then $L\left(\frac{W_f}{W_d}\right) > 0$, that is $\delta < \delta^*$, $\frac{\partial^2 T}{\partial \delta^2} > 0$. If $\frac{W_f}{W_d} > A_0$, then $L\left(\frac{W_f}{W_d}\right) < 0$, that is $\delta > \delta^*$, $\frac{\partial^2 T}{\partial \delta^2} < 0$.

These analyses lead to the conclusion that technology spillovers can reduce the wage gap between two sectors with increasing speed under the condition of $\delta > \delta^*$; once δ exceeds δ^*, the reducing speed will start to slow down. Figure 3 depicts this process.

Figure 3: Effect of Technology Spillover on the Wage Gap



3.3 Comprehensive Influence of Labor Transfer and Technology Spillover

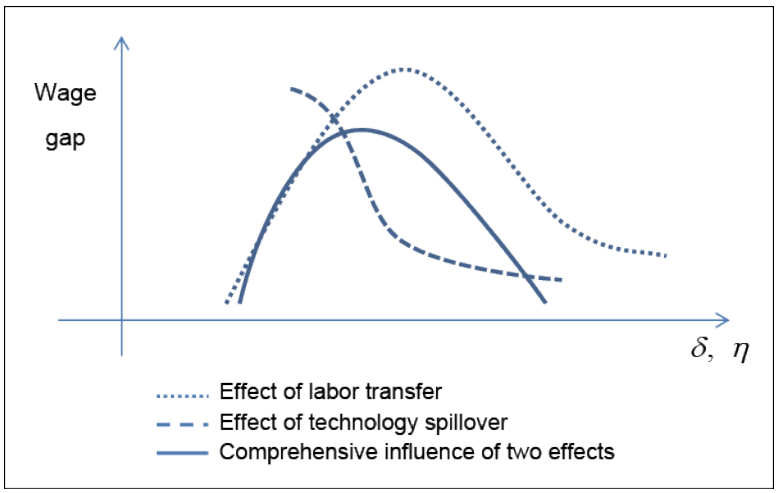
Generally, higher wages and higher welfare paid by foreign firms will surely attract the local qualified labor force to transfer from other sectors, if obstacles of labor mobility do not exist. Therefore, the effect of labor transfer will play a role in the wage gap. Correspondingly, due to restriction of technical barriers, patent system, as well as the

[4] A_0 depends on η.

absorptive capacity of local enterprises, the technology spillover effect lags behind the labor transfer effect. But lag length is influenced by many factors. There are two distribution situations existing in the time dimension.

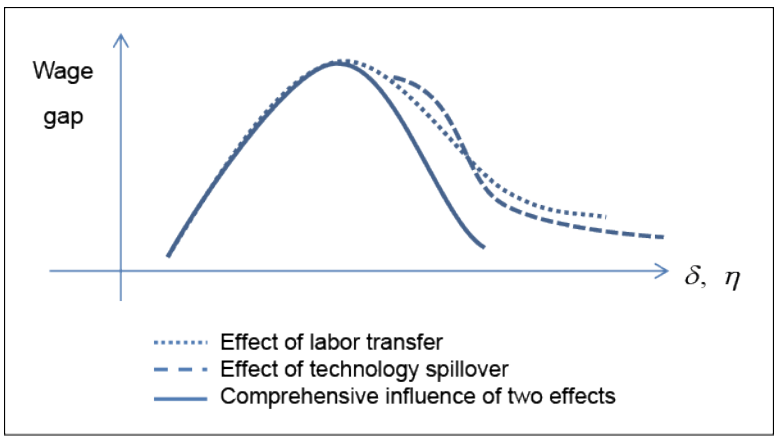
First, the effect of technology spillover happens before the wage gap caused by labor transfer reaches the inflection point. This process is depicted in Figure 4. This means that technology spillover effect has already started to play a role in reducing the wage gap when it is in the expansion phase that the labor-transfer effect works. This situation might lead to two consequences. The first is that expansion phase of wage gap caused by labor transfer is shortened; the second is reduction of maximum value of the wage gap caused by labor transfer, and reduction appears earlier. The overall result is that technology spillover effect leads to an overall reduction of the inverted U-shaped curve compared to the curve caused by the labor transfer effect.

Figure 4: Shorter Lag between Two Effects



Second, the technology spillover effect occurs after the wage gap caused by the labor transfer effect reaches the inflection point. This process is depicted in Figure 5. In this figure, the effect of technology spillover does not affect the first half and vertices of the inverted U curve. But it speeds up the declining rate of the latter part of the curve, which is caused by labor transfer.

Figure 5: Longer Lag between Two Effects



In general, theoretical analysis shows that the wage gap between two sectors increases first and then decreases as labor transfers from domestic sector to foreign sectors. This implies an inverted U-shaped track. Meanwhile, increased technological spillovers reduce the wage gap between the two sectors. Finally, the overall effect of foreign investment leads the wage gap between two sectors first to increase and then to decrease. This means the overall effect of foreign investment on the wage gap also implies an inverted U-shaped track.

Using the Chinese Manufacturing Enterprises Database, the rest of this paper uses a regression-based inequality decomposition approach to explore determinants of the wage gap in the PRC. A comparison between the empirical result and theoretical results could be helpful to examine the robustness of our assumptions.

4. EMPIRICAL METHOD AND DATA

Current research about inequality decomposition includes Oaxaca Decomposition Cotton Decomposition, Neumark Decomposition, Brown Decomposition, and Appleton Decomposition. Each method has its own limitations. We use a regression-based Shapley Decomposition Approach, which has been improved by Wan (2004), to calculate the contributions of explanatory variables to income inequality. The basic idea of this method is that in the regression function we replace each variable by its mean value. The new fitted value can be considered as assessed income inequality ruling out the effect of that variable on inequality. The difference between assessed inequality and actual inequality can be considered as the contribution of that variable.

To implement the decomposition method, we first construct the decomposition function, as below, following the income function proposed by Shorrocks and Wan (2004):

$$\begin{aligned} lnW_{it} = \alpha + \beta_{1t} FCC_{it} + \beta_{2t} DR_{it} + \beta_{3t} EXP_{it} + \beta_{4t} CLA_{it} + \beta_{5t} PCP_{it} + \beta_{6t} OLP_{it} + \beta_{7t} MON_{it} \\ + \beta_{8t} SCAL_{it} + \beta_{9t} NPR_{it} + \beta_{10t} X_i + \varepsilon_{it} \end{aligned} \quad (13)$$

Where W is the average annual wage per worker, which encompasses the accrued payroll and welfare; fcc (Foreign-capital corporations) is the core dummy variable, which is identified as 1 if the enterprise is foreign investment, 0 otherwise. Other control variables include: dr is debt ratio, reflecting the viability of enterprises; exp is export performance, measuring the degree of export dependency; clr is capital-labor ratio, which is used to distinguish labor intensity; pcp is per capita profit as assessment of economic efficiency; olp is overall labor productivity, reflecting the level of production and technology; mon is also a dummy variable, identified as 1 if the enterprise belongs to a monopoly industry[5]; sca is total assets, which indicates enterprise scale; pnp is proportion of new products, which indicates innovation capacity. We also include regional dummy variables, considering different development levels of east-central-west regions in the PRC. To compute the contribution to income inequality, we solve the estimated model to get the income level value. As a consequence, the constant term becomes a scalar so that it does not contribute to inequality. Hence, both the constant and dummy variable terms can be removed without affecting decomposition results (Wan, 2004).

[5] According to Ding (2010), Petroleum and Natural Gas Extraction; Petroleum Processing and Coking; Coal Mining and Processing; Mining and Processing of Non-Ferrous Metal Ores; Manufacture of Tobacco; Production and Supply of Electric Power and Heat Power; Production and Supply of Gas; Production and Supply of Water are classified as the monopoly industries.

$$W_i = \exp(\alpha) \times \exp(\beta_i X_i) \times \exp(T) \times \exp(u) \quad (14)$$

Second, according to the regression result, we adopt the Shapley Decomposition Approach to calculate contributions of explanatory variables to income inequality by using the java program developed by the UNU-WIDER.

The database we use consists of a panel of Chinese manufacturing enterprises from 1999 to 2007. This dataset comes from the National Bureau of Statistics Enterprise Dataset. The National Bureau of Statistics of the PRC (NBSC) obtains annual reports from most state enterprises and large- and medium-sized non-state enterprises (with sales of more than five million yuan per year). These annual reports contain the firm's financial statements and some non-financial information, such as the entry date, district code, industry code, and the main products of the enterprise. This database is used as the base of compiling the statistical data for the aggregate manufacturing sector, which is collected in the China Statistical Yearbook (NBSC, 2000–2008). Statistics in this database on two-digit manufacturing industries are collected in the China Industry Economy Statistical Yearbook (NBSC, 2000-2008). The sample size of 160,000 in 1999 has been increased to 330,000 in 2007. We eliminate outliers according to methods of Cai and Liu (2009)[6] and deflate price separately by CPI, PPI and FAIPI and finally pick up 12,892 enterprises consisting of 7,726 domestic enterprises and 5,116 foreign-invested enterprises from 1999 to 2007.

There might be multi-collinearity among these variables. But none of the Pearson correlation coefficients was larger than 0.4. Variance inflation factors fell from the band of 1.03 to 1.41. This evidence could prove that there is no multiple co-linear relation among variables. Descriptive statistics of primary variables are shown in Table 1.

Table 1: Descriptive Statistics

Variable	Number of Observations	Mean	SD	Min	Max
W	116,028	17,555.26	16,282.34	81.27	1478,836
fcc	116,028	0.41	0.4918	0	1
dr	116,028	57.74	38.58	–46.32	4,846.23
exp	116,028	26.86	39.56	0	104.67
clr	116,028	313.58	695.96	0.17	147,886.4
pcp	116,028	13.44	53.92	–5,501.61	2,678.385
olp	116028	88.77	196.03	–8,801.03	22,506.07
mon	116028	0.07	0.25	0	1
sca	116028	80,251.62	147,725.9	171	2,921,800
pnp	116028	3.68	14.48	0	100

We use data of 12,892 companies to calculate wage ratio between foreign firms and domestic firms (W_f / W_d); the proportion of foreign firms' workforce accounts for the total labor force (η) and the corresponding η^* and η^{**} from 1999 to 2007 (results are reported in Table 2). Seen from the table, η exceeds η^* in 2004. This means that the

[6] The following data observations have been excluded from the sample: those with missing value, those for the enterprises not meeting the criterion of "above designated size' and those outliers in the key variables.

wage gap between the domestic sector and foreign sector caused by labor transfer effect has entered the declining phase, as we predict in our theoretical analysis.

Table 2: Results of $W_f/W_d, \eta, \eta^*, \eta^{**}$

	W_f/W_d	η	η^*	η^{**}
1999	1.6401	0.3564	0.4182	0.8725
2000	1.6301	0.3752	0.4192	0.8748
2001	1.5146	0.3936	0.4312	0.9020
2002	1.5288	0.4140	0.4297	0.8986
2003	1.4805	0.4307	0.4349	0.9101
2004	1.4237	0.4580	0.4414	0.9237
2005	1.3978	0.4658	0.4444	0.9299
2006	1.3887	0.4733	0.4455	0.9321
2007	1.3456	0.4596	0.4507	0.9423

We also calculate the value of Theil index between domestic firms and foreign firms (according formula 9), Theil index for all the companies' average wage, and the changing rate of Theil index from 1999 to 2007. The results are reported in Table 3.

Table 3: Theil Index between Two Sectors and All Companies' Average Wage

	Theil Index between Two Sectors T_{two}	**Rates of Change** (%)	**Theil Index of All Companies' Average Wage** T_{all}	**Rates of Change** (%)	T_{two}/T_{all} (%)
1999	0.0300	–	0.24115	–	12.44
2000	0.0295	–1.67	0.24052	–0.26	12.27
2001	0.0214	–27.46	0.2344	–2.54	9.13
2002	0.0224	4.67	0.24623	5.05	9.10
2003	0.0192	–14.29	0.22288	–9.48	8.61
2004	0.0156	–18.75	0.21027	–5.66	7.42
2005	0.0140	–10.26	0.20417	–2.90	6.86
2006	0.0134	–4.29	0.20774	1.75	6.45
2007	0.0110	–17.91	0.20977	0.98	5.24
Average	0.01961	–11.24	0.22413	–1.63	8.61
1999–2007		–63.33		–7.05	

From Table 3, first, we know the whole wage gap between enterprises in the PRC shows a shrinking trend from 1999 to 2007. This might be because supply and demand of the labor market has undergone structural changes. Labor supply exceeds labor demand slowly. Faced with increasing competition in the labor market, some enterprises that used to provide the low level of wages have to increase the wage level in order to attract the labor force. This leads to a decrease in the wage gap.

Second, the whole wage gap between enterprises is quite significant in the PRC, Theil index of all companies' average wage is within the range of 0.2 to 0.25. The average wage is about 0.22. Theil indexes between domestic firms and foreign firms are from 0.01 to 0.03. The proportions of the latter accounting for the former are from 5% to 12%. The average value of this proportion is more than 8%. This means that contribution of wage gap accounting for the Theil index is obvious. However, the proportion is declining, implying FDI is no longer the main reason for the wage gap between enterprises.

Finally, Table 2 shows that the turning point of the wage gap caused by labor transfer effect takes place in 2004. Table 3 shows that the overall wage gap has been declining since 1999, which means the technology spillover effect took place before 2004. In other words, the total influence of labor transfer effect and technology spillover effect on the wage gap in the PRC supports the first case of our theoretical analysis. The effect of technology spillover happens before the wage gap caused by labor transfer effect reaches the turning point.

5. EMPIRICAL RESULTS

Table 4 presents estimation results of equation (13). Column (1) shows the estimation results of Fixed Effect Model with the log average wage of enterprise as dependent variable. The presence of significant heteroscedasticity and serial correlation can be tested using Wooldridge test and Wald test. Therefore, we report Driscoll-Kraay standard errors that are robust to heteroscedasticity and serial correlation (see Driscoll and Kraay, 1998). Column (2) of Table 4 shows the results.

Table 4: Results of Estimating Equation (13)

	Estimation Results of the Fixed Effect Model	Estimation Results of the Fixed Effect Model with Driscoll and Kraay Standard Errors
fcc	0.0545***	0.0545**
dr	–0.0985**	–0.0985
exp	–0.5273***	–0.5273
cla	0.0351***	0.0351
pcp	0.4072***	0.4072***
olp	0. 2355***	0. 2355***
mon	0. 1688***	0. 1688***
sca	0.0282***	0.0282**
npr	0.0123	0.0123
Central region	–0.1491	–0.1491***
Western region	0.0167	0.0167
Constant	9.1262***	9.1262***
Wooldridge text	594.849 (0.000)	
Wald text	5,300,000 (0.000)	
R^2	0.2981	0.2981
Prob>F	(0.000)	(0.000)
Number of observations	116,028	116,028

Note: Time dummies are all significant at the 1% level. For convenience, they are not reported.

*** p < 0.01, ** p < 0.05, * p < 0.1.

After standard errors have been corrected, estimated coefficients of the foreign-capital company, per capita profit, overall labor productivity, monopoly, and scale of enterprise are statistically significant at least at the 5% level. The estimated coefficient of the foreign-capital company is significantly positive at the 5% level. This suggests that FDI has a significant impact on the wage level of the PRC. This also indicates that foreign-capital companies pay the 5.6% higher wage than domestic companies. There is a significant wage gap between foreign capital and domestic companies.

Per capita profit, enterprise scale, and monopoly have significantly positive coefficients. This means that these variables are important factors for wage determination in the PRC. According to the profit-sharing model (Kahneman et al., 1986), companies with higher profits are more willing to provide high wages for their employees. The cost of the inner supervision, organization, management, and coordination is usually high in large-scale enterprises, a high level of wage can help companies reduce these costs on the basis of efficiency wage theory (Shapiro and Stiglitz, 1984). Monopoly industries with benefits from the government and monopoly prices pay a higher level of wages to employees. This result is recognized by many literature studies.

The impacts of debt ratio and export on the wage level are negative in the PRC. It is clear that a high debt ratio means a bad financial situation. Regarding the export, the PRC still exports labor-intensive products, and export enterprises usually pay relatively lower wages in order to maintain export advantages. Both variables have insignificant coefficients.

According to neoclassical theory, high capital-labor ratio means higher marginal products of labor. This means that only enterprises with higher returns have the ability to conduct research and development of new products and then pay the higher level of wage for workers, but both variables have insignificant coefficients, implying that neither of them is a crucial factor in the wage-determination process.

In order to decompose the annual wage gap, we also need to obtain the annual income estimation equation from 1999 to 2007. That means running the regression on annual cross-sectional data. We put regression results in the Appendix tables.

We compute contributions of each explanatory variable in the regression model using the Shapley value-based approach (decomposition results are shown in Table 5). Since the decomposition results are influenced by choice of the inequality index, decomposition results are presented for two inequality measures: Gini index and Theil index. The table shows the contributed percentage of explanatory variables to total inequality. Decomposition results of Gini coefficient and Theil index are very similar. This shows that the method generates a robust result. Degrees of explanation remain at 50% to 60%, indicating that the results are quite reliable.

The table shows that the contributions of all explanatory variables have obviously changed during the period from 1999 to 2007. This is because the PRC was experiencing the rapid transformation of economic structure.

Table 5：Factor Contributions to Inequality using the Shapley Method (%)

	1999		2000		2001	
	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index
Debt ratio	2.14	0.67	3.98	1.07	1.69	0.41
Export	0.53	–0.01	0.64	0.07	1.53	0.49
Capital-labor ratio	17.56	20.14	15.14	20.12	13.24	21.73
Per capita profit	3.03	2.83	4.88	7.56	4.98	10.79
Overall labor productivity	4.48	6.45	0.97	2.12	5.16	11.93
Monopoly	0.74	0.74	1.04	0.97	1.97	1.56
Foreign-capital companies	17.11	8.05	15.71	6.79	14.07	4.98
Region	9.69	4.11	10.06	4.05	9.28	0.96
Scale	2.24	2.18	2.85	3.07	3.90	3.29
Proportion of new products	0.71	0.22	1.30	0.35	1.04	0.30
Total degrees of explanation	58.22	45.38	56.59	46.19	56.84	56.45
	2002		**2003**		**2004**	
	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index
Debt ratio	12.86	5.59	1.10	0.38	2.65	0.78
Export	1.00	-0.29	1.31	0.46	2.70	0.89
Capital-labor ratio	14.58	25.43	19.12	23.38	10.29	16.80
Per capita profit	5.36	9.38	2.74	7.95	3.94	5.24
Overall labor productivity	4.80	10.67	6.55	15.22	3.35	5.04
Monopoly	1.88	1.76	1.86	1.01	2.22	2.37
Foreign-capital companies	13.12	7.89	12.60	7.21	12.95	4.85
Region	8.26	3.78	8.88	4.55	8.13	3.27
Scale	3.54	3.32	2.62	2.06	4.92	5.30
Proportion of new products	1.31	0.47	1.69	3.01	1.63	0.64
Total degrees of explanation	66.71	67.99	58.48	65.23	52.78	45.18
	2005		**2006**		**2007**	
	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index	Gini Coefficient	Theil Index
Debt ratio	2.08	0.61	2.57	0.46	2.16	0.57
Export	2.20	0.33	1.89	0.26	1.72	0.36
Capital-labor ratio	7.70	10.50	7.06	10.83	8.68	13.66
Per capita profit	1.96	2.58	1.89	2.02	2.14	1.05
Overall labor productivity	4.62	4.60	6.39	9.11	2.46	5.82
Monopoly	2.17	1.66	2.59	1.20	2.45	1.30
Foreign-capital companies	13.34	5.30	13.55	5.41	11.73	4.98
Region	7.68	3.32	7.33	3.12	8.83	4.09
Scale	5.38	4.04	6.56	4.14	7.23	4.99
Proportion of new products	1.63	0.70	1.47	0.48	1.10	0.40
Total degrees of explanation	48.76	33.62	51.30	37.04	48.51	37.22

The impact of foreign-capital companies on the wage gap between domestic companies and foreign companies is quite significant over the period. Decomposition results of Gini coefficient show that the contribution of foreign-capital companies is from 11% to 17%. The decomposition results of Theil index show that the contribution of foreign-capital companies is from 5% to 8%, which is the second-highest contribution to total inequality. In the long run, contribution for the foreign-capital companies shows a

declining trend. The Gini coefficient decomposition results show that it declines from 17.11% in 1999 to 11.73% in 2007. Theil index decomposition results show that it declines from 8.05% to 4.98%. The most possible reason for this declining trend is that labor transfer and technological spillover effects together impact the wage gap between domestic companies and foreign companies. Another reason is that the management level of domestic enterprises has improved rapidly following the development of the PRC's economy. The wage gap between domestic enterprises and foreign enterprises is gradually narrowing.

The Capital-labor ratio has the highest level of contributions to total inequality; Gini coefficient decomposition results show that it is from 13% to 20%. Theil index decomposition results show that it is 8% to 17%. This means that the capital-labor ratio is still the most important factor in the wage determination process. On average, contribution of the region in third place – a variable reflecting the regional barrier for labor mobility – is also high in the PRC. The average scale of the enterprise has increased contributions totaling inequality. Gini coefficient decomposition results show it is from 2.24% in 1999 to 7.23% in 2007. Theil index decomposition results show that it is from 2.18% to 4.99%. This result indicates that economic scale has become the main determination factor for the wage gap.

The contribution of monopoly to the wage gap is small. This result is different from that of previous research. Gini coefficient decomposition results show that it is from 1% to 2.5%. Theil index decomposition results show that it is from 1% to 2%. The main reason is that data used in this paper come from Industrial Enterprises Database, where most observations are from the manufacture sector. However, most of the PRC's monopoly companies concentrate in the non-manufacture sectors.

Regarding the other variables, the contribution of export to the wage gap is not very high, implying that the wage bonus brought by the export tends to disappear in the PRC. The contribution of new products proportion remains at a low level. This is probably due to the reason that there are fewer innovative companies in the database or that innovation ability of industrial enterprises in the PRC is still at a low level. The difference in per capita profits plays the smaller role in the wage gap. This probably implies that enterprises always try to get higher profits by cutting wages.

6. CONCLUSION

Most developing countries have experienced a sharp increase of income inequality over the process of globalization. This study presents evidence that the inflow of FDI is closely associated with inter-enterprise wage inequality. Two mechanisms through which FDI impacts the wage gap between foreign firms and domestic firms in the host country are identified from existing literature: the labor transfer effect and technology spillover effect. We set up a model including these two mechanisms to analyze overall effects of FDI on the wage gap. According to theoretical results, we find that the inflow of FDI in the host country leads to the increase of wage inequality and then the decrease. Using Chinese Industrial Enterprises Database, we investigate the contributions of the observed factors to the wage gap. The turning point of the wage gap caused by labor transfer effect took place in 2004. The technology spillover effect took place before 2004 in the PRC. The results of Shapley-value decomposition show that the contribution of FDI to wage gap shows a declining trend. Our findings about the technology spillover effect of FDI would help to narrow the wage gap between enterprises, suggesting that market-access barriers in the PRC should be eliminated in order to attract more companies with high technological levels.

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APPENDIX

Appendix 1: Regression Results of Annual Cross-sectional Data

	1999	2000	2001	2002	2003
Foreign-capital companies	0.3144***	0.2978***	0.2915***	0.2833***	0.2677***
Debt ratio	–0.1179***	–0.1942***	–0.0908***	–0.0507***	–0.0618***
Export	–0.0714***	–0.0832***	–0.1206***	–0.1184***	–0.0997***
Capital-labor ratio	0.0429***	0.0367***	0.0282***	0.0321***	0.0431***
Per capita profit	0.1563***	0.0171***	0.1475***	0.1611***	0.0669***
Overall labor productivity	0.5342***	0.0888***	0.4545***	0.4183***	0.4945***
Monopoly	0.1206***	0.1530***	0.2380***	0.2357***	0.2319***
Central region	–0.3669***	–0.4001***	–0.4004***	–0.3800***	–0.3738***
Western Region	–0.2242***	–0.2216***	–0.1965***	–0.2044***	–0.1802***
Scale	0.0342***	0.0396***	0.0492***	0.0464***	0.0295***
Proportion of new products	0.0019***	0.0030***	0.0025***	0.0034***	0.0031***
Constant	2.1057***	2.2771***	2.2761***	2.2932***	2.3400***
R^2	0.2718	0.2605	0.2477	0.2621	0.2643
Adjusted R^2	0.2712	0.2599	0.2471	0.2615	0.2637
	2004	**2005**	**2006**	**2007**	
Foreign-capital companies	0.2977***	0.2902***	0.3011***	0.2649***	
Debt ratio	–0.1295***	–0.1029***	–0.1215***	–0.1119***	
Export	–0.1930***	–0.1593***	–0.1462***	–0.1431***	
Capital-labor ratio	0.0193***	0.0147***	0.0121***	0.0147***	
Per capita profit	0.0114***	0.0053***	0.0028***	0.0038***	
Overall labor productivity	0.2693***	0.3444***	0.2625***	0.1364***	
Monopoly	0.2421***	0.2416***	0.2854***	0.1833***	
Central region	–0.3595***	–0.3173***	–0.3437***	–0.3825***	
Western Region	–0.1651***	–0.1720***	–0.1360***	–0.1799***	
Scale	0.0468***	0.0470***	0.0531***	0.0508***	
Proportion of new products	0.0033***	0.0027***	0.0026***	0.0019***	
Constant	2.5590***	2.6247***	2.7556***	2.8926***	
R^2	0.2706	0.2417	0.2397	0.2274	
Adjusted R^2	0.27	0.241	0.2391	0.2268	