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Promote Japanese Employment?

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Abstract

This study analyzes whether the activities of overseas affiliated companies promote Japanese employment. It compares the effect from these activities and the effect of outsourcing to unaffiliated companies and segments activities of overseas affiliated companies by sales destinations. Public concern that outsourcing abroad collapses Japan's domestic labor demand exists; however, counterarguments state no clear-cut evidence of this phenomenon and instead state that moving local production abroad arguably promotes Japanese labor demand.

We construct our data by matching four governmental surveys and estimating firm fixed effect analyses. Our findings are as follows. First, the effect of increasing imports of intermediate inputs is slightly greater than the effect of increasing sales of overseas affiliated companies. Second, increasing sales to Japan decreases the demand for less-educated workers and short-term workers in manufacturing. However, increases in local sales and sales to third countries increase the demand for more highly educated workers in service sectors. Third, the coefficient of wage indicates the complementary effect between less-educated and more highly educated female workers and workers in overseas affiliated companies and the substitute effect between less-educated male workers and workers abroad.

JEL codes: F16, J23

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1 Introduction

In Japan, considerable attention has been paid to overseas production. These companies have ventures abroad or shift manufacturing plant activities overseas. Figure 1 shows the trends in the number of workers of overseas affiliated companies and workers in parent companies. Workers of overseas affiliated companies trend upward; in contrast, workers in parent companies slowly trend downward. Public concern exists that outsourcing abroad collapses Japan's domestic labor demand; however, counterarguments state that no clear-cut evidence exists of such an occurrence. Instead, moving local production abroad arguably promotes Japanese labor demand.

Previous studies analyze this issue by focusing separately on the volume of intermediate import goods, foreign direct investment (FDI) or outsourcing abroad. Feenstra and Hanson (1999), Ekholm and Hakkala (2005) and Ahn, Fukao, and Ito (2008) report that imports of intermediate goods from low-income countries affect labor composition, shifting labor requirements to highly skilled workers. Obashi, Hayakawa, Matsuura, and Motohashi (2010) indicate that foreign direct investment (FDI) increases demand for certain types of workers. Becker et al. (2013) find that offshoring is associated with a shift toward highly educated workers. However, few studies analyze in detail the activities of overseas affiliated companies. Crinò (2009) notes that the literature pays little attention to outward FDI and multinational enterprises' (MNEs) activities in foreign markets; however, the effects of MNEs' foreign activities on the domestic labor market may be strong.

Therefore, our study examines the effect of the activities of overseas affiliated companies on the Japanese labor market. We also compare the effect of intermediate import inputs/final export goods and the effect of activities abroad. Investigating the meaning of ownership, in other words, the differences between the effects of outsourcing to unaffiliated suppliers and the effects of outsourcing to overseas affiliated companies is the first characteristic of our study. When companies outsource to affiliated companies, it is possible to increase the demand for management know-how and R&D of parent companies. Furthermore, wage costs for workers abroad must be considered when companies outsource to overseas affiliated companies.

The second characteristic of our study is to compare the activities of overseas affiliated companies by sales[1] destinations. Our study segments the activities of

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[1] Our study measures the activity of overseas affiliated companies in terms of their sales. Several studies examine the effect of foreign direct investment (FDI), which is increased by the activities of overseas affiliated companies; however, few researchers

overseas affiliated companies to Japan, to local individuals and to third countries and estimates the type of activities that increase domestic labor demand in Japan. Sales of overseas affiliated companies to Japan might be measured by the volume of intermediate inputs imported. Local sales might be measured by the volume of goods exported from Japan if overseas affiliated companies engage in manufacturing activities and use Japanese goods. Moreover, vertical FDI captures the activities of affiliated companies who sell to Japan and horizontal FDI captures local sales activities. However, vertical and horizontal FDI do not clearly capture activities of overseas affiliated companies who sell to third countries. The volume of imported and exported goods does not measure the service activities. In effect, sometimes automobile companies increase in production abroad for North America instead of production in Japan and export their goods.

Our findings are as follows. First, the effect of increasing the import of intermediate inputs is slightly greater than the effect of increasing sales of overseas affiliated companies. Second, increasing sales to Japan decreases the demand for short-term workers in manufacturing and demand for both higher and less-educated workers in service sectors. Similar to public concerns, activities abroad substitute both low-skill workers in manufacturing and high-skill workers in service sectors. This result is consistent with our previous study, by Kazekami and Endoh (2012), which estimates the effect of imports and exports. The domestic labor market in Japan benefits from increasing sales to local individuals because higher sales increase the demand for less-educated workers and short-term workers in manufacturing and for more highly educated workers in service sectors. Regarding increasing sales to third countries, the effect depends on industries. Increasing sales to third countries decrease demand for less-educated workers in manufacturing but increase demand for both less-educated and more highly educated workers in service sectors.

Third, changes in sales and imports/exports cause short-term effects[2]. For the long term, sales of overseas affiliated companies change the wage structure. Increasing wages of less-educated and highly educated female workers decrease the demand for workers abroad in the manufacturing and service sectors, respectively. These domestic female workers and workers abroad are complements. Increasing wages of less-educated male workers increases the demand for workers abroad. Less-educated

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examine the effect of their sales abroad. Sales are a net outcome that includes sales activity abroad.

[2] In particular, wage bill shares are changed by increasing or decreasing sales and imports/exports attributable to changing the demand for working hours.

male domestic workers and workers abroad are substitutes.

The remainder of this paper is organized as follows. The next section reviews previous studies. Section 3 describes our empirical framework and explains the data set. Section 4 presents the empirical results. Section 5 discusses the results and presents our conclusions.

2 Literature Review

A few studies examine the effect on the domestic labor market of activities abroad. Head and Ries (2002) estimate the translog cost function; that is, they estimate the non-production share of the wage bill as an explained variable and examine the effect on Japanese manufacturing of increasing offshore employment using *Toyo Keizai* data. Head and Ries (2002) find a positive estimation coefficient, which indicates the raising of skill intensity levels. Their study is confined to only manufacturing and did not provide a detailed segmentation of workers. However, recent statistics show that only 17% of the employed work in manufacturing in Japan. Head and Ries (2002) focus on non-production workers but do not divide workers into skilled and unskilled labor. Our study analyzes both manufacturing and non-manufacturing sectors, and divides worker groups by educational level and gender.

Hijzen et al. (2005) investigate the link between international outsourcing and the skill structure of labor demand in the UK using a cost function. Their paper calculates outsourcing using import-use matrices of input-output tables for manufacturing industries. They find that international outsourcing has a strong negative effect on the demand for unskilled labor. Our paper does not use volumes of imported goods as a proxy for offshoring and pays attention to the difference between imports and sales of overseas affiliated companies. We investigate whether outsourcing to affiliated companies benefits from spillover effects or whether outsourcing to affiliated companies and unaffiliated suppliers has the same meaning.

Previous studies that use sales as a proxy for offshoring include Becker et al. (2013) and Yamashita and Fukao (2010). Becker et al. (2013) find that offshoring is associated with a shift toward more non-routine and more interactive tasks and with a shift toward highly educated workers. They use plant-level German data and decompose changes in employment at firms into an aggregate effect, a sector mix effect and an individual effect. Their paper measures offshoring using employment and sales

and shows shift-share analysis and that offshoring activities increase the share of the wage bill regardless of task type. Yamashita and Fukao (2010) find weak evidence that increasing offshore employment and sales increases the level of home employment. They argue that increased overseas operations increase the level of home employment through better resource allocations and an expanded overseas market, and estimate the resulting labor demand equation. They find positive effects from offshore employment and sales, but these effects are very small and do not segment workers by skill level.

Crinò (2009) reviews the empirical literature and argues that the literature pays little attention to outward FDI and MNEs' activities in foreign markets and that the effects of foreign MNEs' activities on the domestic labor market may be strong. He refers to several papers and argues that declines in affiliate unskilled wages decrease parent employment and reductions in affiliate skilled wages increase parent employment, that the relationship between parent employment in the United States and affiliate employment in low-income Latin American countries is substitutable in the short term and complementary in the long term, and that the relationship between parent employment and affiliate employment in European cases is substitutable both in the short and long term. Many studies estimate FDI; however, if the productivity of overseas affiliated companies is low, sales/proceeds are low even if FDI is high. Then, our study focuses on sales rather than FDI as the activity of overseas affiliated companies.

Because our paper examines the effect on labor demand of imports and exports as well as the effect of offshoring, we briefly survey previous studies concerning the effect of imports and exports. Feenstra and Hanson (1999) and Feenstra (2004) examine this issue for 447 industries within the U.S. manufacturing sector from 1979 to 1990. Using a cost function, they find a positive effect from outsourcing on the non-production wage share. Ekholm and Hakkala (2005) calculate elasticity using Swedish data from 1995 to 2000. They argue that an increase of one percentage point in outsourcing by a low-income country reduces the demand for workers in that country with an upper secondary education by approximately 3.5% and increases the demand for workers with a tertiary education by 5% to 6%. A clear effect of outsourcing is found by Ahn, Fukao, and Ito (2008), who examine the effect of outsourcing by region and education attainment at the industry level. The elasticity they calculate indicates that intermediate imported inputs from Asia, Europe, and North America are substitutes for workers with lower secondary, upper secondary, and tertiary education levels, respectively. Hummels et al. (2011) estimate how outsourcing and exporting affect wages by skill type by constructing instrument variables. They use firm-level data

rather than industrial-level data to address endogeneity of both offshoring and exporting at the firm level. They find that offshoring tends to increase the wage of high-skilled workers and decrease the wage of low-skilled workers, and that substantial variation exists in the net wage effects of trade depending on firms' offshoring and exporting within the same skill. Biscourp and Kramarz (2007) analyze the link between imports, exports, employment and skill structure and find that increasing imports of final goods destroys employment.

3 Empirical Framework and Data

3.1 Empirical Framework

How do the activities of overseas affiliated companies affect domestic employment in Japan? Our study proposes two hypotheses. First, Japan exports inputs or final goods. If Japan exports high-value-added inputs and overseas affiliated companies use these inputs to increase sales elsewhere, including to Japan, local individuals and third countries, demand for Japanese inputs increases. Therefore, demand for domestic labor increases, particularly for workers who produce these inputs. These increasing sales abroad also catch up to the volume of exports from Japan (this paper eliminates exports to and imports from related companies from total exports and imports attributable to avoid doubling up). If Japan produces low-value-added inputs or final goods and the production of overseas affiliated companies replaces the production in Japan, increasing sales abroad decreases the demand for domestic labor, particularly for less-educated workers in Japan, following public concern.

Second, expanding overseas affiliated companies' activities increases the demand for logistical support, management know-how and R&D in Japan. Hence, the demand for highly educated workers increases. In this case, the increasing activities of overseas affiliated companies cannot be measured through exports or imports. In particular, expanding sales to third countries and increasing the demand for logical support or R&D in Japan does not appear in trade activities.

For the empirical model, in light of Crinò (2009), suppose that the cost function of company i depends on total output Y and the wages paid by the parent W_p and by the affiliated companies in A locations W_a, with a=1,...A:

$$C_i = f(w_p, w_1,..., w_a,..., w_A, Y_i) \tag{3-1}$$

Optimal labor demand by the parent (conditional on Y_i) can then be derived by applying Shephard's lemma to equation (3-1):

$$\frac{\partial C_i(w_p,w_1,\ldots,w_a,\ldots,w_A,y_i)}{\partial w_p} = L_p\big(w_p, w_1, \ldots, w_a, \ldots, w_A, y_i\big) \tag{3-2}$$

Equation (3-2) can be used to derive cross-wage elasticities of parent labor demand with respect to wages in the overseas affiliated companies as

$$\varepsilon_{L_p,w_a} = \frac{\partial \ln L_p(w_p,w_1,\ldots,w_a,\ldots,w_A,y_i)}{\partial \ln w_a} \tag{3-3}$$

Then, if $\varepsilon_{L_p,w_a} > 0$, workers in parent and overseas affiliated companies in location a are substitutes; if $\varepsilon_{L_p,w_a} < 0$, the two labor inputs are complements.

Assuming a log-linear specification for equation (3-2), the estimating equation becomes

$$\ln L_{ipt} = \beta_0 + \beta_p \ln w_{ipt} + \sum_{a=1}^{A} \beta_a \ln w_{iat} + \beta_Y \ln Y_{it} + \sum_n \gamma_n z_{nit} + \alpha_i + \alpha_t + \mu_{ipt} \tag{3-4}$$

and

$$\varepsilon_{L_p,w_a} = \beta_a \ \forall a$$

We employ some definitions for categories of workers in parent companies depending on education level, gender and working hours, which are explained in Section 3.2.2. Structural variable z_{nit} includes factors regarding an overseas affiliated company's economic transactions such as an overseas affiliate dummy, sales to particular regions (Japan, local, and third countries), as well as tangible fixed assets, an export and import dummy, volume of exports to and imports from non-related companies by each company and an industrial dummy. α_i represents a firm-specific effect, α_t represents a year effect, and μ_{ipt} represents an additive disturbance.

Alternatively, assuming a translog specification for equation (3-1), Shephard's lemma yields a wage-share equation that we denote by the wage bill share of parent employment in company i's total wage bill S_{ipt}:

$$S_{ipt} = \beta_p + \beta_{pp} \ln w_{ipt} + \sum_{a=1}^{A} \beta_{pa} \ln w_{iat} + \beta_{pY} \ln Y_{it} + \sum_n \gamma_{pn} z_{nit} + \alpha_i + \alpha_t + \mu_{ipt} \tag{3-5}$$

3.2 Data

3.2.1 Matching method

Data including detailed information on both workers and companies, such as the type of employment, an overseas affiliated company's economic transactions, a parent company's sales, and other information, in one survey do not exist in Japan. Therefore, this study constructs its own data set using the Basic Survey on Wage Structure, the Basic Survey of Japanese Business Structure and Activities, and the Survey of Overseas Business Activities using information from 1998 to 2010. This study conducts an estimation at the company level rather than at the industry level because outsourcing changes the composition of factors at the company level. The Basic Survey on Wage Structure is conducted by the Ministry of Health, Labor and Welfare on establishments with 10 or more regular employees and private establishments with five to nine regular employees, as well as on workers selected through a uniform sampling method from among the establishments selected for the Basic Survey on Wage Structure to obtain a clear picture of the wage structure throughout Japan. The Basic Survey on Wage Structure provides rich information on workers, including their education level, age, gender, type of employee, and workplace. The Survey of Overseas Business Activities is conducted by the Ministry of Economy, Trade and Industry and targets all Japanese corporations that, as of the end of March, own, or have owned, overseas affiliates (excluding those in the financial, insurance, or real estate industries) and their overseas affiliates. This survey provides information on the actual conditions concerning the overseas business activities of Japanese corporations. The Basic Survey of Japanese Business Structure and Activities is also conducted by the Minister of Economy, Trade and Industry, and covers enterprises with 50 or more employees and with excess capital or investment funds valued at more than 30 million yen. Covered industries include mining, manufacturing, wholesale and retail trade, and the food and drink industry. Because the conducted unit of workers' data from the Basic Survey on Wage Structure is work *establishment*, whereas the unit of company data from the Survey of Overseas Business Activities and the Basic Survey of Japanese Business Structure and Activities is *enterprises*, this paper uses the Establishment and Enterprise Census to link both data sets. The Establishment and Enterprise Census is conducted on all establishments in Japan to compile a complete directory as the master sampling framework for various statistical surveys, including the Basic Survey on Wage

Structure by the Statistics Bureau.[3]

Our study connects three data sets as follows. First, data from the Basic Survey of Japanese Business Structure and Activities from 1998 to 2010 are matched with the Survey of Overseas Business Activities using postal codes and company names. Then, we connect this data set to the Establishment and Enterprises Census using postal codes and company names to attach the numbers permanently assigned to enterprises. Only the Establishment and Enterprise Census in 2006 has information on which establishment belongs to which enterprise. Second, each Basic Survey on Wage Structure is matched to the Establishment and Enterprise Census in the year corresponding to the master sampling framework using city codes, survey area codes, the number assigned to the establishment, and a code number corresponding to an industrial classification system. Finally, we link the first and second data sets using the numbers permanently assigned to enterprises.

3.2.2 Explanation of variables and descriptive statistics

Our study uses the hourly wage rate as *wage* and the number of workers as the *demand for labor*. Hourly wage in labor category j in firm i, w_{ij}, is calculated by dividing the sum of contractual cash earnings of employees in labor category j that worked for firm i by the sum of the actual number of their scheduled hours worked and their overtime worked plus bonus divided twelve months. We use average wages among labor category j by firm i. We obtain data on domestic workers' wages from the Basic Survey on Wage Structure. Wages of workers abroad are calculated by dividing the total compensation by the total number of employment abroad. We obtain the data on total compensation and total number of employment abroad from the Survey of Overseas Business Activities.

We now explain some independent variables. First, we employ a definition for labor categories depending on the type of employment. The first definition is used to classify workers into the following five categories: (A1) male graduates of secondary education schools, (A2) male graduates of higher education schools and universities, (A3) female graduates of secondary education schools, (A4) female graduates of higher education schools and universities and (A5) workers in overseas affiliated companies.

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[3]The authors are grateful to the Ministry of Health, Labor and Welfare, the Minister of Economy, Trade and Industry, the Ministry of Internal Affairs and Communications Statistics Bureau for providing us with the Basic Survey on Wage Structure, the Basic Survey of Japanese Business Structure and Activities, and the Establishment and Enterprise Census. We construct the employer-employee dataset ourselves using these data.

The second definition is used to classify workers into the following four categories: (B1) graduates of secondary education schools, (B2) graduates of higher education schools and universities, (B3) short-term workers and (B4) workers in overseas affiliated companies. Second, this study controls trade volume when estimating the effect of the activities of overseas affiliated companies. We exclude imports from or exports to affiliated companies from total imports or exports, respectively.

Table 1 provides detailed descriptive statistics and shows that the male log of mean wages of a company is higher than that of females. The observation is the number of companies, which is reduced by the matching process from approximately 20,000 to 3,000 companies each year in the Basic Survey of Japanese Business Structure and Activities. The samples have a larger percentage (approximately 19%) of overseas affiliated companies in the manufacturing category than in the service sector category (10%).

As for a robustness check, we eliminate samples from 2004–2007, 2009 and 2010 because matching rates of four governmental data samples in these years are less than 30 percent. Moreover, we do not replace zero when wage data in one of labor categories are lacking because of a possible upper bias.

4 Results

Table 2, Table 3 and Table 4 present the estimation results of equation (3-4) from 1998 to 2010 by workers categorized by gender and education level. Table 2 presents the estimation results for all industries, Table 3 shows the estimation results for manufacturing category and Table 4 shows the estimation results for the service sectors. The lower sections of these tables show the robustness checks. Table 5, Table 6 and Table 7 present the same estimation results for all industries, the manufacturing sector and the service sector, respectively, with workers categorized by educational level and working hours.

First, we compare the magnitudes of the effect of overseas affiliated companies' activities and of the effect of trade. The coefficients for male workers show that the effects of imports and exports are slightly greater than the effects of overseas affiliated companies; an increase of one point in imports or exports increases the demand for labor by approximately 0.01–0.025 point. In contrast, an increase of one point in sales abroad increases/decreases the demand for labor by approximately 0.009 point. The effect of

exporting Japanese goods to non-related companies is slightly greater than the effect of sales to local individuals. The effect of importing inputs from non-related companies and the effect of sales to Japan are of the opposite signs, although importing includes raw materials.

Second, we investigate the effect from worker type and the meaning of expanding activities of overseas affiliated companies. Table 3 shows that an increase in sales to local individuals increases the use of both male and female less-educated workers, but an increase in sales to third countries decreases the use of the same workers. Therefore, even some tasks of low-skilled workers are replaced by workers abroad but are complemented with workers abroad in other task areas. Activities of overseas affiliated companies have of an effect on less educated workers in manufacturing; in contrast, Table 4 indicates that activities abroad affect highly educated workers in service sectors. Expanding sales to local individuals and sales to third countries increases the demand for highly educated male and female workers. These results suggest that the demand for management know-how, brand image, logistic support and R&D increases by expanding activities abroad. Table 4 also shows that increasing sales to Japan decreases the demand for both less-educated and highly educated male workers. In addition, the activities of overseas affiliated companies in the information and communication industry do not significantly affect the demand for domestic labor.

Table 5, Table 6 and Table 7 present similar results. Table 5 shows that the effects of imports and exports are slightly greater than the effect of activities abroad even for short-term workers. Table 6 shows that increases in sales to Japan decreases the demand for short-term workers. Activities abroad replace domestic short-term workers. As for less-educated workers, such as shown in Table 3, increasing sales to local individuals increases the demand for labor as well as for short-term workers, and increasing sales to third countries decreases the demand for labor. Table 7 indicates that an increase in sales to Japan in service sectors decreases the demand for domestic short-term workers; an increase in sales to local people increases the demand for short-term workers, such as demand for less-educated and highly educated workers. Table 2 to Table 7 show that expanding the activities of overseas affiliated companies, including sales to Japan, increases the demand for workers abroad.

Third, we look at the result of companies' optimization of labor composition from a change in wage structure. Table 3 shows that an increase in wages of less-educated male workers increases the demand for workers abroad. A robustness check of Table 3 shows that increasing the wages of workers abroad increases the

demand for less-educated male workers, indicating that less-educated male workers and workers abroad are substitutes in manufacturing. Female workers and workers abroad are complements. Table 2 and Table 3 show that increasing the wages of less-educated female workers decreases the demand for workers abroad. Table 4 shows that increasing the wage of highly educated female workers decreases the demand for workers abroad.

Finally, Appendix 1 to Appendix 6 show the results of equation (3-5). Wage bill share is the hourly wage rate multiplied by working hours multiplied by the number employed to the total wage bill in this paper. Hence, changing working hours affects the wage bill share even if the number employed does not change. Appendix 3 shows that sales to third countries decreases the share of workers abroad in service sectors and Appendix 5 shows that sales to local individuals decreases the share of workers abroad in manufacturing, although these sales shows positive effects on the number of labors.

5 Conclusion and Discussion

We analyze whether the activities of overseas affiliated companies promote Japanese employment. We also compare the effect from the activities of overseas affiliated companies with the effect of outsourcing on non-related companies. The initial hypotheses were as follows. 1) Japan exports high-value added intermediate inputs, and then increasing sales abroad increases the demand for Japanese domestic labor. However, if Japan does not make high-value added inputs, the activities of overseas affiliated companies replace production in Japan. 2) Expanding overseas affiliated companies' activities increases the demand for logistical support, management know-how and R&D in Japan. In this case, increasing the activities of overseas affiliated companies cannot be measured by exports or imports. Our study constructed data by matching four governmental surveys and examining these hypotheses.

Our first hypothesis is supported in manufacturing. Increases in sales to Japan and to third countries decrease the demand for less-educated workers and short-term workers. Less skilled domestic workers are replaced by workers abroad, such as public concerns. The results of companies' optimization of labor composition by changing wage structure show that less-educated male workers and workers abroad are substitutes in manufacturing. However, an increase in sales to local individuals increases both male and female less-educated workers and short-term workers. The magnitude of the effects

of imports and exports are slightly greater than that of overseas affiliated companies on male workers.

Our second hypothesis is also supported. Expanding sales to local individuals and sales to third countries increases the demand for highly educated male and female workers in service sectors. These results suggest that expanding activities abroad increases the demand for management know-how, brand image, logistic support and R&D. Increasing the wages of highly educated female workers decreases the demand for workers abroad in service sectors. Female workers and workers abroad are complements.

Overall, there is a public concern that expanding overseas production collapses Japanese domestic labor demand; in contrast, some studies argue that it increases Japanese labor demand. Our study indicates that increasing sales to Japan and to third countries removes jobs from poorly educated workers in manufacturing. However, increasing sales to local people and third countries in service sectors increases not only jobs for highly educated workers but also jobs for less-educated workers.

As with all studies, our study has some limitations. First, we linked four governmental surveys; however, the matching rate was not very high. Second, small companies are not included in our sample. Because our study uses the Basic Survey of Japanese Business Structure and Activities, the companies in our sample have 50 or more employees and capital or investment funds exceeding 30 million yen. Despite these limitations, our findings contribute to a better understanding of the effects of economic transactions of overseas affiliated companies on various worker groups in Japan. Thus, we recommend that future research be conducted to address the effect of production abroad on individual regions in Japan, in other words, on local labor demand. Changes in labor components in Japan may differ among regions. Some industries that may increase their particular labor demand may accumulate in particular regions, whereas other industries may have a similar result in other particular regions. In recent years, some provincial regions have attempted to help their local companies move abroad without support from Tokyo.

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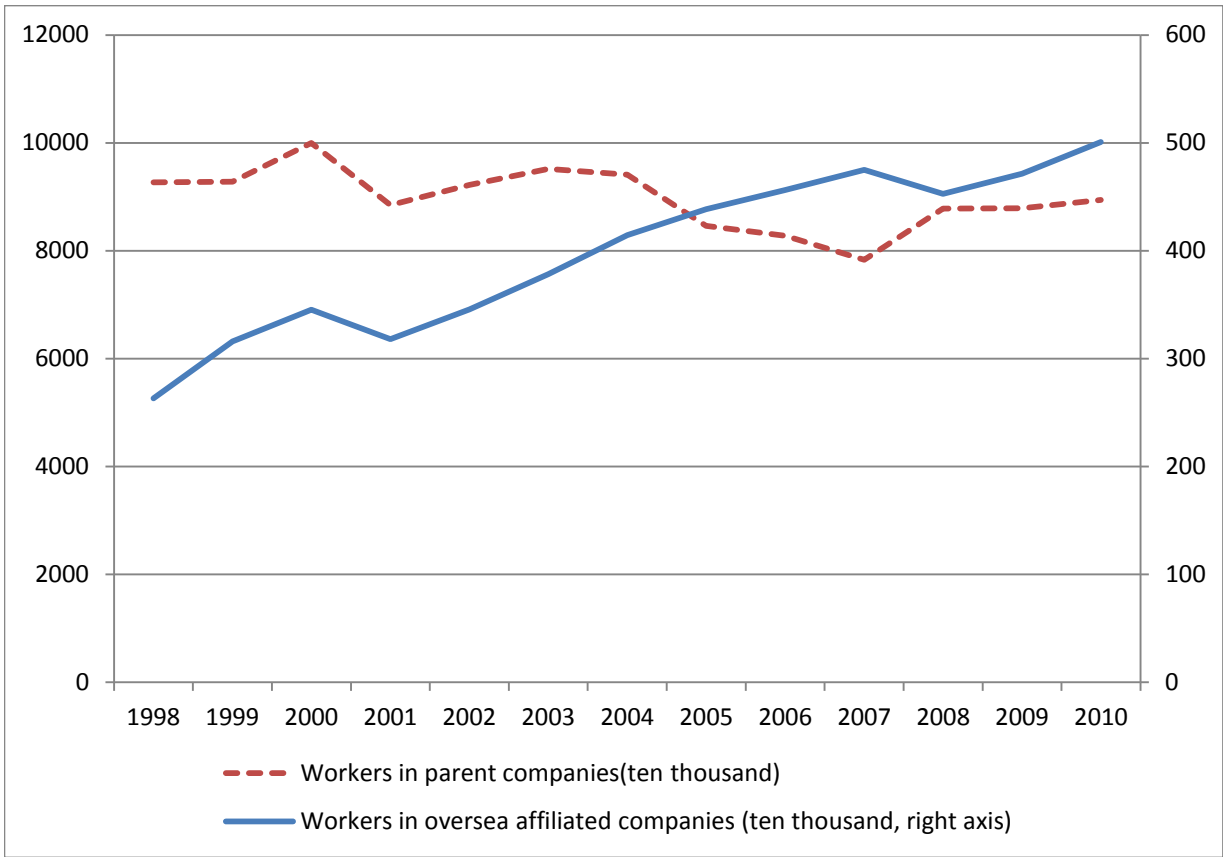
Figure 1 Trends in number of employment

Table1 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln_Labor(male, less edu.)	38308	2.4821	1.0578	0.0000	7.6440
ln_Labor(male, high edu.)	37689	2.0761	1.0804	0.0000	6.5765
ln_Labor(female, less edu.)	34259	1.4511	1.0090	0.0000	5.3327
ln_Labor(female, high edu.)	27887	1.0089	0.9069	0.0000	5.8051
ln_Labor(workers abroad)	5868	6.1874	2.2107	0.0000	12.0943

Variable	Mean	Std. Dev.	Min	Max
ln_wage(male, less edu.)	3.1502	0.3283	1.6386	4.9945
ln_wage(male, high edu.)	3.0188	0.8398	0	4.6491
ln_wage(female, less edu.)	2.3905	0.9572	0	4.7965
ln_wage(female, high edu.)	1.9198	1.3125	0	4.5389
ln_wage(workers abroad)	0.0133	0.4816	-8.9393	6.0343
ln_wage(short time workers)*	2.2852	0.2767	1.3863	5.5215
ln_tangible fixed asset	7.8508	2.0567	0	16.3091
ln_total output	9.3957	1.6765	3.6376	16.3070
ln_exports	1.1335	2.7545	0	15.1938
ln_imports	0.7766	2.2018	0	14.9478
ln_sales to Japan	0.7311	2.2488	0	16.0106
ln_sales to local	1.0890	2.9880	0	15.7628
ln_sales to third countries	0.6509	2.2601	0	15.8058
Export dummy	0.1637	0.3700	0	1.0000
Import dummy	0.1269	0.3329	0	1.0000
Overseas affiliates dummy	0.1546	0.3616	0	1.0000

Industry

Variable	Mean	Std. Dev.	Min	Max
Mining and quarrying of stone and gravel	0.0078	0.0880	0	1
Construction	0.0131	0.1137	0	1
Manufacturing	0.6350	0.4814	0	1
Electricity, gas, heat supply and water	0.0183	0.1341	0	1
Information and communications	0.0309	0.1731	0	1
Transport and postal activities	0.0121	0.1094	0	1
Wholesale and retail trade	0.1852	0.3885	0	1
Accommodations, eating and drinking services (service sectors)	0.0210	0.1434	0	1
Education, learning support (service sectors)	0.0014	0.0368	0	1
Services, N.E.C. (service sectors)	0.0751	0.2635	0	1

Year dummy

Variable	Mean	Std. Dev.	Min	Max
1998	0.0872	0.2822	0	1
1999	0.0885	0.2841	0	1
2000	0.0890	0.2848	0	1
2001	0.0916	0.2884	0	1
2002	0.0961	0.2948	0	1
2003	0.0978	0.2970	0	1
2004	0.0760	0.2650	0	1
2005	0.0581	0.2339	0	1
2006	0.0730	0.2602	0	1
2007	0.0719	0.2583	0	1
2008	0.1155	0.3196	0	1
2009	0.0282	0.1655	0	1
2010	0.0271	0.1623	0	1

Note: This is the sample eliminating the case which the data of male less educated workers is lacked except ln_Labor.

* This is the sample eliminating the case which the data of short time workers is lacked.

Table 2 Estimation results for all industries

	Male graduates of secondary education schools		Male graduates of higher education schools and universities		Female graduates of secondary education schools		Female graduates of higher education schools and universities		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	-0.3213 ***	0.0226	0.0580 ***	0.0069	0.0968 ***	0.0099	0.0653 ***	0.0080	0.0190	0.0140
ln_wage(male, high edu.)	0.0407 ***	0.0061	0.1150 ***	0.0227	0.0587 ***	0.0069	0.1169 ***	0.0120	0.0045	0.0184
ln_wage(female, less edu.)	0.1556 ***	0.0045	0.1021 ***	0.0047	-0.5716 ***	0.0233	0.0080	0.0056	-0.0198 **	0.0097
ln_wage(female, high edu.)	0.0683 ***	0.0035	0.1883 ***	0.0038	0.0223 ***	0.0040	-0.0005	0.0275	-0.0077	0.0081
ln_wage(workers abroad)	-0.0164 *	0.0096	0.0040	0.0103	-0.0162	0.0108	0.0120	0.0120	-0.1826 ***	0.0103
ln_tangible fixed asset	0.0202 **	0.0087	0.0173 *	0.0091	0.0273 ***	0.0103	-0.0114	0.0107	0.0278	0.0211
ln_total output	0.0362 **	0.0166	-0.0012	0.0179	0.0646 ***	0.0187	0.0682 ***	0.0223	0.3573 ***	0.0445
ln_exports	-0.0021	0.0052	0.0108 *	0.0056	-0.0003	0.0058	0.0062	0.0066	0.0017	0.0076
ln_imports	0.0250 ***	0.0057	0.0140 **	0.0061	-0.0023	0.0065	0.0075	0.0071	0.0063	0.0081
ln_sales to Japan	-0.0095 **	0.0044	-0.0070	0.0046	0.0052	0.0049	-0.0003	0.0054	0.0389 ***	0.0051
ln_sales to local	0.0116 ***	0.0038	0.0087 **	0.0040	0.0099 **	0.0043	0.0047	0.0047	0.0295 ***	0.0045
ln_sales to third countries	-0.0096 **	0.0038	-0.0052	0.0041	-0.0132 ***	0.0043	-0.0079 *	0.0048	0.0162 ***	0.0041
Export dummy	0.0136	0.0360	-0.0573	0.0388	-0.0433	0.0400	-0.0047	0.0471	0.0479	0.0626
Import dummy	-0.0984 ***	0.0360	-0.0572	0.0386	0.0483	0.0403	-0.0479	0.0458	-0.0269	0.0567
Overseas affiliates dummy	0.0125	0.0260	0.0259	0.0274	-0.0324	0.0295	0.0845 ***	0.0322		
Constant	2.5182 ***	0.1948	0.3466	0.2154	1.4573 ***	0.2210	-0.8307 ***	0.3144	1.7333 ***	0.5349
Number of obs	38308		37689		34259		27887		5868	
Adj R-squared	0.7354		0.7073		0.6785		0.5722		0.9494	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	-0.3985 ***	0.1199	0.1947 *	0.1177	-0.4781 ***	0.1318	0.2324	0.1479	-0.0077	0.1003
ln_wage(male, high edu.)	-0.1442	0.1238	0.0962	0.1216	-0.0277	0.1362	0.3070 **	0.1528	0.0621	0.1036
ln_wage(female, less edu.)	-0.3061 ***	0.0927	0.0659	0.0911	-0.7205 ***	0.1020	-0.2054 *	0.1144	-0.0331	0.0776
ln_wage(female, high edu.)	0.1646 *	0.0870	0.1671 *	0.0855	-0.0407	0.0957	-0.0197	0.1074	-0.0018	0.0728
ln_wage(workers abroad)	0.0171	0.0179	0.0222	0.0176	0.0126	0.0197	0.0164	0.0221	-0.2241 ***	0.0150
ln_tangible fixed asset	0.1555 **	0.0725	0.0101	0.0712	0.0688	0.0797	0.0030	0.0894	0.0222	0.0607
ln_total output	0.2248 **	0.0883	-0.0013	0.0867	0.1922 **	0.0971	-0.0982	0.1089	0.3467 **	0.0739
ln_exports	-0.0074	0.0123	-0.0119	0.0121	0.0045	0.0135	-0.0149	0.0152	0.0003	0.0103
ln_imports	0.0223 *	0.0129	-0.0128	0.0127	-0.0054	0.0142	0.0169	0.0159	-0.0012	0.0108
ln_sales to Japan	0.0035	0.0096	-0.0150	0.0095	0.0058	0.0106	-0.0061	0.0119	0.0388 ***	0.0081
ln_sales to local	0.0028	0.0109	-0.0025	0.0107	-0.0230 *	0.0119	-0.0014	0.0134	0.0670 ***	0.0091
ln_sales to third countries	-0.0136 *	0.0070	-0.0047	0.0069	-0.0103	0.0077	-0.0102	0.0087	0.0228 ***	0.0059
Export dummy	0.0047	0.1055	0.0267	0.1037	-0.0933	0.1161	0.0704	0.1302	0.0239	0.0883
Import dummy	-0.0901	0.0938	0.1741	0.0921	0.0912	0.1031	-0.1135	0.1157	0.0179	0.0785
Constant	1.0637	1.1924	1.2604	1.1713	2.9942 **	1.3115	1.4253	1.4712	1.3406	0.9980
Number of obs	2472		2472		2472		2472		2472	
Adj R-squared	0.8512		0.7851		0.7863		0.6716		0.9620	

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
 *** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Table 3 Estimation results for manufacturing

	Male graduates of secondary education schools		Male graduates of higher education schools and universities		Female graduates of secondary education schools		Female graduates of higher education schools and universities		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	-0.5426 ***	0.0303	0.0293 *	0.0163	0.0703 ***	0.0209	0.0023	0.0182	0.0542 *	0.0283
ln_wage(male, high edu.)	0.0445 ***	0.0067	0.0476 *	0.0285	0.0557 ***	0.0078	0.0918 ***	0.0151	0.0052	0.0205
ln_wage(female, less edu.)	0.1285 ***	0.0060	0.0811 ***	0.0072	-0.6123 ***	0.0304	-0.0582 ***	0.0086	-0.0266 **	0.0119
ln_wage(female, high edu.)	0.0558 ***	0.0037	0.1613 ***	0.0045	0.0068	0.0043	0.0285	0.0346	-0.0028	0.0084
ln_wage(workers abroad)	-0.0070	0.0095	0.0021	0.0115	-0.0046	0.0112	0.0218 *	0.0133	-0.1525 ***	0.0110
ln_tangible fixed asset	0.0364 ***	0.0111	0.0232 *	0.0137	0.0173	0.0131	0.0084	0.0168	-0.0010	0.0240
ln_total output	0.0397 **	0.0176	-0.0138	0.0219	0.0699 ***	0.0208	0.0415	0.0273	0.2839 ***	0.0485
ln_exports	-0.0065	0.0049	0.0089	0.0060	0.0009	0.0058	-0.0012	0.0071	-0.0008	0.0081
ln_imports	0.0189 ***	0.0057	0.0110	0.0069	0.0048	0.0068	0.0054	0.0079	0.0032	0.0088
ln_sales to Japan	-0.0071	0.0044	-0.0056	0.0053	0.0006	0.0052	0.0016	0.0062	0.0225 ***	0.0055
ln_sales to local	0.0102 ***	0.0039	0.0050	0.0047	0.0077 *	0.0046	-0.0019	0.0055	0.0219 ***	0.0049
ln_sales to third countries	-0.0082 **	0.0037	-0.0020	0.0045	-0.0107 **	0.0044	-0.0072	0.0052	0.0250 ***	0.0042
Export dummy	0.0369	0.0338	-0.0442	0.0415	-0.0549	0.0397	0.0323	0.0503	0.0686	0.0671
Import dummy	-0.0723 **	0.0346	-0.0488	0.0422	0.0149	0.0411	-0.0253	0.0494	-0.0123	0.0594
Overseas affiliates dummy	-0.0076	0.0268	0.0134	0.0325	-0.0173	0.0318	0.1211 ***	0.0380		
Constant	3.1998 ***	0.1785	1.1913 ***	0.2180	1.8914 ***	0.2027	0.1207	0.2683	2.9136 ***	0.5135
Number of obs	24327		23092		22635		16187		4502	
Adj R-squared	0.7100		0.6998		0.6984		0.5203		0.9518	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	-0.8547 ***	0.1347	0.1973	0.1460	-0.7828 ***	0.1604	0.1678	0.1809	-0.0927	0.1178
ln_wage(male, high edu.)	-0.1243	0.1229	0.0209	0.1332	-0.0595	0.1464	0.3396 **	0.1651	0.1156	0.1075
ln_wage(female, less edu.)	-0.2176 **	0.0978	0.2005 *	0.1060	-0.5508 ***	0.1165	-0.1208	0.1314	0.0240	0.0855
ln_wage(female, high edu.)	0.1646 **	0.0840	0.1584 *	0.0910	-0.0095	0.1000	-0.0392	0.1128	0.0476	0.0734
ln_wage(workers abroad)	0.0361 **	0.0177	0.0286	0.0192	0.0293	0.0210	0.0307	0.0237	-0.2048 ***	0.0155
ln_tangible fixed asset	0.2341 ***	0.0781	0.0998	0.0847	0.1352	0.0930	0.1507	0.1049	-0.0138	0.0683
ln_total output	0.1807 **	0.0853	-0.0186	0.0924	0.1862 *	0.1015	-0.1364	0.1145	0.3058 ***	0.0745
ln_exports	0.0074	0.0121	-0.0153	0.0131	0.0053	0.0144	-0.0280 *	0.0163	-0.0040	0.0106
ln_imports	0.0129	0.0128	-0.0015	0.0139	-0.0024	0.0153	0.0256	0.0172	-0.0074	0.0112
ln_sales to Japan	0.0009	0.0096	-0.0174 *	0.0104	-0.0050	0.0114	-0.0078	0.0129	0.0282 ***	0.0084
ln_sales to local	0.0044	0.0110	0.0010	0.0119	-0.0203	0.0131	0.0088	0.0148	0.0662 ***	0.0096
ln_sales to third countries	-0.0048	0.0068	0.0002	0.0074	-0.0008	0.0081	-0.0094	0.0092	0.0234 ***	0.0060
Export dummy	-0.1373	0.1045	0.0501	0.1133	-0.1143	0.1245	0.1757	0.1404	0.0752	0.0914
Import dummy	-0.0452	0.0902	0.1126	0.0977	0.0843	0.1074	-0.1679	0.1211	0.0256	0.0788
Constant	2.1899 **	1.0705	0.4029	1.1603	2.7954 **	1.2748	-0.0502	1.4378	2.3381 **	0.9359
Number of obs	2079		2079		2079		2079		2079	
Adj R-squared	0.8522		0.7852		0.7875		0.6443		0.9644	

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Table 4 Estimation results for service sectors

	Male graduates of secondary education schools		Male graduates of higher education schools and universities		Female graduates of secondary education schools		Female graduates of higher education schools and universities		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	0.0385	0.0746	0.0902 ***	0.0168	0.1481 ***	0.0278	0.0940 ***	0.0202	-0.0410	0.0397
ln_wage(male, high edu.)	-0.0037	0.0213	0.2780 ***	0.0779	0.0417	0.0254	0.0987 ***	0.0331	-0.0630	0.1068
ln_wage(female, less edu.)	0.2029 ***	0.0161	0.0964 ***	0.0140	-0.4013 ***	0.0956	0.0156	0.0169	-0.0223	0.0374
ln_wage(female, high edu.)	0.0937 ***	0.0162	0.2417 ***	0.0154	0.0504 ***	0.0190	-0.0578	0.0946	-0.0572	0.0518
ln_wage(workers abroad)	-0.0265	0.0629	-0.0176	0.0516	-0.0814	0.0716	-0.0368	0.0573	-0.3755 ***	0.0618
ln_tangible fixed asset	-0.0141	0.0419	0.0221	0.0369	0.0108	0.0491	-0.0357	0.0414	-0.2005	0.2462
ln_total output	-0.0680	0.0805	0.0091	0.0740	-0.0107	0.0944	0.0190	0.0846	0.6587 **	0.3164
ln_exports	0.0035	0.0337	0.0354	0.0283	0.0420	0.0420	-0.0041	0.0325	0.0325	0.0419
ln_imports	-0.0118	0.0383	0.0190	0.0322	-0.1281 ***	0.0467	0.0623	0.0389	0.0970	0.0599
ln_sales to Japan	-0.0648 **	0.0274	-0.0704 ***	0.0230	0.0096	0.0319	-0.0372	0.0258	0.0559 *	0.0336
ln_sales to local	0.0477 **	0.0224	0.0363 **	0.0184	0.0188	0.0250	0.0065	0.0212	0.0218	0.0262
ln_sales to third countries	0.0614 **	0.0293	0.0343	0.0245	0.0064	0.0342	0.0486 *	0.0289	0.1039 ***	0.0321
Export dummy	0.0008	0.2146	-0.0761	0.1756	-0.2664	0.2636	0.1323	0.2030	-0.4914 *	0.2735
Import dummy	0.1608	0.2275	0.0051	0.1863	0.9570 ***	0.2817	-0.2646	0.2185	-0.8061 **	0.3879
Overseas affiliates dummy	-0.1456	0.1281	-0.0370	0.1061	-0.1548	0.1479	-0.1082	0.1250		
Constant	2.0680 ***	0.7518	1.1967	0.9364	1.3664	1.1035	1.7294 *	1.0321	0.3324	3.1836
Number of obs	3733		3808		3078		3114		420	
Adj R-squared	0.6902		0.781		0.6215		0.6437		0.9544	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	0.3255	0.5574	0.6033	0.5134	0.3733	0.5068	0.4389	0.5153	0.8492 *	0.4326
ln_wage(male, high edu.)	-0.3959	0.8959	0.6894	0.8251	0.6639	0.8145	1.0004	0.8282	0.2841	0.6952
ln_wage(female, less edu.)	-0.2542	0.4947	0.0382	0.4556	-0.8102	0.4497	-0.6794	0.4573	-0.1079	0.3839
ln_wage(female, high edu.)	0.5497	0.6933	0.0132	0.6386	-0.0777	0.6303	0.0684	0.6409	-1.1585 **	0.5380
ln_wage(workers abroad)	-0.0732	0.1660	0.0537	0.1528	-0.2064	0.1509	0.1790	0.1534	-0.4365 ***	0.1288
ln_tangible fixed asset	-0.9581	0.6777	-0.0273	0.6242	-0.3025	0.6161	0.1408	0.6264	-0.9157 *	0.5258
ln_total output	0.8499	1.0005	-0.7892	0.9215	0.1911	0.9096	-0.2133	0.9249	0.2269	0.7764
ln_exports	-0.0281	0.0976	0.0733	0.0899	0.2117 **	0.0888	0.1025	0.0903	0.1750 **	0.0758
ln_imports	0.1451	0.1629	-0.1821	0.1501	-0.1174	0.1481	-0.0829	0.1506	-0.0931	0.1264
ln_sales to Japan	0.0690	0.0704	-0.1194 *	0.0648	0.0897	0.0640	-0.1024	0.0650	0.0401	0.0546
ln_sales to local	0.1008 *	0.0579	0.0940 *	0.0533	-0.0381	0.0527	0.1124 **	0.0535	-0.0849 *	0.0449
ln_sales to third countries	-0.0846	0.0859	-0.0982	0.0791	0.0092	0.0781	-0.0950	0.0794	-0.0133	0.0666
Export dummy	0.8032	0.7579	-0.2627	0.6980	-1.1080	0.6890	-0.2304	0.7006	-2.0150 ***	0.5881
Import dummy	-1.1989	1.0426	1.3183	0.9602	0.5479	0.9478	-0.1091	0.9638	1.1475	0.8090
Constant	0.7130	11.1943	8.5284	10.3105	1.0217	10.1771	0.0774	10.3483	13.9169	8.6865
Number of obs	158		158		158		158		158	
Adj R-squared	0.8666		0.7545		0.7945		0.7387		0.9668	

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Table 5 Estimation results for all industries, workers categorized by education level and working hours

	Graduates of secondary education schools			Graduates of higher education schools and universities			Short time workers			Workers in oversea affiliated companies		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	-0.4301	***	0.0231	0.1309	***	0.0089	0.1118	***	0.0141	-0.0014		0.0166
ln_wage(high edu.)	0.0949	***	0.0070	0.1350	***	0.0239	0.0428	***	0.0121	-0.0072		0.0201
ln_wage(short time)	0.0532	***	0.0042	0.0444	***	0.0047	0.0251		0.0379	-0.0105		0.0084
ln_wage(workers abroad)	-0.0230	**	0.0098	-0.0051		0.0110	-0.0086		0.0198	-0.1825	***	0.0103
ln_tangible fixed asset	0.0148	*	0.0087	0.0201	**	0.0096	-0.0074		0.0176	0.0278		0.0211
ln_total output	0.0593	***	0.0168	0.0123		0.0190	0.0732	**	0.0334	0.3593	***	0.0445
ln_exports	-0.0021		0.0053	0.0125	**	0.0060	0.0277	**	0.0114	0.0015		0.0076
ln_imports	0.0204	***	0.0058	0.0147	**	0.0066	0.0102		0.0120	0.0065		0.0081
ln_sales to Japan	-0.0038		0.0044	-0.0012		0.0049	-0.0229	***	0.0083	0.0384	***	0.0051
ln_sales to local	0.0136	***	0.0039	0.0097	**	0.0043	0.0196	***	0.0074	0.0294	***	0.0045
ln_sales to third countries	-0.0105	***	0.0039	-0.0078	*	0.0044	-0.0040		0.0080	0.0165	***	0.0041
Export dummy	-0.0010		0.0367	-0.0601		0.0413	-0.1005		0.0747	0.0496		0.0627
Import dummy	-0.0884	**	0.0366	-0.0634		0.0412	-0.1242	*	0.0728	-0.0264		0.0568
Overseas affiliates dummy	-0.0191		0.0264	0.0372		0.0293	-0.0503		0.0499			
Constant	3.0176	***	0.1988	0.4261	*	0.2280	0.0955		0.4404	1.7738	***	0.5375
Number of obs	39093			38453			18858			5868		
Adj R-squared	0.6930			0.6722			0.7289			0.9493		

Robustness check

	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	-0.4885	***	0.1490	0.1707		0.1662	-0.1663		0.2061	0.1187		0.1138
ln_wage(high edu.)	-0.1084		0.1401	0.5703	***	0.1564	-0.2249		0.1938	0.0688		0.1070
ln_wage(short time)	0.0516		0.0928	0.3045	***	0.1036	0.1602		0.1284	-0.0247		0.0709
ln_wage(workers abroad)	-0.0031		0.0250	-0.0095		0.0279	-0.0404		0.0346	-0.2217	***	0.0191
ln_tangible fixed asset	0.0076		0.0772	-0.0719		0.0862	-0.0373		0.1068	-0.0384		0.0590
ln_total output	0.1679		0.1205	0.2434	*	0.1344	0.0732		0.1666	0.3605	***	0.0920
ln_exports	-0.0352	**	0.0180	-0.0301		0.0201	0.0293		0.0249	0.0251	*	0.0137
ln_imports	0.0338	*	0.0183	-0.0025		0.0204	-0.0066		0.0253	0.0144		0.0140
ln_sales to Japan	-0.0055		0.0122	-0.0173		0.0136	-0.0407	**	0.0169	0.0425	***	0.0093
ln_sales to local	0.0046		0.0137	0.0024		0.0152	-0.0154		0.0189	0.0850	***	0.0104
ln_sales to third countries	-0.0212	**	0.0100	0.0086		0.0112	0.0198		0.0139	0.0074		0.0077
Export dummy	0.1203		0.1471	0.1167		0.1642	-0.2455		0.2035	-0.1893	*	0.1123
Import dummy	-0.1324		0.1218	0.1160		0.1359	-0.0092		0.1684	-0.0590		0.0930
Constant	3.3666	**	1.4263	-2.1562		1.5913	2.0909		1.9727	1.4244		1.0890
Number of obs	1514			1514			1514			1514		
Adj R-squared	0.8348			0.7947			0.7441			0.9677		

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Table 6 Estimation results for manufacturing, workers categorized by education level and working hours

	Graduates of secondary education schools		Graduates of higher education schools and universities		Short time workers		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(less edu.)	-0.6592 ***	0.0308	0.1640 ***	0.0200	0.1351 ***	0.0333	0.0088	0.0336
ln_wage(high edu.)	0.0805 ***	0.0074	0.0502 *	0.0293	0.0169	0.0161	0.0035	0.0217
ln_wage(short time)	0.0478 ***	0.0043	0.0553 ***	0.0057	0.1767 ***	0.0457	-0.0094	0.0090
ln_wage(workers abroad)	-0.0100	0.0093	-0.0041	0.0120	-0.0169	0.0214	-0.1524 ***	0.0110
ln_tangible fixed asset	0.0264 **	0.0109	0.0287 **	0.0142	-0.0191	0.0252	-0.0006	0.0239
ln_total output	0.0615 ***	0.0173	-0.0184	0.0227	0.0232	0.0404	0.2908 ***	0.0487
ln_exports	-0.0025	0.0049	0.0108 *	0.0063	0.0299 ***	0.0115	-0.0008	0.0081
ln_imports	0.0127 **	0.0056	0.0082	0.0072	0.0091	0.0129	0.0034	0.0088
ln_sales to Japan	-0.0042	0.0043	-0.0004	0.0056	-0.0262 ***	0.0091	0.0216 ***	0.0055
ln_sales to local	0.0124 ***	0.0038	0.0064	0.0049	0.0163 *	0.0084	0.0217 ***	0.0049
ln_sales to third countries	-0.0121 ***	0.0037	-0.0062	0.0047	0.0021	0.0084	0.0255 ***	0.0042
Export dummy	0.0016	0.0334	-0.0574	0.0434	-0.1444 *	0.0753	0.0693	0.0672
Import dummy	-0.0447	0.0341	-0.0274	0.0441	-0.0979	0.0754	-0.0116	0.0595
Overseas affiliates dummy	-0.0259	0.0264	0.0263	0.0340	0.0130	0.0576		
Constant	3.8947 ***	0.1763	1.4440 ***	0.2248	0.1338	0.3812	2.9269 ***	0.5163
Number of obs	24442		23529		10818		4502	
Adj R-squared	0.6407		0.6709		0.6618		0.9517	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(less edu.)	-0.9678 ***	0.1626	-0.0895	0.2003	-0.1724	0.2479	-0.0025	0.1399
ln_wage(high edu.)	-0.1396	0.1355	0.3285 **	0.1668	-0.0319	0.2065	0.1307	0.1166
ln_wage(short time)	0.1101	0.0941	0.1791	0.1159	0.4257 ***	0.1435	-0.1162	0.0810
ln_wage(workers abroad)	-0.0206	0.0234	0.0013	0.0288	-0.0498	0.0357	-0.1882 ***	0.0201
ln_tangible fixed asset	0.0072	0.0730	-0.0781	0.0899	-0.0128	0.1112	-0.0265	0.0628
ln_total output	0.0960	0.1148	0.4015 ***	0.1414	0.0971	0.1750	0.4134 ***	0.0988
ln_exports	-0.0247	0.0173	-0.0414 *	0.0213	0.0331	0.0263	0.0239	0.0149
ln_imports	0.0247	0.0169	0.0064	0.0208	-0.0068	0.0257	0.0052	0.0145
ln_sales to Japan	-0.0041	0.0114	-0.0209	0.0140	-0.0336 *	0.0173	0.0280 ***	0.0098
ln_sales to local	0.0036	0.0126	0.0139	0.0155	-0.0099	0.0191	0.0720 ***	0.0108
ln_sales to third countries	-0.0114	0.0093	0.0145	0.0115	0.0362 **	0.0142	0.0174 **	0.0080
Export dummy	0.0903	0.1421	0.1692	0.1749	-0.3688 *	0.2166	-0.1638	0.1222
Import dummy	-0.0899	0.1111	0.1168	0.1368	0.0197	0.1694	-0.0320	0.0956
Constant	5.6341 ***	1.2682	-1.9767	1.5618	0.1480	1.9334	1.4451	1.0912
Number of obs	1252		1252		1252		1252	
Adj R-squared	0.8602		0.811		0.7133		0.969	

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Table 7 Estimation results for service sectors, workers categorized by education level and working hours

	Graduates of secondary education schools			Graduates of higher education schools and universities			Short time workers			Workers in oversea affiliated companies		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	-0.1177		0.0782	0.1424	***	0.0219	0.2065	***	0.0316	-0.0769		0.0498
ln_wage(high edu.)	0.0702	***	0.0270	0.2202	***	0.0874	0.0698	**	0.0300	-0.0769		0.1202
ln_wage(short time)	0.0309		0.0192	0.0290		0.0185	0.1801		0.1462	0.0097		0.0442
ln_wage(workers abroad)	-0.1452	**	0.0655	-0.0364		0.0580	-0.0321		0.0958	-0.3647	***	0.0616
ln_tangible fixed asset	-0.0227		0.0424	0.0079		0.0410	0.0281		0.0551	-0.2149		0.2450
ln_total output	-0.0043		0.0860	0.1189		0.0825	-0.0218		0.1143	0.6871	**	0.3153
ln_exports	-0.0054		0.0361	0.0214		0.0319	-0.0617		0.0574	0.0352		0.0415
ln_imports	-0.0046		0.0404	0.0606	*	0.0363	0.0310		0.0590	0.0998	*	0.0602
ln_sales to Japan	-0.0573	**	0.0283	-0.0587	**	0.0258	-0.1432	***	0.0483	0.0555	*	0.0333
ln_sales to local	0.0344		0.0238	0.0448	**	0.0206	0.0738	***	0.0288	0.0231		0.0262
ln_sales to third countries	0.0763	**	0.0301	0.0474	*	0.0275	0.0847		0.0533	0.1039	***	0.0315
Export dummy	-0.0352		0.2286	0.0285		0.1983	0.5637		0.3551	-0.4857	*	0.2741
Import dummy	0.1830		0.2406	-0.1517		0.2095	-0.2018		0.3412	-0.8524	**	0.3925
Overseas affiliates dummy	-0.1796		0.1355	-0.1318		0.1194	-0.2118		0.1692			
Constant	0.5703		1.0727	1.0810		1.0469	-1.7488		1.2930	0.3107		3.2053
Number of obs	3911			3971			2391			420		
Adj R-squared	0.6448			0.7331			0.7807			0.9545		

Robustness check

	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	0.2525		1.8126	1.5086		2.3132	0.8011		2.5290	1.0253		0.8297
ln_wage(high edu.)	2.6203		1.5042	0.8038		1.9196	-0.6027		2.0987	0.8470		0.6886
ln_wage(short time)	-0.2991		0.4793	1.0488		0.6117	0.1081		0.6687	-0.0737		0.2194
ln_wage(workers abroad)	1.3209		0.7647	-0.5023		0.9759	-1.3710		1.0669	0.4458		0.3501
ln_tangible fixed asset	-1.4692		1.0513	0.9994		1.3417	-3.2778		1.4669	0.1442		0.4813
ln_total output	-14.6038	*	5.8347	-1.3690		7.4463	1.7662		8.1409	-5.7708	*	2.6710
ln_exports	-1.5149	**	0.5073	0.4203		0.6474	-0.0731		0.7078	-0.0404		0.2322
ln_imports	-1.6958	*	0.7780	-0.3405		0.9929	0.4908		1.0855	-0.8577	*	0.3561
ln_sales to Japan	-0.3087		0.4722	-0.3582		0.6026	0.1108		0.6588	-0.3913		0.2161
ln_sales to local	6.0631	**	1.9277	-0.1757		2.4602	0.0141		2.6896	1.8593		0.8825
ln_sales to third countries	-0.1048		0.4811	-0.1446		0.6139	0.7579		0.6712	-0.1895		0.2202
Export dummy	11.9814	**	3.3011	-1.4109		4.2129	2.1209		4.6059	0.6438		1.5112
Import dummy	7.2806		3.5262	1.5908		4.5001	-2.7038		4.9199	4.3206	*	1.6142
Constant	130.4616	**	46.7364	2.2244		59.6453	10.0885		65.2086	52.6203	*	21.3946
Number of obs	108			108			108			108		
Adj R-squared	0.8929			0.7734			0.8486			0.9928		

Note: Including industrial dummy and year dummy, dependent variable is log noumber of workers, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix1Estimation results for all industries, wage bill share

	Male graduates of secondary education schools		Male graduates of higher education schools and universities		Female graduates of secondary education schools		Female graduates of higher education schools and universities		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	7.2825 ***	0.1308	-5.2054 ***	0.1293	-0.8060 ***	0.0700	-1.0287 ***	0.0510	-0.2424 ***	0.0209
ln_wage(male, high edu.)	-5.1729 ***	0.1241	7.5332 ***	0.1226	-1.6882 ***	0.0664	-0.4686 ***	0.0483	-0.2035 ***	0.0198
ln_wage(female, less edu.)	-0.1807 **	0.0904	-1.5533 ***	0.0893	2.5209 ***	0.0484	-0.6872 ***	0.0352	-0.0998 ***	0.0144
ln_wage(female, high edu.)	-2.3002 ***	0.0722	1.1546 ***	0.0714	-0.8552 ***	0.0387	2.1009 ***	0.0282	-0.1001 ***	0.0115
ln_wage(workers abroad)	-0.4385 **	0.2006	-0.0289	0.1983	-0.1941 *	0.1074	0.1107	0.0782	0.5508 ***	0.0320
ln_tangible fixed asset	0.0713	0.1737	0.0979	0.1717	0.0447	0.0930	-0.1424 **	0.0677	-0.0714 ***	0.0277
ln_total output	0.2554	0.3405	-0.5626 *	0.3366	0.2435	0.1823	0.0856	0.1327	-0.0219	0.0543
ln_exports	-0.2042 *	0.1087	0.2418 **	0.1075	-0.0102	0.0582	0.0134	0.0424	-0.0408 **	0.0174
ln_imports	0.3039 **	0.1194	-0.1216	0.1180	-0.0950	0.0639	-0.0213	0.0465	-0.0660 ***	0.0191
ln_sales to Japan	-0.2028 **	0.0896	0.0520	0.0885	0.0913 *	0.0480	-0.0251	0.0349	0.0846 ***	0.0143
ln_sales to local	0.0650	0.0786	-0.0842	0.0777	0.0003	0.0421	-0.0161	0.0306	0.0350 ***	0.0125
ln_sales to third countries	-0.1183	0.0801	0.0393	0.0792	0.0031	0.0429	-0.0053	0.0312	0.0812 ***	0.0128
Export dummy	1.0607	0.7475	-1.0408	0.7389	-0.2319	0.4002	0.0318	0.2913	0.1802	0.1193
Import dummy	-1.3187 *	0.7465	0.6408	0.7379	0.6143	0.3997	-0.1712	0.2909	0.2347 **	0.1192
Overseas affiliates dummy	0.2869	0.5319	0.0935	0.5259	-0.5038 *	0.2848	0.3353	0.2073	-0.2120 **	0.0849
Constant	53.9708 ***	3.8712	26.2937 ***	3.8269	11.1670 ***	2.0727	6.3782 ***	1.5086	2.1904 ***	0.6179
Number of obs	40218		40218		40218		40218		40218	
Adj R-squared	0.7897		0.7666		0.8173		0.7353		0.1531	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	1.4008	2.2393	4.1946 *	2.2370	-5.2784 ***	0.8209	0.1910	0.5698	-0.5080	0.3118
ln_wage(male, high edu.)	-15.4806 ***	2.3131	17.1796 ***	2.3107	-1.4722 *	0.8479	-0.1900	0.5885	-0.0368	0.3221
ln_wage(female, less edu.)	-6.0269 ***	1.7328	5.4330 ***	1.7311	0.7470	0.6352	-0.0666	0.4409	-0.0865	0.2413
ln_wage(female, high edu.)	-0.8086	1.6256	0.5141	1.6239	-1.3546 **	0.5959	1.8898 ***	0.4136	-0.2407	0.2263
ln_wage(workers abroad)	-0.2738	0.3349	-0.0188	0.3346	-0.0572	0.1228	-0.0742	0.0852	0.4240 ***	0.0466
ln_tangible fixed asset	2.8298 **	1.3540	-2.5775 *	1.3526	0.1266	0.4964	-0.1543	0.3445	-0.2245	0.1885
ln_total output	4.3972 ***	1.6491	-3.3758 **	1.6474	0.1838	0.6045	-1.4654 ***	0.4196	0.2601	0.2296
ln_exports	-0.0454	0.2295	0.0100	0.2293	0.1139	0.0841	-0.0155	0.0584	-0.0630 **	0.0320
ln_imports	0.4162 *	0.2414	-0.4875 **	0.2412	0.0210	0.0885	0.0641	0.0614	-0.0138	0.0336
ln_sales to Japan	0.1469	0.1802	-0.2701	0.1801	0.0807	0.0661	0.0322	0.0459	0.0103	0.0251
ln_sales to local	0.2888	0.2028	-0.0983	0.2026	-0.2427 ***	0.0744	0.0044	0.0516	0.0478 *	0.0282
ln_sales to third countries	-0.1263	0.1313	0.1493	0.1312	-0.0308	0.0481	-0.0337	0.0334	0.0414 **	0.0183
Export dummy	0.5390	1.9720	-0.1513	1.9700	-0.6228	0.7229	-0.0776	0.5017	0.3127	0.2746
Import dummy	-3.0330 *	1.7520	4.4554 **	1.7502	-0.6036	0.6423	-0.8003 *	0.4458	-0.0184	0.2440
Constant	27.8898	22.2776	47.1696 **	22.1372	32.0202 ***	8.1666	19.4886 ***	5.6682	2.8755	3.1020
Number of obs	2472		2472		2472		2472		2472	
Adj R-squared	0.7921		0.7438		0.8709		0.846		0.68	

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix2 Estimation results for manufacturing, wage bill share

	Male graduates of secondary education schools		Male graduates of higher education schools and universities		Female graduates of secondary education schools		Female graduates of higher education schools and universities		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	8.8206 ***	0.2787	-5.5370 ***	0.2690	-1.2280 ***	0.1420	-1.4467 ***	0.0784	-0.6088 ***	0.0357
ln_wage(male, high edu.)	-4.2314 ***	0.1475	6.0010 ***	0.1423	-1.5816 ***	0.0751	-0.0910 **	0.0415	-0.0969 ***	0.0189
ln_wage(female, less edu.)	-0.0024	0.1313	-1.1894 ***	0.1267	1.9689 ***	0.0669	-0.7025 ***	0.0369	-0.0746 ***	0.0168
ln_wage(female, high edu.)	-1.8724 ***	0.0817	1.3479 ***	0.0788	-0.8420 ***	0.0416	1.4512 ***	0.0230	-0.0847 ***	0.0104
ln_wage(workers abroad)	-0.3957 *	0.2112	-0.1749	0.2039	-0.0896	0.1076	0.1276 **	0.0594	0.5326 ***	0.0270
ln_tangible fixed asset	0.2484	0.2450	-0.0776	0.2364	0.0876	0.1248	-0.1002	0.0689	-0.1582 ***	0.0314
ln_total output	0.4239	0.3912	-0.5938	0.3775	0.2448	0.1993	-0.0235	0.1100	-0.0514	0.0501
ln_exports	-0.2067 *	0.1101	0.2143 *	0.1063	0.0052	0.0561	0.0095	0.0310	-0.0223	0.0141
ln_imports	0.2906 **	0.1264	-0.1407	0.1220	-0.0369	0.0644	-0.0203	0.0355	-0.0926 ***	0.0162
ln_sales to Japan	-0.1366	0.0979	-0.0483	0.0945	0.0559	0.0499	0.0207	0.0275	0.1083 ***	0.0125
ln_sales to local	0.1093	0.0867	-0.0813	0.0837	0.0113	0.0442	-0.0210	0.0244	-0.0184 *	0.0111
ln_sales to third countries	-0.1674 **	0.0833	0.1203	0.0803	-0.0155	0.0424	-0.0224	0.0234	0.0850 ***	0.0107
Export dummy	1.3692 *	0.7557	-1.0360	0.7292	-0.4326	0.3850	-0.0241	0.2126	0.1234	0.0967
Import dummy	-1.3372 *	0.7695	0.6773	0.7425	0.4025	0.3921	-0.0836	0.2164	0.3410 ***	0.0985
Overseas affiliates dummy	-0.3424	0.5969	0.4674	0.5760	-0.3133	0.3041	0.3264 *	0.1679	-0.1382 *	0.0764
Constant	37.3724 **	3.5939	34.8491 ***	3.4682	14.9509 ***	1.8312	8.9610 ***	1.0109	3.8666 ***	0.4599
Number of obs	24587		24587		24587		24587		24587	
Adj R-squared	0.7474		0.7136		0.8589		0.678		0.2766	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(male, less edu.)	-1.2743	2.7645	8.3047 ***	2.7536	-7.0226 ***	1.0132	0.2031	0.6216	-0.2110	0.3381
ln_wage(male, high edu.)	-15.6904 ***	2.5229	15.5670 ***	2.5130	-0.2865	0.9247	0.3877	0.5673	0.0222	0.3086
ln_wage(female, less edu.)	-7.5748 ***	2.0075	6.5836 ***	1.9997	0.8334	0.7358	0.2162	0.4514	-0.0584	0.2455
ln_wage(female, high edu.)	-1.2629	1.7235	0.8422	1.7168	-1.2416 **	0.6317	1.7697 ***	0.3876	-0.1074	0.2108
ln_wage(workers abroad)	-0.2129	0.3627	-0.1889	0.3613	0.0505	0.1330	-0.0678	0.0816	0.4191 ***	0.0444
ln_tangible fixed asset	1.9981	1.6030	-2.1546	1.5967	0.2384	0.5875	0.0069	0.3605	-0.0888	0.1961
ln_total output	3.9084 **	1.7496	-3.1160 *	1.7427	0.3434	0.6413	-1.2719 ***	0.3934	0.1360	0.2140
ln_exports	0.3025	0.2483	-0.3088	0.2473	0.1292	0.0910	-0.0815	0.0558	-0.0415	0.0304
ln_imports	0.2643	0.2633	-0.3060	0.2623	-0.0245	0.0965	0.1107 *	0.0592	-0.0444	0.0322
ln_sales to Japan	0.1707	0.1965	-0.2775	0.1957	0.0175	0.0720	0.0504	0.0442	0.0390	0.0240
ln_sales to local	0.2568	0.2259	-0.0942	0.2250	-0.2109 **	0.0828	0.0209	0.0508	0.0274	0.0276
ln_sales to third countries	-0.0482	0.1403	0.0975	0.1397	-0.0269	0.0514	-0.0423	0.0315	0.0200	0.0172
Export dummy	-2.7318	2.1453	2.4687	2.1369	-0.6573	0.7863	0.6417	0.4824	0.2788	0.2624
Import dummy	-2.1645	1.8504	3.5003 *	1.8431	-0.3615	0.6782	-1.0351 **	0.4161	0.0608	0.2263
Constant	62.7329 ***	21.9689	-5.5295	21.8829	29.8760 ***	8.0521	11.2237 **	4.9399	1.6970	2.6869
Number of obs	2079		2079		2079		2079		2079	
Adj R-squared	0.7563		0.7138		0.8771		0.7312		0.5315	

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix3 Estimation results for service sectors, wage bill share

	Male graduates of secondary education schools			Male graduates of higher education schools and universities			Female graduates of secondary education schools			Female graduates of higher education schools and universities			Workers in oversea affiliated companies		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(male, less edu.)	7.0503	***	0.3374	-4.8191	***	0.3312	-1.0018	***	0.2131	-0.9232	***	0.1820	-0.3061	***	0.0805
ln_wage(male, high edu.)	-6.9013	***	0.3907	10.0702	***	0.3835	-1.6335	***	0.2468	-1.0734	***	0.2108	-0.4621	***	0.0932
ln_wage(female, less edu.)	-0.3569		0.2850	-1.8642	***	0.2798	3.4518	***	0.1800	-1.1150	***	0.1538	-0.1157	*	0.0680
ln_wage(female, high edu.)	-2.8703	***	0.2968	0.6896	**	0.2914	-1.5891	***	0.1875	3.8797	***	0.1602	-0.1099		0.0708
ln_wage(workers abroad)	-0.5739		1.0814	0.3924		1.0616	-0.2285		0.6831	-0.1392		0.5835	0.5492	**	0.2580
ln_tangible fixed asset	-0.1434		0.7399	0.2096		0.7264	0.1734		0.4674	-0.2354		0.3992	-0.0041		0.1765
ln_total output	-1.7808		1.5215	0.2712		1.4937	0.5436		0.9611	1.0765		0.8209	-0.1105		0.3630
ln_exports	-0.3094		0.5977	0.2872		0.5868	0.1182		0.3776	-0.0748		0.3225	-0.0212		0.1426
ln_imports	-0.1676		0.6804	0.7318		0.6679	-0.4098		0.4297	0.1488		0.3671	-0.3033	*	0.1623
ln_sales to Japan	-0.2450		0.4828	-0.1312		0.4740	0.0313		0.3050	0.3309		0.2605	0.0140		0.1152
ln_sales to local	-0.0770		0.3785	-0.2073		0.3716	-0.1816		0.2391	-0.3828	*	0.2042	0.8487	***	0.0903
ln_sales to third countries	0.8397	*	0.5105	-0.4712		0.5012	0.4108		0.3225	-0.0023		0.2755	-0.7770	***	0.1218
Export dummy	-1.6348		3.7116	1.8228		3.6437	-1.2046		2.3444	1.0301		2.0026	-0.0135		0.8856
Import dummy	0.9243		3.9225	-4.5808		3.8507	3.7553		2.4776	-1.6752		2.1164	1.5764	*	0.9359
Overseas affiliates dummy	0.8551		2.2223	0.1180		2.1816	1.8190		1.4037	-1.3756		1.1990	-1.4166	***	0.5302
Constant	45.4083	**	18.8087	43.0998	**	18.4645	-1.3991		11.8803	9.9531		10.1482	2.9378		4.4877
Number of obs	4247			4247			4247			4247			4247		
Adj R-squared	0.7992			0.8261			0.7983			0.7503			0.0791		

Robustness check

	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(male, less edu.)	7.6558		7.9296	1.6378		8.9289	-3.4027		3.5088	-5.4862		3.8631	-0.4048		1.9241
ln_wage(male, high edu.)	-21.6071	*	12.7440	28.7062	*	14.3500	-12.4745	**	5.6392	6.6458		6.2085	-1.2703		3.0923
ln_wage(female, less edu.)	-4.4530		7.0370	9.3228		7.9238	-0.5492		3.1139	-4.7338		3.4282	0.4132		1.7075
ln_wage(female, high edu.)	4.5799		9.8626	-9.1873		11.1055	-1.7255		4.3642	5.8230		4.8048	0.5099		2.3931
ln_wage(workers abroad)	-0.1651		2.3607	-0.7848		2.6582	-0.6066		1.0446	0.5673		1.1501	0.9892	*	0.5728
ln_tangible fixed asset	-10.6128		9.6398	7.1292		10.8545	1.9669		4.2656	0.5934		4.6962	0.9233		2.3390
ln_total output	19.3592		14.2323	-23.6893		16.0258	-0.8595		6.2978	4.9629		6.9335	0.2267		3.4534
ln_exports	-0.5803		1.3889	1.1034		1.5639	0.3688		0.6146	-0.1363		0.6766	-0.7556	**	0.3370
ln_imports	2.8517		2.3177	-3.0022		2.6097	0.0087		1.0256	0.1498		1.1291	-0.0080		0.5624
ln_sales to Japan	1.5421		1.0008	-2.4852	**	1.1269	1.2643	***	0.4429	-0.5203		0.4876	0.1991		0.2428
ln_sales to local	0.5236		0.8240	0.1846		0.9278	-1.1088	***	0.3646	0.2909		0.4014	0.1098		0.1999
ln_sales to third countries	0.4222		1.2214	-1.1749		1.3754	0.9273	*	0.5405	-0.1448		0.5950	-0.0298		0.2964
Export dummy	11.1282		10.7806	-10.5032		12.1391	-0.6589		4.7704	-2.5155		5.2520	2.5493		2.6158
Import dummy	-26.4902	*	14.8305	31.2241	*	16.6994	1.5106		6.5625	-8.0752		7.2250	1.8307		3.5985
Constant	-58.8748		159.2414	169.3332		179.3081	51.7690		70.4640	-53.2953		77.5776	-8.9321		38.6389
Number of obs	158			158			158			158			158		
Adj R-squared	0.8607			0.821			0.7981			0.8256			0.1319		

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix4 Estimation results for all industries, wage bill share, workers categorized by education level and working hours

	Graduates of secondary education schools		Graduates of higher education schools and universities		Short time workers		Workers in oversea affiliated companies	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(less edu.)	6.6129 ***	0.1670	-4.2573 ***	0.1665	-2.1467 ***	0.0856	-0.2089 ***	0.0191
ln_wage(high edu.)	-5.4329 ***	0.1484	7.3867 ***	0.1479	-1.8231 ***	0.0761	-0.1308 ***	0.0170
ln_wage(short time)	-1.0315 ***	0.0900	-0.8878 ***	0.0898	1.9962 ***	0.0462	-0.0769 ***	0.0103
ln_wage(workers abroad)	-0.6542 ***	0.2132	0.0289	0.2126	0.0629	0.1093	0.5624 ***	0.0244
ln_tangible fixed asset	0.1016	0.1846	0.1996	0.1840	-0.2281 **	0.0946	-0.0731 ***	0.0211
ln_total output	0.4236	0.3616	-0.7330 **	0.3604	0.3317 *	0.1853	-0.0223	0.0413
ln_exports	-0.2656 **	0.1156	0.3391 ***	0.1152	-0.0159	0.0592	-0.0576 ***	0.0132
ln_imports	0.2297 *	0.1269	-0.1416	0.1265	-0.0313	0.0650	-0.0568 ***	0.0145
ln_sales to Japan	-0.1544	0.0952	0.1107	0.0949	-0.0521	0.0488	0.0958 ***	0.0109
ln_sales to local	0.1109	0.0835	-0.0776	0.0833	-0.0327	0.0428	-0.0006	0.0095
ln_sales to third countries	-0.1039	0.0851	-0.0068	0.0849	0.0188	0.0436	0.0919 ***	0.0097
Export dummy	0.8964	0.7946	-1.5992 **	0.7921	0.4152	0.4073	0.2877 ***	0.0908
Import dummy	-0.8428	0.7933	0.7403	0.7908	-0.1014	0.4066	0.2038 **	0.0907
Overseas affiliates dummy	-0.4690	0.5651	0.8129	0.5633	-0.1913	0.2896	-0.1527 **	0.0646
Constant	60.8169 ***	4.1241	25.5297 ***	4.1113	11.9158 ***	2.1140	1.7377 ***	0.4714
Number of obs	40276		40276		40276		40276	
Adj R-squared	0.7921		0.7736		0.8108		0.2262	

Robustness check

	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln_wage(less edu.)	0.0459	2.7719	0.8496	2.9343	-0.4211	1.2327	-0.4744	0.2949
ln_wage(high edu.)	-23.8377 ***	2.6071	26.7026 ***	2.7598	-2.2781 **	1.1594	-0.5868 **	0.2773
ln_wage(short time)	-5.1206 ***	1.7271	4.5639 **	1.8283	0.8047	0.7681	-0.2480	0.1837
ln_wage(workers abroad)	-0.0679	0.4658	-0.1506	0.4931	-0.1218	0.2071	0.3403 ***	0.0496
ln_tangible fixed asset	1.0287	1.4370	-0.8511	1.5212	0.2633	0.6391	-0.4409 ***	0.1529
ln_total output	2.9871	2.2413	-0.9425	2.3726	-2.2323 **	0.9968	0.1877	0.2384
ln_exports	-0.2142	0.3343	0.0441	0.3539	0.1949	0.1487	-0.0248	0.0356
ln_imports	0.6917 **	0.3408	-0.6079 *	0.3608	-0.0937	0.1516	0.0099	0.0363
ln_sales to Japan	0.2866	0.2275	-0.2165	0.2408	-0.0872	0.1012	0.0171	0.0242
ln_sales to local	0.1271	0.2540	-0.0748	0.2689	-0.0340	0.1129	-0.0184	0.0270
ln_sales to third countries	-0.5655 ***	0.1867	0.4099 **	0.1977	0.1038	0.0830	0.0518 ***	0.0199
Export dummy	0.8496	2.7373	0.0609	2.8977	-1.1990	1.2173	0.2885	0.2912
Import dummy	-4.5504 **	2.2654	4.1816 *	2.3982	0.5560	1.0075	-0.1871	0.2410
Constant	101.9373 ***	26.5334	-41.2445	28.0881	32.2002 ***	11.8000	7.1069 **	2.8226
Number of obs	1514		1514		1514		1514	
Adj R-squared	0.8078		0.7751		0.8616		0.8223	

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
*** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix5 Estimation results for manufacturing, wage bill share, workers categorized by education level and working hours

	Graduates of secondary education schools			Graduates of higher education schools and			Short time workers			Workers in oversea affiliated companies		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	8.9275	***	0.3590	-6.8149	***	0.3500	-1.5472	***	0.1346	-0.5654	***	0.0417
ln_wage(high edu.)	-5.6088	***	0.1795	6.6677	***	0.1750	-0.9621	***	0.0673	-0.0969	***	0.0209
ln_wage(short time)	-1.1821	***	0.1071	-0.3244	***	0.1044	1.6025	***	0.0401	-0.0960	***	0.0124
ln_wage(workers abroad)	-0.5348	***	0.2306	-0.0931		0.2248	0.1026		0.0864	0.5254	***	0.0268
ln_tangible fixed asset	0.1767		0.2674	0.0583		0.2607	-0.0796		0.1002	-0.1555	***	0.0311
ln_total output	0.7243	*	0.4269	-0.7651	*	0.4162	0.0736		0.1600	-0.0328		0.0496
ln_exports	-0.2712	**	0.1202	0.2378	**	0.1172	0.0659		0.0451	-0.0324	**	0.0140
ln_imports	0.2520	*	0.1379	-0.1493		0.1344	-0.0226		0.0517	-0.0800	***	0.0160
ln_sales to Japan	-0.0870		0.1068	0.0490		0.1041	-0.0676	*	0.0400	0.1056	***	0.0124
ln_sales to local	0.1175		0.0947	-0.1139		0.0923	0.0145		0.0355	-0.0182	*	0.0110
ln_sales to third countries	-0.1616	*	0.0908	0.0850		0.0886	-0.0094		0.0340	0.0859	***	0.0106
Export dummy	1.1654		0.8248	-1.0265		0.8041	-0.3255		0.3091	0.1865	*	0.0958
Import dummy	-0.9794		0.8398	0.7402		0.8187	-0.0219		0.3147	0.2610	***	0.0976
Overseas affiliates dummy	-1.1395	*	0.6514	0.9503		0.6350	0.3321		0.2441	-0.1430	*	0.0757
Constant	46.6002	***	3.9482	41.2321	***	3.8491	8.8822	***	1.4796	3.2855	***	0.4587
Number of obs	24601			24601			24601			24601		
Adj R-squared	0.7105			0.7074			0.7327			0.2632		

Robustness check

	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	-3.5255		3.5326	1.6903		3.6571	1.8696		1.2600	-0.0343		0.2701
ln_wage(high edu.)	-21.3258	***	2.9433	20.9456	***	3.0470	0.8398		1.0498	-0.4597	**	0.2251
ln_wage(short time)	-2.4751		2.0448	0.6421		2.1169	1.9657	***	0.7293	-0.1328		0.1564
ln_wage(workers abroad)	-0.5316		0.5084	0.4429		0.5263	-0.1697		0.1813	0.2584	***	0.0389
ln_tangible fixed asset	1.1689		1.5852	-0.5213		1.6411	-0.3635		0.5654	-0.2842	**	0.1212
ln_total output	-0.1732		2.4936	2.7803		2.5815	-2.3688	***	0.8894	-0.2383		0.1907
ln_exports	0.1347		0.3755	-0.3468		0.3887	0.1818		0.1339	0.0303		0.0287
ln_imports	0.3886		0.3669	-0.3617		0.3798	-0.0010		0.1309	-0.0258		0.0281
ln_sales to Japan	0.3424		0.2466	-0.3844		0.2553	-0.0064		0.0880	0.0483	**	0.0189
ln_sales to local	-0.0315		0.2728	0.1926		0.2824	-0.1411		0.0973	-0.0200		0.0209
ln_sales to third countries	-0.5404	***	0.2027	0.3539	*	0.2098	0.1465	**	0.0723	0.0401	***	0.0155
Export dummy	-0.9164		3.0862	1.6141		3.1950	-0.8429		1.1008	0.1453		0.2360
Import dummy	-3.2927		2.4140	4.1088		2.4992	-0.7004		0.8610	-0.1158		0.1846
Constant	132.9052	***	27.5516	-61.8222	**	28.5231	20.8457	**	9.8271	8.0712	***	2.1070
Number of obs	1252			1252			1252			1252		
Adj R-squared	0.7681			0.7626			0.8205			0.764		

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
 *** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent

Appendix6 Estimation results for service sectors, wage bill share, workers categorized by education level and working hours

	Graduates of secondary education schools			Graduates of higher education schools and universities			Short time workers			Workers in oversea affiliated companies		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	4.9343	***	0.3967	-2.5758	***	0.4036	-2.2676	***	0.2928	-0.0909	***	0.0258
ln_wage(high edu.)	-5.0763	***	0.4606	8.4216	***	0.4686	-3.2588	***	0.3399	-0.0865	***	0.0300
ln_wage(short time)	-2.0328	***	0.3409	-1.3951	***	0.3469	3.4228	***	0.2516	0.0051		0.0222
ln_wage(workers abroad)	-0.7275		1.0858	-0.1779		1.1048	0.4195		0.8014	0.4860	***	0.0706
ln_tangible fixed asset	-0.1364		0.7395	0.4828		0.7525	-0.3303		0.5458	-0.0160		0.0481
ln_total output	-2.1784		1.5258	0.4793		1.5526	1.6997		1.1261	-0.0007		0.0992
ln_exports	0.3328		0.6018	1.1020	*	0.6123	-1.4197	***	0.4441	-0.0151		0.0391
ln_imports	-1.0385		0.6816	0.7501		0.6936	0.4179		0.5031	-0.1295	***	0.0443
ln_sales to Japan	0.0361		0.4848	0.3267		0.4933	-0.3850		0.3578	0.0223		0.0315
ln_sales to local	-0.2917		0.3809	-0.0254		0.3876	0.1759		0.2811	0.1412	***	0.0248
ln_sales to third countries	0.6167		0.5123	-0.4550		0.5213	-0.1071		0.3781	-0.0546		0.0333
Export dummy	-5.7314		3.7383	-3.0999		3.8040	8.8181	***	2.7591	0.0132		0.2431
Import dummy	6.7218	*	3.9294	-3.0206		3.9984	-4.3383		2.9001	0.6371	**	0.2555
Overseas affiliates dummy	2.3893		2.2339	-0.9722		2.2731	-1.4627		1.6488	0.0455		0.1453
Constant	31.9102	*	18.9788	77.2425	***	19.3121	-9.7805		14.0075	0.6278		1.2343
Number of obs	4266			4266			4266			4266		
Adj R-squared	0.8239			0.8424			0.8483			0.2292		

Robustness check

	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
ln_wage(less edu.)	-4.2202		27.1516	10.0104		32.9998	-1.1433		16.4872	-4.6469		10.7669
ln_wage(high edu.)	-1.1338		22.5317	3.7053		27.3848	-4.0398		13.6818	1.4684		8.9349
ln_wage(short time)	-20.2967	**	7.1796	18.7353	*	8.7261	3.6071		4.3597	-2.0457		2.8471
ln_wage(workers abroad)	24.3756	*	11.4549	-22.8911		13.9222	-9.8559		6.9557	8.3714		4.5424
ln_tangible fixed asset	-29.9333		15.7484	36.4204		19.1405	-6.6636		9.5628	0.1764		6.2450
ln_total output	-140.5683		87.4022	132.8757		106.2277	23.3123		53.0728	-15.6197		34.6590
ln_exports	-23.5489	**	7.5986	24.5912	*	9.2353	2.3730		4.6141	-3.4153		3.0132
ln_imports	-12.3611		11.6541	11.0482		14.1643	4.3623		7.0767	-3.0494		4.6214
ln_sales to Japan	3.2299		7.0727	-3.7858		8.5961	1.4377		4.2947	-0.8818		2.8047
ln_sales to local	69.6089	*	28.8766	-70.7916		35.0963	-7.6915		17.5346	8.8742		11.4509
ln_sales to third countries	2.9504		7.2060	-6.5559		8.7581	5.1879		4.3757	-1.5825		2.8575
Export dummy	158.3376	**	49.4494	-162.0261	*	60.1003	-17.9693		30.0269	21.6577		19.6090
Import dummy	46.2538		52.8206	-43.0398		64.1976	-20.8697		32.0740	17.6558		20.9458
Constant	1440.81		700.0937	-1329.25		850.8866	-144.6022		425.1144	133.0479		277.6191
Number of obs	108			108			108			108		
Adj R-squared	0.9059			0.8921			0.941			-0.7507		

Note: Including industrial dummy and year dummy, dependent variable is wage bill share, firm fixed effect estimation.
 *** significant at the 1 percent level, **significant at the 5 percent level, * significant at the 10 percent