Do R&D or Capital Expenditures Impact Wage Inequality? Evidence from the IT Industry in Taiwan ROC

Yu-Cheng Lai*

Shih Chien University Kaohsiung Campus

Abstract: Using detail published firm-level panel data from the Taiwan Economic Journal (TEJ), this study measures the effect of foreign ownership on wage dispersion. The estimation has been done by the Ordinary Least Squares (OLS) technique. It finds that current R&D and capital expenditures lead to decreased wage dispersion in response to a rise in the foreign investment in Taiwan ROC. However, the lag two year's R&D and capital expenditures lead to increased wage dispersion in response to a rise in foreign investment.

Keywords: Foreign Direct Investment (FDI), Wage dispersion, Capital expenditure, IT industry

JEL Classification: J31, D24, F20

1. Introduction

The government of Taiwan had provided incentives to multinational corporations to attract inward investment, presumably because the government believes that there is some kind of spillover effect from FDI which benefits the domestic market. However, despite evidence of such spillover effects in terms of productivity and wages (Sarkar and Lai, 2009; Girma et al., 1999) along with the benefits of FDI are some undesirable affects upon the labour market.

Taylor and Driffield (2005) examine whether inward flows of FDI have contributed to increasing wage inequality and find that FDI has a pure significant effect on wage dispersion which can be interpreted as evidence of a technology spillover. The high R&D activities involve the employment of high quality (relatively high skilled) workers (Katz and Autor, 1999). However, Chen (2004) indicates that the attributes of R&D in Taiwan are product and process R&D. It claims that the product and process R&D will encourage the product and skill mix difference between R&D firms and others. Moreover, after the product and process R&D investment in Taiwan, the capital investment will shift towards products produced by high skilled workers and away from products produced by low skilled workers could yield rising wage dispersion across firms in the same industry. Piekkola (2007) claims that the distribution of capital and Research and Development (R&D) investment across firms in Finland has worked in the direction of mitigating wage inequality between the firms and the highest pay.

Based above analysis, this paper has considered the role of multinational firms operating in then IT (information technology) industry in Taiwan R.O.C. upon the growing wage dispersion for current and lag R&D and capital investment over the period 2005 to 2008. We suppose that FDI

has a strong impact upon wage dispersion (and is robust to different measures of FDI) in current levels and with time lags. This paper investigates the impact of foreign firms' capital and R&D on the wage dispersion for the firms which have different ratios of foreign investment in Taiwan.

2. Data and Model

The study uses the detailed firm-level panel data for computer industries from the Taiwan Economic Journal (TEJ). Based on the data of TEJ, this paper collects the data from 2003 to 2008. Each observation is collect from Taiwan's stock market and OTC (Over-the-counter) market. On the other hand, it should consider the data completion for each firm whose data can last for four years. Therefore, the final sample size is 932. Due to the constraints on matching variables of different types and to obtain greater homogeneity in data set, the present study has used data related to only 233 firms distributed among the information industry for six years (2003 to 2008).[1] The data set originally used for analysis consists of 233 firms from 8 industries, because some observations were dropped due to the missing value. In order to test the effect of wage dispersion and spillover with one year lag, the sample of six years was merged into four years' sample which has two year lag. However, the sample used for empirical test in this paper is not a panel data. Therefore, we did not require to adopt the techniques generally used for panel data (like fixed and random effect), and we used OLS method to test the effects of wage dispersion.

With regard to dependent variables, the firm's wage derivate should first concern, which W_{ijt} is the average wages for firms i in industry j at the year t. The wages dispersion will be represented by differences between W_{ijt} and the highest firms' wage in an industry *j* (W_{ijt}^{Max}) in terms of its wage deviation from the highest pay firm. Therefore, the dispersion of firm-level wages from the highest wages of firm presented by WD_{ijt} would be:

$$WD_{ijt} = \frac{W_{ijt}^{Max} - W_{ijt}}{W_{ijt}^{Max}} \tag{1}$$

Now, with the aim of finding out whether benefit from the presence of foreign firms is apparently accumulated by different types of domestic firms with varied level of wage dispersion equally, the hypothesis of the study was tested.

$$WD_{ijt} = \alpha_{it} + \beta_1 FDI_{ijt} + \sum_{k=1}^{n=8} \delta_k X_{ijt} + \sum_{k=1}^{n=8} \chi_k FDI_{ijt} \times X_{ijt} + d_{it} + \varepsilon_{ijt} \tag{2}$$

where

$$X_{ijt} = \sum_{h=0}^{n=2} RD_{ijt-h} + \sum_{h=0}^{n=2} Cap_{ijt-h} + Sz_{ijt} + Lp_{ijt}$$

The independent variable is a vector of variables X_{ijt}, which is a matrix of inputs hypothesized to impact on output, namely firm size (Sz_{ijt}), capital input (Cap_{ijt}) and labor productivity (Lp_{ijt}).

All variables related with money were deflated with year of 2003 as the base year. There were two measures of foreign ownership i.e., FDI_{ijt} . β_1 is a parameter to be estimated. FDI_{ijt} is a variable used to capture the share of foreign ownership at firm level. FDI_{ijt} = 1, if the percentage of industry sales of NDF to total sales of industry in one year is not lesser than 50%, otherwise will be zero. This was our first benchmark. In order to do the robust tests, we also checked other ratios of FDI_{ijt}. The second benchmark was where the percentage of the ratio fdi in a year is not lesser than 40%. The third to the fifth benchmarks are where the percentage is not lesser than 30% to 10%. In order to avoid the problem of endogeneity, it set variables (Xijt) which could simultaneously determine the foreign ownership and firm's output including the current and one/two year lagged R&D ratio (RD_{ijt-h}),current and one/two year lagged log value of capital input (Cap_{ijt-h}), and log value of firm size (Sz_{ijt}), of a firm. Since the R&D and capital input have the lag effect on output, we have considered the one/two year lagged R&D ratio (RD_{ijt-h}) and capital input (Cap_{ijt-h}) in this paper. The variable FDI_{ijt}×Xijt was able to control the problem of endogeneity of a firm. Assuming that α is correlated with regressors, dummy variables or "within estimator" d_{it} was used where α_{it} for each firm i is obtained by including dummy variables, which takes the value 1 for the corresponding i and 0, otherwise. d_{it} denotes the coefficient of industry dummy (Ind_1 –Ind_8) and time dummy (year 2005-2008). ε is a random error term. The type of industry and year in which foreign investment is made might be correlated with factors that also affect output. Use of annual time dummy and industry dummy has helped us to tone down such concerns. The foreign subscribed capital (equity) participation in firm and it increases that firm's wage, one should observe a positive coefficient on FDI_{ijt}. Finally, the coefficient on the interaction term of FDI_{ijt}×RD_{ijt-h} can measure the effect of current and lag R&D on wage deviates on wages in a firm from the highest wage firm in an industry. The estimation of the above equations has been done by the OLS method.

3. Results

The significant positive coefficient for the interaction term of FDI_{ijt}×RD_{ij} signifies a negative effect of current R&D ratio on wage dispersion with a foreign ownership between 40% and 10% (as seen in column (2)-(5) of table). It implies that the high current R&D ratio will increase the firms' wage to decline their wage derivate from the highest wage of firm in the industry of this year. On the other hand, the two year's lag R&D ratios show a significant increase firm's wage dispersion for foreign ownership 40% and 30% (as seen in column (2) and (3) of table). The significant positive coefficient for the interaction term of FDI_{ijt}×Cap_{ij} signifies the higher current capital expenditure will have a negative effect on wage dispersion with a foreign ownership of 50% (as seen in column (5) of table). The high current capital expenditure will reduce the wage dispersion for the firm having larger than 50 percent of foreign investment. However, the two year's lag capital expenditures show a significant increase firm's wage dispersion for foreign ownership 50%.

4. Conclusion

The current R&D investment from the low foreign investment firms may be protected by patent. They can have advantage and not spillover to domestic firms, leading to the smaller wage inequality between the highest pay of firms and firms of low foreign investment. However, the last two years' R&D investment for low FDI firms will not be protected by the patent, may be decoded by other firms, and may spillover to domestic firms. Therefore, the employees' wage of domestic firms may benefit from technology transfer, and foreign firms will no more have advantage of lagged R&D, leading to the increased wage inequality between low FDI firms and highest pay firms.

Regarding capital investment, the current capital investment for high foreign investment firms will encourage them to hire more skilled and high pay workers than other domestic firms, leading to smaller wage dispersion. However, the information industry does not have a long product life, and the capital investment for high FDI firms two years ago may be imitated by the domestic firms, leading to larger wage inequality between high FDI and the highest pay firms.

Acknowledgment

We would like to thank Shih Chien University for providing us the grant for the research of this paper, and grant number is USC-99-05-05007.

Endnotes

* Department of Finance, Shih Chien University Kaohsiung Campus, No. 200 University Rd, Neimen Shiang, Kaohsiung 845, Taiwan; Email: br00846@yahoo.com; Tel.:+886 7 3326801; Fax: + 886 75371641.

1. The information industry include 8 information industry based on the TSE (Taiwan Security exchange) two-digit industry code, electronic parts, semi conduct, electronic distribution, computer accessory, photoelectric, communication network, information services, other information industry.

Reference

Chen, S. H. 2004. "Taiwanese IT firms' offshore R&D in China and the connection with the global innovation network," *Research Policy*, 33(2), 337–349.

Girma, S., D. Greenaway, and K.Wakelin. 2001. "Who benefits from foreign direct investment in the UK?" *Scottish Journal of political economy*, 48, 119-133.

Katz, L. and Autor, D. 1999. "Changes in the Wage Structure and Earnings Inequality," in AshenfelterO. and CardD. (eds.) *Handbook of Labor Economics*, Amsterdam: North Holland: 1463 – 1555.

Piekkola, H. 2007. "Wage Dispersion in Finland: Searching for Human Capital," *Journal of Income distribution*, 1(16), 8-25.

Sarkar, S. and Lai, Y. C. 2009. "Foreign direct investment, spillovers and output dispersion – The case in India." *International Journal of Information and Management Science*, 20(4), 491-503.

Taylor, K. and Driffield, N. L. 2005. "Wage dispersion and the role of multinationals: Evidence from UK panel data," *Labour Economics*, 12 (1), 223–249

Table 1: Effect of Foreign Investment on Wage dispersion

	FDI≧50% (1)	FDI≧40% (2)	FDI≧30% (3)	FDI≧20% (4)	FDI≧10% (5)
FDI	0.135(0.387)	0.348(0.331)	0.565(0.245)**	0.290(0.205)	0.182(0.189)
FDI×Size$_{ijt}$	0.057(0.059)	-0.012(0.047)	-0.069(0.037)*	-0.071(0.032)**	-0.059(0.030)**
FDI×Lp$_{ijt}$	0.039(0.027)	0.008(0.024)	0.002(0.020)	0.008(0.016)	-0.006(0.014)
FDI×RD$_{ijt}$	-0.009(0.013)	-0.031(0.007)***	-0.029(0.005)***	-0.012(0.003)***	-0.013(0.002)***
FDI×RD$_{ijt-1}$	-0.011(0.013)	-0.018(0.010)*	-0.009(0.009)	0.003(0.007)	0.0001(0.006)
FDI×RD$_{ijt-2}$	0.016(0.018)	0.030(0.013)**	0.019(0.011)*	0.003(0.008)	0.004(0.006)
FDI×Cap$_{ijt}$	-0.163(0.048)***	-0.042(0.034)	-0.007(0.026)	0.001(0.019)	0.015(0.016)
FDI×Cap$_{ijt-1}$	-0.083(0.064)	0.004(0.044)	0.012(0.030)	0.028(0.019)	0.020(0.016)
FDI×Cap$_{ij-2}$	0.122(0.057)**	-0.005(0.043)	-0.010(0.031)	0.011(0.021)	0.020(0.016)
Sample Size	932	932	932	932	932
R^2	0.432	0.434	0.447	0.434	0.439

Notes:

1. Dependent Variable = Wage Dispersion

2.* p < .01 ** p < .005 *** p < .001