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Full Length Research Paper

The efficiency performance of Taiwanese enterprises in China: Tax incentive perspective

Li-Hua Huang, Hsing-Chin Hsiao* and Jui-Chih Wang

Department of Accounting Information, National Taipei College of Business, Taipei, Taiwan.

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This paper explores the efficiency performance of individual Taiwanese manufacturing enterprises in China and Chinese tax incentives impact. Applying data envelopment analysis (DEA) to operations data for 3,506 firms over the four year period (2004 to 2007), the study finds that Taiwanese firms located in the special tax incentive zones benefit from tax incentives than their counterparts in the other zones along with better efficiency performances with statistical significance. In addition, the productive technology industry enjoys better tax incentives but the efficiency performance worsens due to the higher capital requirements and greater operating risks. The average investment years of Taiwanese manufacturing enterprises in productive technology industry are shorter and the payback period is longer rather than other industries. The major production type of the technology industry is original equipment manufacturer (OEM) with lower margin rate, compared with the upstream value chain of the high technology sector. Finally, the study demonstrates that Taiwanese firms with the smaller size and higher sales growth exhibit better efficiency performance.

Key words: Tax incentives, efficiency, foreign direct investment (FDI), data envelopment analysis (DEA).

INTRODUCTION

In order to attract foreign direct investment (FDI) and enhance economic development, a country needs to obtain at least one core efficiency-creating competency among the key inputs of labor, tax, education, and infrastructure (Bunyaratavej et al., 2008). Studies reveal the tax incentives to be an important and effective factor in urging FDI (Swenson, 1994; Hines, 1996; Tung and Cho, 2000; Trevino et al., 2008). The developing countries often use tax incentives to promote FDI and satisfy various employment levels, locations, export requirements, and performance requirements for businesses (Hadari, 1990; Davies and Ellis, 2007; Sethi, 2009). China adopted the “open door” policy in 1979, provided various tax incentives for FDI. Chinese economic reform has been considered critical and interesting research issues after a 30 year period of economic stagnation (Wu, 2000; Wang and Yao, 2003; Henderson et al., 2007; Xu et al., 2008; Fetscherin et al., 2010; Luo et al., 2010).

China has attracted investment from 80% of the world’s top 500 enterprises (Powers, 2001). The majority resources of FDI in China are 41.35% from Hong Kong and Macau. Taiwan at around 5.66% is the fifth largest resource of FDI in China. According to the Investment Commission of the Ministry of Economic Affairs (ICMOEA) of Taiwan, the approved investment to China accumulates rapidly to US $75.56 billions from 1991 to 2008. The Chinese investment (93%) is 31 times of the second largest investment to America (3%). For Taiwan, China is now the biggest trade partner, the largest exports market, the second largest imports resource, and the largest resources of trade surplus country. ICMOEA conducts an empirical survey to the Taiwanese enterprises in China in 2006. The cheaper and abundant labor supply and tax incentives are the two major factors to attract Taiwanese enterprises investment. From the early 1980s to the early 1990 periods, China continually open many special tax incentive zones from the South to North as well as from the coastal regions to the inner parts for FDI. The foreign investment enterprises operating in the zones are granted concessionary tax

*Corresponding author. E-mail: thinking@webmail.ntcb.edu.tw. Tel: 886-2-2322-6363.

rates of either 15 or 24% compared with the statutory tax rate (33%) levied on foreign investment enterprises outside the tax incentives areas (Tung and Cho, 2000). Additionally, China has provided different tax incentives for various high and new technology industries since 2000.

Concerning the Chinese tax incentive issue, studies mostly concentrate on the effect of tax incentive on foreign investment amounts, organizational form, and regional investment decisions. They find tax incentives to be an important factor in attracting FDI and in the making of regional investment decisions (Swenson, 1994; Hines, 1996; Tung and Cho, 2000). Davies and Ellis (2007) argue that tax incentives to attract FDI are tied to performance requirements. It is imperative to investigate the performance of foreign enterprises for both policymakers and FDI managers (Jefferson et al., 2000; Baek, 2004). Some studies explore the characteristics and performance of FDI (Beamish and Delios, 2001; Beamish and Jiang, 2002; Makino et al., 2004; Mohr and Puck, 2005; Dupasquier and Osakwe, 2007). Taiwan has become the fifth largest resource of FDI in China (Ministry of Commerce of the People's Republic of China Department of Foreign Trade, 2008), but there is scant literature related to Taiwanese FDI issue.

This study explores the efficiency performance of individual Taiwan manufacturing enterprises in China and Chinese tax incentives impact. This research utilizes data envelopment analysis (DEA) to measure efficiency performance and analyze the impact of tax incentives on the efficiency for Taiwanese FDI in China during the four year period 2004 to 2007, including the sample of 3,506 firms in China. The results indicate that the efficiency performance of Taiwanese FDI in the special tax incentives zones are granted concessionary tax rates of either 15 or 24% are better than other investment zones. The tax incentive programs lower the tax expenses and improved business efficiency performance. Furthermore, the results reveal that the productive technology industry enjoys better tax incentives but the efficiency performance worsens due to the higher capital requirements and greater operating risks. The tax incentive may not be considered as an imperative consideration. The average investment years of productive technology industry are shorter and the payback period is longer rather than other industries. The major production type of the technology industry is original equipment manufacturer (OEM) with lower margin rate compared with the upstream value chain of the high technology sector. Finally, the study finds Taiwanese FDI with the smaller size and higher sales growth exhibit better efficiency performance.

The study contributes to the literature in at least two ways. First, the study provides evidence of the efficiency performance of the individual Taiwanese FDI in China, filling the gap in literature relating to Taiwanese FDI issue. Evaluating the efficiency performance of the Taiwanese manufacturing enterprises in China provides insight for current and potential foreign direct investors seeking to improve performance and for policymakers considering FDI. Second, the study demonstrates additional empirical evidence on the impact of tax incentives on efficiency performance. Many governments have used a variety of tax and financial incentive programs to foster economic stimulation influencing business relocation and expansion. Despite the large amount of attention and resources that policy makers have devoted to these incentive programs, there is scant systematic empirical evidence concerning the tax incentives impacts (Chen et al., 2006; Lee, 2008).

The remainder of this paper is organized as follows. The paper briefly delineates the FDI studies, Taiwanese FDI in China, Chinese tax incentives programs and hypotheses development, after which, it describes the research methodology. Furthermore, a presentation of the empirical results is stated by the study. Finally, conclusions and implications of the findings are discussed.

LITERATURE REVIEW

Foreign direct investment

The study classifies past research regarding the foreign direct investment (FDI) as three fields- FDI investment location, effect of tax incentives on FDI, and FDI management practice issues. Regarding the investment location, Dunning (1988) claims the importance of the economic areas for critical international FDI in terms of share structure, investment location, and the degree of internationalism. Porter (1990) suggests that the choice criteria for investment location should consider the unique competitiveness for the FDI target companies, the domestic market growth, and the local incentives for the target industry development. Mudambi (1995) considers that the influential factors for investment location composed of domestic GDP, the labor cost, the cost of power consumption, and the local population size for a manufacturing industry. Doh (2005) claims that the share structures and degree of internationalism are the least important factors since firms might transfer the process to different countries. The competitive advantage of the investment location is composed of the total asset combination in terms of lower input cost and resources affordability. Bunyaratavej et al. (2008) use DEA to examine which countries use their resource efficiency to produce higher outputs for attracting service offshoring. They find that China, India, Ireland, Northern Europe, Pakistan, Spain, and the UK are particularly attractive locations for offshore services. These countries all possess at least one core efficiency advantage either in labor, tax, education or infrastructure. Klimberg and Ratick (2008) develop location modeling formulations and apply DEA to find optimal and efficient facility location/allocation patterns.

Various studies examine the effect of tax incentives on FDI and find tax incentives to be an important and effective factor in attracting FDI (Swenson, 1994; Hines, 1996; Tung and Cho, 2000). Pertaining to management practice of FDI in China studies are composed of: the performance and influential factors, strategic considerations, and regional economic development issues. Byrnes and Storbeck (2000) use DEA model to investigate the efficiency gains of four regions (Shanghai, Beijing, Guangzhou, and Lanzhou). Ma and Goo (2005) apply DEA to study the relative efficiency and total factor productivity change in the Chinese High and New Technology Industry Development Zones. While some studies examine the characteristics and performance of FDI (Beamishand and Delios, 2001; Beamish and Jiang, 2002; Makino et al., 2004; Mohr and Puck, 2005; Dupasquier and Osakwe, 2006), there is scant research discussed Taiwanese FDI in China. Therefore, the paper explores the efficiency performance of individual Taiwanese manufacturing enterprises in China and Chinese tax incentives impacts as well.

Taiwan foreign direct investment in China

Taiwanese enterprises have initiated their investments in China as early in the 1980s based on China's open door policy. Taiwanese authorities begin to allow Taiwanese enterprises to invest in China since 1990. Taiwanese enterprises start the labor intensive industries in the four economic zones (Shenzhen, Zhuhai, Xiamen, and Shantou) in the 1980s. Following the Chinese tax incentives policy, Taiwanese enterprises move from South to North as well as from the coastal regions to the inner regions of China. The investment industries are from labor intensive to capital intensive. Based on the 2008 ICMOEA's statistical data (ICMOEA, 2009), the number of approved investment cases to China has increased to 37,181 cases ($75.56 billions USD) from 1991 to 2008 and Chinese FDI is about 93% of total Taiwanese FDI. Taiwanese enterprises are critical investment partners for Chinese economy.

The investments in China from Taiwan have facilitated Chinese economic development and stimulated the enhancement of Taiwanese industry as well as fostering changes in the trade structure (Chen and Ku, 2000; Beamish and Jiang, 2002; Tsai and Li, 2009; Wang and Kafouros, 2009; Sun and Du, 2010). Most Taiwanese enterprises in China focus on the food, chemical, textile, plastics, and electronic and equipment industries before 1995 (ICMOEA, 2009). After 1995, the Taiwanese investment scale has enlarged and increased on the higher technical electronic industry. The growth of the Chinese domestic market, the cheap labor, tax incentives, and the availability of natural resources have all attracted FDI along with the promoted industries with more investment exemptions, deductions, and tax rebates for reinvestment.

China's tax incentive programs and hypotheses development

Following the open door policy, China provided various tax incentives for FDI. In the 1980s, two different income tax laws determined the tax rates and incentives for the different forms of FDI. In 1991, China announced the Income Tax Law for Foreign Investment Enterprises and Foreign Enterprises (ITLFIE) that replaced the 1980s laws and regulated all FDI. ITLFIE imposes a flat income rate of 30% and a 3% local surcharge tax on all FDI. The aggregate tax rate is 33%, which is higher than the highest corporate tax rate of 25% in Taiwan. However, the 7th and 8th rules of ITLFIE provide various tax exemptions and incentives in terms of different investment zones and industries as:

1. Foreign investment enterprises and foreign enterprises in production industries located in the special economic zones and economic technology development zones are taxed by 15% (the 7th rule of ITLFIE).
2. Foreign investment enterprises in production industries located in the coastal economic open zones, development zones of old cities, approved by cities, counties, and regions are taxed by 24% (the 7th rule of ITLFIE).
3. Exemption from the corporate income tax for the first two-profit-making years and a 50% reduction in the third to fifth years, for foreign investment enterprises engaged in an industry of a production nature and operated more than ten years (two years exemptions and three years half-tax deductions) (the 8th rule of ITLFIE).
4. A further reduction in the corporate income tax of 15 to 30% for ten additional years following the initial five year tax concession period described previously, for foreign investment enterprises engaged in low-profit operations and located in economically underdeveloped areas (the 8th rule of ITLFIE).

The foreign investment enterprises operating in the zones are granted concessionary tax rates of either 15 or 24%, compared with the statutory tax rate (33%) levied on foreign investment enterprises outside these areas. Klimberg and Ratick (2008) suggest that the location affects the efficiency performance. Tung and Cho (2000) find tax incentives to be an important factor in attracting FDI and in the making of investment location decision. Schloes and Wolfson (1992) argue that the tax rules influence investment decision by affecting the rates of return on assets. The rates of return on assets differ because the returns on similar assets are taxed differently if they are located in varying tax jurisdictions.

The FDI establish in the regions with both economic and tax incentives. Specifically, Taiwanese enterprises

investing in China seek to increase their after-tax returns. The investment areas of Taiwanese enterprises prefer in the special tax incentive zones that offer concessionary rates of 15 or 24%, compared with other areas where FDI subject to higher statutory tax rates. The tax expenses are levies on the net revenues after the business operating costs. The net income after-tax would be higher along with tax breaks as well as the decreased cash outflow. Therefore, the study proposes the following hypothesis:

H_1: Ceteris paribus, the efficiency performance of Taiwanese enterprises in the special tax incentive zones is expected to perform better than other investment zones.

In July 2000, China's State Council announced "the Software industry and integrated circuit (IC) industry development" policy. The FDI over RMB $8 billion and the IC productive industries with IC line width less than 0.25 μm (micrometer) have five years exemptions and five years half-tax deductions tax privileges. In 2002, the productive industries with IC line width less than 0.8 μm (micrometer) have two years exemptions and three years half-tax deductions tax privileges. The software productive enterprises established in China also receive the income tax incentives. The new software productive enterprises, once approved, obtain two years exemptions and three years half-tax deductions tax privilege. These industry incentive programs have attracted many global software and IC productive industries to China. Based on Schloes and Wolfson (1992), Tung and Cho (2000), and Klimberg and Ratick (2008), we propose the following hypothesis:

H_2: Ceteris paribus, the efficiency performance of Taiwanese enterprises in the productive technology industries are expected to perform better than other industries.

METHODOLOGY

DEA and test statistics

The study applies DEA model of multi-unit efficiency measurement to explore the efficiency performance of individual Taiwanese manufacturing enterprises in China. The study adopts an output-oriented efficiency measure by assuming that firms maximize output given the available inputs (Düzakin and Düzakin, 2007). This output-oriented approach measures how much output can be generated from a given level of inputs (Chang et al., 2004). The output-oriented efficiency measure θ_j is estimated by the following DEA model:

$$\theta_j = Max\,\theta \quad (1)$$

s.t.

$$X_{ij} \geq \sum_{j=1}^{N} \lambda_j X_{ij}, i = 1,...,I \quad (2)$$

$$\theta Y_{rj} \leq \sum_{j=1}^{N} \lambda_j Y_{rj}, r = 1,...,R \quad (3)$$

$$\sum_{j=1}^{N} \lambda_j = 1 \quad (4)$$

$$\lambda_j \geq 0 \quad (5)$$

Where *j* is the firm being evaluated, θ_j is the estimated inefficiency for firm *j*, X_{ij} is input *i* for firm *j*, Y_{rj} is output *r* for firm *j*, and λ is the weight placed on each firm. Model (1) is constructed under the assumption of variable returns to scale and referred to as the BCC model of DEA (Banker et al., 1984). If a constant return to scale is maintained instead, Equation (4) is removed and the resulting model is labeled as the CCR model of DEA (Charnes et al., 1978). If $\theta_j = 1$ represents the firm is efficient, and $\theta_j > 1$ shows the firm is inefficient.

Prior research applies two conventional parametric based tests to examine efficiency differences between two groups of DMUs: Welch's mean test and the Mann-Whitney test (Siegel and Castellan, 1988). However, Banker and Chang (1995) document that these two test statistics did not perform as well as those of the DEA-based tests. The study employs two DEA-based test statistics (Banker, 1996; Banker and Chang, 1995) to evaluate efficiency differences. If θ_j is assumed to be exponentially distributed, this study then tests the null hypothesis which the two groups have no efficiency difference. The following equation is used:

$$T_{EXP} \equiv \left[\sum_{j=G1}^{N1}\left(\theta_j - 1\right)/N1\right] / \left[\sum_{j=G2}^{N2}\left(\theta_j - 1\right)/N2\right] \quad (6)$$

which is evaluated with *F*-distribution with (2*N1*, 2*N2*) degrees of freedom. *N1* and *N2* are the number of two groups sample, respectively.

If the θ_j is assumed to be half-normally distributed for firms, then, the null hypothesis would be tested against the alternate hypothesis described previously by employing the test statistic given by:

$$T_{HN} \equiv \left[\sum_{j=G1}^{N1}\left(\theta_j - 1\right)^2/N1\right] / \left[\sum_{j=G2}^{N2}\left(\theta_j - 1\right)^2/N2\right] \quad (7)$$

which is evaluated by the F-distribution with (*N1*, *N2*) degrees of freedom.

Multivariate analysis

In order to evaluate the influence of factors on efficiency performance for Taiwanese enterprises in China, the research design uses the two-stage procedures represented in Equation (8). Banker and Natarajan (2008) have provided theoretical justification for the use of two-stage models in DEA to evaluate the contextual variables affecting DEA efficiency scores.

$$\ln\theta = \beta_0 + \beta_1 S\_ZONE + \beta_2 P\_TECH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (8)$$

where $\ln\theta$ is the natural logarithm of the inefficiency estimator θ obtained from Equation (1). *S_ZONE* is a dummy variable that takes the value of 1 to indicate the firms located in the special tax incentive zones are granted concessionary tax rates of either 15 or 24%. *P_TECH* is a dummy variable that takes the value of 1 to indicate productive technology industry. Company characteristics may contribute to efficiency performance (Hu and Chen, 1996; Makino et al., 2004). The study chooses two firm specific characteristics: firm size (Dhawan, 2001; Margono and Sharma, 2006) and growth (Chang and Choi, 1988; Dunne and Hughes, 1994; Koh, 2002) as the control variables (Hamblin and Iyer, 1996). The study measures the natural logarithm of total asset (*SIZE*) to proxy for the firm size and the growth rate of total sales (*GROWTH*) to proxy for firm growth. Finally, it includes three years control variables (*DYEAR5*, *DYEAR6* and *DYEAR7*) to proxy for year 2005, 2006, and 2007. Due to the data availability, the derived limitation is unable to completely control for the correlated-omitted-variable problem.

Data

The samples of Taiwanese enterprises in China included in this study are derived from the top 1,000 Taiwanese Enterprises in China database by China Credit Information Service, Limited. The database contains data from the top 1,000 Taiwanese enterprises in China each year. However, the data only consists of the total revenue, total assets, net value of firm, net income after-tax, capital, number of employees, and growth rate of total revenue for each business. The study examines four annual periods from 2004 to 2007. It begins with an original total sample of 4,000 firms and eliminates the data with incomplete information. The final sample consists of 3,506 Taiwanese enterprises in China: Comprising 861 firms in 2004, 714 firms in 2005, 951 firms in 2006, and 980 firms in 2007.

DEA is an approach for measuring the relative efficiency of peer decision making units (DMUs). Düzakin and Düzakin (2007) argue that assets and shareholders' equity together as inputs and revenues and profits both as outputs lead to erroneous analysis results because they might be restricting real performance values. Färe and Grosskopf (1996, 2000), Seiford and Zhu (1999), Zhu (2000), Chen and Zhu (2004), and Kao and Hwang (2008) identify revenue as an intermediate product. The study chooses net income after-tax as output and number of employees and paid-in capital as inputs based on the literature (Düzakin and Düzakin, 2007; Mok et al., 2007; Zofio and Prieto, 2007; Lee et al., 2008; Goto et al., 2008; and Tseng et al., 2009).

EMPIRICAL RESULTS

Descriptive analyses

The study investigates the efficiency performance of Taiwanese enterprises in China. Based on Panel A of Table 1, the mean of paid-in capital for Taiwanese enterprises is RMB $183,584.44. The highest paid-in capital is in 2006. The mean of the employee number is 1,847.4. The net income after-tax is RMB $35,698.78. The numbers of the employees, the net income after-tax, and the size increase incrementally each year but the sales growth deteriorates consequently.

With regards to the investment location, the study identifies the special tax incentives zones with concessionary rates of 15 or 24% as *EA* and the other zones with the statutory tax of 33% as *NEA*. From Panel B, the numbers of enterprises in *NEA* is 3,193 more than the enterprise numbers in *EA* (313). The study finds the Taiwanese enterprises locate in the tax incentives zones demonstrating higher paid-in capital, net income after-tax, size, and sales growth but fewer numbers of the employees.

If the productive technology industry is compared (*TI*) with the others industries (*NTI*) (Panel C), it would be found that a larger paid-in capital, the numbers of the employee, net income after-tax, and firm sizes in the productive technology industry rather than the other industries. However, the sales growth is less for the productive technology industry. The productive technology industry requires more land, equipments, capitals, and employees compared to the others. More plants, properties and equipments represent the firms facing higher operating risks and subject to more government restraints.

Efficiency performance analyses

Based on Panel A of Table 2, the efficiency performance analysis demonstrates that the mean of the inefficiency value is 2.4077. In 2004, the efficiency performance is the best and deteriorates thereafter. Based on Panel B, the mean of efficiency performance at the special tax incentive zones is 2.3826 better than the non-additional tax incentives zones (2.4101). As shown in Panel C, the study uses dichotomy for the productive technology industry (*TI*) and other industries (*NTI*). The *TI* numbers are 829 fewer than the numbers of *NTI* (2,677). The mean of the inefficiency value of the productive technology industry (*TI*) is 2.6833 worse than the mean of other industries (*NTI*) (2.3223).

Univariate mean test

Table 3 exhibits the statistic test of efficiency difference for *EA* versus *NEA* and *TI* versus *NTI*. The *EA* with the tax advantage of either 15 or 24% yet shows the better efficiency performance, consistent with the predictions of the research but only statistics significant shown in the DEA test.

The efficiency performance of Taiwanese FDI in productive technology industries (*TI*) is significantly worsened than the other industries. The productive

Table 1. Descriptive statistics on inputs, outputs, and the other variables. Panel A: By Year. *N*=3,506.

Variable	Year	Mean	Std Dev	Q1	Median	Q3
Input items						
Paid-in Capital (x_1)	2004	98577.60	145598.50	29070.00	58017.00	116158.00
	2005	136581.85	251950.56	35287.00	72599.50	157243.00
	2006	299531.25	789739.86	59603.00	125000.00	272579.00
	2007	179998.06	234688.80	50014.50	103380.00	221144.00
	2004 to 2007	183584.44	456531.33	41390.00	90942.50	188254.00
Employee Number (x_2)	2004	1277.08	2965.97	280.00	613.00	1300.00
	2005	1594.80	4857.74	300.00	708.00	1458.00
	2006	2160.04	6192.54	445.00	970.00	2019.00
	2007	2229.10	7332.53	490.00	999.00	2050.00
	2004 to 2007	1847.40	5703.54	365.00	831.50	1792.00
Output item						
Net Income after-tax (y_1)	2004	21172.47	78440.92	841.00	5617.00	18400.00
	2005	27903.81	120415.79	1660.00	6930.00	23897.00
	2006	40779.46	164602.03	3211.00	15872.00	39731.00
	2007	49210.05	174126.66	3084.50	15590.50	47017.50
	2004 to 2007	35698.78	142807.66	1983.00	10152.50	32709.00
Regression variables						
Size	2004	12.23	1.10	11.54	12.13	12.86
	2005	12.48	1.11	11.77	12.36	13.14
	2006	12.83	1.02	12.12	12.70	13.39
	2007	12.97	1.03	12.24	12.79	13.56
	2004 to2007	12.65	1.10	11.93	12.56	13.27
Growth	2004	52.68	142.82	6.72	27.54	58.95
	2005	65.60	782.09	0.32	15.76	42.78
	2006	45.03	211.75	2.84	20.05	44.85
	2007	21.53	113.46	-5.54	7.73	28.58
	2004 to 2007	44.53	381.36	0.83	17.31	42.21

Paid-in capital: paid-in capital of company per year (RMB).
Employee Number: employee number of company per year.
Net Income after-tax: net income after-tax of company per year (RMB).
SIZE: log of the total asset.
GROWTH: the growth rate of net sales.

technology industry enjoys various tax privileges but the huge invested paid-in capital, the vast number of employees, and the high operating risk compared with the traditional industries results in the worse efficiency performance than its counterparts (*NTI*).

Multivariate regression analyses

The regression result of Table 4 shows the coefficient of *S_ZONE* (β_1) is significantly negative (-0.0714) with efficiency performance consistent with the prediction of the research hypotheses H_1. The efficiency performance of Taiwanese investment enterprises located in special tax incentive zones enjoys more tax privileges than in the other zones are better with statistics significant. China provides low 15 or 24% corporate tax rates and two years exemptions and three years half-tax deductions or reductions of taxes to the FDI firms located in the designated special tax incentives zones. Compared to the 25% statutory tax rate in Taiwan, the lower tax incentives triggers Taiwanese FDI and in the making of regional investment decisions. Schloes and Wolfson (1992) argue that the tax rules influence investment decision by affecting the rates of return on assets. The study finds the empirical evidence that the tax rule

Panel B. By EA vs. NEA.

Variable	Location zones	Mean	Std Dev	Q1	Median	Q3
Input item						
Paid-in capital (x_1)	*EA*	273139.34	502231.43	74655.00	143514.00	311885.00
	NEA	174805.65	450932.26	41280.00	85485.00	175898.00
Employee number (x_2)	*EA*	1407.08	3315.46	323.00	824.00	1486.00
	NEA	1890.56	5884.29	378.00	832.00	1820.00
Output item						
Net Income after-tax (y_1)	*EA*	69431.55	209133.79	3905.00	20084.00	65392.00
	NEA	32392.06	134150.14	1902.00	9699.00	31204.00
Regression variable						
Size	*EA*	13.00	1.10	12.28	12.95	13.67
	NEA	12.62	1.07	11.91	12.53	13.24
Growth	*EA*	50.76	213.05	3.55	18.50	46.37
	NEA	43.92	394.03	0.61	17.24	41.68

EA: Special tax incentives zones with concessionary rates of 15 or 24% (*N*=313).
NEA: others zones of non-additional tax incentives with statutory tax rates, 33% (*N*=3,193).
SIZE: log of the total asset.
GROWTH: the growth rate of net sales.

Panel C: By TI vs. NTI.

Variable	Technology industries	Mean	Std Dev	Q1	Median	Q3
Input item						
Paid-in capital (x_1)	*TI*	264648.56	749217.93	61602.00	117548.00	245334.00
	NTI	158480.91	310865.28	40212.00	81600.00	167651.00
Employee number (x_2)	*TI*	3081.90	10066.49	670.00	1269.00	2980.00
	NTI	1465.10	3261.15	300.00	700.00	1460.00
Output item						
Net Income after-tax (y_1)	*TI*	59266.63	218858.60	2745.00	16230.00	49763.00
	NTI	28400.41	108008.13	1909.00	8985.00	29300.00
Regression variable						
Size	*TI*	13.14	1.22	12.31	12.98	13.88
	NTI	12.50	1.02	11.85	12.45	13.10
Growth	*TI*	41.90	133.36	-0.50	21.38	49.27
	NTI	45.34	430.10	0.96	16.58	39.81

TI: high technology industry (*N*=829).
NTI: others industries (*N*=2,677).
SIZE: log of the total asset.
GROWTH: the growth rate of net sales.

promotes the efficiency performance of Taiwanese enterprises in China.

China aims to promote the productive technology industries by providing tax incentives, such as the “two

Table 2. Descriptive statistics of efficiency performance. Panel A: By Year *N*= 3,506.

Year	Mean	Std Dev	Q1	Median	Q3
2004	1.8074	0.6063	1.3882	1.6523	2.0264
2005	2.1008	1.0135	1.4549	1.8448	2.4501
2006	2.2236	1.3917	1.6135	2.0659	2.5819
2007	3.3372	5.9322	2.0888	2.6982	3.6869
2004 to 2007	2.4077	3.3185	1.5474	2.0171	2.7211

Inefficiency performance θ is estimated by Equation (1).

Panel B: By EA vs. NEA.

Location zones	Mean	Std Dev	Q1	Median	Q3
EA	2.3826	1.3840	1.5551	2.0806	2.7400
NEA	2.4101	3.4503	1.5474	2.0121	2.7171

EA: Special tax incentives zones with concessionary rates of 15 or 24% (*N*=313).
NEA: Others zones of non-additional tax incentives with statutory tax rates with statutory tax rates, 33% (*N*=3,193).

Panel C: By TI vs. NTI.

Electronic Industries	Mean	Std Dev	Q1	Median	Q3
TI	2.6833	1.5183	1.7719	2.3622	3.1473
NTI	2.3223	3.6986	1.5000	1.9422	2.5931

TI: high technology industry (*N*=829).
NTI: others industries (*N*=2,677).

Table 3. Statistical test results of efficiency performance.

Test methods	Statistics	***EA* vs. *NEA***	***TI* vs. *NTI***
		Test-statistics (*p*-value)	**Test-statistics (*p*-value)**
DEA-Based tests	T_{EXP}	1.02 (0.37)	1.57 (0.00)***
	T_{HN}	3.64 (0.00)***	3.00 (0.00)***
Conventional tests	*T*	-0.28 (0.78)	4.06 (0.00)***
	Mann-Whitney	0.63 (0.53)	10.55 (0.00)***
	Kolmogorov-Smirnov	0.90 (0.39)	4.73 (0.00)***

Note: *10% significance, **5% significance, ***1% significance.

years exemptions and three years half-tax deductions" or "five years exemptions and five years half-tax deductions" tax incentives. The empirical results find that the coefficient of *P_TECH* (β_2) is significantly positive (0.0363) with efficiency performance for the Taiwanese enterprises in productive technology industries whereas their actual efficiency performance are worse. The results are inconsistent with the predictions of our research and unable to support the hypotheses H_2. The productive technology industry is mainly impacted by economic fluctuations. The study uses year 2008 minus each enterprise established year to find the average investment years for Taiwanese enterprises. For the productive technology industry is 8.76 years, compared to the 10.72 years for the enterprises in the others industries. Regardless of the investment locations in the special tax incentives zones or the other zones, the invested years of productive technology industry are all fewer than the others. In addition, the paid-in capitals of the productive technology industry are very substantial.

The initial time involved from plant inception through machinery purchase, installation, and trial run to mass production is longer than other industries. For the productive technology industry, the required number of

Table 4. Multivariate regression results.

Variables	Coeff.	Predict signs	Model (8)		Model (9)		Model (10)	
			Parameter estimated	*t* value (*p* value)	Parameter estimated	*t* value (*p* value)	Parameter estimated	*t* value (*p* value)
Intercept	β_0		-1.3129	-18.46*** (0.00)	-1.3121	-18.44*** (0.00)	-1.3171	-18.23*** (0.00)
S_ZONE	β_1	−	-0.0714	-3.39*** (0.00)	-0.0655	-2.80*** (0.01)		
*S_ZONE*P_TECH*	β_{12}	−			-0.0306	-0.57 (0.57)		
*S_ZONE*SIZE*	β_{13}	−					-0.0063	-3.77*** (0.00)
*S_ZONE*GROWTH*	β_{14}	−					0.0001	1.14 (0.25)
P_TECH	β_2	−	0.0363	2.50*** (0.01)	0.0387	2.56*** (0.01)		
*P_TECH*SIZE*	β_{23}	+					0.0032	2.71*** (0.01)
*P_TECH*GROWTH*	β_{24}	−					-0.0002	-2.11** (0.04)
SIZE	β_3	+	0.1518	26.21*** (0.00)	0.1517	26.17*** (0.00)	0.1523	25.81*** (0.00)
GROWTH	β_4	−	-0.00003	-1.81* (0.07)	-0.00003	-1.79* (0.07)	-0.00002	-1.57 (0.12)
DYEAR5	β_5		0.0784	4.38*** (0.00)	0.0784	4.37*** (0.00)	0.0770	4.30*** (0.00)
DYEAR6	β_6		0.0891	5.26*** (0.00)	0.0891	5.26*** (0.00)	0.0880	5.19*** (0.00)
DYEAR7	β_7		0.3785	22.23*** (0.00)	0.3785	22.23*** (0.00)	0.3763	22.05*** (0.00)
$\mathrm{Adj}-\mathrm{R}^2$			33.38%		33.37%		33.44%	
F value			251.89 (<.0001)		220.41 (<.0001)		196.69 (<.0001)	

$$\ln\theta = \beta_0 + \beta_1 S\_ZONE + \beta_2 P\_TECH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (8)$$

$$\ln\theta = \beta_0 + \beta_1 S\_ZONE + \beta_2 P\_TECH + \beta_{12} S\_ZONE * P\_TECH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (9)$$

$$\ln\theta = \beta_0 + \beta_{13} S\_ZONE * SIZE + \beta_{14} S\_ZONE * GROWTH + \beta_{23} P\_TECH * SIZE + \beta_{24} P\_TECH * GROWTH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (10)$$

Note 1: *10% significance；**5% significance；***1% significance. Note 2: Definition of variables: *ln* θ: log of the operating inefficiency. *S_ZONE*: dummy variable, when the firms located in special tax incentive zones with concessionary tax rates of either 15 or 24%, the value is 1, otherwise is 0. *ELEC*: dummy variable, when the firm is high-technology industry, the value is 1, otherwise is 0. *S_ZONE*ELEC*: the variable of interaction on *S_ZONE* and *ELEC*. *S_ZONE*SIZE*: the variable of interaction on *S_ZONE* and *SIZE*. *S_ZONE*GROWTH*: the variable of interaction on *S_ZONE* and *GROWTH*. *ELEC*×*SIZE*: the variable of interaction on *ELEC* and *SIZE*. *ELEC*×*GROWTH*: the variable of interaction on *ELEC* and *GROWTH*. *SIZE*: log of the total asset. *GROWTH*: the growth rate of net sales. *DYEAR5*: dummy variable, when the sample year 2005, the value is 1, otherwise 0. *DYEAR6*: dummy variable, when the sample year 2006, the value is 1, otherwise 0. *DYEAR7*: dummy variable, when the sample year 2007, the value is 1, otherwise 0.

years to achieve profit return is longer, the operating risk is higher, and the necessary time for the promotion of efficiency performance is considerably more than the others. The major production type of the productive technology industry is original equipment manufacturer (OEM) in China. Therefore, the margin is relative smaller than upstream value chain of the productive technology industry. Furthermore, the Taiwanese authorities impose more restraints on the Taiwanese FDI in China and results in the worse relatively efficiency performance.

For the company size control variables, when the company size becomes larger, the efficiency performance worsens. This finding is consistent with works of Dhawan (2001) and Margono and Sharma (2006). The higher productivity or efficiency of smaller firms is the consequence of their leaner organizational structure. The lean operation allows taking strategic actions, exploiting emerging market opportunities, and creating a niche market position (Dhawan, 2001). In addition, the higher sales growth company exhibit better efficiency performance consistent with evidence of Margono and Sharma (2006).

Finally, the study controls and investigates the impacts of macro economy environment on the efficiency performance with *DYEAR5*, *DYEAR6*, and *DYEAR7*. Table 4 shows the efficiency performance for the year 2007 deteriorated relative to other years (2004, 2005, and 2006).

Additional analyses

In order to increase the robustness of this study, all the interaction effects among the special tax incentives zones, industry type, and the control variables (size and sales growth) respectively on efficiency performance are considered. First, the interaction effects of the special tax incentives zones and industry type on the efficiency performance are investigated. The interaction effects as model (9) are added and expect the coefficient (β_{12}) to be negative with efficiency performance:

$$\ln\theta = \beta_0 + \beta_1 S\_ZONE + \beta_2 P\_TECH + \beta_{12} S\_ZONE * P\_TECH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (9)$$

For Taiwanese enterprises in the special tax incentives zones and productive technology industry, they would take not only 15 or 24% lower tax rates privileges but also enjoy the “two years exemptions and three years half-tax deductions” or “five years exemptions and five years half-tax deductions” tax incentive benefit. Based on the empirical results of Table 4, the regression coefficient (β_{12}) is negative (-0.0306) but not statistically significant. The tax incentives enhance the efficiency performance of Taiwanese FDI in China. However, there are only 58 Taiwanese productive technology firms (over the four year periods) that invested in the special tax incentives zones, sharing only 1.65% of the total sample of 3,506. Therefore, the finding did not reach statistical significance.

In addition, the prior results in efficiency performance analyses, univariate mean test and multivariate regression analyses all demonstrate that Taiwanese FDI in the productive technology industry receives tax privileges but achieves worse efficiency performance compared to the other industries. The productive technology industry faces more capital invested and higher operating risks. Therefore, the study control the company size (SIZE) and sales growth (GROWTH) to explore the interaction impacts among the investment location (S_ZONE), industry type (P_TECH) and size (SIZE) and sales growth (GROWTH) on efficiency performance. It modify model (8) as shown in the following model (10):

$$\ln\theta = \beta_0 + \beta_{13} S\_ZONE * SIZE + \beta_{14} S\_ZONE * GROWTH + \beta_{23} P\_TECH * SIZE + \beta_{24} P\_TECH * GROWTH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (10)$$

Based on Table 4, the regression coefficient (β_{13}) of the *S_ZONE*SIZE* is significant and negative. When the Taiwanese investment enterprises locate in the special tax incentive zones with larger investment size, their efficiency performance are better. Regarding the industry comparison, the productive technology requires more land, facilities, equipment, and labor compared to the other industries. Therefore, the productive technology industry with larger company size exhibits the worst efficiency performance. The regression coefficient 0.0032 of the *P_TECH*SIZE* ((β_{23}) is positive and significant. The productive technology industry with higher sales growth

shows better efficiency performance. The regression coefficient -0.00002 of the *P_TECH*GROWTH* (β_{24}) is negative and significant. We can conclude that the lower tax expense is not only imperative consideration for productive technology industry for the Taiwanese enterprises in China. The study also finds that during the research periods (2004 to 2007), the efficiency performance of the Taiwanese enterprises in China is getting worse yearly.

Before 2008, China focused on "Regional tax Incentives Programs" (Demurger, 2001; Geng and Weiss, 2007) and established the special tax incentives zones to attract FDI. The infrastructures in the specific zones are superior to the other zones and offer better tax incentives to urge FDI and higher efficiency performance promotion. The ITLFIE offered more tax incentives for designated regions and exhibits the regional oriented development policy. After 2008, China provided more tax privileges to high and new technology industry rather than the regional development. The trend to pursuit the advanced technology is critical to the recent economy development concern in China.

Conclusions

The study explores the efficiency performance of individual Taiwanese manufacturing enterprises in China and Chinese tax incentives impact. Applying DEA to the operations data for 3,506 firms over the four year period 2004 to 2007, we find that the efficiency performance of Taiwanese FDI in the special tax incentives zones granted concessionary tax rates of either 15 or 24% perform better than other zones. The tax incentive programs lower the tax expenses and improve the efficiency performance. Furthermore, the results reveal that the productive technology industries enjoy better tax incentives but worse efficiency performance due to the higher capital requirements and greater operating risks and the tax incentive is not only imperative consideration. The average investment years of productive technology industry are shorter and the payback period is longer rather than other industries. The major production type of the technology industry is original equipment manufacturer (OEM) with lower margin rate compared with the upstream value chain of the high technology sector. The study also finds Taiwanese FDI with the smaller size and higher sales growth exhibits better efficiency performance. During the research periods (from 2004 to 2007), the general efficiency performance of the Taiwanese enterprises in China are getting worse year by year. One limitation of the study is that it was unable to completely control for the correlated-omitted-variable problem.

Reform in China began in the late 1970s and China has embarked on a path of rapid economic growth (Xu et al., 2006). However, China's dynamic and rapid economic transformation and development has led to an unbalanced economic structure, regional economic development disparity, and a burgeoning gap between rich and poor. China has initiated the market economic mechanism and there are several problems of economic structures for FDI. The Chinese government has been trying to modify the industry structure and import/export goods structure. In order to solve the related economic problems, China has continuously announced and implemented various new economic and trade policies since 2008. For FDI, the new corporate tax laws and policies were implemented on January 1, 2008. This significant regulation changes impact all FDI enterprises and increase the tax burdens in terms of the business models, investment structures, site selections, and financing strategies.

The study suggests that the enterprises who plan to invest in China should consider various sophisticated matters. There are several advantages in terms of cheaper land, materials, and labor costs, and lower tax incentives programs. However, there are some operating risks which need to be treated with caution. From the view of operation strategy, FDI entity should consider an economic-oriented rather than a political-oriented investment location. The enterprises need to develop core competency for competitive advantage, promote brand recognition, expand the market share, enhance the management skill, resource allocation, and maintain a favorable relationship with the government for an effective operating performance (Sanyal and Guvenli, 2000; Ma and Delios, 2007).

Finally, the study provides evidence of the efficiency performance of the individual Taiwanese FDI in China, filling the gap in literature relating to Taiwanese FDI issue. Evaluating the efficiency performance of the Taiwanese manufacturing enterprises in China provides insight for current and potential foreign direct investors seeking to improve performance and for policymakers considering FDI. Many governments have used a variety of tax and financial incentive programs to foster economic stimulation influencing business relocation and expansion. Despite the large amount of attention and resources that authority policy makers have devoted to these incentive programs and the enterprises owners need to comprehend the governmental incentive programs for strategy consideration respectively.

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