



## 摘要

對外投資已是台灣廠商擴展國外市場並在國際上市場與對手國(rivals)競爭的一個重要策略，國外投資對國內的生產以及 R&D 活動的影響如何是一個值得重視與研究的問題。

利用民國 85 年對外投資資料的實證研究結果可知，海外生產對國內生產與 R&D 活動的影響大小決定於一些因素，包括：對外投資型態，投資地區，廠商規模大小，出口傾向以及產業別等。該實證結果並指出台灣母公司與海外子公司的生產有垂直整合的互補效果，對外投資有加強國內母公司 R&D 的顯著效果，特別是在電子電機產業更為顯著。

關鍵詞：國外投資，國內生產，R&D 活動，多國公司

## **Abstract**

Investment in production outside Taiwan is a method by which Taiwan firms expand their shares in foreign markets and defend rivals to retain from other countries their export. The effect of foreign investment on domestic production and R&D is worth to investigate.

The empirical evidence shows that overseas production have significant effects on domestic production and R&D activities which depend on factors such as type of investment, investing area, firm size, export tendency and different industries. The results also suggest the foreign investment appears to have the vertical integration between parent company and foreign affiliates. The R&D activity will be reinforced by foreign production, especially in electrical & electronic industry and developed country.

**Keywords:** Foreign investment; Domestic production; R&D; MNC

# Foreign Investment and Domestic Production 、 R&D : Evidence from Taiwan's MNCs

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The empirical evidence shows that overseas production have significant effects on domestic production and R&D activities which depend on factors such as type of investment, investing area, firm size, export tendency and different industries. The results also suggest the foreign investment appears to have the vertical integration between parent company and foreign affiliates. The R&D activity will be reinforced by foreign production, especially in electrical & electronic industry and developed country.

*JEL classification:* F21; F23; L10

*Keywords:* Foreign investment; Domestic production; R&D; MNC

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## 1. Introduction

Although Taiwan's industries have long ago started to invest in foreign countries, a more rapid increase in foreign investment began in 1987. At that time, the domestic investment environment had become worse. Land prices drastically increased, the labor supply ran short, and the Taiwan dollar sharply appreciated. On the other hand, the foreign investment environment greatly improved, as changes in investment environments drove many Taiwanese firms to invest in foreign countries. According to Central Bank statistics on international income and expenditure, Taiwan's foreign investment amounted to about 100 million US dollars a year by 1987. Since then, the amount has grown consistently. In the past few years, it has remained at the level of 2~3 billion US dollars. The growth indicates that international production has become one of the important strategies for Taiwan's industry.

Taiwan's large scale of growth in foreign investment could be attributed to two forces. On the one hand, foreign investment is inevitable because of the pursuit of sustainable growth. Firms increase their foreign investment to exploit their assets, such as patents, other technological assets, reputation, and more generally, skills in production, marketing, and advertising. This foreign operation appears to play an expansive role in the international market. On the other hand, it is also driven by a change for the worse in the domestic investment environment. Firms attempt to escape from the worsening domestic investment environment and turn to foreign investment to keep their export markets and competitiveness in their industries. Thus, foreign operations appear to play a defensive role in retaining export markets for firms under adverse investment conditions at home.

The two types of foreign investment have different effects on manufacturers' domestic production. Under expansive foreign investment, foreign investment is quite complementary to domestic production. It leads to growth for the industry's manufacturing and development (Blomstrom and Kokko, 1994 for survey; Chen, 1998). However, defensive foreign investment is a substitute for domestic production. It thus is necessary to empirically examine the type of investment on parent production using individual firm data.

Taiwan's foreign investment is concentrated in less-developed countries (LDC), such as Mainland China and South-east Asia (around 65% until 1997). However, we also found that many firms keep investing in developed countries (DC), such as the U.S., Japan and Europe (around 12%). A negative association of parent production for firms investing in a developing country with production of affiliates would suggest a displacement of labor-intensive production to a lower-waged country. A positive association would suggest either an expanding market share or requiring intermediate goods from the parent company. Since theoretically it is not possible to determine whether the net effect on production is positive or negative, this issue has to be settled empirically.

Although there are numerous empirical studies on determinants of manufacturers' R&D (Cohen, 1987 ; Griliches, 1984 ; Lin, 1997) , the impact of types of foreign investment on domestic R&D and foreign affiliates have rarely been examined. A possible underlying theory is that a large amount of foreign production may require the parent company's technological assets or patents. The parent companies are thus pushed to conduct more R&D activities. Lipsey (1994) also indicated an allocation of more

capital-intensive parts to the parent company and of more labor-intensive parts to affiliates, especially in developing country. This finding explains why R&D activities and management are allocated to home operations, while production is farmed out to foreign affiliates. In addition, we have also found that many Taiwan firms have invested in developed country such as the U.S., Japan and Europe. This opposite direction of foreign investment is not unique for Taiwan. A possible explanation for investing in a more developed country is not only for expanding foreign market, but also for acquiring technology. If this is the case, the firms' R&D activity would be reinforced by foreign investment. To find out if R&D characteristics of manufacturers with foreign investment are useful to all industries certainly deserves further studies.

In brief, this paper serves two purposes. One examines the effect of foreign investment on the domestic production of individual firms. The effect on production may vary by investment types, investment areas, types of production, firm size and characteristics of industries and individual firms. This information is useful in assessing how manufacturers can enjoy sustainable growth, while others may be replaced by foreign productions. The other purpose is to investigate the determinants of domestic R&D for the firms with foreign investment and the relationship between domestic and foreign R&D activities. We are especially concerned if the relationship is complementary or substitutive.

The primary source of data for this study is from 1998 survey on foreign investment of the manufacturing industry in the Taiwan Area, Republic of China conducted by the Department of Statistics, Ministry of Economic Affairs. The data are mostly discrete or ordered. Thus, an ordered probit model, probit model, and logit model are employed in



domestic production scale and R&D activities after investing in foreign countries.

This paper is organized as follows: Section I, Introduction ; Section II, Earlier work on home-country effects ; Section III, the data ; Section IV, Specified econometric model ; Section V, Results of empirical analysis ; and the final section offers conclusions and suggestions.

## **2. Earlier work on home-country effects**

The most extensively studied aspect of home-country effects has been whether production by foreign affiliates of a home country's firms is a 'substitute' or a 'complement' to home-country export and employment by the parent firm. There is no literature that investigates the relationship between foreign investment and home parent production and R&D activity directly. This research makes a first attempt for a small open economy. Although this paper is the first to estimate the effects of foreign investment on domestic production and R&D activities, several papers have investigated related questions.

Evidence from studies of U.S. MNCs trade has suggested either a positive relationship or no relationship between US-owned production and exports to that market by the parent firms and by U.S. firms in general (see e.g. Blomstrom et. al 1988). It has also found a negative relationship between US-owned production and exports to the host country firm from other sources. A positive relation was found across firms, production

abroad and their export. (Lipsey and Weiss, 1981, 1984) Studies of Swedish firms have reported some more mixed results (see e.g. Swedenborg 1979), while more recent reports offer negative ones (Svensson 1996).

Other aspects of home-country effects that have been studied include the competition between the home and foreign market for MNCs capital resources, the extent to which expansion of foreign production by a U.S. MNC reduces labor demand at home, and the relation of foreign production to home-country wage levels. On the first topic, a study of a few U.S. firms indicated that home and foreign investment were not independent, and that an increase in plant and equipment investment by the foreign operation caused a decrease at home, because it raised the firm's cost of capital (Stevens and Lipsey 1992). Feldstein (1994) also found that the effect of foreign investment on domestic capital is a substitute. The estimating results suggest that each dollar of foreign assets acquired by U.S. foreign affiliates reduces the U.S. domestic capital by between 20 cents and 38 cents. Brainar and Riker (1997) have recently concluded that foreign affiliate employment by U.S. MNCs only modestly substitute for U.S. parent employment at the margin. They find a much stronger substitution among workers in U.S. foreign affiliates located in different low-wage host countries.

Blomstrom et. al. (1997) meanwhile found that in U.S. firms, larger foreign production is associated with smaller parent employment, given the size of parent production. When the variable measuring foreign production is divided between developed and developing countries, the impact on parent employment is traced to the production in developing countries. On the other hand, Swedish employ more labor at home, given the size of home production, when they produce more abroad, and that effect

is particularly large for production in developing countries.

The findings of several literatures (Lundberg 1988, Hansson and Lundberg 1995, Blomstrom and Kokko 1994, and Fors 1997) about R&D in the home and foreign affiliates indicate that a firm's R&D undertaken in the home country is used as an input in both the home and foreign affiliates of MNCs. This suggests that technology is transferred to the foreign affiliates. Chuang & Lin (1999) studied the relationship between foreign investment and R&D activity using Taiwanese firm-level data. They found that foreign investment and technology purchases are substitutes to R&D activity. Earlier studies find it difficult to disentangle that de-industrialization from MNC's displacement of home production and exports of technology to foreign affiliates or an erosion of the technology advantages of the home country.

### **3. Data**

The primary source of data for this analysis is from the 1998 survey on foreign investment by manufacturers conducted by the Department of Statistics, Ministry of Economic Affairs. A sample is randomly drawn from the list of manufacturers that permission of foreign investment granted by the Investment Commission, Ministry of Economic Affairs and the list of manufacturers with foreign investment established by the survey of industry and business conducted by the Department of Statistics, Ministry of Economic Affairs. The survey sample consisted of 3,280 manufacturers. When manufacturers, which are closed, moving, not investing yet, and intending to withdraw

from investing were excluded, there were 1,264 manufacturers left. Based on this sample, by the end of 1997 investment in Mainland China, South-east Asia, and developed countries (mainly the U.S.) accounted for 66.6%, 19.3% and 11.5% of the total investing cases, respectively.

Table 1  
Manufacturers' Foreign Investment by Areas

Area	Cases	%
Developed Country	145	11.5
Mainland China (including Hong Kong)	842	66.6
South-east Asia	244	19.3
Others	33	7.6

Source: 1998 survey on foreign investment by manufacturers conducted by the Department of Statistics.

It is of high concern if manufacturers' domestic production increased or decreased after investing in foreign countries. Table 2 shows that overall speaking, about 49% of the manufacturers made no change in their domestic production scale. Another 31% increased their domestic investment, while the rest (18%) reduced their production. Table 2 also shows that there was an area differential in changes of domestic production scale. Sixty percent of manufacturers invested in the U.S. expanded their domestic investment, while 35% of them remained unchanged. This suggests that manufacturers investing in the United States adopted the strategy of expansive investment. On the other hand, the majority of manufacturers investing in Mainland China and South-east Asia did not change their domestic investing scale. Twenty-eight percent of manufacturers invested in Mainland China increased their domestic production, while

manufactures with decreasing or unchanged domestic production accounted for 20% and 50%, respectively. The counterpart percentages for manufacturers investing in South-east Asia were 27%, 17%, and 55%. According to the primary statistics, it is difficult to conclude if the impact of foreign investment on domestic production in the developing country is positive or negative.

Table 2

Number of Manufacturers by Investing Area and Changes of Domestic Scale

Area	Domestic Scale Production	Stop	Decrease	No Change	Increase	Total
Developed Country	0	10 (6.9%)	53 (37%)	82 (57%)	145	
Mainland China (including Hong Kong)	20 (2%)	171 (20%)	419 (50%)	232 (28%)	842	
South-east Asia	2 (1%)	41 (17%)	134 (55%)	67 (27%)	244	
Others	0	9 (15%)	22 (36%)	30 (49%)	61	
Total	22 (2%)	228 (18%)	616 (49%)	398 (31%)	1,264	

Source: 1998 survey on foreign investment by manufacturers conducted by the Department of Statistics.

Table 3

## Causes of Investment and Changes of Domestic Scale

Causes of Investment	Domestic Scale	Stop Production	Decrease	No Change	Increase	Total
Market expansion		7	72	302	257	638
Demand by foreign customers		7	73	178	124	382
Follow Taiwan consumers		8	50	136	83	277
Incentives from investing area		0	24	45	32	101
Acquirement of technology		0	4	18	31	53
Acquirement of land		3	39	107	67	216
Material supply		3	42	108	63	216
Cheap labor		15	183	416	210	824
Capital utilization		2	17	107	103	229
Deterioration of domestic environment		14	125	237	88	464
Others		1	6	18	11	36

Source: 1998 survey on foreign investment by manufacturers conducted by the Department of Statistics.

Table 3 shows the relationship between causes of investing (type of investment) in foreign countries and changes of parent production. It suggests that when the causes of investment are to expand into a market, acquirement of technology, and capital utilization, then manufacturers with foreign investment are inclined to increase their domestic production. On the contrary, firms investing overseas because of cost savings such as acquirement of land, material supply, cheap labor, and deterioration of domestic investment environment are inclined to decrease or unchanged their domestic production. Table 4 shows the affiliates' production type and changes of parent production. According to table 4, most Taiwanese oversea production (about 63%) is horizontal integration, which includes new product at home, new product abroad and the same product with a difference. There were 197 MNCs (about 16% of the sample) that

adopted the forward or backward integration. Both horizontal and vertical integration tend to increase or not change the parent company's production. Table 5 shows the relationship between the firms' size and changes of parent production. It suggests that large MNCs with foreign investment are inclined to adopt the strategy of expanding parent production. The small MNCs take the strategy of replacing parent production, while the strategy for medium-size manufacturers is in-between.

Table 4

Type of Production and Changes of Parent Production

Type of parent Domestic Scale	Stop Production	Decrease	No Change	Increase	Total
Horizontal Division	14(1.77)	126(15.89)	404(50.95)	249(31.40)	793
Vertical Division	0(0.00)	43(21.83)	91(46.19)	63(31.98)	197
Irrelavent Product	8(5.10)	38(24.2)	65(41.4)	46(29.3)	157

Table 5

Firm- size and Changes of Parent Production Scale

Firm Sized Domestic Scale	Stop Production	Decrease	No Change	Increase	Total
Small	19	204	418	123	764
Medium	0	8	65	85	158
Large	3	16	133	190	342
Total	22	228	616	398	1264

Source: 1998 survey on foreign investment by manufacturers conducted by the Department of Statistics.

This paper also examines R&D activities of manufacturers with foreign investment. The survey of manufacturers' foreign investment conducted by Ministry of Economic Affairs did not provide data about R&D expenditure and staff numbers, as it offered data only if there were R&D departments in the domestic parent company or foreign affiliates. We suppose that the establishment of an R&D department would lead to R&D activities, and vice versa. However, it has the defect of being unable to infer the level and content of R&D activities. Table 6 shows 75% and 35% of the manufacturers have R&D departments in their domestic and foreign institutes, respectively. It suggests that R&D activities of the domestic parent company are more important, because technology of foreign affiliates probably comes from parent companies. They thus have less need for R&D activities.

Whether R&D activities of manufacturers with foreign investment may vary by areas with different degrees of development is another critical question. Eighty-five percent of manufacturers with investment in the U.S. did have domestic R&D departments. The counterpart proportions are 73% and 71% for those investing in Mainland China and South-east Asia, respectively. The proportions with foreign R&D are 43%, 35% and 33% for those investing in the U.S., Mainland China and South-east Asia. The statistics suggests that manufacturers investing in more developed countries have more domestic and foreign R&D departments ; how even manufactures investing in developing countries have less domestic and foreign R&D.



Table 6

## Domestic and Foreign R&amp;D Department by Investment Areas

Areas	Domestic R&D department		Foreign R&D department	
	no	yes	No	Yes
Developed Country	25(17.93%)	119(82.07%)	87(60%)	58(40%)
Mainland China (including Hong Kong)	235(28%)	606(72%)	543(64%)	299(36%)
South-east Asia	71(29%)	173(71%)	164(67%)	80(33%)
Others	15(25%)	46(75%)	46(65%)	15(25%)
Total	339(27%)	924(73%)	820(65%)	444(35%)

Note : the ratio in parentheses is the ratio of having R&D.

Source: Monthly report on the investment by overseas Chinese and foreigners, foreign investment, technological cooperation, indirect investment in mainland China, and introduction of technology from mainland China.

#### 4. Empirical results

The survey data used in the analysis are measured by discrete or ordered scales. We thus specify regression models with discrete dependent variables to analyze the variation of production and R&D strategies after foreign investment. According to the survey data, the domestic production is categorized as stop production, decreased production, unchanged production, and increased production, which are indicated by an ordered scale 0, 1, 2, 3. We then specified an ordered probit model to analyze the effects of foreign investment. As to the determination of R&D by MNCs, we focus on the relationship of R&D in the parent and foreign affiliates. Since the firms' survey data mentioned above provided only the "with" or "without" an R&D department at the parent company, we built the probit model to probe the determinant factors of home R&D.

The analyses of Section 3 show that there has been an increasing trend of Taiwanese overseas foreign investment since 1991, while the scale of investments also keeps increasing. Regardless if the investments are defensive or expansive, they are of much concern by researchers and government officials. On the one hand, defensive investment may lead to a decrease or stoppage in domestic production. On the other hand, expansive investment may lead to a supplementary relationship between domestic and foreign productions. This section, aims to examine the factors that would result in Taiwan's foreign investments being mainly complementary or substitutive. Thus, we can further discuss the possible effect on industry structure after foreign investment.

#### *4.1 Description of explanatory variables*

There are a few theories on foreign investment, including theory of industrial organization (Hymer, 1976; Caves, 1971), production cycle theory (Vernon, 1966), endowment theory (Kojima, 1973, Ozawa 1979), endogenous theory (Rugman, 1981), and compromising theory (Dunning, 1988). The theories vary by emphasizing various types of foreign investment (motivations). The impact of various motivations can be either complementary or substitutive.

There have been quite a number of empirical researches on the impact of Taiwan's overseas investment. Most of them focus on a single area (mainland China or East Asia) and they mostly rely on aggregate data. Research based on data of individual firms is rather limited. This study will use firm-level data to investigate the impact of type of foreign investment, type of production, different industry, firm's size and other firms'

characteristic on domestic production after investing in foreign countries. The analytical model includes not only elements of relevant theories but also characteristics of industries and firms. The explanatory variables are as follows:

(1) Type of investment

The type of investment can be divided into four types, including market expansion, technology acquisition, cost savings and others, based on the causes of investment that were described in the questionnaire. Three dummy variables are created here to represent four types of investing motivation. Cost savings include causes in the savings of production materials, land, labor cost, and deterioration of domestic environment. They can be classified as defensive investing elements. Their expected coefficient signs are thus negative. On the other hand, market expansion and technology acquisitions are both expansive investing elements. Their expected coefficient signs are thus positive.

(2) Ratio of foreign investment to total investment

The ratio of foreign investment to total investment in the past three years will be used as an explanatory variable to the relationship between foreign investment and domestic investment. If foreign investment has a squeeze impact on domestic investment, then its sign is negative. If it has a supplementary effect, then its sign is positive.

(3) Investing area

Investing area is divided into three categories, i.e. developed countries (include the U.S., Japan, and those in Europe), Mainland China, and South-east Asia which

are taken as less-developed countries (LDC). Two dummy variables are created to represent them.

#### (4) Type of production

Types of production are divided into three categories, i.e. horizontal division, vertical division and completely irrelevant production. We expect the horizontal division and vertical division to tend to reduce the production cost and to increase the market share, and thus their effects are complimentary on home production.

#### (5) Profit status

Parent firms with a profit in 1997 are assigned code 1; otherwise 0. It is expected that the parent firms with a profit after investing in foreign countries will keep expanding their domestic production.

#### (6) Firm size

Firm size is classified by small and large firms. Firms with 100 or more employees are assigned code 1; otherwise, code 0. According to the theory of foreign investment and the strategies of multinational companies (MNCs), the large firms tend to expand their domestic production. However, the small firms may be pushed to a less-developing country, because of the deterioration of domestic economic environment. Thus, the coefficient of firm size is expected to be positive.

#### (7) Parent R&D

Parent R&D is reported by "have" or "not have" R&D activities. It is expected that R&D has a positive impact on expanding production scale.

#### (8) Export tendency

Based on the 1991 census, the ratio of export amount to total sales amount of a four-digit industry is used to indicate export tendency. If the majority of products are for export, foreign investment may lead to a substitute effect or a negative effect on domestic production.

#### (9) Type of industry

Two variables are created to indicate the characteristics of each firm. One is labor-intensive industry. If the ratio of employee to value added (in NT \$ 1,000.00) is greater than 0.0025 (see Chen et. al 1991), the firms are classified as a labor-intensive industry and assigned code 1 (see Chen et. al 1991). The rest of the firms have a code of 0. The other variable is detailed types of industry. Dummy variables are created for two-digit industries. However, the empirical results show that electric and electronics and fabricated metal production are significant.

The summary statistics for the explanatory variables are shown in Tables 7&8.

Table 7

## Summary statistics for explanatory variables

Variable	mean	Standard deviation	Minimum	Maximum
Area – Developed Country	0.1252	0.3262	0	1
Mainland China	0.6836	0.4652	0	1
South-east Asia	0.1954	0.3967	0	1
Ratio of foreign investment (%)	35.2454	30.3247	5	95
Profit status	0.7467	0.4351	0	1
Market expansion	0.5723	0.4950	0	1
Technology acquirement	0.2156	0.4114	0	1
Cost savings	0.7818	0.4132	0	1
Firm size	0.3988	0.4899	0	1
Export ratio	0.3602	0.2217	0	0.8769
Labor-intensive industry	0.3874	0.4874	0	1
Vertical division	0.1727	0.3781	0	1
Horizontal division	0.6950	0.4606	0	1
With domestic R & D	0.7274	0.4455	0	1
With foreign R & D	0.3462	0.4760	0	1

Table 8

## Type of industry by investing area

Type of industry	Developed country	Mainland China	South-east Asia
11. Food	1	27	9
13. Textile mill products	3	48	17
14. Wearing apparel & accessories	1	12	11
15. Leather & fur products	-	16	-
16. Wood & bamboo products	3	14	8
17. Furniture & fixtures	2	13	13
18. Pulp paper & paper products	3	11	8
19. Printing processings	1	10	3
21. Chemical materials	7	17	7
22. Chemical products	1	40	8
23. Petroleum & coal products	-	1	-
24. Rubber products	1	21	7
25. Plastic products	6	99	21
26. Non-metallic mineral products	3	28	6
27. Basic metal	4	24	10
28. Fabricated metal products	5	58	26
29. Machinery & equipment	6	66	21
31. Electrical & electronics machinery	72	198	51
32. Transport equipment	9	61	11
33. Precision instruments	3	23	-
39. Miscellaneous industrial products	9	55	6
Total	138	780	223

#### 4.2 Results of empirical analysis

This section employs an ordered probit model to examine the effect of the explanatory variables stated above on domestic production.

The analytical results for the total sample are shown in Table 9. Table 9 shows that “market expansion” and “technology acquirement” have a significant positive effect. The effect of “technology acquirement” is much less than that of “market expansion.” but “cost savings” is very significant and negative. It reflects that “cost savings” has a

substitute effect on parent production. The results indicate that both expansive and defensive investments co-exist. The co-existence of the two types of foreign investment may lead to an industrial shift or structure change.

The effect of “investing area” is negative, as it reflects that investments in Mainland China and South-east Asia are defensive. In the two areas it has a significantly negative effect on parent production, relative to investment in the developed country. Moreover, the substitution effect in South-east Asia is greater in Mainland China, and the types of production are important factors to parent production.

Both horizontal division and vertical division are positive and significant. It suggests that production of parent firms and foreign affiliates are complementary. The results confirm the theory of comparative advantage by location.

Some other results of Table 9 also suggest that foreign investment has a squeeze effect on domestic investment. Parent scale has a greater probability of a decrease with an increase of in the ratio in foreign investment. The coefficient size of “firm size” and “profit status” are significantly positive at the 0.01 level. After investing in foreign countries, large firms will expand their parent scale, but small firms do not take the same strategy. This implies that small firms may be pushed to foreign countries to retain their export market, under the loss of competitive advantages in Taiwan, while large firms acting as MNCs in a developed country increase parent production to expand market share. At the same time, it is as expected that firms with a profit will expand their domestic production, and vice versa. Finally, the parent R&D has a significantly positive effect on parent production scale. In other words, R&D activity is an important factor for firms to expand.



The characteristics of industries also have a significant effect. After investing in foreign countries, labor-intensive industries will reduce domestic production. This reflects that labor-intensive industries are short of comparative advantages at home, making it difficult for them to survive in Taiwan. They thus move to foreign countries, especially developing countries. In an individual industry, except for Electrical & Electronic and Metal industries, the signs are positive. It thus suggests that foreign investments made by those non-labor intensive industries may have a positive effect on parent production. However, if they are labor-intensive firms, their foreign investments have a negative effect on domestic production, because the coefficient of the labor-intensive variable is greater than the coefficient of the individual industry. This result also indicates that in those industries, labor-intensive firms are substituted by oversea production and non-labor intensive firms expand their parent production by oversea investment.

Table 10 shows the analyses by investing areas. The results show that investing motivation has a different effect in different investing areas. Investing in a developed country, the technology acquisition motivation is significantly positive on parent production; however, in Mainland China and South-east Asia its effects are not significant. Investing in Mainland China, market expansion motivation has the largest positive effect on parent production in all investing area. The results also show that the effect of Taiwan's MNCs investing in Mainland China is complementary by three types of motivations. Of cost savings motivation, there is some evidence that foreign production has a negative impact, or we can hypothesize a substitution effect. Specifically, in South-east Asia, the estimated coefficient is

-0.8392 and significant at the 0.01 level. Profit status and a firm's scale have consistent results in the three areas. Although the effects of export ratio and types of industry are consistent, DC is the area, which is insignificant. Another significant difference is observed for "ratio of foreign investment." It is positive, but insignificant, for investment in DC. They, however, are negative and significant for investment in Mainland China and South-east Asia. The results also show that investment in Mainland China, South-east Asia is competitive in the finance of investing home, but it is not true in the U.S. Moreover, if the firms have a higher export ratio, the probability to expand domestic production is lower. This is especially true in Mainland China. The evidence seems to show that production in Mainland China is a substitute for Taiwan exports.

Table 9

## Empirical results for ordered probit model

Variable	Coefficient	z value
Intercept	2.4332	12.632 ***
Type of investment –		
Market expansion	0.2407	3.015 ***
Technology acquisition	0.1325	1.402
Cost savings	-0.3489	-3.945 ***
Investment area –		
Mainland China	-0.4318	-3.474 ***
South-east Asia	-0.4811	-3.417 ***
Type of production –		
Horizontal integration	0.2714	2.821 ***
Vertical integration	0.2898	2.251 **
Firm size	0.7657	9.563 ***
Ratio of foreign Investment	-0.6133	-5.178 ***
Profit status	0.5611	6.764 ***
Export ratio	-0.5818	-2.953 ***
Industry –		
Labor-intensive	-3.144	-3.580 ***
Electrical & Electronics	0.1553	1.568
Fabricated metal products	0.2631	1.807 *
R&D	0.3123	3.751 ***
$\mu_1$	1.5253	15.379 ***
$\mu_2$	3.2894	31.192 ***
Log likelihood	-1015.245	–
Chi-squared	473.736	–
Number	1141	–

Note : \*\*\*, \*\* and \* indicate significance at 1, 5, and 10% level, respectively using a two-sided z test for all variables. z values are in parentheses. The estimation software package used is LIMDEP.

Table 10  
Empirical results for ordered probit model by area

Variable	Developed countries	Mainland China	South-east Asia
Constant	0.5409 * (1.737)	1.9903 *** (10.974)	2.6535 *** (5.676)
Type of investment --			
Market expansion	0.0320 * (1.715)	0.2508 *** (2.597)	0.1608 (0.824)
Technology acquirement	0.1879 * (1.664)	0.1485 (1.249)	0.2255 (1.027)
Cost savings	-0.4030 (-1.493)	-0.2317 ** (-2.203)	-0.8392 *** (-3.181)
Type of production --			
Horizontal integration	0.2519 (0.754)	0.2756 ** (2.288)	0.3108 (1.195)
Vertical integration	0.3976 (0.877)	0.2506 * (1.671)	0.3465 (1.154)
Ratio of foreign investment	-0.0036 (-0.084)	-0.7230 *** (-5.072)	-0.6060 ** (-2.014)
Profit status	0.3546 (1.218)	0.6053 *** (6.063)	0.4525 * (1.845)
Firm size	0.7251 ** (2.540)	0.8718 *** (8.871)	0.4356 ** (2.410)
Export ratio	-0.0827 (-0.155)	-0.7872 *** (-3.877)	-0.0196 (-0.505)
Industry --			
Labor-intensive	-0.7692 ** (-2.519)	-0.2445 *** (-2.642)	-0.3914 * (-1.996)
R&D	1.1670 *** (2.619)	0.2466 ** (2.558)	0.3185 (1.626)
$\mu_1$	1.9520 *** (7.546)	1.5020 *** (13.711)	1.6457 *** (5.670)
$\mu_2$		3.2507 *** (27.831)	3.5025 *** (11.424)
Log likelihood	-88.4638	-715.824	-196.28
Chi-squared	66.95	320.14	61.293
Number	138	780	223

Note : \*\*\*, \*\* and \* indicate significance at 1, 5, and 10% level, respectively, using a two-sided Z test for all variables. Z values are in parentheses. The estimation software package used is LIMDEP.

### 4.3 R&D activities

As mentioned in section III, the proportions of the firms with R&D activities in Taiwan and foreign affiliates are 73% and 35%, respectively. What are the determinants of R&D activities? How do companies promote their R&D activities? Answers to these questions are critical to the firms' development in the future. This section focuses on examining if R&D activities for a Taiwan parent company are affected by investing motivation, area, and foreign investment ratio? In our R&D model, the explanatory variables include characteristics of foreign investment, determinants of R&D activities, and industrial characteristics. (See the description of explainable variables)

Analytical results are shown in Table 11. Table 11 shows that Schumpeter's hypothesis is supported in this test. In other words, large firms or monopolistic industries will enhance their R&D activities. In addition, characteristics of foreign investment that may affect R&D activities mainly come from investment motivation. The firms that are motivated to expand into a foreign market and rely on technology from domestic parent companies are more inclined to conduct R&D activities. The effect of "investing in developed countries" on R&D activities is positive, but not significant. The horizontal integration and vertical integration production has positive effects on conducting R&D activities. In addition, the amount of foreign investment does not have a squeeze effect on R&D activities. This suggests that both foreign investment and R&D activities are important strategies for a firm's development and growth. They do not conflict with each other.

Table 11 also shows that foreign affiliates that rely on parent companies' technology lead their parent companies to conduct more R&D activities. It thus supports the

hypothesis of labor division that parent companies conduct R&D activities and foreign affiliates are in charge of production. Moreover, the R&D in foreign affiliates is complementary to R&D in the parent firm.

Table 11  
The determination of R&D for parent firms

Variable	Coefficient	z value
Intercept	-0.7480	-3.422 ***
Firm size	0.9954	9.661 ***
Concentration ratio	0.0037	1.730 *
Investment area —		
Mainland China	-0.0296	-0.187
South-east Asia	-0.0999	-0.558
Type of investment —		
Market expansion	0.2462	2.582 ***
Technology acquirement	0.2237	1.183
Cost savings	0.2818	0.025
Type of production —		
Horizontal integration	0.2548	2.053 **
Vertical integration	0.3505	2.289 **
Technology source parent firm	0.5267	3.923 ***
Ratio of foreign Investment	-0.0009	-0.600
Industry —		
Electrical & Electronics	0.2311	2.109 **
Affiliate with R&D	0.4311	4.546 ***
Log likelihood	-565.6658	—
Chi-squared	193.20	—
Number	1131	—

Note : \*\*\*, \*\* and \* indicate significance at 1, 5, and 10% level, respectively, using a two-sided z test for all variables. z values are in parentheses. The estimation software package used is LIMDEP.

## 5. Conclusions and suggestions

In viewing that the expansion of foreign investment has a profound impact on the development of industry, this study aims to examine the determinations of effect of foreign investment on domestic production and R&D activities. The results provide insights about the growth of domestic industries and changes of industrial structure. In addition, earlier research relied on aggregate data and focused on a single area. They neglect the analyses of impact of foreign investment on production with firm data. Moreover, the impact of foreign investment on domestic R&D activities has scarcely been examined. This study, based on the data of a 1997 survey on manufacturers' foreign investment conducted by the Ministry of Economics. Thus features discussing the impact of foreign investment on domestic production and R&D activities at the firm level.

Empirical results show that firms in labor-intensive industries adopt the strategy of defensive foreign investment. Their foreign affiliates have a tendency to replace domestic production. This is especially true for firms investing in Mainland China and South-east Asia. In order to save cost and to increase its competition ability, small firms are more inclined to adopt defensive foreign investment. Most of those firms investing in DC do not belong to a labor-intensive industry. Their scales are relatively larger and their investing motivations are to expand into a market or to acquire technology. The strategy they adopt is expansive investment. After investing in foreign countries, their scale of production expands further.

Based on these results we may infer that foreign investment will lead to a decline in a labor-intensive industry, the growth of non-labor-intensive industry, and changes of

industrial structure toward more non-labor-intensive industries. Moreover, it will not lead to emptiness in the industry. In brief, labor-intensive industries do not have comparative advantages in Taiwan. Their production, employment, and export will decrease in the future. However, how will the resources of a labor-intensive industry be transferred to other industries to avoid the waste of resources, or how will they promote their technology to maintain sustainable growth? These are critical issues that are of concern by the government. Another critical issue is whether the replacement of domestic production by foreign production is profitable for firms or not. Answers toward this question depend on the growth of foreign production and are left to be studied further.

The movement of small firms to foreign countries is more serious than for medium and large firms. It reflects that the development of small firms in Taiwan is becoming more difficult, and they may gradually lose importance in Taiwan. This is a rather critical issue that deserves our concern. For an individual industry, the major force for foreign investment comes from non-labor-intensive firms in textile, plastic, metal manufacturing, electric and electronics industry, and transportation tool manufacturing. They mostly adopt an expansive investment strategy. On the other hand, a labor-intensive industry adopts a defensive investment strategy, and thus leads to a vertical integration of the labor-intensive industry and non-labor-intensive industry in foreign countries. This model of vertical integration in foreign countries is a strategy of giving up a weakness and picking up strength. It must be beneficial to Taiwan's industrial development.

Our results also suggest that R&D activities are influenced by a firm's scale and



technology need of foreign affiliates. Consequently, if foreign affiliates rely on technology from parent companies, parent companies are inclined to conduct more R&D activities, reflecting that there is a vertical integration between foreign affiliates and parent companies. The division is helpful toward the promotion of technology in Taiwan. In addition, we have also found that there is a complementary relationship between R&D activities of foreign affiliates and parent companies. Specifically, R&D activities of foreign affiliates stimulate more R&D activities of parent companies, implying that the government must encourage R&D activities of foreign affiliates and parent companies.

This study also has some limitations. It relies on a cross-section survey data on firms with foreign investment. It thus is unable to examine differences between production and R&D activities of firms with and without foreign investment. It also fails to compare production and R&D activities prior to and after foreign investment. Moreover, the survey did not collect data about production of foreign affiliates. Consequently, we are unable to evaluate the overall production changes including parent companies and foreign affiliates. Our conclusion is thus limited to the impact of foreign investment on production and R&D activities of domestic parent companies with foreign investment.

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The analyses of Section 3 show that there has been an increasing trend of Taiwanese overseas foreign investment since 1991, while the scale of investments also keeps increasing. Regardless if the investments are defensive or expansive, they are of much concern by researchers and government officials. On the one hand, defensive investment may lead to a decrease or stoppage in domestic production. On the other hand, expansive investment may lead to a supplementary relationship between domestic and foreign productions. This section, aims to examine the factors that would result in Taiwan's foreign investments being mainly complementary or substitutive. Thus, we can further discuss the possible effect on industry structure after foreign investment.

#### *4.1 Description of explanatory variables*

There are a few theories on foreign investment, including theory of industrial organization (Hymer, 1976; Caves, 1971), production cycle theory (Vernon, 1966), endowment theory (Kojima, 1973; Ozawa, 1979), endogenous theory (Rugman, 1981), and compromising theory (Dunning, 1988). The theories vary by emphasizing various types of foreign investment (motivations). The impact of various motivations can be either complementary or substitutive.

There have been quite a number of empirical researches on the impact of Taiwan's overseas investment. Most of them focus on a single area (mainland China or East Asia) and they mostly rely on aggregate data. Research based on data of individual firms is rather limited. This study will use firm-level data to investigate the impact of type of foreign investment, type of production, different industry, firm's size and other firms'

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