Journal of Business Economics and Management
www.jbem.vgtu.lt
2010, 11(3): 396–414

OUTWARD FOREIGN DIRECT INVESTMENT AND PRODUCT QUALITY OF DOMESTIC PRODUCTIONS: AN EMPIRICAL INVESTIGATION

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Received 2 October 2009; accepted 30 April 2010

Abstract. While conceptual and theoretical studies have claimed that outward foreign direct investment (FDI) is an effective way to improve the quality of domestic production, there has been less systematic investigation into that claim. The statistical analysis of a survey of Taiwan's outward FDI activity shows that FDI had a positive effect on the quality of only 33.4% of investing firms. We further employ the microeconometric technique to analyze what kinds of globalization behaviors improve the quality of domestic firms' products. The empirical results show that the strategy of expansionary FDI is more effective than defensive FDI at improving product quality because it allows domestic firms to learn advanced technologies from guest countries. Moreover, the reallocation of export between foreign affiliates and the parent company is an effective way for investing firms to focus on improving domestic product quality.

Keywords: outward FDI, product quality, globalization activities, production network.

Reference to this paper should be made as follows: Weng, Y; Yang, C.-H.; Tu, F.-C. 2010. Outward foreign direct investment and product quality of domestic productions: an empirical investigation, *Journal of Business Economics and Management* 11(3): 396-414.

1. Introduction

The effect of outward foreign direct investment (FDI) on domestic industries is a subject of continuous debate. Many studies have discussed its impacts on domestic exports (Sevensson 1996)[1], production (Liu and Huang 2006)[2], employment (Blomstrom *et al.* 1997), R&D (Head and Ries 2002), firm survival (Chen and Ku 2000), and so on[3]. There is little empirical study focusing on the effect of outward FDI on quality

[1] Relevant research can be seen in Lipsey and Weiss (1984) and Head and Ries (2001).

[2] Please refer to Lipsey and Weiss (1984), Dunning (1988), Rugman (1990), Grubert and Mutti (1991) and Chen *et al.* (1995) for further discussion.

[3] In contrast to outward FDI discussed in this paper, a number of empirical studies focus on is-

ISSN 1611-1699 print/ISSN 2029-4433 online doi: 10.3846/jbem.2010.19

of domestic products by the investing firms, while product quality is one of the major variables firms take into account when making decisions on production as well as price and quantity (Phillips *et al.* 1983; Calantone and Knight 2000)[4]. This paper empirically examines the relationship between outward FDI and the quality of domestic products. It is important to clarify this relationship, since outward FDI is regarded as a possible cause of industrial hollowing out, and the quality of domestic products is one of the indicators that show if domestic industry is hollowed out after outward FDI. To examine this issue, we are especially concerned about the link between product quality and firms' globalization behaviors, which are crucial to FDI firms' resource allocation decisions. No such analysis yet exists in the FDI literature.

One can observe from the reality of international investment activity that over the past two decades not only has FDI going to developing and less developed countries (LDCs) increased, but the rate of increase has increased. As a consequence, host countries have absorbed new technologies and have made use of their low-cost labor (Tvaronavičienė *et al.* 2008), and the products made by developing and LDCs have become a far larger presence in international markets. Therefore, investing firms might abandon the production of low-price, low-quality, and labor-intensive products, upgrading their product quality and bringing products with higher added value to new markets. Indeed, FDI is a globalization strategy that enables investing firms to retain world market share by rearranging their production lines both at home and abroad. Though formal theoretical prediction of the relation between FDI and product quality is rare, the conceptual arguments on the positive quality effect of FDI can be traced back to the product cycle theory of FDI.

Vernon (1966) identified the products covered by defensive FDI as those in the mature stage of the product life cycle, where technology is widely diffused, production process is standardized, and price competition prevails[5]. This argument implies that investing firms move the production lines of mature products abroad as well as devote more effort and resources to developing new, higher quality products at home. Observing Japanese experience of FDI, Kojima (1973) argued that labor-seeking FDI spurs Japanese firms

sues related to inward FDI. Brock and Urbonavicius (2008), Vissak (2009) and Tvaronavičienė and Kalašinskaitė (2010) examine the impacts of inward FDI on host country economy, Pazienza and Vecchione (2009) investigate the determinants of inward FDI, and Ucal *et al.* (2010) analyze the effects of financial crisis of 2008 on FDI inflows.

[4] Previous research has theoretically and empirically shown that product quality affect firms' domestic and international performance. Based on a survey-based case study of 285 internationally active industrial firms, Calantone and Knight (2000) confirm that product quality is the most critical direct and mediating factor in firms' international performance. Phillips *et al.* (1983) ascertain that accent on product quality can have a significant, positive effect on the firm's return on investment.

[5] FDI can be roughly separated into two categories, expansionary and defensive (Chen and Yang 1999; Chen and Ku 2000). Defensive FDI, called labor-oriented FDI by Kojima (1973), seeks cheap labor in the host country to reduce the cost of production, while expansionary FDI, what Kojima (1973) called market-oriented FDI, refers to investment toward those countries with a higher per capita GNP than that of the host country.

to emphasize developing high-quality products[6]. More recently, a theoretical article has used more sophisticated modeling frameworks to explore this issue. Lu (2007) formalized a new vision of product cycle trade in which the impetus of movement to the South is not just the pull of cost-seeking FDI, the moving-out force, but also the push created by the introduction of a superior product in the North, the moving-up force.

Apart from the defensive FDI–product quality relation, there are some arguments on the relation between expansionary FDI and product quality. Chen and Yang (1999) showed that one of the major motives that developing countries take expansionary FDI toward advanced countries is to acquire advanced technologies. Chen *et al.* (1995) and Chen and Ku (2000) further demonstrated that local production in the foreign country through expansionary FDI can enrich product value by deepening sales networks, improving access to market information, and providing better service to foreign customers. These arguments seem to imply that acquisition of advanced technology, ability to meet local demand, and grasp of market information can be raised through explanatory FDI, enabling firms to enhance competitiveness and the quality of domestic products.

Although theoretical arguments claim that investing firms, whether they engage in expansionary FDI or defensive FDI, improve the quality of their domestic products through acquiring advanced technologies abroad and by ceasing to produce low-quality products, the question of whether FDI really enables firms to improve the quality of domestic products has been less systematically investigated and is less understood. What factors affect investing firms' ability to improve product quality?[7] This paper aims to empirically investigate this issue by focusing on the roles of firms' globalization behaviors, which specifically include FDI types, foreign-based activities, and network relationship between parent firm and foreign affiliates.

Based on Taiwan data, our empirical results show that Research and Development (R&D) consistent with economic intuition plays as the major driving force for improving product quality when firms' globalization behaviors are not considered. However, if globalization behaviors are taken into account, relative to defensive FDI, the expansionary FDI firms have 16.7% higher probability of improving their domestic product quality through absorbing (or learning) advanced technologies and grasping market information from host countries. Moreover, if the investing firms continue to increase the share of export orders that is exported directly from the parent company or continue

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[6] Dunning (2002) argued that defensive FDI is a preferred way for firms to organize production activities to attain competitive advantages. Meanwhile, it can also serve as a survival strategy for investing firms to fight uncontrollable cost increases in their home base (Chen and Ku 2000; Ozawa 1979; Kojima 1978).

[7] Although there is a long-established thread of theoretical and empirical literature concerned with the effects on product quality, many studies are undertaken from the viewpoint of trade rather than of FDI. These trade topics include trade liberalization effects (Kabiraj and Roy 2006; Bose and Kemme 2002; Gottschalk 2002), market size effect (Highfill and Scott 2006; Berry and Waldfogel 2005), market structure effect (Chatterjee and Raychaudhuri 2004; Rodrik 1988), trade policy effect (Hur 2006; Feenstra 1984), and direction of trade (Hallak 2006; Carlos 2003). Research on the relationship between FDI and product quality is very rare.

to raise the ratio of foreign employees to total employees, this global resource allocation from distribution of production through FDI usually enables investing firms to focus on domestic production of high value-added and high-quality products.

The remainder of the paper is organized as follows. Section 2 provides a brief discussion on the dataset used in this study and then develops the empirical framework. In section 3 we analyze the empirical estimates. Concluding remarks and policy implications are summarized in the final section.

2. Data Description, Empirical Framework, and Econometric Technique

One plausible way to identify the effect of FDI on the quality of domestic products is by using two cohorts of firms, one that invested and one did not invest abroad over the same time period. Due to the difficulty of collecting information for product quality of non-investing firms, this study instead concentrates on the behavior of investing firms and explores the question of what characteristics of FDI firms influence the quality of its domestic products. This paper will focus on firm-specific characteristics as well as firms' globalization behaviors.

The data for investing firms were taken from a survey conducted in 2000 by the Department of Statistics of the Ministry of Economic Affairs on 2051 Taiwanese manufacturing firms that have undertaken outward direct investment. Table 1 displays investing firms' answers to this survey according to industry and region. Among the investing firms, 33.4% of the sample firms believe FDI is beneficial to improvement of domestic product quality while 2.78% of them think that it is harmful to domestic product quality. The other 63.82% of firms answer that quality is unchanged. Why is the reality of the effect of FDI on product quality not consistent with the previous research predictions? This is worth further investigation.

There are two points worth noting from Table 1. First, the effect of FDI on quality improvement seems to vary across industries; it exhibits a stronger positive impact on technology-intensive industries, such as "Computer, Telecommunication, and Visual Audio Products" (40.07%) and "Precision Instrument & Optical Products" (39.13%), while the quality effect of FDI tends to be lesser for industries with standard processes, such as "Petroleum & Coal Products" (0.0%) and "Printing" (16.67%).

Secondly, the quality effect of the expansionary FDI that firms invested in advanced countries (including the U.S., Japan, and Europe) seems to be larger than that of the defensive FDI invested in developing and LDCs (including China, South East Asia, Middle and South America, and Africa). From the statistics in Table 1 it is reasonable to argue that the quality effect of FDI is influenced by industry characteristics and the types of FDI. In addition to these influential factors, whether to increase the quality of domestic products should be substantially influenced by the firms' resource allocations between the parent firm and foreign affiliations.

To empirically examine what factors affect the improvement of the quality of domestic products for investing firms, we consider not only the potential influences of firm-

Table 1. Industrial and Regional Distributions of Response on Quality of Domestic Products among Investing Firms

	Improved (%)	Unchanged (%)	Lowered (%)
Total	33.40%	63.82%	2.78%
Industry			
1 Food and Beverages	21.57	76.47	1.96
2 Textiles Mills	35.44	60.76	3.80
3 Wearing Apparel & Clothing Accessories	34.00	58.00	8.00
4 Leather, Fur & Related Products	20.00	74.00	6.00
5 Wood & Bamboo Products	29.17	62.50	8.33
6 Furniture	34.78	60.87	4.35
7 Pulp, Paper & Paper Products	29.17	62.50	8.33
8 Printing	16.67	75.00	8.33
9 Chemical Material	17.24	81.03	1.72
10 Chemical Products	33.33	65.33	1.33
11 Petroleum & Coal Products	0.00	100.00	0.00
12 Rubber Products	34.38	65.63	0.00
13 Plastic Products	32.99	62.89	4.12
14 Non-metallic Mineral Products	20.45	79.55	0.00
15 Basic Metal	31.11	68.89	0.00
16 Fabricated Metal Products	26.45	71.90	1.65
17 Machinery & Equipment	37.56	59.02	3.41
18 Computer, Telecommunication, and Visual and Audio Products	44.07	54.92	1.02
19 Electronic Parts & Components	32.51	65.02	2.47
20 Electrical Equipment	36.78	61.49	1.72
21 Transport Equipment	27.42	70.16	2.42
22 Precision Instrument & Optical Products	39.13	57.97	2.90
23 Miscellaneous Manufacturing	33.93	59.82	6.25
Region			
US	50.49	49.02	0.49
Japan	34.62	65.38	0.00
Europe	52.63	47.37	0.00
China	32.10	64.58	3.32
South East Asia	26.93	69.11	3.96
Middle and South America	18.18	72.73	9.09
Africa	0.00	100.00	0.00

specific variables, industrial characteristics, but also the firm's globalization behaviors, which include FDI types, foreign-based activities, and production networks. We then specify the empirical equation:

$$Quality_i = \beta_0 + \beta_1 \ln(SIZE_i) + \beta_2 \ln(RD_i) + \beta_3 \ln(CAPINT_{it}) + \beta_4 FDID_i + \beta_5 FRDR_i + \beta_6 FEMPR_i + \beta_7 NET1_i + \beta_8 NET2_i + u_i, \quad (1)$$

where $Quality_i$ is a dummy variable of three categories for investing firm i. It is equal to 1 if the quality of domestic products is improved; it is equal to 2 if quality is lowered and is equal to 0 when the quality is unchanged.

In terms of explanatory variables, we first include firm-specific characteristics that have potential impacts on the improvement of quality, since the choice of product quality is one of important decision variables for a firm whether it invests abroad or not. The size of the firm is measured as the logarithm of employment, ln(*SIZE*). Whether large firms have remarkable advantages in supporting the improvement of quality is unclear theoretically, and therefore there is no prior expectation on the estimated sign for firm size[8]. The research and development (R&D) spending, in logarithm, ln(*RD*), should be the most important variable in the quality equation. Intuitively, the aim of R&D is to develop new products or improve the quality of products[9]. We then expect a positive effect of R&D on quality improvement. The variable *CAPINT* denotes the capital intensity, in logarithm, ln(*CAPINT*), which is measured as the ratio of fixed capital to employees. This variable is considered to reflect the essential feature of production: a high (or low) capital–employee ratio reveals that the firm's production is more capital (or labor) intensive and usually enables it to produce high (or low) quality products within an industry[10].

Theoretical literature on FDI argues that FDI can serve as an effective method to organize both domestic and foreign production lines such that it would be beneficial for investing firms to pay attention to developing new and high-quality products in home countries. However, as shown in Table 1, 63.82% of investing firms think that the quality of domestic products is unaffected by FDI behavior. Therefore, whether product quality is improved through FDI should be related to the characteristics of firms'

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[8] Although there is no theoretical and empirical literature to examine the relationship between firm size and product quality, research on the relationship between firm size and growth is plentiful. The empirical evidence is mixed. For example, Singh and Whittington (1975) find a positive relationship, Variyam and Kraybill (1992) find a negative relationship, and Hymer and Pachigian (1962) find no noticeable relationship.

[9] In the trade literature, Faruq (2006), using panel data on US imports from 58 countries, finds that R&D activities have significant positive impacts on the export of high-quality differentiated goods. Meanwhile, in order to explain the determination of import volumes for both Germany and the United Kingdom, Anderton (1999) finds that product quality proxied by relative R&D and patenting activity plays an important role.

[10] Although using country-level data instead of firm-level data, Faruq (2006) finds that countries with larger capital stock per worker tend to produce and export higher quality products.

globalization behaviors. In this paper, we consider three behaviors, including FDI types, foreign-based activities, and network relationship between parent firms and foreign affiliates.

The FDI type (*FDID*) is a dummy that is equal to 1 if FDI is expansionary and 0 if it is defensive. Investment in developed countries is well recognized as a method to acquire advanced technologies (Kogut and Chang 1991; Neven and Siotis 1996; Chen and Yang 1999). Although defensive FDI may also enable investing firms to focus on producing high-quality products due to the moving-up force (Lu 2007), the expansionary FDI should be more helpful in improving product quality through raising investing firms' technological capability[11].

The two variables *FRDR* and *FEMPR* capture foreign-based activities. *FRDR* represents the ratio of foreign R&D expenditures to total R&D expenditures. R&D effort is the major driving force for developing new products and improving product quality. If R&D resources are allocated more to foreign affiliates located in developing countries, it may be inferred that the parent company focuses more on marketing or distribution in overseas markets than on production at home. It is therefore less likely to improve the quality of products produced at home. However, if R&D resources are allocated more to foreign affiliates located in developed countries, it may be implied that the quality of products produced at home can be improved from spillover from foreign affiliates R&D. Thus, the estimated coefficient for FRDR is expected to be positive.

The *FEMPR,* the ratio of foreign employees to total employees, reflects how production is internationally allocated. One of the important motivations for the defensive FDI is to move the production lines of labor-intensive products to countries that possess labor costs that are relatively lower than those in the home country. Is defensive FDI complementary to and incline to expand domestic production, or does it substitute for and tend to hollow out domestic production? Incompatible answers are given to this question[12] . If a complementary relationship exists, the impetus to move to developing countries is not just the pull of cost-seeking but also the push created by the introduction of superior domestic products (Lu 2007).

However, if a substitutionary relationship holds, the domestic production is hollowed out and it is less likely to improve the product quality at home. Thus, the estimated coefficient for FEMPR is expected to be indeterminate.

Finally, two network relationships between parent company and foreign affiliates are

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[11] By using 1256 FDI projects that were approved by the Taiwan government between 1986 and 1991 and total amount of investment reaching US$4.7 billion, Chen and Ku (2000) demonstrate empirically that both expansionary FDI and defensive FDI are helpful to the survival of firms. However, the former has the additional beneficial of contributing to the sales growth of investing firms at home while the latter is neutral to sales growth.

[12] Stevens and Lipsey (1992) state both are substitutes, whereas Desai *et al.* (2005) consider them complements. By using time series data, Herzer and Schrooten (2008) show that US outward FDI is complementary to its domestic investment in the long run, while in Germany, both are complements in the short run and are substitutes in the long run.

included in the empirical specification. *NET1* denotes the change of the share of export orders that is exported from Taiwan. Export-led growth indeed has been a successful strategy since 1958 (Chu 1988). Over the past decades, the share of export orders exported from Taiwan's parent companies has gradually decreased while investing firms exported directly from host countries, especially China, has increased.

According to the report from Taiwan's Ministry of Economic Affairs in 2003, the share of export orders delivered from Taiwan before 1990 was nearly 100%. The share began to decrease in the early 1990s. It was 85.67% in 1998 and approached 76.12% in 2001. Such dramatic share decreases, as demonstrated in Liu *et al.* (2004), reveal that Taiwanese firms outsource a certain percentage of export orders to foreign subsidiaries or foreign firms. Taiwanese firms adopt outsourcing primarily to reduce production cost[13]; this shows the deterioration of Taiwan's comparative advantage in certain or all stages of production.

However, the share of export orders delivered from Taiwan increased again after this long-term decrease because Taiwanese firms regained some comparative advantage that enabled them to overcome high production costs in Taiwan. These emerging comparative advantages could come from higher quality products, new products, or more functions that cannot be performed in the host countries, especially in developing countries. In such a case, one would expect the estimated coefficient for *NET1* to be positive.

The variable *NET2* represents the change of the share of foreign affiliates' production resold to the home market in Taiwan. This *reverse import*, a term employed by Bayoumi and Lipworth (1997), was discussed by Vernon (1966) and Xing and Zhao (2008) under the product cycle framework and the new trade theory framework, respectively, and was empirically examined by Liu and Huang (2006) using Taiwanese firm data.

It can be regarded as a proxy of intrafirm trade. When foreign affiliates in the south export products back to home markets, parent companies can use the spare domestic capacity that had formerly been used to produce labor-intensive, low value–added products to produce new, capital-intensive, high-quality products.

As shown in Liu and Huang (2006), foreign production has no significant substitution effect on domestic production when reverse imports are taken into account. Their empirical evidence further confirms that reverse import is a global integration strategy that enables a multinational firm to reduce transaction cost and to augment its comparative advantages from moving up. Therefore, we expect a positive effect of *NET2* on the improvement of product quality.

Table 2 compiles the variable definitions and basic statistics for these variables.

Because the dependent variable is a discrete variable, a classical linear estimation model is inadequate. For variables for which there are more than two discrete choices, the multinomial logit model provides a good alternative.

[13] The other motivations for outsourcing include requests of foreign buyers, the needs for flexibility and secure intermediate inputs, and the advantage of preferential tariffs.

In the multinomial logit model the conditional probability density function for event *j* is shown in Equation (2):

$$\text{Prob}(event \quad j \quad occurs) = \frac{e^{\beta_j' X_i}}{\sum_{k=0}^{J} e^{\beta_k' X_i}}, \; j = 0, 1, \ldots, J, \qquad (2)^{14}$$

where X_i is a vector of explanatory variables, β_j and β_k are coefficient vectors and there are J+1 choices. Therefore, we use the maximum likelihood method to execute the estimating procedure for Equation (1).

Table 2. Variable Definitions and Summary Statistics

Variable	Definition	Mean (S.D)
Quality (Change of product quality)	A discrete variable, 0 if quality unchanged, 1 if quality improved, 2 if quality lowered	0.39 (0.54)
SIZE (Firm size)	The number of employees	983 (6159)
RD (R&D expenditures)	The research and development spending (NT$ thousands)	39161 (236466)
CAPINT (Capital intensity)	The ratio of fixed capital to employees (NT$ thousands per person)	1527 (22768)
FDID (FDI type)	A dummy variable, 1 for expansionary FDI (such as the US, Japan, and Europe), 0 for defensive FDI (such as China, South East Asia, Middle and South America, and Africa)	0.12 (0.33)
FRDR (Foreign R&D ratio)	The ratio of foreign R&D expenditures to total R&D expenditures (%)	11.78 (18.70)
FEMPR (Foreign employee ratio)	The ratio of foreign employees to total employees (%)	37.86 (34.02)
NET1 (Export order network)	Change of the share of export orders that is exported from home country, a dummy variable, 1 if increased and 0 if others	0.50 (0.50)
NET2 (Resold network)	Change of the share of foreign affiliates' sales that is resold to home country, a dummy variable, 1 if increased and 0 if others	0.31 (0.46)

[14] Please see Chapter 19 in Greene (2000) for a theoretical discussion of the multinomial logit model.

3. Empirical Results

3.1. Basic Model

Because there is theoretical discussion on why product quality improves after a firm invests abroad, we first separate the quality variable as a binary variable equal to 1 if product quality is improved and then employ the logit model to estimate the effect of FDI on potential product quality. Table 3 documents a series of estimation results.

Table 3. Logit Model Estimation for Product Quality Improvement

	Model (1)	Model (2)	Model (3)	Model (4)
Constant	−1.011***	−0.995***	−1.229***	−1.214***
	(0.190)	(0.190)	(0.197)	(0.198)
ln(SIZE)	0.001	−0.38E-03	−0.024	−0.027
	(0.034)	(0.035)	(0.039)	(0.040)
ln(RD)	0.036***	0.031***	0.025**	0.023**
	(0.011)	(0.011)	(0.012)	(0.013)
ln(CAPINT)	0.032**		0.032**	
	(0.014)		(0.015)	
ln(CAPINT) × D1		0.030		0.035
		(0.021)		(0.022)
ln(CAPINT) × D2		0.056***		0.045**
		(0.018)		(0.019)
ln(CAPINT) × D3		0.012		0.014
		(0.023)		(0.023)
ln(CAPINT) × D4		0.012		0.025
		(0.024)		(0.025)
FDID			0.711***	0.686***
			(0.147)	(0.150)
FRDR			0.003	0.003
			(0.003)	(0.003)
FEMPR			0.004**	0.004**
			(0.002)	(0.002)
NET1			0.463***	0.461***
			(0.110)	(0.110)
NET2			0.140	0.131
			(0.139)	(0.139)
Log-likelihood	−1294.05	−1291.75	−1269.83	−1268.99

Note: Figures in parentheses are standard deviations. "***" and "**" indicate significance at the 1% and 5% statistical levels, respectively. D1, D2, D3, and D4 are broad industry dummies: D1 is Metal & Machinery industry (including industries 15, 16, 17 and 21), D2 is Information & Electronic industry (including industry 18, 19, 20 and 22), D3 is Chemical industry (including industry 4, 7, 8, 9, 10, 12, 11, and 13) and D4 is Food, Textile and other industry (including industry 1, 2, 3, 5, 6, 14 and 23).

Columns (1) and (2) are specified as the benchmark models; only firm-specific characteristics, as explanatory variables are included in model (1) and industry dummies (D1–D4) are further considered in model (2). The estimated coefficient for firm size is not significantly different from zero, implying that firm size does not matter to firms' ability to improve product quality. Alternatively, whatever a firm size is, the product quality can be improved if the firm devotes more efforts to R&D. This argument can be clearly verified from the estimated coefficients of ln*RD* that is positive and significantly at 1% statistical level in models (1) and (2). Moreover, the significantly positive coefficient on ln*CAPINT* shows that a firm with higher capital intensity tends to have a higher probability of improving its product quality, especially within the Information & Electronic Industry, as shown in model (2). Both estimation results on ln*RD* and ln*CAPINT* seem to be consistent with the outcomes recorded in trade literature (Farug 2006; Anderton 1999).

After controlling firm-specific characteristics, the main issue we are concerned with is, what characteristics of investing firms' globalization behaviors influence the probability of improving product quality? The estimations are shown in models (3) and (4) of Table 3. Comparing the results obtained in models (1)–(2) and (3)–(4), one can clearly see that the signs and impacts of estimated coefficients for firm-specific characteristics of (1) and (2) are quite similar to each other, as are those of (3) and (4). As for the potential impacts of firms' globalization behaviors, the significantly positive coefficient for *FDID* reveals that, relative to the defensive FDI, the expansionary FDI (i.e., the FDI in advanced countries) tends to have a higher probability of improving the quality of domestic products. This result is economically intuitive, because one of major objectives for expansionary FDI is to acquire advanced technology and management knowledge from developed countries, and it subsequently is beneficial for investing firms to improve their technological capability and product quality. Alternatively, defensive FDI is expected to be a way of reorganizing production lines according to the product life cycle theory of FDI. However, defensive FDI perhaps serves as a survival strategy (Chen and Ku 2000) rather than as a way of reorganizing production lines for some investing firms, and that is why the impact of defensive FDI on the probability of improving product quality is limited.

The estimated coefficient for *FRDR* is positive. It shows that an increase in the ratio of foreign R&D to total R&D increases has a positive spillover effect from foreign affiliates to the parent firm; and this spillover helps investing firms improve product quality, though this effect is not significant[15]. We find that the coefficient for *FEMPR* has positive and significant impact at the 5% statistical level in models (3) and (4). A higher value for *FEMPR* can be regarded as an allocation of human resource that distributes labor-intensive productions to foreign affiliates. This allocation enables parent firms to concentrate resources on introducing superior products in the home countries. Thus, the estimated coefficient for *FEMPR* is positive as expected. This result seems to

[15] By using panel data and time series approaches, Zeng *et al.* (2009) demonstrated that technology spillover from FDI has negative effects on indigenous firms in Shanghai, China.

show that there exists a positive (complementary) relationship between outward FDI and home production (and hence product quality). That outward FDI hollows out Taiwan industries is not supported.

Finally, the estimates for network variables show that both the coefficients for *NET*1 and *NET*2 are positive, though only the former has a statistically significant impact on the probability of quality improvement. The result indicates that when the change of the share of export orders that is exported from Taiwan increases (*NET*1), the firm's Taiwan-made product seems to exhibit higher quality. As for the effect of intrafirm trade that is proxied by NET2, it is positive, as expected, though it is less significant. This result seems to support the argument that foreign production has no significant substitution effect on domestic production when reverse imports are taken into account (Liu and Huang 2006).

3.2. Multinomial Logit Estimations

The estimates of the multinomial logit model for equation (1), which are presented in Table 4, provide further insights into the effect of firms' globalization behaviors on the quality change of domestic productions.

Table 4. Multinomial Logit Estimation for Product Quality Change

	Model (5–1)	Model (5–2)	Model (6–1)	Model (6–2)
	Quality Improved	Quality Degradation	Quality Improved	Quality Degradation
Constant	−0.934***	−2.338***	−1.222***	−1.968***
	(0.191)	(0.506)	(0.202)	(0.534)
ln(SIZE)	−0.002	−0.076	−0.042	−0.380***
	(0.034)	(0.098)	(0.040)	(0.122)
ln(RD)	0.033***	−0.064*	0.029**	0.011
	(0.011)	(0.034)	(0.012)	(0.038)
ln(CAPINT)	0.030**	−0.043	0.031**	−0.003
	(0.014)	(0.033)	(0.015)	(0.038)
FDID			0.720***	−1.058
			(0.147)	(1.032)
FRDR			0.003	0.004
			(0.003)	(0.006)
FEMPR			0.004**	0.021***
			(0.002)	(0.005)
NET1			0.371***	−0.793**
			(0.100)	(0.324)
NET2			0.107	0.243
			(0.107)	(0.298)
Log-likelihood	−1525.91		−1485.50	

Note: Figures in parentheses are standard deviations. "***" and "**" indicate significance at the 1% and 5% statistical levels, respectively.

Comparing results obtained in model (5–1) and model (1), after controlling for the alternative choice of lowering product quality, we see that the estimated impacts of firm-specific characteristics on product quality improvement are very similar. That is to say, a firm with higher R&D expenditure and more capital intensity tends to have a higher propensity to improve the quality of its domestic products. In regard to firms' globalization behaviors, a comparison of model (6–1) compared and model (3) shows that expansionary FDI leads to a greater increase in the probability of quality improvement than does defensive FDI. Moreover, the coefficients for *FEMPR* and *NET*1, 0.004 and 0.371, respectively, also exhibit a significantly positive impact on the probability of quality improvement, revealing that the reallocation of labor and the existence of production networks between foreign affiliates and parent companies perhaps enable investing firms to concentrate resources on improving the quality of domestic products.

Alternatively, what are the potential influences that degrade the quality of investing firms' domestic products? Since there are no theoretical discussions on this issue, we predict that the determinants of quality improvement and quality degradation should exhibit symmetric influences. One can clearly see that most of the estimated coefficients in models (5–2) and (6–2), which are drawn from the estimates of quality degradation in models (5–1) and (6–1), appear to have effects opposite to their impacts on quality improvement. There are also several points worth noting. First, both firm size and R&D expenditures tend to significantly reduce the probability of quality degradation for the investing firms. Second, the estimated impacts of *FEMPR* on both quality improvement and degradation are significantly positive. Third, the coefficients on *NET*1 are significantly positive for quality improvement and negative for quality degradation.

It may seem hard to illustrate the above results regarding the effects of firm size (SIZE) and FEMPR on product quality. However, further data analysis reveals some economic interpretations. The statistical data[16] show that firms in labor-intensive industries (such as Wearing Apparel & Clothing Accessories, Wood & Bamboo Products, Pulp, Paper & Paper Products and Printing), that invest in developing countries (such as Middle and South America, South East Asia, and China), and that are small tend to have greater quality degradation. Moreover, the percentage of firms exhibiting quality degradation is positively related to the ratio of foreign sales to total sales, positively related to the ratio of foreign R&D to total R&D, positively related to the ratio of foreign employees to total employees, and negatively related to change of reverse imports. This statistical evidence demonstrates that large firms possessing more resources tend to take advantage of FDI, balance production in both domestic and foreign markets, and possibly upgrade product quality in both markets, while small firms lacking resources incline to locate a greater or even all production abroad. These small firms may maintain only an administrative office and shut down (or degrade) domestic production in Taiwan. Therefore, when resource constraint is under consideration, a relatively large (or small) firm is likely to have a lower (or higher) probability of degrading the quality of its domestic products, as shown in model (6–2).

[16] A statistical summary can be obtained from the authors on request.

Finally, one possible interpretation for the positive effect of FEMPR on product quality is that the foreign employee ratio–product quality nexus is nonlinear. That investing firms allocate more employees to foreign affiliates can be attributed to the reorganization of labor-intensive and technology-intensive production between home and host countries because it improves the quality of domestic products. However, it could be that the high share of foreign employees is a pure survival strategy of cost-seeking and domestic production is being replaced by outward investment and thus hollowed out. Therefore, it is overall harmful to the product quality.

3.3. Marginal Effects of Determinants

Though the signs of the estimated coefficients exhibited in Tables 3 and 4 show their positive or negative effects on quality change, government interest should lie in determining the marginal effect of change in the explanatory variables. Outward FDI is usually regarded as one of the culprits in the rise in unemployment, and it could cause industrial hollowing out. However, if FDI is necessary for industry restructuring that enables firms in investing countries to concentrate resources on improving product quality and developing new products, policy makers must understand the marginal effects of firms' specific characteristics and globalization behaviors on the improvement of product quality.

Table 5 displays the marginal effects of changes in explanatory variables on the conditional probability of quality improvement derived from both logit and multinomial logit models.

Among the variables of firm-specific characteristics, both R&D expenditure and capital intensity (CAPINT) exhibit high marginal effects on product quality. A 1% increase in R&D expenditure (or in capital intensity) results in an increase of about 0.79% (or 0.70%) in the probability that quality will be improved. The results show that, whether

Table 5. Marginal Effects of Regressors on Quality Improvement

	Logit Model		*Multinomial Logit Model*	
	(1)	(2)	(3)	(4)
ln(SIZE)	0.229E-03	−0.539E-02	0.862E-04	−0.747E-02
ln(RD)	0.790E-02***	0.543E-02**	0.794E-02***	0.630E-02**
ln(CAPINT)	0.705E-02**	0.713E-02**	0.692E-02**	0.695E-02**
FDID		0.168***		0.166***
FRDR		0.620E-03		0.726E-03
FEMPR		0.822E-03**		0.872E-03***
NET1		0.105***		0.087***
NET2		0.031		0.022

Note: "***" and "**" indicate significance at the 1% and 5% statistical levels, respectively.

a firm invests abroad or no, it must devote effort to R&D activity and enhance capital intensity so that it can improve product quality, develop new products (usually higher quality), and make its production more efficient. In Taiwan, the government ever since the early 1980s has undertaken several measures to actively support industrial R&D and automated production, aiming to improve firms' technological capabilities to meet the challenge of global competition in the current high-tech era.

As for the marginal effects of firms' globalization behaviors on product quality, there are two important points worth emphasizing. First, relative to defensive FDI toward developing and LDCs, firm-established foreign affiliates in developed countries (i.e., the result of expansionary FDI) have a 16.7% higher probability of improving the quality of their domestic products. From a policy perspective, this result implies that the government should consider using the same measures it uses to promote R&D spending and automated production to encourage firms to import advanced technologies for the purpose of promoting technological development. Assisting firms in investing in developed countries is another way to raise the technological capability of domestic producers. Second, the marginal effect of *NET*1 on quality improvement is near 10%, implying that if the investing firms continue to increase the share of export orders that is exported directly from the parent company, this distribution of productions through FDI can be an efficient way to improve product quality.

4. Conclusion

The upsurge of outward FDI is sometimes regarded as the main cause of industry hollowing, and it is also regarded as one cause of rising unemployment in many countries. However, theoretical and conceptual literature on FDI argues that outward FDI is an effective way for firms to reorganize production activities to attain competitive advantage through acquiring advanced technology from or switching low-quality, labor-intensive production to foreign affiliates. It then claims that outward FDI is beneficial, enabling investing firms to concentrate resources on developing new and high-quality products in parent firms. Does outward FDI really enable firms to improve the quality of domestic products? What factors enable investing firms to improve product quality? Empirical studies do not yield clear answers to these questions.

Based on a survey of Taiwan's outward FDI activity, the preliminary statistical analysis shows that only 33.4% of investing firms benefit from FDI, implying that a firm's specific characteristics and activities taken in response to globalization determine whether outward FDI benefits product quality. This paper empirically investigates the effects on product quality change from firms' globalization behaviors, including FDI types, foreign-based activities, and network relationships between parent firm and foreign affiliates.

We have employed the techniques of logit and multinomial logit models. The empirical findings can be summarized as follows: First, whether a firm invests abroad or not, the quality effect of R&D is essential and direct; it is the main force for improving the quality of domestic products. Second, outward FDI actually exhibits an indirect effect

on improving product quality. Relative to defensive FDI, the strategy of expansionary FDI is beneficial to improving product quality, allowing firms in the host countries to learn advanced technologies from firms from guest countries. Third, the reallocation of production and export between foreign affiliates and the parent company can serve as an effective way for investing firms to focus on improving the quality of domestic products.

Acknowledgement

We would like to thank the journal's editor, the assistant of editor-in-chief Lina Bartkiene and two anonymous referees for their helpful and constructive suggestions. The hospitality of Professor Donald Hester and the Department of Economics, University of Wisconsin-Madison, where part of this research was conducted by Yungho Weng as a visiting scholar in 2009, is gratefully acknowledged. We also thank Cindy Severt, Senior Special Librarian in Data and Information Services Center at University of Wisconsin-Madison, for providing excellent data for this research. Financial support by Taiwan's National Science Council, grant number NSC 92-2415-H-004-006, is gratefully acknowledged. The usual disclaimer applies.

References

Anderton, B. 1999. Innovation, product quality, variety, and trade performance: an empirical analysis of Germany and the UK, *Oxford Economic Papers* 51(1): 152–167. doi:10.1093/oep/51.1.152

Bayoumi, T.; Lipworth, G. 1997. Japanese foreign direct investment and regional trade, *Finance and Development* 34(3):11–13.

Berry, S.; Waldfogel, J. 2005. *Product Quality and Market Size*. Yale University, Department of Economics, working papers.

Blomstrom, M.; Fors, G.; Lipsey, R. 1997. Foreign direct investment and employment: home country experience in the United State and Sweden, *Economic Journal* 107: 1787–1797. doi:10.1111/1468-0297.00257

Bose, P.; Kemme, D. M. 2002. Liberalization, entry and product quality in transition economies, *Economic Systems* 26(4): 353–366. doi:10.1016/S0939-3625(02)00060-2

Brock, G.; Urbonavicius, S. 2008. Regional FDI growth in Lithuania, 1996–2003, *Transformations in Business & Economics* 7(1): 80–88.

Calantone, R.; Knight, G. 2000. The critical role of product quality in the international performance of industrial firms, *Industrial Marketing Management* 29(6): 493–506. doi:10.1016/S0019-8501(00)00124-3

Carlos, J. 2003. The effect of cross-country differences in product quality on the direction of international trade 2002, in *Research Seminar in International Economics*, University of Michigan, working papers, 493.

Chatterjee, T.; Raychaudhuri, A. 2004. Product quality, income inequality and markets structure, *Journal of Economic Development* 29: 51–84.

Chen, J. R.; Yang, C. H. 1999. Determinants of Taiwanese foreign direct investment: comparison between expansionary FDI and defensive FDI, *Taiwan Economic Review* 27: 215–240.

Chen, T. J.; Ku, Y. H. 2000. The effect of foreign direct investment on firm growth: the case of Taiwan's manufacturers, *Japan and the World Economy* 12(2): 153–172. doi:10.1016/S0922-1425(99)00035-3

Chen, T. J.; Chen, Y. P.; Ku, Y. H. 1995. Taiwan's outward direct investment: has the domestic industry been hollowed out? in *The New Wave of Foreign Direct Investment in Asia*. Tokyo: Nomura Research Institute; Singapore: Institute of Southeast Asian Studies, 87–110.

Chu, W. W. 1988. Export-led growth and import dependence: the case of Taiwan, 1969–1981, *Journal of Development Economics* 28(2): 265–276. doi:10.1016/0304-3878(88)90064-8

Desai, M. A.; Foley, C. F.; Hines, J. R. 2005. Foreign direct investment and the domestic capital stock, *American Economic Review* 95(2): 33–38. doi:10.1257/000282805774670185

Dunning, J. H. 1988. Toward an eclectic theory of international production: a restatement and some possible extensions, *Journal of International Business Studies* 19(1): 1–31. doi:10.1057/palgrave.jibs.8490372

Dunning, J. H. 2002. Relational asset, network and international business activity, in J. H. Dunning. *The Selected Essays of John H. Dunning: Theories and Paradigms of International Business Activities*. MA: Edward Elgar, 476–501.

Feenstra, R. 1984. Voluntary export restraint U.S. autos, 1980–81: quality, employment, and welfare effects, in R. Baldwin; A. Krueger. *The Structure and Evolution of Recent U.S. Trade Policies*, Chicago: The University of Chicago Press, 35–65.

Faruq, H. 2006. *New Evidence on Product Quality and Trade.* Center for Applied Economics and Policy Research, Economics Department, Indiana University, Bloomington, CAEPR working papers: 2006-019, 1–39.

Gottschalk, S. D. 2002. Product quality and the international location of manufacturing industry, *Journal of Economic Integration* 17: 363–376.

Greene, W. H. 2000. *Econometric Analysis*. New Jersey: Prentice Hall International, Inc.

Grubert, H.; Mutti, J. 1991. Taxes, tariffs and transfer pricing in multinational corporate-decision making, *Review of Economics and Statistics* 73(2): 285–293. doi:10.2307/2109519

Hallak, J. C. 2006. Product quality and the direction of trade, *Journal of International Economics* 68(1): 238–265. doi:10.1016/j.jinteco.2005.04.001

Head, K.; Ries, J. 2001. Overseas investment and firm exports, *Review of International Economics* 9(1): 108–122. doi:10.1111/1467-9396.00267

Head, K.; Ries, J. 2002. Offshare production and skill upgrading by Japanese manufacturing firms, *Journal of International Economics* 58(1): 81–105. doi:10.1016/S0022-1996(01)00161-1

Herzer, D.; Schrooten, M. 2008. Outward FDI and domestic investment in two industrialized countries, *Economics Letters* 99(1): 139–143. doi:10.1016/j.econlet.2007.06.014

Highfill, J. K.; Scott, R. C. 2006. Product quality and market size: price competition between a large and small country, *Global Economy Journal* 6(1):1–22. doi:10.2202/1524-5861.1104

Hur, J. 2006. Preferential tariff policy, product quality and welfare, *Hitotsubashi Journal of Economics* 47(2): 197–217.

Hymer, S.; Pashigian, P. 1962. Firm size and the rate of growth, *Journal of Political Economy* 70(6): 556–569. doi:10.1086/258716

Kabiraj, T.; Roy, S. 2006. Effects of liberalization on domestic product quality, *Journal of Economic Integration* 21: 273–293.

Kogut, B.; Chang, S. J. 1991. Technological capabilities and Japanese foreign direct investment in the United States, *Review of Economics and Statistics* 73(3): 401–413. doi:10.2307/2109564

Kojima, K. 1973. A macroeconomic approach to foreign direct investment, *Hitotsubashi Journal of Economics* 14: 1–21.

Kojima, K. 1978. *Direct Foreign Investment: a Japanese Model of Multinational Business Operations*. New York: Praeger.

Lipsey, R. E.; Weiss, M. Y. 1984. Foreign production and exports of individual firms, *Review of Economics and Statistics* 66(2): 304–308. doi:10.2307/1925832

Liu, B. J.; Huang, F. M. 2006. Outward direct investment, reverse import, and domestic production: evidence from Taiwanese manufacturing firms, *Hitotsubashi Journal of Economics* 46(1): 65–84.

Liu, B. J.; Lu, A. Y.; Tung, A. C. 2004. *Manufacturing firms' outsourcing behavior and its determinants:* the case of Taiwan, paper presented at the 2004 Taiwan Economic Association Conference, Taipei.

Lu, C. H. 2007. Moving up or moving out? A unified theory of R&D, FDI, and trade, *Journal of International Economics* 71(2): 324–343. doi:10.1016/j.jinteco.2006.04.003

Neven, D.; Siotis, G. 1996. Technology sourcing and FDI in the EC: an empirical evaluation, *International Journal of Industrial Organization* 14(5): 543–560. doi:10.1016/0167-7187(95)00510-2

Ozawa, T. 1979. International investment and industrial structure: new theoretical implications from the Japanese experience, *Oxford Economic Paper* 31(1): 72–79.

Pazienza, P.; Vecchione, V. 2009. Preliminary investigation of the determinants of FDI distribution in Italy, *Journal of Business Economics and Management* 10(2): 99–107. doi:10.3846/1611-1699.2009.10.99-107

Phillips, L.; Chang, D.; Buzzell, R. 1983. Product quality, cost position and business performance – a test of some key hypotheses, *Journal of Marketing* 47(2): 26–43. doi:10.2307/1251491

Rodrik, D. 1988. *Industrial Organization and Product Quality: Evidence from South Korean and Taiwanese Exports*. NBER Working Paper Series, No. 2722.

Rugman, A. M. 1990. *Multinationals and Canada-United States Free Trade*. Columbia, SC: University of South Carolina Press.

Sevensson, R. 1996. Effects of overseas production on home country exports: evidence based on Swedish multinationals, *Weltwirtschaftliches Archiv – Review of World Economics* 132(2): 304–329.

Singh, A.; Whittington, G. 1975. The size and growth of firms, *Review of Economic Studies* 42(1): 15–26. doi:10.2307/2296816

Stevens, G. V. G.; Lipsey, R. E. 1992. Interactions between domestic and foreign investment, *Journal of International Money and Finance* 11(1): 40–62. doi:10.1016/0261-5606(92)90020-X

Tvaronavičienė, M.; Grybaitė, V.; Korsakienė, R. 2008. Foreign capital destinations: Baltic States versus India, *Journal of Business Economics and Management* 9(3): 227–234. doi:10.3846/1611-1699.2008.9.227-234

Tvaronavičienė, M.; Kalašinskaitė, K. 2010. Whether globalization in form of FDI enhances national wealth: empirical evidence from Lithuania, *Journal of Business Economics and Management* 11(1): 5–19. doi:10.3846/jbem.2010.01

Ucal, M.; Özcan, K. M.; Bilgin, M. H.; Mungo, J. 2010. Relationship between financial crisis and foreign direct investment in developing countries using semiparametric regression approach, *Journal of Business Economics and Management* 11(1): 20–33. doi:10.3846/jbem.2010.02

Variyam, J.; Kraybill, D. 1992. Empirical evidence on determinants of firm growth, *Economics Letters* 38(1): 31–36. doi:10.1016/0165-1765(92)90157-T

Vernon, R. 1966. International investment and international trade in the product cycle, *Quarterly Journal of Economics* 80: 190–207. doi:10.2307/1880689

Vissak, T. 2009. The impact of FDI on host country subsidiaries: three case-stories from Estonia, *Transformations in Business & Economics* 8(1): 34–49.

Xing, Y.; Zhao, L. 2008. Reverse imports, foreign direct investment and exchange rates, *Japan and the World Economy* 20(2): 275–289. doi:10.1016/j.japwor.2006.11.004

Zeng, S. X.; Wan, T. W.; Tam, V. W. Y. 2009. Towards FDI and technology spillover: a case study in China, *Transformations in Business & Economics* 8(1): 50–62.

ĮEINANČIOS TIESIOGINĖS UŽSIENIO INVESTICIJOS IR VIDAUS PRODUKCIJOS KOKYBĖ: EMPIRINIS TYRIMAS

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Santrauka

Remiantis koncepcinių ir teorinių tyrimų rezultatais, įeinančios tiesioginės užsienio investicijos yra veiksmingas būdas vidaus produkcijos kokybei gerinti, tačiau tokiam teiginiui pagrįsti nebuvo atlikti sistemingi tyrimai. Taivanio įeinančių tiesioginių užsienio investicijų veiklos tyrimo statistinės analizės duomenimis, tiesioginių užsienio investicijų iš visų įmonės investicijų įtaka kokybei sudaro tik 33,4 %. Toliau buvo taikoma mikroekonometrinė metodika, siekiant ištirti, kokios rūšies globalizacijos elgsena pagerina vietinės įmonių produkcijos kokybę. Empirinio tyrimo rezultatai parodė, kad, gerinant produkcijos kokybę, plėtros tiesioginės užsienio investicijos yra efektyvesnės nei apsauginės tiesioginės užsienio investicijos. Taip yra todėl, kad jos leidžia šalies vidaus įmonėms sužinoti apie pažangias kitų šalių technologijas. Be to, eksporto perskirstymas tarp užsienio filialų ir pagrindinės įmonės yra veiksmingas būdas investuojančiai įmonei daugiausia dėmesio skirti vidaus produkcijos kokybei.

Reikšminiai žodžiai: įeinančios tiesioginės užsienio investicijos, produkto kokybė, globalizacija, gamybos tinklas.

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