Chapter 7

Empirical Study of the Formation of Internal Innovation Capability and External Linkages in ASEAN Economies

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CHAPTER 7

Empirical Study of the Formation of Internal Innovation Capability and External Linkages in ASEAN Economies

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This paper analyzes how firms in ASEAN countries obtain and accumulate information on technology, know-how, and the market and then assimilate it into their internal capability to promote innovation. In so doing, an index is constructed from various factors related to creating innovation by using AHP (Analytical Hierarchical Process). This index is a proxy of the internal innovation capability of firms. Using this index, how product and process innovation are related to internal capability. Another estimation objective in this paper is to handle the endogeneity problem of variables. This methodological problem is related to reverse correlation between innovation and the internal capability, and we have to prove that the relationship between those variables is causation rather than simple correlation. Coping with these theoretical problems, the treatment model and other methods are utilized to solve the above-mentioned two problems. In addition, this study also uses the propensity score matching (PSM) method to handle so-called "sample selection bias." As a result, we prove the following hypotheses: (1) Internal capability promotes innovation significantly; (2) External linkages, particularly MNC/JC, have an influence on enhancing internal capability; (3) Internal capability affects external linkages, that is, firms with the higher internal capability index tend to have more external linkages; and (4) External linkages have a less significant effect on innovation, as they enhance internal capability and then promote innovation indirectly. Finally, strategic policy measures to promote innovation in ASEAN countries are provided based on these analyses

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1. Introduction

Industrial agglomeration in East Asia has been continuing even after the Lehmann shock, and the economic recovery from the shock in this area has contributed much to that of the global economy. This proves that “decoupling” is plausible. Further agglomeration has been transforming the area from a simple production base to knowledge-based economies. This paper attempts to analyze how firms in this area obtain and accumulate information on technology, know-how, and the market and then assimilate it into their internal capability to create their own products and services, technologies and ideas. In particular, this paper focuses on firms’ capability to create innovation, which can be termed as internal innovation capability. There are many sources for promoting this capability, including technological ability, managerial organization to enhance the flow of information and ideas related to innovation, orientation of top management to create innovation, human resources such as top management, engineers, and workers at the job shop. Moreover, firms in East Asia have been absorbing the necessary technology and information from outside firms, including MNCs, universities, regional research institutions, and business organizations. These external sources are referred to as linkages. Thus, this paper analyzes how these two sources contribute to firms’ innovations, whether these are substitutive or complementary, and in the case of the latter we have to verify how internal capability is affected by linkages.

The concept of internal innovation capability contains many factors, including the level of technology, ability and skills of engineers, managerial ability of top management. Accordingly, it is difficult to identify which factors really contribute to

the realization of innovation. In coping with this, the paper attempts to define an index which is a proxy of the internal innovation capability of firms. In other words, this paper aims to construct an index from various factors related to creating innovation. In so doing, a rigorous analytical method named AHP (Analytical Hierarchical Process) is applied to construct the index. Then, using this index, we estimate how product and process innovation are related to internal capability.

Another estimation objective of this paper is to solve the endogeneity problem of variables. Economic variables used in empirical studies are more or less endogenous variables whose values are determined inside the model. Without a proper estimation method, estimated coefficients tend to have biases. In addition, we also examine a second important methodological problem related to reverse correlation between innovation and the internal innovation capability index or other variables. We have to prove that the relationship between those variables is causation rather than simple correlation. Coping with these theoretical problems, the treatment model and other methods are utilized to solve the above-mentioned two problems.

In addition to the endogeneity problem, this study uses the propensity score matching (PSM) method to handle so-called “sample selection bias,” because only firms with a higher internal capability index might be selected through the survey, or firms could respond arbitrarily and the resulting data from the survey might not be reliable. The PSM method is proposed by Rosenbaum and Rubin (1983), (1985), and developed by Heckman, *et al.* (1997), (1998b) and Heckman *et al.* (1998a). This method enables estimation with less sample selection bias.

The structure of the paper is as follows. After the introduction, we present the construction of an index of internal innovation capability in Section 2. The

methodology of analysis is provided in Section 3, and the results of the estimations are presented in Section 4. Brief conclusions as well as policy recommendations are shown in Section 5.

2. Index of internal innovation capability

Firstly, the definition of internal innovation capability of firms and the construction of an index are presented.

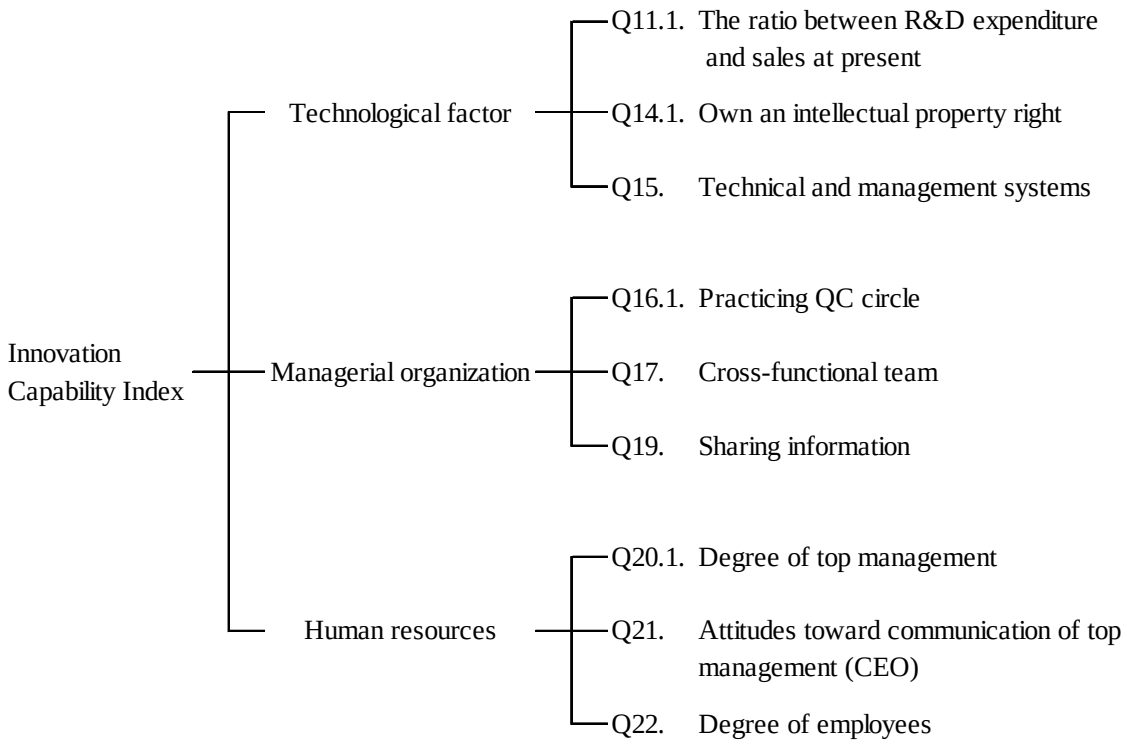
2.1. Definition of Internal Innovation Capability

In the previous ERIA papers (Tsuji and Miyahara, 2010a, 2010b), we mainly focused on the linkage of firms from which new information related to technology, products and the market is obtained. In this paper, on the other hand, we attempt to identify the capability of firms to create innovation according to questions in the questionnaire.

We postulate the following three factors which contribute to innovation: (i) technology; (ii) managerial organization; and (iii) human resources. (i) The technological factor is clearly the basis of innovation. These three constitute the "first layer" and are referred to as first layer factors. Moreover, each of these factors consists of its own detailed sub-factors, which form the "second layer." These sub-factors are called the second layer factors. Let us take the example of (i) the technological factor, which includes the following three second layer factors: (a) ratio of R&D expenditure to sales at present asked as Q11.1.; (b) owning an intellectual property right (Q14.1.); and (c) technical and management systems (Q15). (ii) Managerial organization

indicates whether the managerial organization is designed and functioning to encourage exchange and share information among employees. This first layer factor consists of the following three second layer factors: (d) practicing QC circle (Q16.1); (e) cross-functional team (Q17); and (f) sharing information (Q19). Finally, the first layer factor of human resources is an important factor for engaging in innovation activities as well as for design and managing R&D, which consist of the following three second layer factors: (g) degrees of top management; (h) attitudes toward communication of top management (Q21); and (i) degrees of employees (Q22). Table 1 shows the tree structure of the index and related questions in the questionnaire.

Table 1: Construction of Internal Innovation Capability



2.2. AHP Approach

This paper utilizes AHP to construct the index. The process, which was initiated by Saaty (1980), (1986), attempts to give people's decision-making a numerical value. For example, when making a purchase, on what basis does a consumer decide? AHP formulates the mechanism of such decision-making. It allows us to give a numerical value to vague parts of people's decision-making, with possible application to a wide array of fields. An individual makes a decision based on his/her own criteria. Normally, not one but several evaluation criteria exist, and these often conflict with each other. In a consumer's decision-making process, the "problem" of what to choose comes first, followed by several "alternatives." AHP attempts to comprehend the process of the decision-making, assuming that there are some criteria relating the specific problem and the alternatives. Thus, AHP's approach is to construct an individual's decision-making according to the hierarchic structure.

In order to apply our AHP analysis, we need pair-wise comparisons of all the factors in each layer. That is, taking the value of one factor as one, the value of another factor is measured. To be concrete, scholars or specialists in this filed were asked to choose a number from 1/9, 2/9 …, 8/9, 1, 2, 3 …, 9. If they choose 1, equal importance is placed on two factors. 1/9 (9) implies that its factor is the least (most) important compared to another. Each answer of the pair-wise comparison is termed a "score," which is the basis of weights of factors. The obtained weights of factors of the first and second layers are shown in Table 2.

2.3. Distribution of Capability Index

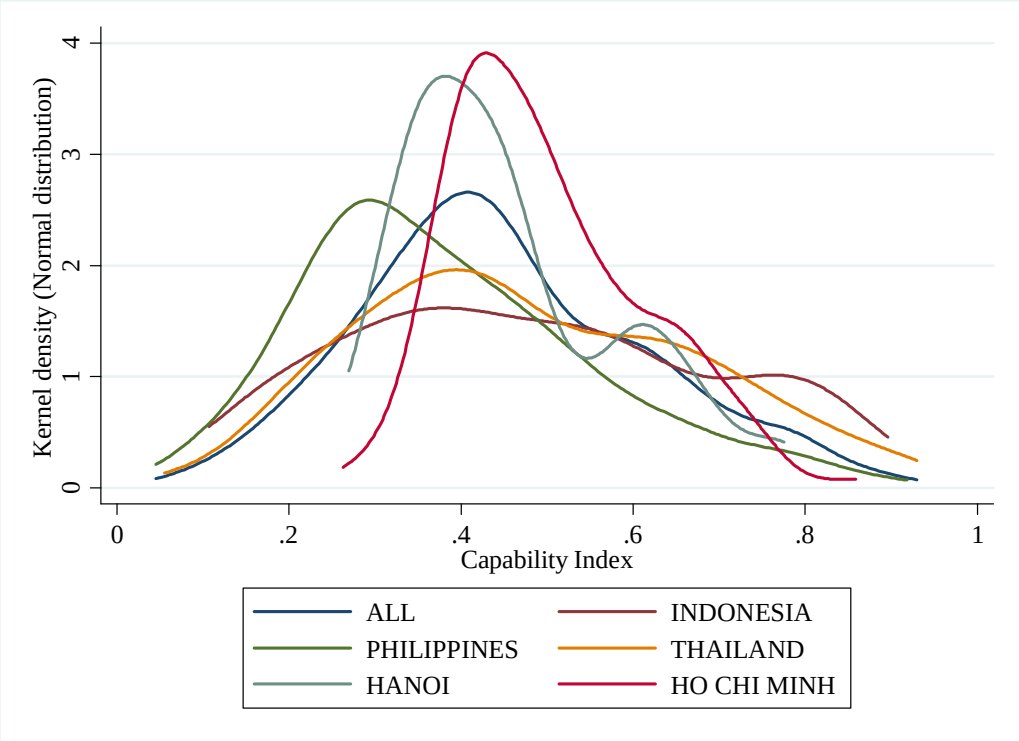
Based on the weights of factors by AHP, the distribution of the internal innovation capability index of the five regions of Indonesia, Thailand, the Philippines, the Ho Chi

Minh City area, and the Hanoi area are shown in Figure 1. The average value of the index of the five areas is 0.449 and the averages of Indonesia, Thailand, the Philippines, the Ho Chi Minh City area, and the Hanoi area are 0.479, 0.479, 0.384, 0.498, and 0.485, respectively. As for the average value of each, the Ho Chi Minh City area has the largest value, while that of the Philippines is lower than the average. The shapes of distribution of the five areas are also different from the five areas' average. Ho Chi Minh City and Hanoi have more concentrate around their averages, while Indonesia and Thailand are flatter than the five areas' average. We will examine what makes these differences among five areas.

Table 2: Weights of Factors by AHP

Technical factor	0.529084637	R&D investment	0.550325432
		Owing property right	0.293328156
		Technical and management systems	0.156346412
Managerial organization	0.253556004	Practicing QC	0.29619297
		Cross-function team	0.351660652
		Sharing of information	0.352146378
Human resources	0.217359359	Career of COE	0.213007622
		Managerial attitude of CEO	0.562255373
		Career of employee	0.224737005

Figure 1: Distribution of Capability Index



3. Methodology of Analysis

Here a rigorous econometric methodology and main hypotheses are explained, in addition to data for estimation.

3.1. General Procedure of Analysis

This study postulates that innovation is enhanced by two main forces inside and outside firms, namely "internal innovation capability" or simply "internal capability" and "external linkages." The former consists of factors prompting innovation by internal forces which were already explained in the previous sections, while the latter represents sources of necessary information for innovation, including information of technology, know-how, the market, consumers, and so on. Those are obtained through networks of customers, suppliers, competitors, universities, local R&D institutions, and so on.

Internal capability and external linkages surely affect the innovation of firms, but these mechanisms must be proved by empirical studies. We term this procedure Step 1, namely:

Step 1: internal capability enhances product and process innovation (C to I).

The next procedure is to examine the relationship between internal capability and external linkages, namely, external linkages enhance firms' internal capability by obtaining new information. On the other hand, the higher internal capability firms achieve, the more other firms approach to start transactions with them. Higher internal capability is a signal of higher technology or a reliable partner of transactions and R&D activities. Thus, we examine whether internal capability promotes more connection with external linkages or external linkages enhance internal capability. Accordingly, there are two steps, namely:

Step 2: external linkages affect internal capability (E to C),

Step 3: internal capability affects external linkages (C to E).

Since C to I is already examined in Step 1, the remaining external capability is analyzed as to whether it affects the promoting of innovation. Therefore, we have the following:

Step 4: external linkages affects innovation (E to I).

In what follows, we analyze these four hypotheses one by one. It should be noted that estimation methods which handle the endogeneity problem are fully applied.

3.2. Situation of Innovation in Different Countries

This paper is based on a survey conducted in November 2010. The questionnaire was sent to firms in Indonesia, Thailand, the Philippines, and the Hanoi area and the

Ho Chi Minh City area in Vietnam. Let us briefly examine the current situation of innovation in these countries and areas. Figures 2, 3, and 4 show the number of firms which achieved five different product innovations and process innovations, namely: Figure 2 is product innovation defined by the change in packages and Figure 3 is the number of developments of a totally new product based on new technologies. Process innovation is shown in Figure 4. These figures show that many firms achieved a simple type of product innovation, while more difficult innovations such as a new product based on new technology was achieved by fewer firms, less than one-third of firms in fact. According to Figure 4, the process innovation of “Reduced delivery delay” was achieved by most of the countries and areas, while “Reduced variation in product quality” was achieved by fewer firms.

Figure 2: Product Innovation (Change in Packaging)

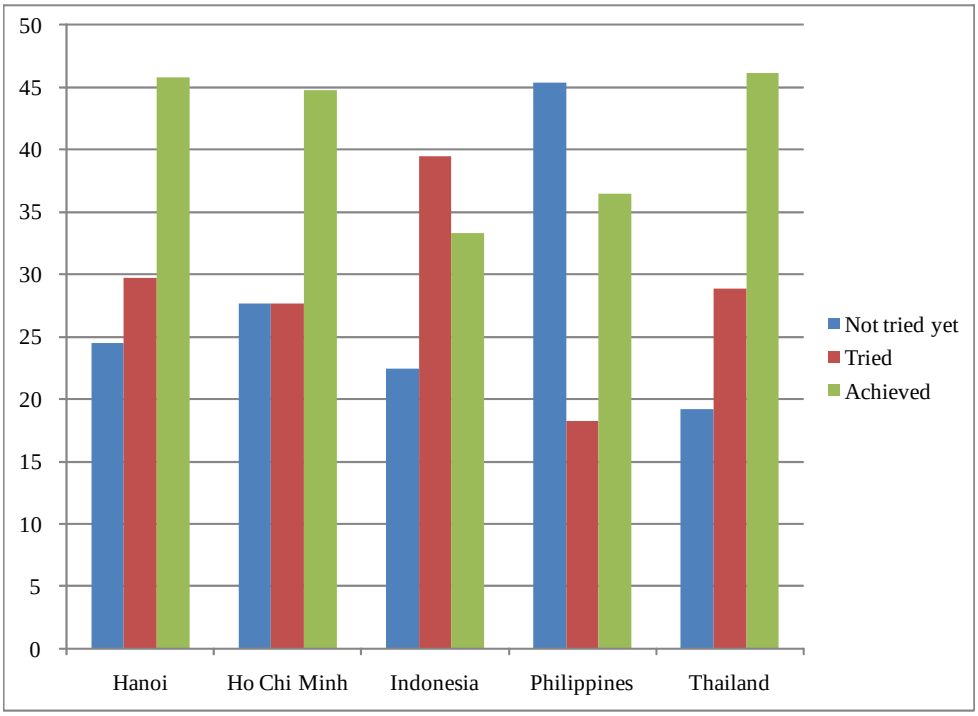


Figure 3: Product Innovation (New Product based on New Technologies)

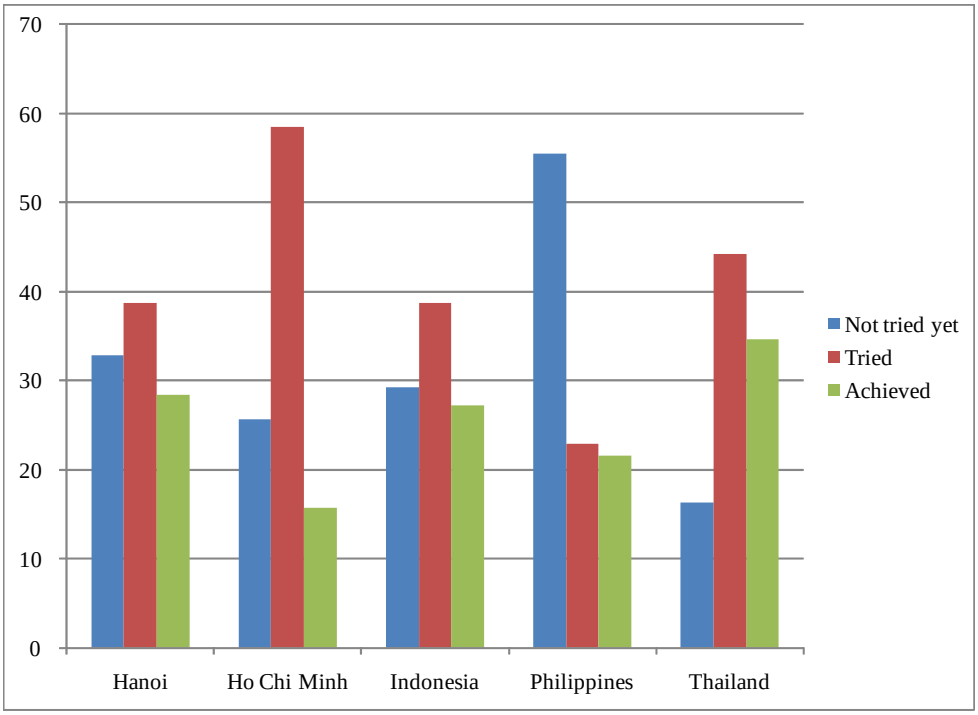
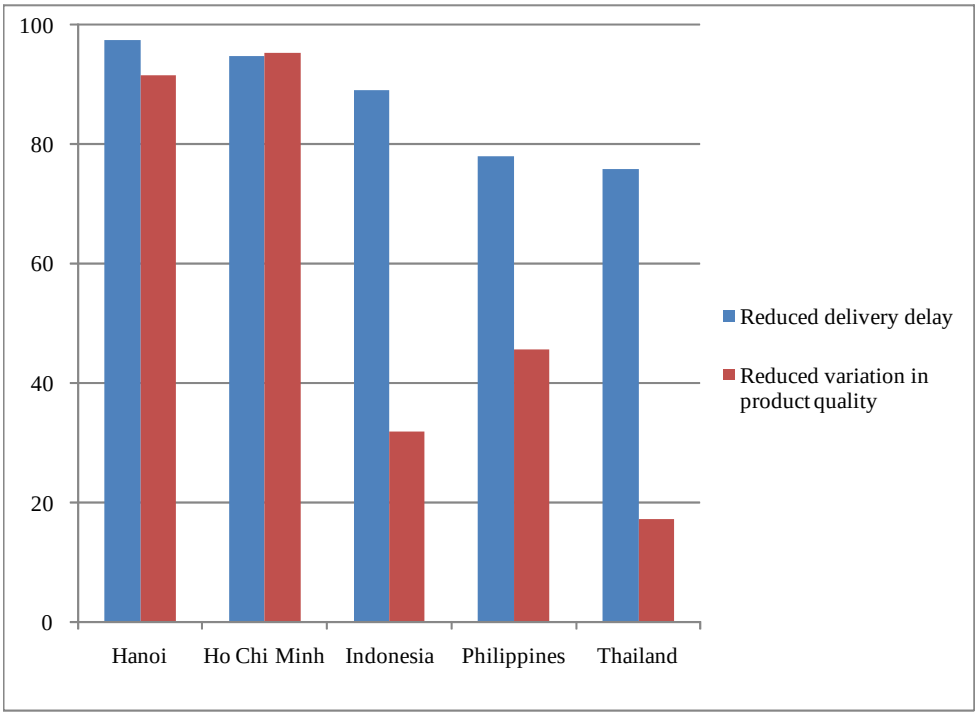


Figure 4: Process Innovations



4. Results of Estimations

Here we present the results of a series of estimations which examine the relationship between internal capability and external linkages and their effect on innovation.

4.1. Effect of Internal Capability on Innovation

In the estimation, the numbers of product innovations and process innovations are taken as the dependent variables. As for product innovation, the following questions are taken as dependent variables, namely:

Q12.1.1. Significant change in packaging or appearance design,

Q12.1.2. Significant improvement of an existing product,

Q12.1.3. Development of a totally new product based on the existing technologies for your establishment,

Q12.1.4. Development of a totally new product based on new technologies for your establishment,

Q12.6. Has the number of your product types increased between 2009 and 2010?

As for process innovation, this paper has a different approach from the usual Schumpeterian definition which includes the creation of a new production method, obtaining new markets, and new organization. These definitions are quite heterogeneous and make analysis more complicated. This paper utilizes the following two questions as proxy of process innovation. Answers to these two questions can be interpreted as the performance achieved by process innovation, namely:

Q13.6. Reduced delivery delay,

Q13.18. Reduced variation in product quality.

These two are also taken as dependent variables for estimation of product innovation.

As for explanatory variables, the innovation capability index, which was explained in the previous section, the industry and country dummy, and the size of firms are selected. The summary statistics is shown in Table 3.

Table 3: Summary Statistics

Variables	Obs.	Mean	S. D.	Min	Max
Change in packaging	781	1.10	0.84	0	2
Improvement of an existing product	787	1.45	0.71	0	2
New product based on the existing technologies	787	1.21	0.77	0	2
New product based on new technologies	782	0.89	0.77	0	2
Number of product increased	790	1.49	0.66	0	2
Reduced delivery delay	788	1.13	0.33	1	2
Reduced variation in product quality	784	1.41	0.49	1	2
Capability Index	738	0.47	0.18	0.04	0.98
Capability Index (Technology)	772	0.41	0.25	0	1
Capability Index (Organization)	794	0.41	0.22	0	0.97
Capability Index (Human)	757	0.65	0.20	0.04	1
The year begin operating in the region	764	1992.1	66.49	190	2010
Spin-off from multinational firm	777	1.81	0.40	1	3
The ratio between R&D expenditure and sales	772	0.84	1.08	0	3
Adopted just-in-time delivery	786	1.42	0.49	1	2
QC circle - Research	794	0.20	0.40	0	1
QC circle - Development	794	0.28	0.45	0	1
QC circle - Engineering	794	0.44	0.50	0	1
QC circle - Production	794	0.78	0.41	0	1
QC circle - Quality Control	794	0.64	0.48	0	1
QC circle - Procurement	794	0.37	0.48	0	1
QC circle - Accounting	794	0.22	0.41	0	1
QC circle - Human Resources	794	0.26	0.44	0	1
QC circle - Sales & Marketing	794	0.33	0.47	0	1
QC circle - Others	794	0.08	0.28	0	1
QC circle within a department across your establishment	771	1.29	0.45	1	2
Introduction of a new product - No effors for it	794	0.22	0.41	0	1
Introduction of a new product - No team	794	0.12	0.33	0	1
Introduction of a new product - Market Research	794	0.20	0.40	0	1
Introduction of a new product - Research	794	0.20	0.40	0	1
Introduction of a new product - Development	794	0.24	0.43	0	1
Introduction of a new product - Production Engineering	794	0.27	0.83	0	8
Introduction of a new product - Manufacturing	794	0.31	0.46	0	1
Introduction of a new product - Quality Control	794	0.43	0.50	0	1
Introduction of a new product - Procurement	794	0.12	0.32	0	1
Introduction of a new product - Accounting	794	0.12	0.33	0	1
Introduction of a new product - Human Resources	794	0.11	0.32	0	1
Introduction of a new product - Sales & Marketing	794	0.29	0.46	0	1
Introduction of a new product - Logistics/Distribution	794	0.13	0.34	0	1
Introduction of a new product - IT System	794	0.06	0.23	0	1
Quality Control - No effors for it	794	0.16	0.37	0	1
Quality Control - No team	794	0.11	0.32	0	1
Quality Control - Market Research	794	0.10	0.31	0	1
Quality Control - Research	794	0.16	0.37	0	1
Quality Control - Development	794	0.27	0.44	0	1
Quality Control - Production Engineering	794	0.27	0.45	0	1
Quality Control - Manufacturing	794	0.33	0.47	0	1
Quality Control - Quality Control	794	0.48	0.50	0	1
Quality Control - Procurement	794	0.11	0.31	0	1
Quality Control - Accounting	794	0.06	0.24	0	1
Quality Control - Human Resources	794	0.08	0.27	0	1
Quality Control - Sales & Marketing	794	0.19	0.39	0	1
Quality Control - Logistics/Distribution	794	0.10	0.30	0	1
Quality Control - IT System	794	0.12	0.32	0	1
IT system for Information Sharing - Market Research	794	0.40	0.49	0	1
IT system for Information Sharing - Basic Research	794	0.28	0.45	0	1
IT system for Information Sharing - Development	794	0.30	0.46	0	1
IT system for Information Sharing - Procurement	794	0.36	0.48	0	1

Table 3 *(Continued)*

Variables	Obs.	Mean	S. D.	Min	Max
IT system for Information Sharing - Production Management	794	0.40	0.49	0	1
IT system for Information Sharing - Production Engineering	794	0.34	0.47	0	1
IT system for Information Sharing - Quality Assurance	794	0.23	0.42	0	1
IT system for Information Sharing - Sales and Marketing	794	0.51	0.50	0	1
IT system for Information Sharing - After-sales Services	794	0.20	0.40	0	1
IT system for Information Sharing - Accounting	794	0.27	0.44	0	1
IT system for Information Sharing - Human Resources	794	0.43	0.49	0	1
share information - Success of your establishment	794	0.68	0.47	0	1
share information - Failure of your establishment	794	0.23	0.42	0	1
share information - Success of other firms	794	0.26	0.44	0	1
share information - Failure of other firms	794	0.18	0.38	0	1
Top management has a bachelor (BA), master or Ph.D. degree	789	1.22	0.64	0	3
Top management is/was an engineer	780	1.39	0.49	0	2
Top management has an experience working for a MNC/JV	761	1.60	0.49	1	2
Major function in the MNC/JV -Planning	377	0.35	0.50	0	3
Major function in the MNC/JV -Other administration	377	0.44	0.50	0	1
Major function in the MNC/JV -Engineering work	377	0.24	0.43	0	1
Major function in the MNC/JV -Procurement	377	0.10	0.30	0	1
Personal connections with people from industry	789	3.36	0.85	1	4
Personal connections with people from politics or government	788	2.55	1.00	1	4
Personal connections with people from academia	787	2.53	0.96	1	4
Top management directs employee	788	3.46	0.75	1	4
Top management strives to listen to his/her employees	789	3.40	0.72	1	4
Top management emphasizes decision-making speed	787	3.59	0.60	1	4
Top management is well-versed in the market of products	788	3.44	0.81	1	4
Top management delegates authorities to job sites/actual places	788	2.86	1.09	1	4
Top management often goes to job sites/actual places	791	2.95	1.00	1	4
Blue-collar workers high school graduates or higher	790	3.69	1.27	0	5
Engineers technical college graduates or higher	788	3.12	1.82	0	5
Training program for employees	764	1.23	0.42	1	2
Engineers quit last year - Middle-class Engineers	779	1.73	1.06	1	5
Engineers quit last year - Senior-class Engineers	779	1.42	0.79	1	5
Engineers quit last year - Manager	782	1.53	0.91	1	5
External source - Final Consumer	784	3.50	0.84	0	4
External source - Competitor	787	3.26	0.90	0	4
External source - Buyer or trading company	782	3.22	1.01	0	4
External source - Consultant	785	2.69	1.15	0	4
External source - Local customer (100% local capital)	785	3.06	1.17	0	4
External source - Local supplier	782	3.04	1.01	0	4
External source - MNC/JV customer located in Country	778	2.44	1.44	0	4
External source - MNC/JV supplier located in Country	779	2.36	1.42	0	4
External source - MNC/JV customer located in a foreign country	777	2.35	1.44	0	4
External source - MNC/JV supplier located in a foreign country	776	2.21	1.40	0	4
External source - Public organization	785	2.21	1.43	0	4
External source - Local business organization	784	2.36	1.34	0	4
External source - University or Public Research Institute	785	1.86	1.36	0	4
Capital structure of customer - 100% locally owned	763	0.54	0.50	0	1
Capital structure of customer - 100% foreign owned	763	0.29	0.45	0	1
Capital structure of supplier - 100% locally owned	749	0.50	0.50	0	1
Capital structure of supplier - 100% foreign owned	749	0.26	0.44	0	1
Duration of the relationship with the customer	782	5.39	1.60	1	7
Duration of the relationship with the supplier	778	5.42	1.52	1	7
Employment size of the customer	734	2.65	1.40	1	5
Employment size of the supplier	731	2.43	1.30	1	5
Distance from your establishment to the customer	773	5.43	3.35	1	11
Distance from your establishment to the supplier	769	6.03	3.30	1	11

Table 4 shows the results of estimations of how internal capability affects innovation (product and process innovation) using a treatment-effects model. Since internal capability consists of many factors, it is considered as an endogenous variable. The treatment-effects model controls such endogeneity by some exogenous variables (country, size of establishment, and industries in this model), and calculates unbiased estimators. The result shows that internal capability is positively significant to both product and process innovation.

In estimation, the significant variables are as follows: Ho Chi Minh ($p<0.05$); Philippines ($p<0.05$-$p<0.10$); Textiles ($p<0.10$, but not significant in Case 5); Plastic, rubber products ($p<0.05$); Iron, steel ($p<0.10$, but not significant in Cases 1, 5); Machinery, equipment, tools ($p<0.05$-$p<0.10$); Other electronics & components ($p<0.05$-$p<0.10$); Precision instruments ($p<0.10$, but not significant in Case 5); and Other transportation equipment and parts ($p<0.01$). A coefficient of the controlled capability index is statistically significant to both product (Cases 1 to 5) and process innovation (Cases 6 and 7), positively, at the 1% significance level.

Table 4: Innovation and Capability Index (Treatment-Effects Model)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Capability Index	0.922 ***	1.470 ***	0.870 ***	0.925 ***	0.553 ***	0.284 ***	0.516 ***
	(0.193)	(0.196)	(0.170)	(0.171)	(0.156)	(0.079)	(0.110)
Constant	0.625 ***	0.720 ***	0.770 ***	0.416 ***	1.182 ***	-1.271 ***	-1.635 ***
	(0.103)	(0.105)	(0.092)	(0.092)	(0.084)	(0.042)	(0.059)
Capability Index							
Ho Chi Minh (dummy)	0.379 **	0.403 **	0.387 **	0.405 **	0.356 **	0.402 **	0.396 **
	(0.175)	(0.174)	(0.174)	(0.175)	(0.175)	(0.174)	(0.174)
Indonesia (dummy)	-0.191	-0.157	-0.179	-0.163	-0.194	-0.161	-0.166
	(0.179)	(0.178)	(0.179)	(0.179)	(0.178)	(0.178)	(0.178)
Philippines (dummy)	-0.404 ***	-0.386 **	-0.394 ***	-0.382 **	-0.427 ***	-0.387 ***	-0.381 **
	(0.150)	(0.149)	(0.149)	(0.150)	(0.150)	(0.149)	(0.149)
Thailand (dummy)	-0.078	-0.040	-0.039	-0.029	-0.102	-0.057	-0.069
	(0.198)	(0.197)	(0.198)	(0.199)	(0.195)	(0.197)	(0.198)
Food, beverages, tobacco	-0.280	-0.276	-0.291	-0.298	-0.244	-0.278	-0.282
	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)
Textiles	-0.477 *	-0.445 *	-0.458 *	-0.470 *	-0.403	-0.447 *	-0.446 *
	(0.265)	(0.262)	(0.262)	(0.262)	(0.262)	(0.262)	(0.262)
Apparel, leather	-0.211	-0.203	-0.217	-0.228	-0.168	-0.210	-0.174
	(0.271)	(0.270)	(0.271)	(0.271)	(0.270)	(0.270)	(0.273)
Wood, wood products	-0.452	-0.460	-0.464	-0.475	-0.418	-0.460	-0.742
	(0.541)	(0.540)	(0.541)	(0.541)	(0.540)	(0.540)	(0.629)
Paper, paper products, printing	-0.443	-0.440	-0.453	-0.460	-0.413	-0.442	-0.444
	(0.311)	(0.310)	(0.310)	(0.311)	(0.311)	(0.310)	(0.310)
Coal, petroleum products	-0.495	-0.495	-0.520	-0.529	-0.448	-0.492	-0.490
	(0.675)	(0.673)	(0.676)	(0.675)	(0.673)	(0.674)	(0.674)
Chemicals, chemical products	0.245	0.248	0.239	0.231	0.274	0.245	0.242
	(0.294)	(0.294)	(0.294)	(0.295)	(0.294)	(0.294)	(0.294)
Plastic, rubber products	-0.465 **	-0.463 **	-0.456 **	-0.469 **	-0.429 **	-0.468 **	-0.471 **
	(0.201)	(0.201)	(0.202)	(0.203)	(0.201)	(0.201)	(0.201)
Other non-metallic mineral products	-0.351	-0.341	-0.356	-0.364	-0.312	-0.348	-0.356
	(0.329)	(0.328)	(0.329)	(0.329)	(0.329)	(0.328)	(0.328)
Iron, steel	-0.441	-0.487 *	-0.500 *	-0.511 *	-0.459	-0.494 *	-0.499 *
	(0.287)	(0.281)	(0.281)	(0.282)	(0.281)	(0.281)	(0.281)
Non-ferrous metals	-5.110	-5.092	-5.106	-5.105	-4.918	-5.098	-5.101
	(173.7)	(173.7)	(173.7)	(173.7)	(116.0)	(173.7)	(173.7)

Table 4 *(Continued)*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Metal products	-0.291	-0.292	-0.297	-0.310	-0.260	-0.297	-0.301
	(0.192)	(0.191)	(0.192)	(0.192)	(0.192)	(0.191)	(0.191)
Machinery, equipment, tools	-0.415 **	-0.414 **	-0.420 **	-0.457 **	-0.382 *	-0.419 **	-0.421 **
	(0.205)	(0.205)	(0.205)	(0.208)	(0.205)	(0.205)	(0.205)
Computers & computer parts	0.125	0.137	0.124	0.113	0.427	0.129	0.126
	(0.483)	(0.483)	(0.483)	(0.483)	(0.564)	(0.483)	(0.483)
Other electronics & components	-0.365 *	-0.361 *	-0.370 *	-0.383 **	-0.326 *	-0.377 *	-0.371 *
	(0.193)	(0.192)	(0.193)	(0.193)	(0.193)	(0.193)	(0.192)
Precision instruments	-0.613 *	-0.616 *	-0.618 *	-0.632 *	-0.582	-0.621 *	-0.622 *
	(0.368)	(0.367)	(0.367)	(0.368)	(0.367)	(0.367)	(0.367)
Automobile, auto parts	-0.037	-0.033	-0.047	-0.055	0.051	-0.035	-0.040
	(0.255)	(0.255)	(0.255)	(0.255)	(0.260)	(0.255)	(0.255)
Other transportation equipments and parts	-1.034 ***	-1.028 ***	-1.040 ***	-1.053 ***	-0.992 ***	-1.034 ***	-1.037 ***
	(0.332)	(0.331)	(0.332)	(0.332)	(0.331)	(0.331)	(0.332)
Number of obs.	701	705	703	702	706	705	704
Wald chi2(1)	22.86	56.27	26.04	29.34	12.55	12.94	22.04
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note 1: Standard errors are in parentheses.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Change in packaging
Case 2: Improvement of an existing product
Case 3: New product based on the existing technologies
Case 4: New product based on new technologies
Case 5: Number of product increased
Case 6: Reduced delivery delay
Case 7: Reduced variation in product quality.

4.2. Effect of First Layer Factors on Innovation

Since internal capability consists of three first layer factors such as the technological factor, managerial organization, and human resources, we estimate how the three factors also influence individually two categories of innovation. The treatment-effects model is also adopted in this estimation. Tables 5, 6, and 7 show the results of estimations. According to Table 5 which shows technology, Ho Chi Minh ($p<0.01$), Indonesia ($p<0.05$), Philippines ($p<0.01$-$p<0.05$), and Chemicals, chemical products ($p<0.10$) are significant for the index of the technological factor in the treatment equation. The capability index of technology is statistically significant to product innovation ($p<0.01$), although it does not have a strong effect on process innovation. The capability index shows a positive coefficient for Case 6, "Reduced delivery delay ($p<0.05$)," but a negative coefficient for Case 7, "Reduced variation in product quality ($p<0.01$)." In Table 6, which explains the managerial organization, Ho Chi Minh ($p<0.01$); Food, beverages, tobacco ($p<0.01$); Textiles ($p<0.05$-$p<0.10$); Apparel, leather ($p<0.05$-$p<0.10$); Wood, wood products ($p<0.05$-p,0.10); Paper, paper products, printing ($p<0.01$-$p<0.05$); Iron, steel ($p<0.05$-$p<0.10$); and Metal products ($p<0.05$) have a significant coefficient to the capability index of organization. On the other hand, the organization factor is significant to process innovation ($p<0.01$), but it is not strongly significant to product innovation in contrast with the results of the technological factor. Finally, Table 7 represents the results of the human factor, in which Indonesia ($p<0.05$), Philippines ($p<0.05$), Thailand ($p<0.01$), Food, beverages, tobacco ($p<0.05$-$p<0.10$), Chemicals, chemical products ($p<0.10$), Iron, steel ($p<0.10$, only Case 1), Computers & computer parts ($p<0.10$, not significant in Case 5), and Automobile, auto parts ($p<0.10$, not significant in Case 5) are significant for the

capability index of human resources. The coefficient of the index is positively significant to both product and process innovation ($p<0.01$ for Cases 1, 2, 3, and 4, and $p<0.05$ for Cases 5 and 6).

Based on the results, we can summarize that the technological factor is statistically significant to product innovation, while the organization factor is significant to process innovation. The human factor is significant to both product and process innovation. Since the technological factor does not satisfy Case 7 (Table 5), we conclude that this is not significant to product innovation. In Table 6, managerial organization does not satisfy Case 5, and we also conclude that this is not significant to process innovation. Table 8 provides the summary of these results. The results seem to coincide with the realty.

Table 5: Innovation and Capability Index (Technology, Treatment-Effects Model)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Capability Index (Technology)	0.839 ***	0.729 ***	0.856 ***	1.011 ***	0.727 ***	0.174 **	-0.481 ***
	(0.195)	(0.165)	(0.171)	(0.177)	(0.159)	(0.077)	(0.130)
Constant	0.693 ***	1.116 ***	0.802 ***	0.400 ***	1.123 ***	-1.207 ***	-1.163 ***
	(0.097)	(0.083)	(0.086)	(0.089)	(0.080)	(0.039)	(0.065)
Capability Index (Technology)							
Ho Chi Minh (dummy)	-0.571 ***	-0.539 ***	-0.562 ***	-0.546 ***	-0.567 ***	-0.546 ***	-0.555 ***
	(0.171)	(0.170)	(0.170)	(0.171)	(0.170)	(0.170)	(0.170)
Indonesia (dummy)	-0.399 **	-0.360 **	-0.388 **	-0.373 **	-0.380 **	-0.368 **	-0.376 **
	(0.177)	(0.176)	(0.176)	(0.177)	(0.176)	(0.176)	(0.176)
Philippines (dummy)	-0.654 ***	-0.638 ***	-0.649 ***	-0.633 ***	-0.654 ***	-0.639 ***	-0.634 ***
	(0.148)	(0.147)	(0.147)	(0.148)	(0.147)	(0.147)	(0.147)
Thailand (dummy)	-0.044	0.009	0.027	0.001	-0.023	0.005	-0.025
	(0.180)	(0.179)	(0.179)	(0.181)	(0.177)	(0.178)	(0.179)
Food, beverages, tobacco	-0.083	-0.082	-0.098	-0.100	-0.068	-0.097	-0.097
	(0.193)	(0.193)	(0.193)	(0.193)	(0.193)	(0.193)	(0.193)
Textiles	-0.149	-0.134	-0.147	-0.150	-0.113	-0.135	-0.131
	(0.256)	(0.254)	(0.255)	(0.254)	(0.254)	(0.254)	(0.254)
Apparel, leather	0.019	0.058	0.049	0.006	0.070	0.053	0.085
	(0.264)	(0.261)	(0.261)	(0.264)	(0.261)	(0.261)	(0.263)
Wood, wood products	-0.250	-0.256	-0.260	-0.271	-0.241	-0.258	-0.489
	(0.548)	(0.548)	(0.549)	(0.548)	(0.548)	(0.548)	(0.628)
Paper, paper products, printing	0.082	0.077	0.062	0.063	0.091	0.075	0.026
	(0.296)	(0.295)	(0.295)	(0.295)	(0.295)	(0.295)	(0.300)
Coal, petroleum products	-0.472	-0.480	-0.514	-0.501	-0.458	-0.483	-0.471
	(0.681)	(0.679)	(0.682)	(0.681)	(0.679)	(0.680)	(0.679)
Chemicals, chemical products	0.519 *	0.523 *	0.514 *	0.506 *	0.535 *	0.521 *	0.518 *
	(0.293)	(0.292)	(0.293)	(0.293)	(0.293)	(0.292)	(0.292)
Plastic, rubber products	-0.035	-0.033	-0.015	-0.030	-0.018	-0.035	-0.038
	(0.193)	(0.193)	(0.194)	(0.194)	(0.193)	(0.193)	(0.193)
Other non-metallic mineral products	0.243	0.255	0.246	0.232	0.264	0.250	0.240
	(0.321)	(0.320)	(0.321)	(0.320)	(0.320)	(0.320)	(0.320)
Iron, steel	-0.196	-0.246	-0.254	-0.266	-0.233	-0.249	-0.253
	(0.267)	(0.262)	(0.263)	(0.263)	(0.262)	(0.262)	(0.262)
Non-ferrous metals	-5.111	-5.091	-5.104	-5.105	-5.095	-5.095	-5.101
	(173.7)	(173.7)	(173.7)	(173.7)	(173.7)	(173.7)	(173.7)

Table 5 *(Continued)*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Metal products	-0.258	-0.258	-0.257	-0.273	-0.244	-0.259	-0.263
	(0.189)	(0.189)	(0.189)	(0.189)	(0.189)	(0.189)	(0.189)
Machinery, equipment, tools	-0.171	-0.171	-0.154	-0.205	-0.154	-0.155	-0.157
	(0.199)	(0.199)	(0.198)	(0.201)	(0.199)	(0.198)	(0.197)
Computers & computer parts	-0.052	-0.041	-0.046	-0.063	0.129	-0.043	-0.048
	(0.427)	(0.426)	(0.427)	(0.427)	(0.456)	(0.426)	(0.427)
Other electronics & components	-0.190	-0.186	-0.190	-0.205	-0.170	-0.195	-0.192
	(0.188)	(0.188)	(0.188)	(0.188)	(0.188)	(0.188)	(0.188)
Precision instruments	-0.489	-0.494	-0.488	-0.505	-0.477	-0.493	-0.494
	(0.382)	(0.381)	(0.382)	(0.382)	(0.382)	(0.381)	(0.382)
Automobile, auto parts	0.299	0.329	0.315	0.284	0.317	0.325	0.296
	(0.256)	(0.254)	(0.255)	(0.256)	(0.257)	(0.254)	(0.256)
Other transportation equipments and parts	-0.406	-0.402	-0.409	-0.422	-0.386	-0.404	-0.407
	(0.326)	(0.326)	(0.326)	(0.326)	(0.326)	(0.326)	(0.326)
Number of obs.	732	738	737	733	739	738	735
Wald chi2(1)	18.59	19.56	24.97	32.48	20.87	5.08	13.80
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.024	0.000

Note 1: Standard errors are in parentheses.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Change in packaging
Case 2: Improvement of an existing product
Case 3: New product based on the existing technologies
Case 4: New product based on new technologies
Case 5: Number of product increased
Case 6: Reduced delivery delay
Case 7: Reduced variation in product quality.

Table 6: Innovation and Capability Index (Organization, Treatment-Effects Model)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Capability Index (Organization)	0.296 **	0.883 ***	0.268 **	0.243 **	0.073	0.173 ***	0.728 ***
	(0.120)	(0.104)	(0.109)	(0.108)	(0.095)	(0.047)	(0.075)
Constant	0.945 ***	1.006 ***	1.075 ***	0.759 ***	1.436 ***	-1.215 ***	-1.775 ***
	(0.070)	(0.060)	(0.063)	(0.063)	(0.055)	(0.027)	(0.043)
Capability Index (Organization)							
Ho Chi Minh (dummy)	1.991 ***	1.979 ***	1.988 ***	1.969 ***	1.948 ***	1.996 ***	1.987 ***
	(0.243)	(0.242)	(0.242)	(0.242)	(0.242)	(0.242)	(0.242)
Indonesia (dummy)	0.075	0.059	0.067	0.054	0.040	0.068	0.056
	(0.177)	(0.176)	(0.176)	(0.177)	(0.176)	(0.176)	(0.176)
Philippines (dummy)	-0.064	-0.070	-0.067	-0.082	-0.095	-0.065	-0.069
	(0.147)	(0.146)	(0.146)	(0.147)	(0.146)	(0.146)	(0.146)
Thailand (dummy)	-0.122	-0.157	-0.186	-0.162	-0.189	-0.180	-0.168
	(0.176)	(0.175)	(0.176)	(0.177)	(0.174)	(0.175)	(0.177)
Food, beverages, tobacco	-0.866 ***	-0.855 ***	-0.853 ***	-0.849 ***	-0.833 ***	-0.840 ***	-0.857 ***
	(0.204)	(0.203)	(0.204)	(0.204)	(0.203)	(0.204)	(0.204)
Textiles	-0.565 *	-0.587 **	-0.580 **	-0.580 **	-0.559 *	-0.612 **	-0.631 **
	(0.295)	(0.291)	(0.292)	(0.291)	(0.291)	(0.288)	(0.289)
Apparel, leather	-0.529 *	-0.548 **	-0.554 **	-0.513 *	-0.522 *	-0.551 **	-0.536 **
	(0.270)	(0.267)	(0.267)	(0.270)	(0.267)	(0.267)	(0.269)
Wood, wood products	-1.185 **	-1.174 **	-1.174 **	-1.164 **	-1.147 **	-1.173 **	-1.100 *
	(0.582)	(0.582)	(0.583)	(0.582)	(0.582)	(0.583)	(0.601)
Paper, paper products, printing	-0.801 ***	-0.788 **	-0.784 **	-0.783 **	-0.768 **	-0.783 **	-0.933 ***
	(0.306)	(0.306)	(0.306)	(0.306)	(0.306)	(0.306)	(0.323)
Coal, petroleum products	-0.149	-0.124	-0.112	-0.119	-0.094	-0.110	-0.140
	(0.646)	(0.646)	(0.645)	(0.646)	(0.645)	(0.645)	(0.647)
Chemicals, chemical products	0.082	0.090	0.090	0.096	0.108	0.092	0.076
	(0.289)	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)	(0.289)
Plastic, rubber products	-0.132	-0.122	-0.156	-0.140	-0.099	-0.127	-0.139
	(0.209)	(0.209)	(0.210)	(0.210)	(0.208)	(0.208)	(0.209)
Other non-metallic mineral products	-0.426	-0.423	-0.428	-0.414	-0.402	-0.426	-0.440
	(0.317)	(0.317)	(0.317)	(0.317)	(0.317)	(0.316)	(0.317)
Iron, steel	-0.584 **	-0.505 *	-0.512 *	-0.498 *	-0.483 *	-0.508 *	-0.524 *
	(0.293)	(0.284)	(0.285)	(0.285)	(0.284)	(0.284)	(0.285)
Non-ferrous metals	-4.689	-4.691	-4.695	-4.691	-4.747	-4.692	-4.703
	(100.6)	(100.6)	(100.6)	(100.6)	(113.9)	(100.6)	(100.6)

Table 6 *(Continued)*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Metal products	-0.481 **	-0.472 **	-0.483 **	-0.465 **	-0.450 **	-0.480 **	-0.489 **
	(0.193)	(0.192)	(0.192)	(0.193)	(0.192)	(0.192)	(0.192)
Machinery, equipment, tools	-0.320	-0.312	-0.341	-0.281	-0.290	-0.340	-0.349
	(0.223)	(0.223)	(0.221)	(0.226)	(0.223)	(0.221)	(0.221)
Computers & computer parts	-0.332	-0.331	-0.341	-0.324	-0.004	-0.338	-0.356
	(0.612)	(0.611)	(0.612)	(0.610)	(0.752)	(0.612)	(0.612)
Other electronics & components	-0.284	-0.277	-0.284	-0.268	-0.253	-0.303	-0.296
	(0.204)	(0.204)	(0.204)	(0.204)	(0.204)	(0.205)	(0.204)
Precision instruments	-0.397	-0.387	-0.399	-0.381	-0.367	-0.397	-0.403
	(0.427)	(0.426)	(0.426)	(0.426)	(0.426)	(0.427)	(0.427)
Automobile, auto parts	-0.266	-0.283	-0.282	-0.249	-0.228	-0.280	-0.271
	(0.243)	(0.240)	(0.240)	(0.243)	(0.244)	(0.240)	(0.243)
Other transportation equipments and parts	-0.095	-0.085	-0.091	-0.078	-0.061	-0.089	-0.103
	(0.371)	(0.371)	(0.372)	(0.371)	(0.371)	(0.371)	(0.372)
Number of obs.	745	751	750	746	753	753	749
Wald chi2(1)	6.07	72.71	6.10	5.02	0.58	13.29	94.34
Prob > chi2	0.014	0.000	0.014	0.025	0.445	0.000	0.000

Note 1: Standard errors are in parentheses.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Change in packaging,
Case 2: Improvement of an existing product
Case 3: New product based on the existing technologies
Case 4: New product based on new technologies
Case 5: Number of product increased
Case 6: Reduced delivery delay
Case 7: Reduced variation in product quality.

Table 7: Innovation and Capability Index (Human, Treatment-Effects Model)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Capability Index (Human)	0.683 ***	1.378 ***	0.665 ***	0.695 ***	0.399 **	0.181 **	0.643 ***
	(0.221)	(0.225)	(0.199)	(0.203)	(0.168)	(0.084)	(0.137)
Constant	0.755 ***	0.772 ***	0.879 ***	0.537 ***	1.268 ***	-1.219 ***	-1.703 ***
	(0.116)	(0.118)	(0.104)	(0.107)	(0.088)	(0.044)	(0.072)
Capability Index (Human)							
Ho Chi Minh (dummy)	0.118	0.123	0.138	0.122	0.126	0.128	0.122
	(0.173)	(0.172)	(0.172)	(0.173)	(0.172)	(0.172)	(0.172)
Indonesia (dummy)	-0.451 **	-0.443 **	-0.424 **	-0.439 **	-0.444 **	-0.440 **	-0.445 **
	(0.177)	(0.176)	(0.176)	(0.177)	(0.176)	(0.176)	(0.176)
Philippines (dummy)	-0.377 **	-0.365 **	-0.358 **	-0.369 **	-0.362 **	-0.363 **	-0.369 **
	(0.148)	(0.147)	(0.147)	(0.148)	(0.147)	(0.147)	(0.147)
Thailand (dummy)	-0.548 ***	-0.536 ***	-0.545 ***	-0.554 ***	-0.547 ***	-0.551 ***	-0.531 ***
	(0.193)	(0.193)	(0.194)	(0.194)	(0.191)	(0.193)	(0.193)
Food, beverages, tobacco	-0.380 *	-0.401 **	-0.389 *	-0.383 *	-0.403 **	-0.398 **	-0.402 **
	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)	(0.201)
Textiles	0.201	0.219	0.228	0.238	0.218	0.222	0.217
	(0.265)	(0.262)	(0.262)	(0.262)	(0.262)	(0.262)	(0.262)
Apparel, leather	-0.059	-0.084	-0.076	-0.068	-0.090	-0.086	-0.124
	(0.266)	(0.266)	(0.266)	(0.266)	(0.266)	(0.266)	(0.269)
Wood, wood products	-0.888	-0.909	-0.903	-0.894	-0.911	-0.907	-0.824
	(0.580)	(0.580)	(0.580)	(0.580)	(0.580)	(0.580)	(0.598)
Paper, paper products, printing	0.053	0.034	0.043	0.050	0.033	0.037	0.033
	(0.294)	(0.294)	(0.294)	(0.294)	(0.294)	(0.294)	(0.294)
Coal, petroleum products	-0.469	-0.499	-0.477	-0.469	-0.495	-0.488	-0.503
	(0.697)	(0.697)	(0.697)	(0.697)	(0.697)	(0.697)	(0.697)
Chemicals, chemical products	-0.520 *	-0.538 *	-0.531 *	-0.525 *	-0.541 *	-0.537 *	-0.538 *
	(0.293)	(0.293)	(0.293)	(0.293)	(0.293)	(0.293)	(0.293)
Plastic, rubber products	0.153	0.131	0.112	0.123	0.127	0.129	0.131
	(0.195)	(0.195)	(0.196)	(0.196)	(0.195)	(0.195)	(0.195)
Other non-metallic mineral products	0.142	0.120	0.127	0.135	0.114	0.118	0.121
	(0.316)	(0.316)	(0.315)	(0.316)	(0.315)	(0.315)	(0.315)
Iron, steel	0.495 *	0.383	0.388	0.397	0.378	0.381	0.383
	(0.291)	(0.281)	(0.281)	(0.281)	(0.281)	(0.281)	(0.281)
Non-ferrous metals	-4.800	-4.808	-4.799	-4.800	-4.810	-4.808	-4.809
	(116.0)	(116.0)	(116.0)	(116.0)	(116.0)	(116.0)	(116.0)

Table 7 *(Continued)*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Metal products	0.099	0.077	0.076	0.087	0.072	0.074	0.077
	(0.188)	(0.187)	(0.187)	(0.188)	(0.187)	(0.187)	(0.187)
Machinery, equipment, tools	-0.114	-0.133	-0.133	-0.100	-0.138	-0.136	-0.133
	(0.203)	(0.203)	(0.203)	(0.205)	(0.203)	(0.203)	(0.203)
Computers & computer parts	0.942 *	0.921 *	0.926 *	0.937 *	0.822	0.917 *	0.921 *
	(0.549)	(0.549)	(0.549)	(0.549)	(0.566)	(0.549)	(0.549)
Other electronics & components	0.149	0.127	0.130	0.141	0.122	0.111	0.127
	(0.187)	(0.187)	(0.187)	(0.187)	(0.187)	(0.187)	(0.187)
Precision instruments	0.344	0.326	0.322	0.335	0.321	0.322	0.326
	(0.370)	(0.370)	(0.370)	(0.370)	(0.370)	(0.370)	(0.370)
Automobile, auto parts	0.446 *	0.423 *	0.435 *	0.442 *	0.398	0.426 *	0.423 *
	(0.250)	(0.250)	(0.250)	(0.250)	(0.253)	(0.250)	(0.250)
Other transportation equipments and parts	-0.316	-0.337	-0.334	-0.323	-0.342	-0.339	-0.337
	(0.312)	(0.312)	(0.312)	(0.312)	(0.312)	(0.312)	(0.312)
Number of obs.	713	717	715	714	719	718	717
Wald chi2(1)	9.57	37.59	11.15	11.69	5.63	4.67	21.97
Prob > chi2	0.002	0.000	0.001	0.001	0.018	0.031	0.000

Note 1: Standard errors are in parentheses.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Change in packaging
Case 2: Improvement of an existing product
Case 3: New product based on the existing technologies
Case 4: New product based on new technologies
Case 5: Number of product increased
Case 6: Reduced delivery delay
Case 7: Reduced variation in product quality.

Table 8: Summary of Treatment Models

	Product innovation	Process innovation
Capability Index	O	O
Technological factor	O	X
Managerial organization	X	O
Human Resources	O	O

4.3. Effect of External Linkages on Internal Capability

In this estimation, the capability index is taken as a dependent variable, and independent variables are in common with the first estimation, and external linkages (or external sources) are included, which are listed as follows.

Q23.1. Final consumer

Q23.2. Competitor

Q23.3. Buyer or trading company

Q23.4. Consultant

Q23.5. Local customer (100% local capital)

Q23.6. Local supplier

Q23.7. MNC/JV customer located in country

Q23.8. MNC/JV supplier located in country

Q23.9. MNC/JV customer located in a foreign country

Q23.10. MNC/JV supplier located in a foreign country

Q23.11. Public organization

Q23.12. Local business organization

Q23.13. University or public research institute

Table 9 and Table 10 show the results of the estimation of internal capability and external sources by Instrument GMM, since external sources are also considered

endogenous. As noted in the previous sections, instrumental variables are the "Number of full-time employees," "Dummy variable of startup after 2000," "Countries, Year beginning operation," "Dummy variable of spin-off firms from MNC/JV," and "Dummy variable of locally-owned firm." Since the number of instruments is larger than the endogenous variables (instrumented variables), the constraint of overidentification restrictions is tested by Hansen's J test. In most estimations, the constraint of overidentification restrictions is satisfied. The result shows that external sources except "MNC/JV," "Public Organization," and "University or Public Research Institute" have negative coefficients to internal capability, which does not satisfy the sign condition. "Public Organizations" and "University or Public Research Institute" are not significant either. These results are interpreted that such external linkages do not enhance the internal capability of firms. By contrast, "MNC/JV customer & supplier located in country ($p<0.01$)" and "MNC/JV customer & supplier located in a foreign country ($p<0.01$)" are significant to internal capability. Thus, multinational/joint venture companies are concluded as being primary external sources that enhance internal capability, which coincides with the results obtained in the previous papers (Tsuji and Miyahara 2010a, 2010b).

We also estimate some other external factors promoting internal capability shown in Table 10. We assume these factors are endogenous, and the instrumental variable of the GMM estimation is adopted again. According to the results, "Duration of relationship with customer ($p<0.01$)," "Employment size of the customer & supplier ($p<0.01$)," and "Granted a technical license or know-how to the customer ($p<0.05$) & supplier ($p<0.01$)" are revealed as statistically significant.

Table 9: Capability and External Sources (1)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Final Consumer	-0.412 ***								
	(0.114)								
Competitor		-0.641 ***							
		(0.226)							
Buyer or trading company			-0.595 ***						
			(0.221)						
Consultant				-0.615					
				(0.638)					
Local customer (100% local capital)					-0.155 ***				
					(0.045)				
Local supplier						-0.298 *			
						(0.174)			
MNC/JV customer located in Country							0.180 ***		
							(0.030)		
MNC/JV supplier located in Country								0.171 ***	
								(0.033)	
MNC/JV customer located in a foreign country									0.122 ***
									(0.024)
Number of full-time employees	0.026 ***	0.032 ***	0.046 ***	0.061	0.017 ***	0.024 ***	0.010 *	0.005	0.005
	(0.006)	(0.009)	(0.011)	(0.043)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Startup 2000	0.022	-0.040	0.018	0.007	0.005	-0.013	0.016	0.031	0.011
	(0.029)	(0.048)	(0.046)	(0.056)	(0.019)	(0.031)	(0.021)	(0.020)	(0.016)
Ho Chi Minh (dummy)	0.016	0.194 *	0.532 **	0.426	0.146 ***	0.310 *	-0.173 ***	-0.211 ***	-0.145 ***
	(0.061)	(0.107)	(0.211)	(0.425)	(0.049)	(0.168)	(0.046)	(0.056)	(0.044)
Indonesia (dummy)	0.014	0.142	0.293 *	0.231	-0.061	0.077	-0.102 **	-0.075 *	-0.116 ***
	(0.059)	(0.111)	(0.160)	(0.296)	(0.040)	(0.079)	(0.040)	(0.039)	(0.034)
Philippines (dummy)	0.098	0.051	0.539 **	0.330	-0.031	0.285	-0.036	-0.125 ***	-0.108 ***
	(0.074)	(0.108)	(0.241)	(0.410)	(0.040)	(0.202)	(0.037)	(0.040)	(0.032)
Thailand (dummy)	0.000	0.060	0.332 **	0.203	0.066	0.292	-0.023	-0.078 *	-0.053
	(0.065)	(0.101)	(0.154)	(0.235)	(0.045)	(0.182)	(0.038)	(0.043)	(0.033)
Constant	1.731 ***	2.306 ***	1.759 ***	1.563	0.822 ***	1.031 **	0.028	0.118 *	0.234 ***
	(0.389)	(0.707)	(0.539)	(1.251)	(0.141)	(0.402)	(0.063)	(0.060)	(0.038)
Number of obs.	696	698	696	696	698	697	694	696	695
Wald chi2(7)	40.61	29.22	23.52	7.00	75.15	40.37	102.91	84.79	114.05
Prob > chi2	0.000	0.000	0.001	0.429	0.000	0.000	0.000	0.000	0.000
Hansen's J chi2(2)	1.35	0.69	0.03	1.72	5.11	7.51	1.37	3.55	2.88
Prob > chi2	0.510	0.707	0.986	0.424	0.078	0.023	0.505	0.170	0.237

Note 1: Instrumented: External sources, Duration of relationship, Employment size (customer/supplier), Grant technical license/know-how to customer/supplier.
Note 2: Instruments: Number of full-time employees, Startup 2000, Countries, Year beginning operating, Spin-off from MNC/JV, Local firm.
Note 3: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 4: Standard errors are in parentheses.

Table 10: Capability and External Sources (2)

	Case 10	Case 11	Case 12	Case 13	Case 14	Case 15	Case 16	Case 17	Case 18
MNC/JV supplier located in a foreign country	0.128 *** (0.028)								
Public organization		-0.077 (0.174)							
Local business organization			-0.347 ** (0.173)						
University or Public Research Institute				-1.743 (5.212)					
Duration of relationship (customer)					0.369 *** (0.110)				
Employment size (customer)						0.194 *** (0.037)			
Employment size (supplier)							0.230 *** (0.081)		
Grant technical license/know-how to customer								0.587 ** (0.236)	
Grant technical license/know-how to supplier									0.503 *** (0.128)
Number of full-time employees	0.004 (0.005)	0.022 *** (0.006)	0.022 *** (0.007)	0.073 (0.156)	-0.001 (0.011)	-0.006 (0.008)	-0.018 (0.014)	0.016 *** (0.005)	0.011 ** (0.005)
Startup 2000	-0.003 (0.017)	0.005 (0.021)	-0.024 (0.040)	-0.067 (0.281)	0.392 *** (0.122)	0.001 (0.023)	0.033 (0.025)	-0.010 (0.024)	0.004 (0.019)
Ho Chi Minh (dummy)	-0.113 *** (0.040)	0.079 (0.149)	0.150 * (0.090)	1.438 (4.254)	-0.031 (0.083)	0.054 (0.045)	-0.033 (0.047)	0.240 *** (0.091)	0.203 *** (0.053)
Indonesia (dummy)	-0.059 * (0.031)	-0.079 (0.097)	-0.400 ** (0.195)	-1.078 (3.161)	0.329 ** (0.139)	0.091 * (0.051)	0.019 (0.044)	-0.063 (0.047)	0.022 (0.038)
Philippines (dummy)	-0.104 *** (0.032)	-0.022 (0.112)	0.045 (0.088)	0.393 (1.385)	-0.319 *** (0.114)	0.026 (0.048)	0.053 (0.057)	-0.027 (0.040)	-0.046 (0.034)
Thailand (dummy)	-0.026 (0.033)	0.032 (0.125)	0.160 (0.110)	1.645 (4.923)	-0.184 * (0.105)	0.177 *** (0.050)	0.113 * (0.060)	-0.171 ** (0.080)	-0.146 *** (0.054)
Constant	0.223 *** (0.045)	0.514 * (0.300)	1.187 *** (0.412)	2.910 (7.609)	-1.643 *** (0.597)	-0.093 (0.095)	-0.061 (0.157)	1.346 *** (0.396)	1.248 *** (0.230)
Number of obs.	693	698	696	697	698	667	665	685	685
Wald chi2(7)	92.34	77.41	19.21	0.83	33.57	136.69	44.73	57.04	93.54
Prob > chi2	0.000	0.000	0.008	0.997	0.000	0.000	0.000	0.000	0.000
Hansen's J chi2(2)	2.91	17.76	1.33	0.12	0.31	1.05	1.09	8.54	1.74
Prob > chi2	0.233	0.000	0.514	0.941	0.856	0.592	0.580	0.014	0.418

Note 1: Instrumented: External sources, Duration of relationship, Employment size (customer/supplier), Grant technical license/know-how to customer/supplier.
Note 2: Instruments: Number of full-time employees, Startup 2000, Countries, Year beginning operating, Spin-off from MNC/JV, Local firm.
Note 3: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 4: Standard errors are in parentheses.

4.4. Effect of Internal Capability on External Linkages

In the last section, we examine whether external linkages enhance internal capability. Here we attempt to estimate whether internal capability promotes the attracting of external sources, taking the external resources listed in Section 4.3. as dependent variables and the internal capability and other variables such as industries, countries, and the size of firms as explanatory variables. Again, we use the treatment-effects model.

The results of the estimations are summarized in Table 11 and Table 12. According to the results, Ho Chi Minh ($p<0.01$), Philippines ($p<0.05$), "Number of full-time employees ($p<0.01$)," "Other transportation equipment and parts ($p<0.01$)," and "Local firms ($p<0.01$)" are significant for internal capability. The controlled internal capability also has effects on external linkages in the cases of "Competitor ($p<0.05$)," "Consultant ($p<0.10$)," "MNC/JV customer located in country ($p<0.01$)," "MNC/JV supplier located in country ($p<0.01$)," "MNC/JV customer located in a foreign country ($p<0.01$)," "MNC/JV supplier located in a foreign country ($p<0.01$)," "Public organization ($p<0.01$)," and "University or Public Research Institute ($p<0.01$)." These results show there is a reverse causality of internal capability and external linkages, that is, if firms enhance internal capability, then they have a higher possibility to construct external linkages with various institutions. Again, this relationship is especially strong for connecting with multinational and joint-venture companies.

Table 11: Estimation of Results of Reverse Causality from Internal Capability to External Linkages (1) (Treatment Model)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Capability Index	-0.161	0.398 **	0.196	0.434 *	0.270	-0.264	2.437 ***
	(0.169)	(0.186)	(0.212)	(0.239)	(0.245)	(0.215)	(0.360)
Constant	3.605 ***	3.075 ***	3.117 ***	2.517 ***	2.907 ***	3.142 ***	1.254 ***
	(0.090)	(0.099)	(0.113)	(0.127)	(0.131)	(0.115)	(0.192)
Capability Index							
Ho Chi Minh (dummy)	0.547 ***	0.546 ***	0.565 ***	0.558 ***	0.523 ***	0.547 ***	0.542 ***
	(0.179)	(0.179)	(0.180)	(0.180)	(0.180)	(0.179)	(0.180)
Indonesia (dummy)	-0.026	-0.027	0.000	-0.014	-0.039	-0.026	-0.034
	(0.182)	(0.182)	(0.184)	(0.183)	(0.183)	(0.182)	(0.183)
Philippines (dummy)	-0.349 **	-0.349 **	-0.332 **	-0.336 **	-0.360 **	-0.349 **	-0.365 **
	(0.151)	(0.151)	(0.151)	(0.151)	(0.151)	(0.151)	(0.152)
Thailand (dummy)	0.039	0.048	0.054	0.054	0.048	0.039	0.029
	(0.202)	(0.201)	(0.202)	(0.202)	(0.201)	(0.202)	(0.202)
Number of full-time employees	0.090 ***	0.090 ***	0.089 ***	0.089 ***	0.090 ***	0.090 ***	0.091 ***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Food, beverages, tobacco	0.010	0.006	0.006	0.007	0.011	0.010	0.028
	(0.216)	(0.215)	(0.216)	(0.216)	(0.216)	(0.216)	(0.216)
Textiles	-0.250	-0.254	-0.258	-0.254	-0.219	-0.250	-0.252
	(0.272)	(0.272)	(0.272)	(0.272)	(0.269)	(0.272)	(0.272)
Apparel, leather	-0.118	-0.120	-0.130	-0.126	-0.109	-0.118	-0.059
	(0.273)	(0.274)	(0.274)	(0.274)	(0.274)	(0.273)	(0.277)
Wood, wood products	-0.177	-0.179	-0.186	-0.184	-0.171	-0.177	-0.170
	(0.559)	(0.559)	(0.559)	(0.559)	(0.559)	(0.559)	(0.559)
Paper, paper products, printing	-0.241	-0.244	-0.245	-0.243	-0.240	-0.241	-0.241
	(0.318)	(0.318)	(0.318)	(0.318)	(0.318)	(0.318)	(0.318)
Coal, petroleum products	-0.205	-0.215	-0.213	-0.210	-0.212	-0.205	-0.209
	(0.676)	(0.677)	(0.676)	(0.676)	(0.677)	(0.676)	(0.676)
Chemicals, chemical products	0.393	0.421	0.387	0.391	0.428	0.393	0.423
	(0.301)	(0.298)	(0.301)	(0.301)	(0.298)	(0.301)	(0.298)
Plastic, rubber products	-0.320	-0.322	-0.332	-0.324	-0.309	-0.320	-0.320
	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)
Other non-metallic mineral products	-0.119	-0.122	-0.126	-0.123	-0.113	-0.119	-0.116
	(0.337)	(0.337)	(0.337)	(0.337)	(0.337)	(0.337)	(0.338)
Iron, steel	-0.341	-0.343	-0.351	-0.344	-0.331	-0.341	-0.342
	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)

Table 11 *(Continued)*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Non-ferrous metals	-4.670	-4.671	-4.667	-4.974	-4.978	-4.670	-4.674
	(88.0)	(88.0)	(87.9)	(172.8)	(172.8)	(88.0)	(88.0)
Metal products	-0.157	-0.159	-0.188	-0.163	-0.147	-0.157	-0.156
	(0.196)	(0.196)	(0.198)	(0.196)	(0.196)	(0.196)	(0.196)
Machinery, equipment, tools	-0.253	-0.254	-0.263	-0.256	-0.239	-0.253	-0.281
	(0.210)	(0.210)	(0.210)	(0.210)	(0.210)	(0.210)	(0.212)
Computers & computer parts	0.288	0.286	0.281	0.286	0.527	0.288	0.283
	(0.497)	(0.497)	(0.497)	(0.497)	(0.574)	(0.497)	(0.496)
Other electronics & components	-0.264	-0.266	-0.275	-0.269	-0.251	-0.264	-0.263
	(0.194)	(0.194)	(0.195)	(0.194)	(0.195)	(0.194)	(0.195)
Precision instruments	-0.469	-0.470	-0.482	-0.473	-0.454	-0.469	-0.471
	(0.373)	(0.373)	(0.373)	(0.373)	(0.373)	(0.373)	(0.373)
Automobile, auto parts	0.080	0.076	0.072	0.039	0.083	0.080	0.120
	(0.258)	(0.258)	(0.258)	(0.262)	(0.258)	(0.258)	(0.263)
Other transportation equipments and parts	-0.973 ***	-0.975 ***	-0.985 ***	-0.978 ***	-0.960 ***	-0.973 ***	-0.972 ***
	(0.339)	(0.339)	(0.339)	(0.339)	(0.339)	(0.339)	(0.339)
Local firm	-0.398 ***	-0.397 ***	-0.404 ***	-0.403 ***	-0.396 ***	-0.398 ***	-0.390 ***
	(0.100)	(0.100)	(0.100)	(0.100)	(0.100)	(0.100)	(0.100)
Number of obs.	704	705	703	703	705	704	701
Wald chi2(1)	0.91	4.59	0.85	3.30	1.22	1.50	45.94
Prob > chi2	0.341	0.032	0.356	0.069	0.270	0.221	0.000

Note 1: Standard errors are in parentheses.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Final Consumer
Case 2: Competitor
Case 3: Buyer or trading company
Case 4: Consultant
Case 5: Local customer (100% local capital)
Case 6: Local supplier
Case 7: MNC/JV customer located in Country.

Table 12: Estimation of Results of Reverse Causality from Internal Capability to External Linkages (2) (Treatment Model)

	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13
Capability Index	2.249 ***	2.802 ***	2.467 ***	0.773 ***	0.242	1.030 ***
	(0.344)	(0.375)	(0.353)	(0.298)	(0.284)	(0.289)
Constant	1.276 ***	0.977 ***	1.008 ***	1.791 ***	2.211 ***	1.288 ***
	(0.184)	(0.201)	(0.189)	(0.159)	(0.151)	(0.154)
Capability Index						
Ho Chi Minh (dummy)	0.540 ***	0.538 ***	0.527 ***	0.546 ***	0.547 ***	0.547 ***
	(0.179)	(0.180)	(0.180)	(0.179)	(0.179)	(0.179)
Indonesia (dummy)	-0.033	-0.036	-0.044	-0.027	-0.026	-0.026
	(0.183)	(0.183)	(0.183)	(0.182)	(0.182)	(0.182)
Philippines (dummy)	-0.355 **	-0.355 **	-0.368 **	-0.349 **	-0.347 **	-0.349 **
	(0.151)	(0.151)	(0.152)	(0.151)	(0.151)	(0.151)
Thailand (dummy)	0.034	0.031	0.042	0.048	0.044	0.039
	(0.201)	(0.202)	(0.203)	(0.201)	(0.201)	(0.202)
Number of full-time employees	0.090 ***	0.091 ***	0.091 ***	0.090 ***	0.090 ***	0.090 ***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Food, beverages, tobacco	0.026	0.026	0.057	0.006	0.007	0.010
	(0.216)	(0.216)	(0.218)	(0.215)	(0.215)	(0.216)
Textiles	-0.250	-0.250	-0.242	-0.254	-0.253	-0.250
	(0.272)	(0.272)	(0.272)	(0.272)	(0.272)	(0.272)
Apparel, leather	-0.114	-0.067	-0.053	-0.120	-0.120	-0.118
	(0.274)	(0.277)	(0.277)	(0.274)	(0.273)	(0.273)
Wood, wood products	-0.177	-0.175	-0.164	-0.179	-0.180	-0.177
	(0.559)	(0.559)	(0.560)	(0.559)	(0.559)	(0.559)
Paper, paper products, printing	-0.241	-0.242	-0.237	-0.244	-0.243	-0.241
	(0.318)	(0.318)	(0.318)	(0.318)	(0.318)	(0.318)
Coal, petroleum products	-0.207	-0.207	-0.208	-0.215	-0.210	-0.205
	(0.676)	(0.677)	(0.677)	(0.677)	(0.676)	(0.676)
Chemicals, chemical products	0.423	0.423	0.431	0.421	0.422	0.393
	(0.298)	(0.298)	(0.298)	(0.298)	(0.298)	(0.301)
Plastic, rubber products	-0.318	-0.319	-0.307	-0.322	-0.321	-0.320
	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)	(0.206)
Other non-metallic mineral products	-0.119	-0.121	-0.108	-0.122	-0.122	-0.119
	(0.337)	(0.337)	(0.338)	(0.337)	(0.337)	(0.337)
Iron, steel	-0.339	-0.341	-0.329	-0.343	-0.342	-0.341
	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)	(0.288)

Table 12 *(Continued)*

	Case 8	Case 9	Case 10	Case 11	Case 12	Case 13
Non-ferrous metals	-4.671	-4.673	-4.672	-4.671	-4.670	-4.670
	(88.0)	(88.0)	(88.0)	(88.0)	(88.0)	(88.0)
Metal products	-0.155	-0.155	-0.143	-0.159	-0.158	-0.157
	(0.196)	(0.196)	(0.196)	(0.196)	(0.196)	(0.196)
Machinery, equipment, tools	-0.251	-0.251	-0.240	-0.254	-0.254	-0.253
	(0.210)	(0.210)	(0.210)	(0.210)	(0.210)	(0.210)
Computers & computer parts	0.289	0.287	0.299	0.286	0.287	0.288
	(0.496)	(0.497)	(0.497)	(0.497)	(0.497)	(0.497)
Other electronics & components	-0.261	-0.263	-0.235	-0.266	-0.265	-0.264
	(0.195)	(0.195)	(0.197)	(0.194)	(0.194)	(0.194)
Precision instruments	-0.467	-0.467	-0.454	-0.470	-0.470	-0.469
	(0.373)	(0.373)	(0.374)	(0.373)	(0.373)	(0.373)
Automobile, auto parts	0.117	0.115	0.123	0.076	0.065	0.080
	(0.262)	(0.263)	(0.263)	(0.258)	(0.259)	(0.258)
Other transportation equipments and parts	-0.969 ***	-0.972 ***	-0.960 ***	-0.975 ***	-0.974 ***	-0.973 ***
	(0.339)	(0.339)	(0.339)	(0.339)	(0.339)	(0.339)
Local firm	-0.391 ***	-0.395 ***	-0.396 ***	-0.397 ***	-0.396 ***	-0.398 ***
	(0.100)	(0.100)	(0.100)	(0.100)	(0.100)	(0.100)
Number of obs.	703	702	700	705	704	704
Wald chi2(1)	42.77	55.72	48.79	6.74	0.72	12.67
Prob > chi2	0.000	0.000	0.000	0.009	0.395	0.000

Note 1: Standard errors are in parentheses.

Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Note 3: Dependent variables;

Case 8: MNC/JV supplier located in Country

Case 9: MNC/JV customer located in a foreign country

Case 10: MNC/JV supplier located in a foreign country

Case 11: Public organization

Case 12: Local business organization

Case 13: University or Public Research Institute.

4.5. Effect of External Linkages on Innovation

The following three causal inferences were analyzed for: (1) effect of the internal capability on innovation; (2) effect of external linkages on internal capability; and (3) effect of internal capability on external linkages. All of the inferences were found to be significant. In this section, the remaining causality is analyzed, namely (4) effect of external linkages on innovation. In so doing, we also examine whether internal capability and external linkages are complementary to influence innovation. This estimation concludes the analysis of how innovation is promoted by the interaction between internal capability and external linkages.

Even though treatment-effects models or instrumental variables estimations were used in the series of previous estimations, a sample selection bias is not considered. In other words, through the survey, only firms with a higher internal capability index might be selected, as firms could respond arbitrarily and the resulting data from the survey might not be reliable. These may yield sample selection bias. In order to handle this problem, we utilize the PSM method, proposed by Rosenbaum and Rubin (1983), (1985), and developed by Heckman, *et al*. (1997), (1998b) and Heckman *et al.* (1998a). In accordance with PSM, samples are divided into two groups: (i) the innovative group (treatment group) and (ii) the non-innovative group (control group). These two groups are matched so that their propensity scores as calculated by their attributes are similar to one another. This method enables estimation with less sample selection bias. The procedure of the PSM method is as follows:

1. A propensity score is calculated by the probit analysis. The propensity score is interpreted as a predicted probability of this probit estimation. The model consists of the innovation as a dependent variable, and the “Size of the firm,”

"Industry," "Country," and "Local firms" as independent variables.

2. The treatment group and control group are matched based on the propensity score. There are several ways of matching, and we utilize kernel matching in this model. Moreover, it is tested as to whether sample matching is appropriate by a balancing test, in which independent variables used in probit estimation are examined by the t-test between treatment and control groups. If no significant difference exists, then matching can be successful.

3. Finally, the effect of internal capability and external linkages on innovation is examined with matched samples.

The result of the PSM model is shown in Tables 13, 14, and 15. Table 13 summarizes the result of probit estimation, while the result of the balancing test after matching is shown in Table 14. The row named as "Before matching" indicates a simple comparison of the raw data, while "After kernel matching" shows that of matched samples after kernel matching. The result indicated that matching is successful, since there are only two variables that have a statistically significant difference after matching. The effects of internal capability and external linkages on innovation are summarized in Table 15. According to this table, firstly the internal capability has a significant effect even after matching, where Cases 1, 2, 3, and 5 ($p<0.01$) and Case 4 ($p<0.10$) are significant. Since the internal capability still has a larger effect after removing sample selection bias, the effect of internal capability is robust. On the other hand, external linkages are significant for "Final consumer" ($p<0.10$ for Cases 3, 5), "Competitor" ($p<0.05$ for Cases 2, 3, 4), "Buyer or trading company" ($p<0.01$ for Case 3), "Consultant" ($p<0.01$ for Case 1, $p<0.05$ in Case 2, $p<0.01$ for Case 3, and $p<0.05$ for Case 4), Local customer/supplier ($p<0.05$ for Case

1, $p<0.01$ for Case 3), MNC/JV supplier in a foreign country ($p<0.05$ for Case 1, $p<0.10$ for Case 2), Local business organization ($p<0.05$ for Cases 1, 3), University or Public Research Institute ($p<0.01$ for Case 1, $p<0.05$ for Case 2, $p<0.01$ for Case 3, $p<0.10$ for Case 4). “Consultant” and “Universities” especially show large effects, and they significantly contribute to innovation. However, there are many insignificant external linkages after matching, which shows that their effects on innovation are not robust. This is quite different from internal capability.

In this analysis, we cannot determine which mechanism, from capability to linkages or from linkages to capability, has a stronger effect in this cumulative process. According to the previous studies, MNC/JCs have technological superiority, and constructing ties with them seems to be essential for promoting internal capability. We are required to conduct further rigorous research to verify this.

Table 13: Probit Regression for Propensity Score

	Case 1	Case 2	Case 3	Case 4	Case 5
Number of full-time employees (Persons)	0.068 ***	0.068 ***	0.032	0.054 *	0.080 ***
	(0.022)	(0.022)	(0.022)	(0.028)	(0.022)
Local firm	-0.159	-0.159	-0.113	-0.056	-0.073
	(0.110)	(0.110)	(0.110)	(0.141)	(0.112)
Ho Chi Minh (dummy)	-0.248	-0.248	-0.317 *	-0.675 ***	0.137
	(0.191)	(0.191)	(0.189)	(0.230)	(0.190)
Indonesia (dummy)	-0.146	-0.146	0.299	-0.027	0.186
	(0.196)	(0.196)	(0.193)	(0.232)	(0.196)
Philippines (dummy)	-0.360 **	-0.360 **	-0.401 **	0.202	-0.452 **
	(0.181)	(0.181)	(0.180)	(0.228)	(0.181)
Thailand (dummy)	-0.505 **	-0.505 **	-0.334	-0.074	0.233
	(0.216)	(0.216)	(0.214)	(0.254)	(0.218)
Food, beverages, tobacco	0.364	0.364	0.265	0.343	0.163
	(0.228)	(0.228)	(0.227)	(0.281)	(0.228)
Textiles	0.278	0.278	0.617 **	0.056	-0.045
	(0.278)	(0.278)	(0.274)	(0.344)	(0.278)
Apparel, leather	0.212	0.212	0.208	-0.080	-0.267
	(0.281)	(0.281)	(0.281)	(0.372)	(0.290)
Wood, wood products	-0.396	-0.396	-0.453	0.281	-0.059
	(0.613)	(0.613)	(0.612)	(0.441)	(0.527)
Paper, paper products, printing	0.114	0.114	-0.120		0.040
	(0.331)	(0.331)	(0.347)		(0.336)
Coal, petroleum products			-0.347	0.299	
			(0.693)	(0.918)	
Chemicals, chemical products	0.501	0.501	-0.012	-0.894 **	0.264
	(0.304)	(0.304)	(0.311)	(0.445)	(0.311)
Plastic, rubber products	0.102	0.102	0.140	-0.046	0.107
	(0.215)	(0.215)	(0.215)	(0.268)	(0.215)
Other non-metallic mineral products	-0.057	-0.057	0.007	-1.087 *	0.331
	(0.346)	(0.346)	(0.342)	(0.588)	(0.337)
Iron, steel	0.137	0.137	0.246	0.127	0.072
	(0.290)	(0.290)	(0.283)	(0.361)	(0.294)
Metal products	0.090	0.090	0.181	-0.046	0.101
	(0.209)	(0.209)	(0.207)	(0.262)	(0.210)
Machinery, equipment, tools	0.209	0.209	0.158	0.359	0.244
	(0.225)	(0.225)	(0.225)	(0.278)	(0.228)
Computers & computer parts	1.072 **	1.072 **	0.290	-0.732	0.937
	(0.506)	(0.506)	(0.455)	(0.664)	(0.579)
Other electronics & components	0.136	0.136	0.279	0.168	0.235
	(0.209)	(0.209)	(0.206)	(0.256)	(0.210)
Precision instruments	1.179 ***	1.179 ***	0.236	-0.342	0.404
	(0.410)	(0.410)	(0.381)	(0.510)	(0.382)
Automobile, auto parts	0.293	0.293	0.308	0.129	0.488 *
	(0.280)	(0.280)	(0.275)	(0.338)	(0.291)
Other transportation equipments and parts	0.260	0.260	-0.007	0.147	-0.187
	(0.327)	(0.327)	(0.330)	(0.433)	(0.326)
Startup 2000	-0.155	-0.155	-0.214 **	0.003	0.235 **
	(0.104)	(0.104)	(0.104)	(0.136)	(0.105)
Constant	-0.294	-0.294	-0.176	-0.439	-0.315
	(0.240)	(0.240)	(0.237)	(0.293)	(0.238)
Number of obs.	685	685	690	437	689
Log likelihood	-442.37	-442.37	-447.23	-268.99	-429.06
Pseudo R2	0.050	0.050	0.051	0.078	0.088
LR chi2(23/24)	46.81	123.10	48.12	45.21	82.77
Prob > chi2	0.002	0.000	0.002	0.004	0.000

Note 1: Standard errors are in parentheses.

Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Note 3: Dependent variables;

Case 1: Change in packaging

Case 2: Improvement of an existing product

Case 3: New product based on the existing technologies

Case 4: New product based on new technologies

Case 5: Number of product increased.

Table 14: Balancing Test

		Case 1			Case 2			Case 3			Case 4			Case 5			
		T	C	t test	T	C	t test	T	C	t test	T	C	t test	T	C	t test	
Number of full-time employees	Before matching	5.25	4.39	0.000 ***	5.15	4.17	0.000 ***	5.18	4.43	0.000 ***	5.54	4.92	0.013 **	5.20	4.16	0.000 ***
	After kernel matching	5.13	5.11	0.938	5.10	5.28	0.306	5.08	4.99	0.686	5.35	5.36	0.984	5.14	5.04	0.572
Local firm	Before matching	0.59	0.66	0.039 **	0.63	0.64	0.650	0.60	0.65	0.156	0.55	0.64	0.044 **	0.62	0.64	0.569
	After kernel matching	0.59	0.58	0.792	0.63	0.57	0.060 *	0.61	0.58	0.458	0.57	0.59	0.656	0.62	0.63	0.847
Ho Chi Minh (dummy)	Before matching	0.21	0.18	0.328	0.28	0.08	0.000 ***	0.18	0.21	0.315	0.12	0.29	0.000 ***	0.22	0.15	0.017 **
	After kernel matching	0.24	0.23	0.906	0.30	0.32	0.645	0.20	0.20	0.976	0.14	0.17	0.536	0.26	0.28	0.375
Indonesia (dummy)	Before matching	0.22	0.18	0.196	0.25	0.13	0.000 ***	0.28	0.14	0.000 ***	0.23	0.20	0.427	0.23	0.14	0.002 ***
	After kernel matching	0.25	0.24	0.821	0.27	0.26	0.779	0.31	0.32	0.881	0.26	0.24	0.704	0.27	0.24	0.393
Philippines (dummy)	Before matching	0.27	0.33	0.074 *	0.22	0.42	0.000 ***	0.24	0.34	0.003 ***	0.26	0.18	0.023 **	0.20	0.44	0.000 ***
	After kernel matching	0.28	0.28	0.947	0.22	0.22	0.885	0.26	0.26	0.960	0.28	0.30	0.757	0.22	0.22	0.925
Thailand (dummy)	Before matching	0.15	0.20	0.099 *	0.12	0.27	0.000 ***	0.16	0.20	0.131	0.21	0.19	0.603	0.21	0.14	0.009 ***
	After kernel matching	0.08	0.08	0.920	0.07	0.07	0.752	0.09	0.09	0.973	0.13	0.12	0.854	0.12	0.10	0.428
Food, beverages, tobacco	Before matching	0.10	0.08	0.333	0.07	0.12	0.056 *	0.08	0.10	0.423	0.12	0.06	0.051 *	0.08	0.11	0.189
	After kernel matching	0.09	0.09	0.960	0.07	0.07	0.997	0.08	0.07	0.700	0.11	0.13	0.685	0.08	0.06	0.444
Textiles	Before matching	0.04	0.05	0.746	0.05	0.05	0.856	0.06	0.04	0.260	0.04	0.06	0.284	0.04	0.05	0.764
	After kernel matching	0.05	0.04	0.939	0.05	0.05	0.827	0.06	0.06	0.927	0.04	0.04	0.936	0.04	0.05	0.885
Apparel, leather	Before matching	0.05	0.05	0.974	0.03	0.06	0.053 *	0.04	0.05	0.330	0.04	0.03	0.640	0.02	0.08	0.001 ***
	After kernel matching	0.05	0.04	0.959	0.04	0.04	0.971	0.04	0.04	0.910	0.04	0.04	0.949	0.03	0.03	0.972
Wood, wood products	Before matching	0.00	0.02	0.101	0.00	0.02	0.008 ***	0.00	0.02	0.087 *	0.00	0.01	0.115	0.01	0.02	0.270
	After kernel matching	0.00	0.00	0.984	0.00	0.00	0.999	0.00	0.00	0.960	0.00	0.00	.	0.01	0.01	0.818
Paper, paper products, printing	Before matching	0.03	0.03	0.860	0.02	0.04	0.286	0.02	0.04	0.245	0.03	0.02	0.615	0.03	0.03	0.686
	After kernel matching	0.02	0.03	0.919	0.02	0.02	0.909	0.02	0.01	0.579	0.03	0.03	0.962	0.03	0.02	0.536
Coal, petroleum products	Before matching	0.00	0.01	0.095 *	0.00	0.01	0.017 **	0.00	0.01	0.485	0.01	0.00	0.730	0.00	0.01	0.022 **
	After kernel matching	0.00	0.00	.	0.00	0.00	.	0.00	0.00	0.928	0.01	0.00	0.903	0.00	0.00	.
Chemicals, chemical products	Before matching	0.04	0.03	0.252	0.04	0.02	0.168	0.03	0.04	0.522	0.02	0.05	0.041 **	0.04	0.03	0.457
	After kernel matching	0.04	0.06	0.394	0.04	0.03	0.409	0.03	0.03	0.936	0.01	0.01	0.993	0.03	0.03	0.896
Plastic, rubber products	Before matching	0.09	0.10	0.752	0.12	0.07	0.032 **	0.10	0.09	0.589	0.09	0.10	0.769	0.10	0.09	0.458
	After kernel matching	0.10	0.10	0.939	0.12	0.11	0.817	0.10	0.11	0.912	0.09	0.10	0.895	0.11	0.11	0.869
Other non-metallic mineral products	Before matching	0.02	0.03	0.586	0.02	0.04	0.211	0.02	0.03	0.508	0.01	0.03	0.064 *	0.03	0.03	0.873
	After kernel matching	0.02	0.02	0.792	0.02	0.01	0.524	0.02	0.02	0.934	0.01	0.01	0.966	0.03	0.03	0.947
Iron, steel	Before matching	0.04	0.04	0.740	0.04	0.04	0.876	0.04	0.04	0.616	0.04	0.04	0.905	0.04	0.04	0.993
	After kernel matching	0.04	0.04	0.925	0.04	0.05	0.614	0.04	0.05	0.816	0.04	0.05	0.740	0.04	0.04	0.845
Non-ferrous metals	Before matching	0.00	0.00	0.239	0.00	0.01	0.092 *	0.00	0.00	0.227	0.00	0.00	.	0.00	0.00	0.847
	After kernel matching	0.00	0.01	0.206	0.00	0.01	0.132	0.00	0.00	0.226	0.00	0.00	.	0.00	0.00	0.900
Metal products	Before matching	0.13	0.14	0.742	0.13	0.13	0.833	0.16	0.11	0.074 *	0.14	0.13	0.707	0.14	0.13	0.692
	After kernel matching	0.13	0.13	0.897	0.14	0.14	0.884	0.17	0.16	0.753	0.14	0.13	0.667	0.14	0.14	0.700
Machinery, equipment, tools	Before matching	0.09	0.08	0.710	0.10	0.07	0.305	0.09	0.09	0.769	0.10	0.08	0.601	0.10	0.07	0.181
	After kernel matching	0.09	0.10	0.715	0.10	0.11	0.414	0.09	0.09	0.895	0.10	0.09	0.758	0.10	0.12	0.456
Computers & computer parts	Before matching	0.02	0.01	0.060 *	0.02	0.00	0.043 **	0.02	0.01	0.617	0.01	0.03	0.092 *	0.02	0.00	0.050 *
	After kernel matching	0.02	0.02	0.600	0.02	0.00	0.055 *	0.01	0.01	0.898	0.01	0.00	0.681	0.02	0.02	0.748

Table 14 *(Continued)*

		Case 1				Case 2				Case 3				Case 4				Case 5			
		T	C	t test		T	C	t test		T	C	t test		T	C	t test		T	C	t test	
Other electronics & components	Before matching	0.11	0.12	0.612		0.13	0.10	0.194		0.12	0.11	0.697		0.13	0.11	0.633		0.12	0.10	0.460	
	After kernel matching	0.12	0.12	0.978		0.13	0.13	0.856		0.13	0.13	0.837		0.13	0.13	0.935		0.13	0.13	0.994	
Precision instruments	Before matching	0.04	0.01	0.004	***	0.03	0.00	0.009	***	0.02	0.02	0.553		0.01	0.03	0.233		0.02	0.01	0.264	
	After kernel matching	0.04	0.03	0.513		0.03	0.03	0.733		0.02	0.02	0.736		0.01	0.01	0.957		0.03	0.03	0.520	
Automobile, auto parts	Before matching	0.05	0.05	0.911		0.04	0.06	0.282		0.04	0.05	0.678		0.06	0.04	0.428		0.05	0.05	0.961	
	After kernel matching	0.05	0.05	0.991		0.04	0.04	0.943		0.04	0.05	0.734		0.06	0.06	0.974		0.05	0.04	0.867	
Other transportation equipments	Before matching	0.03	0.02	0.706		0.03	0.02	0.558		0.02	0.03	0.508		0.02	0.03	0.728		0.02	0.03	0.538	
	After kernel matching	0.03	0.03	0.817		0.03	0.03	0.672		0.02	0.02	0.972		0.02	0.03	0.829		0.03	0.03	0.845	
Startup 2000	Before matching	0.40	0.47	0.049	**	0.43	0.47	0.289		0.40	0.48	0.043	**	0.41	0.43	0.515		0.47	0.41	0.073	*
	After kernel matching	0.41	0.40	0.855		0.43	0.45	0.705		0.41	0.44	0.567		0.43	0.42	0.876		0.48	0.49	0.927	

Note 1: T and C stand for “Treatment group” and “Control group,” respectively.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Dependent variables;
Case 1: Change in packaging
Case 2: Improvement of an existing product
Case 3: New product based on the existing technologies
Case 4: New product based on new technologies
Case 5: Number of product increased.

Table 15: Effect of Capability Index and External Sources

		Case 1		Case 2		Case 3		Case 4		Case 5	
		t value	p value	t value	p value	t value	p value	t value	p value	t value	p value
Capability Index	Before matching	7.58	0.000 ***	9.08	0.000 ***	6.33	0.000 ***	1.96	0.051 *	7.43	0.000 ***
	After kernel matching	5.31	0.000 ***	3.26	0.001 ***	4.36	0.000 ***	1.95	0.052 *	3.23	0.001 ***
Final Consumer	Before matching	-0.30	0.764	1.23	0.219	1.56	0.119	2.74	0.006 ***	1.58	0.115
	After kernel matching	-0.15	0.881	1.47	0.142	1.78	0.076 *	1.39	0.165	1.71	0.088 *
Competitor	Before matching	2.09	0.037 **	4.00	0.000 ***	3.02	0.003 ***	2.43	0.016 **	2.40	0.017 **
	After kernel matching	1.34	0.181	2.37	0.018 **	2.43	0.015 **	2.26	0.024 **	1.08	0.281
Buyer or trading company	Before matching	1.02	0.308	1.97	0.049 **	2.32	0.021 **	1.80	0.073 *	0.96	0.337
	After kernel matching	0.86	0.390	1.24	0.215	2.73	0.006 ***	1.59	0.113	1.38	0.168
Consultant	Before matching	2.96	0.003 ***	2.88	0.004 ***	2.45	0.015 **	2.56	0.011 **	0.68	0.497
	After kernel matching	2.82	0.005 ***	2.10	0.036 **	2.85	0.005 ***	2.50	0.013 **	-0.21	0.834
Local customer (100% local capital)	Before matching	0.88	0.379	0.72	0.472	0.71	0.478	-0.33	0.742	0.75	0.454
	After kernel matching	1.33	0.184	0.62	0.535	2.65	0.008 ***	0.74	0.460	0.45	0.653
Local supplier	Before matching	0.59	0.555	-0.57	0.569	0.64	0.522	1.32	0.188	-0.65	0.516
	After kernel matching	2.25	0.025 **	1.04	0.299	2.66	0.008 ***	0.64	0.523	0.83	0.407
MNC/JV customer located in Country	Before matching	2.59	0.010 ***	3.60	0.000 ***	1.81	0.071 *	-0.13	0.897	3.78	0.000 ***
	After kernel matching	1.06	0.290	-0.51	0.610	-0.10	0.920	1.22	0.223	0.80	0.424
MNC/JV supplier located in Country	Before matching	2.37	0.018 **	2.41	0.016 **	0.63	0.529	-0.17	0.865	2.28	0.023 **
	After kernel matching	1.38	0.168	-1.00	0.318	-0.24	0.810	0.81	0.418	-0.08	0.936
MNC/JV customer located in a foreign country	Before matching	2.81	0.005 ***	4.61	0.000 ***	1.56	0.119	0.09	0.928	3.27	0.001 ***
	After kernel matching	0.67	0.503	0.48	0.631	-0.41	0.682	0.77	0.442	0.02	0.984
MNC/JV supplier located in a foreign country	Before matching	3.84	0.000 ***	5.75	0.000 ***	2.28	0.023 **	0.56	0.576	2.64	0.008 ***
	After kernel matching	2.25	0.025 **	1.94	0.053 *	1.30	0.194	1.46	0.145	0.31	0.757
Public organization	Before matching	1.56	0.119	-0.14	0.889	-0.39	0.697	0.82	0.413	-0.61	0.542
	After kernel matching	1.51	0.132	-0.21	0.834	1.26	0.208	1.13	0.259	-0.97	0.332
Local business organization	Before matching	1.78	0.076 *	0.23	0.818	-0.04	0.968	0.05	0.960	-0.50	0.617
	After kernel matching	2.03	0.043 **	1.50	0.134	2.18	0.030 **	0.14	0.889	0.02	0.984
University or Public Research Institute	Before matching	3.00	0.003 ***	2.37	0.018 **	1.58	0.115	1.11	0.268	1.14	0.255
	After kernel matching	3.13	0.002 ***	2.44	0.015 **	3.16	0.002 ***	1.77	0.077 *	0.55	0.582

Note 1: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Note 2: Dependent variables;

Case 1: Change in packaging

Case 2: Improvement of an existing product

Case 3: New product based on the existing technologies

Case 4: New product based on new technologies

Case 5: Number of product increased.

5. Conclusions

The results of the estimations are summarized here and the hypotheses proved are presented with the possibility of remaining problems.

5.1. Summary of Results

Let us summarize the results here.

(1) Internal capability promotes innovation significantly.

(2) External linkages, particularly MNC/JC, influence the enhancing of internal capability.

(3) Internal capability affects external linkages, that is, firms with the higher internal capability index tend to have more external linkages.

(4) External linkages seem to have less significant effect on innovation in this estimation. In other words, external linkages enhance internal capability, but not innovation directly.

According to the above results, there is a cumulative process between internal capability and external linkages. Internal capability itself enhances product as well as process innovation directly, while external linkages promote product innovation indirectly via enhancing internal capability. In this sense, internal capability is a core of innovation. The reasons for these results are that internal capability is presented by one single index, while external linkages are not expressed by one index but by various individual sources. This might highlight internal capability.

This conclusion can be applied for designing policy to promote innovation. It seems that all policy recommendations proposed thus are rather comprehensive and applicable in general. Since resources to promote innovation are limited, strategic

policy measures target specific objectives. In what follows, we present policy recommendations to promote innovation in ASEAN economies.

5.2. Policy Recommendation: Strategic Measures to Promote Innovation

The results of estimations in this paper precisely focus on internal capability which promotes innovation. In order to identify factors promoting internal capability in more detail, mixed logit estimation is used for identifying factors which categorize a particular firm at a particular stage of the capability index. In order to achieve this, the internal capability index is divided into four stages: Stage 1 has the highest capability index, while Stage 4 is the lowest. The number of firms in the four categories is the same, since this division of samples yields the best estimation results. In estimation, the third category is taken as a base outcome.

Table 16 summarizes the results of the estimation. It shows that "Accept guest engineers ($p<0.01$)" and "Audit supplier ($p<0.01$)" are significant for firms in the lowest category, while "Accept engineers ($p<0.01$)" and "Provide customer on-site technical assistance ($p<0.10$)" are significant only for Stage 1 firms. "Public financial support ($p<0.05$)" and "Just-in-time ($p<0.10$)" are significant only for Stage 4 firms with the highest degree of capability index.

Thus, firms with a low capability index really need technological assistance to promote their technological level, while firms with a high index require financial assistance and linkages with large customers which are practicing the just-in-time system. Since they have already achieved some level of technology, they need financial support to purchase equipment suitable to them or large customers to supply their parts under their delivering system. These are pinpointed policies for firms with a particular stage of capability index.

Table 16: Stages of Capability Index (Mixed Logit Estimation)

	Stage 1	Stage 2	Stage 3
Accept guest engineers	1.201 ***	0.238	-0.092
	(0.325)	(0.327)	(0.330)
Audit supplier	1.009 ***	0.470 *	0.286
	(0.303)	(0.285)	(0.299)
Provide customer on-site technical assistance	0.505 *	-0.390	0.022
	(0.296)	(0.292)	(0.281)
B2C E-commerce	0.836 *	1.108 ***	1.715 ***
	(0.470)	(0.405)	(0.417)
Public financial support	-0.043	-0.112	0.302 **
	(0.158)	(0.144)	(0.149)
Just-in-time supplier	0.274	-0.167	0.544 *
	(0.311)	(0.310)	(0.318)
Ho Chi Minh (dummy)	-3.731 ***	-2.045 ***	-2.962 ***
	(0.924)	(0.737)	(0.734)
Indonesia (dummy)	-1.162 *	-0.262	-1.845 ***
	(0.602)	(0.538)	(0.535)
Philippines (dummy)	0.176	-0.178	-1.461 ***
	(0.510)	(0.516)	(0.491)
Thailand (dummy)	-0.218	0.519	-0.479
	(0.626)	(0.627)	(0.556)
Number of full-time employees	-0.141 **	-0.109 **	0.043
	(0.057)	(0.049)	(0.047)
Food, beverages, tobacco	-0.013	-1.116	-0.216
	(0.567)	(0.695)	(0.527)
Textiles	0.063	0.095	-0.222
	(0.741)	(0.641)	(0.629)
Apparel, leather	-0.470	-0.682	-1.202
	(0.672)	(0.730)	(0.790)
Wood, wood products	1.139	-13.832	-0.265
	(1.249)	(944.2)	(1.511)
Paper, paper products, printing	0.524	0.206	0.198
	(0.869)	(0.847)	(0.820)
Coal, petroleum products	1.852	-14.091	-0.902
	(1.351)	(1002.3)	(1.495)
Chemicals, chemical products	-2.111 *	-0.090	0.192
	(1.189)	(0.663)	(0.629)
Plastic, rubber products	1.065 *	0.930 *	0.677
	(0.606)	(0.498)	(0.493)
Other non-metallic mineral products	1.517	0.222	1.159
	(0.928)	(1.069)	(0.909)
Iron, steel	1.370 *	0.590	0.279
	(0.761)	(0.667)	(0.667)
Non-ferrous metals	14.765	-0.361	-0.779
	(2921.0)	(4148.1)	(4131.1)
Metal products	0.954 *	-0.019	-0.141
	(0.541)	(0.466)	(0.473)
Machinery, equipment, tools	-0.117	0.202	-0.565
	(0.653)	(0.473)	(0.519)
Computers & computer parts	0.962	-0.352	0.816
	(1.466)	(1.221)	(0.841)
Other electronics & components	0.723	0.282	-0.150
	(0.551)	(0.463)	(0.467)
Precision instruments	0.092	0.943	0.205
	(1.305)	(0.819)	(0.908)
Automobile, auto parts	-0.434	0.043	-0.012
	(0.692)	(0.630)	(0.608)
Other transportation equipments and parts	1.442	2.126 **	0.913
	(1.145)	(0.861)	(0.941)

Table 16 *(Continued)*

	Stage 1	Stage 2	Stage 3
Constant	-2.782 ***	0.037	0.294
	(1.050)	(1.006)	(1.000)
Number of obs.	691		
Log likelihood	-785.38		
Pseudo R2	0.180		
LR chi2(87)	344.90		
Prob > chi2	0.000		

Note 1: The base outcome is 3.
Note 2: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Note 3: Standard errors are in parentheses.

5.3. Further Research

In this analysis, pooled data is used for empirical study, but the sample consists of MNV/JC and local firms. The former tends to have a higher capability index, and the latter a low index. The results might be influenced by the nature of the sample. It is necessary to construct the model with MNC/JC and local firms. The same thing can be said as to which has a stronger effect on the mutual process between internal capability and external linkages. Engaging this research will lead to a more fruitful strategic policy for enhancing innovation in East Asian economies.

In this paper, internal capability is measured by one single index, but external linkages are not. This is unfair treatment, but external linkages include many heterogeneous sources and no consistent rationale was found. It is better to construct a single index of external linkages.

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