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The Innovation System of Culture-Specific MNEs: The Effects of Diversified and Geographically Dispersed Knowledge Sourcing Mechanism[1]

By

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Abstract

Traditional multinational enterprises (MNEs) have introduced new products in overseas markets while conducting Research and Development (R&D) activities mainly in their home country. However, over the last 10–20 years, as a result of the geographical dispersion of scientific and technological knowledge creation, these companies now conduct R&D activities in collaboration with other institutions at home and abroad.

This study investigates how the accession and integration of geographically dispersed and technologically diversified knowledge affect innovative performance at corporate-level. We focus on the cases of two Japanese MNEs, (Kao and Ajinomoto), two European MNEs (Unilever and Nestlé) and one American MNE (P&G) to examine innovation mechanisms, with particular focus on the knowledge-sourcing of MNEs in a culture-specific industry. We find that some MNEs' ability to integrate technologically-diversified knowledge positively affects their innovative performance, while others do not get statistically positive effects. This finding contributes to a better understanding of the advantages of cross-border collaborative R&D activities in a firm's knowledge accumulation, with an additional time-series perspective.

Key Words

Knowledge Creation, Diversified knowledge sources, Globalization of R&D, Collaborative R&D Activities, Dynamic Capabilities

Introduction

The objective of this paper is to investigate how the accession and integration of geographically-dispersed and technologically-diverse knowledge may affect the innovative

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performance of multinational enterprises (MNEs) in the global market, and to determine the extent to which MNEs leverage external knowledge within their group. We analyze how firms can retain competitive advantages from a viewpoint of the global knowledge-creation mechanisms which MNEs possess. In doing so, we try to overcome intrinsically static views in the resource-based view and clarify sources of contemporary MNEs' dynamic capabilities (Cantwell, 1995; Dunning, 1996; Teece, 2009: 136–175; Wernerfelt, 1984). We also examine changes in the relationship between MNE headquarters and overseas subsidiaries and the dynamic capabilities of contemporary MNE groups, which from the analysis of the roles of R&D functions in subsidiaries can be seen as MNE-specific. In particular, we shall clarify the relationship between mechanisms of innovative activities and knowledge creation by MNE groups and sources of competitive advantages in the global market.

Scholars have recently focused on the role of knowledge in explaining the existence of MNEs. Large MNEs exist not as a response to market failure in the buying and selling of knowledge, but as a consequence of their ability to organize the generation and transfer of knowledge worldwide. These firms can be described as repositories of knowledge with the ability to create unique capabilities. Since these capabilities are fostered through firm-specific social learning processes, they are easier to transfer within an MNE than across organizations, and constitute the true ownership advantages of the MNE as a group (Cantwell, 1989, 1991, 1994; Kogut and Zander, 1993, 1995). As much existing literature on R&D globalization and decentralization has suggested, MNEs have been trying to innovate through knowledge-creation processes, through utilizing subsidiaries' R&D resources and facilities in host countries.

In the rapidly changing competitive environment, MNEs have been under considerable pressure to respond to competitor firms, not only in their home country, but also in host countries, and have sought to develop differentiated new products to enhance their global reach. Therefore, a critical issue for MNEs has been to generate new technological knowledge and concepts that are necessary for companies to develop new products. In order to raise global sales figures through success in new product development, the general R&D strategy employed up to the 1990s was to invest further in R&D facilities and human resources, and thereby to raise R&D capability within the organization. However, due to changes in the global competitive environment and shorter product lifecycles, in many organizations strengthening R&D activities has actually led to further lowering of R&D investment efficiency.

Although R&D has been the least-globalized function of MNEs (UNCTAD, 2005), the more global the company, the more pressure it is under to deploy R&D human resources strategically, regardless of nationality. Traditionally, R&D decentralization was from developed home-country to developed host-countries; where undertaken in developing countries, it was for adapting products or processes to local conditions. The production process is no longer driven only by the need for local adaptation; R&D by MNEs is required to respond to increased competition, access foreign research-talent pools, reduce costs and accelerate technology development (UNCTAD, 2005). As a result, global companies can retain multicultural knowledge resources as part of their institutional capability, and in consequence, theoretical arguments on R&D globalization have evolved. In the 1970s and 1980s, theoretical discussions of R&D globalization centered on MNEs from the USA and Europe. However, a backdrop of difficulty in maintaining global competitive edge and a global decentralization of the production of scientific technological knowledge has motivated even highly-globalized companies to shift away from closed innovation systems

towards the principle of "metanational innovation" (Asakawa, 2006; Doz, Santos, and Williamson, 2001).

New knowledge generation is generally a process of combining current and acquired knowledge or recombining current knowledge (Kogut and Zander, 1992). In the former case, the ability to create or access new technological knowledge has become critical for the growth of firms, given increasing knowledge complexity in the global market. Firms may increasingly have to acquire new knowledge from external sources (Chesbrough, 2003) in order to complement and support their own in-house R&D. We examine to what extent firms may draw upon a wider range of existing knowledge originating from a greater variety of external knowledge sources. Such external knowledge sources may be, for instance, researchers located in different countries (e.g. in subsidiaries in a host country) or from different technological fields (e.g. through inter-organizational collaborative R&D activities). It is also argued that firms increasingly need and are able to access technologically distant knowledge in quite different technological areas (Cantwell, Noonan, and Zhang, 2008)

Previous research on the analysis of various aspects of subsidiaries' R&D activities in the culture-free industry (e.g. MNEs in electrical and electronics industries) suggests that competence-creating subsidiaries have established R&D laboratories to utilize local knowledge and creative inputs, including technology, to develop new products aimed at expanding the global marketing scope of their MNE group. Evidence from previous research in this industry also suggests that that globalization of R&D activities has evolved over time (Serapio and Hayashi, 2004; Hayashi and Serapio, 2006; Iguchi, 2006, 2008). We chose the culture-specific industry (which includes toiletry, food and beverage sectors), because firms in this industry have among the highest incentives to source local knowledge.

In order to develop our research to focus on these issues, we need to analyze subsidiary-specific R&D capabilities on the mechanism of knowledge creation through inter-organizational networks (Bartlett and Ghoshal, 1990) and network-based MNEs (Sölvell and Zander, 1998). We look at five MNEs in the culture-specific industry in which sensitivity to locally-bounded consumer demand is necessary. In order to clarify how MNEs create knowledge strategically in the process of new-product development for global or regional markets, we employ methods which analyze research papers as outcomes of R&D activities and knowledge-creating and knowledge-sourcing activities by MNE groups. We collected those technical and scientific research papers which proved competitive in developing new products in culture-specific industries and which appeared in the names of authors (researchers and engineers) belonging to Kao, Ajinomoto, P&G, Unilever and Nestlé. Using analytical methods, we categorized these papers into the departments of the above five MNEs to which authors belonged, the national origin of affiliated organizations, and the technological fields of researchers. The categorized information was used to investigate the evolution of global mechanisms of knowledge creation by the selected MNEs. The periods selected for study were 1986–1988, 1991–1993, 1996–1998, 2001–2003 and 2006–2008. Technical and scientific research papers are limited to those published in the UK, US, and Netherlands, home-base for the major scientific journals.

Hypothesis Development

Issues related to inter-organizational linkages between the capabilities of subsidiaries and MNE home-country headquarters have been discussed in terms of subsidiary evolution

from the dynamic capabilities perspective (Birkinshaw and Hood, 1998), and home-base-augmenting or -exploiting R&D from a globalization of R&D point of view (Kuemmerle, 1997). Studies have also suggested supply-side factors such as obtaining R&D human resources and access to new technology (Florida, 1997), competence-creating and competence-exploiting subsidiaries (Cantwell and Mudambi, 2005) for linkages, and dynamic enhancement of R&D capabilities of overseas subsidiaries and MNE headquarters (Asakawa, 2001a, 2001b, 2004; Song, Asakawa, and Chu, 2011). Although previous focus has been on issues of MNEs in general or subsidiaries in the USA or European host countries, recent researches on subsidiary evolution in contemporary MNEs have shifted to subsidiaries in host developing countries, such as those in ASEAN (Iguchi, 2006, 2008).

Large MNEs such as Kao, Ajinomoto, P&G, Unilever and Nestlé exist not as a response to market failure in the buying and selling of their knowledge, but as a consequence of their ability to organize the generation and transfer of this knowledge worldwide. Since these capabilities are fostered through firm-specific social learning processes, they are easier to transfer within an MNE than across organizations, and constitute the true ownership advantages of the MNE as a group (Cantwell, 1989, 1991, 1994; Kogut and Zander, 1993, 1995). The responsibilities and roles of subsidiaries and the functional scope that a subsidiary has in a host country will vary depending on the nature of sources available in the host country. However, due to changes in subsidiaries and their history of operations in host countries, subsidiaries have become aware that the parent organization is not the sole source of competitive advantage for the MNE group. The parent-driven view has been largely abandoned in preference for organizing locationally-dispersed competence-creating activities within the MNE.

In recent years, some subsidiaries have acquired a more creative role linked to the closer integration of subsidiaries into global networks within the MNE group. Subsidiaries that are part of internationally integrated strategies in an MNE group are characterized as having a competence-creating role, while others continue to be competence-exploiting subsidiaries (Cantwell and Mudambi, 2005). Competence-creating subsidiaries use local knowledge and creative inputs to develop new products aimed at expanding the global marketing scope of their MNE group (Burgelman, 1983a, 1983b; White and Poynter, 1984; D'Cruz, 1986; Cantwell, 1987; Pearce, 1992, 2001; Rugman and Verbeke, 1992; Dunning, 1996). Competence-creating subsidiaries have supportive autonomy and creative scope, allowing some element of asset- or knowledge-seeking behavior based on their ability to affect the MNE group's competitiveness and the creative assets of the host or regional economy. In order to function effectively, the MNE must rely on the area in which the subsidiary is located to obtain existing local technology and unique elements of research capacity in the local science base and sufficiency in human capital. Therefore, the emergence of competence-creating subsidiaries is a crucial manifestation of an increasingly decentralized approach to the generation and application of knowledge in contemporary MNEs. This approach attaches importance to the role of a subsidiary's capabilities and emphasizes that the subsidiary is part of a network (Birkinshaw and Hood, 1998).

The significance of technological knowledge accumulation and creation in a firm's success has been emphasized for almost a century (Schumpeter, 1934; Cantwell and Santangelo, 2000); a firm's ability to integrate technologically and geographically diverse knowledge through combination and recombination positively affects its performance in an increasing knowledge complex market.

Although there has been insufficient research on different types of R&D laboratories

in different types of industry, previous research[2] on the analysis of various aspects of subsidiaries' R&D activities suggests that competence-creating subsidiaries have established R&D laboratories to utilize local knowledge and creative inputs, including technology, to develop new products aimed at expanding the global marketing scope of their MNE group in the culture-free industry. If a subsidiary has basic research laboratories, it tends to pursue collaborative research linking inter-organizationally, such as with a university or public research institutes.[3] Since basic research is defined as research that advances scientific knowledge but does not have specific immediate commercial objectives, those with basic research facilities pursue research projects that have yet to develop as a product. We can also assume that R&D laboratories in basic research facilities in the culture-free industry have been carrying out 'seed' research through utilizing local research inputs. However, there is evidence that in the culture-specific industry, collaborative research is confirmed even where a laboratory has a product-development role.

To develop products with brand-new concepts, an MNE's ability to integrate related knowledge becomes essential (Sölvell and Zander, 1998). In particular, we look here at MNEs' knowledge-sourcing and accumulation from geographically dispersed sources, as well as their knowledge accumulation across technological fields. We focus our study on the culture-specific industry, through identifying how R&D in subsidiaries contributes to MNEs' product development in the global market, and hence on sales figures in the global market.

Based on the theoretical argument discussed earlier, we try to investigate how the accession and integration of geographically dispersed and technologically diverse knowledge will have positive effects on innovative activities through the diversification of R&D. Therefore, three hypotheses have been developed for the strategic behavior of MNEs operating in the culture-specific industry (an industry highly likely to be influenced significantly from cultural factors within the targeted market or region) in the global competitive environment.

Hypothesis 1
The ability to access diverse technological knowledge obtained through collaborative research projects is positively associated with better innovative performance.
Hypothesis 2
The ability to access a diverse range of researchers in R&D facilities through collaborative overseas research projects is positively associated with better innovative performance.
Hypothesis 3
The ability to access technologically diverse fields through collaborative research projects is positively associated with better innovative performance.

For Hypothesis 1, we investigate the number of authors involved in completing a paper to see to what extent MNEs have the ability to perform such research. For Hypothesis 2, we investigate the number of national origins of the authors involved in a paper, to see to what extent MNEs have access to a diverse range of research talents. For Hypothesis 3, we

[2] Research has targeted the culture-free industry (electrical and electronics industry) in Malaysia, Thailand and Singapore, and the culture-specific industry in Thailand and Singapore. Interviews were carried out for ten Japanese MNE subsidiaries and questions focused on a) what type of R&D laboratories they have, 2) what type of R&D activities they have, 3) the reasons behind the R&D level in the host countries, and other relevant questions (Iguchi, 2012).

[3] Although with a small sample, results in the culture-free industry indicate a positive relationship between basic research and collaborative R&D (Iguchi, 2012).

investigate the number of different technological fields included in the research paper. We examine whether inherently different knowledge-creation mechanisms can be ascertained through analyzing the outcome of R&D activities by Kao, Ajinomoto, P&G, Unilever and Nestlé.

R&D by MNEs in the Culture-Specific Industry

Our research focuses on R&D by MNEs from various home countries in the culture-specific industry, namely Kao Corporation (Japan), Ajinomoto (Japan), Procter and Gamble (USA), Unilever (UK and Netherland) and Nestlé (Switzerland).

Kao was originally founded in 1887 and formally established in 1940. In fiscal year 2010, its turnover was US$12,993 million, with an operating income of US$985.4 million (net income US$656.2 million). It invested about US$519 million in R&D in 2009. In total, Kao has 33,745 employees, with global production and sales networking operations in 24 countries. Its first foreign direct investments were in Thailand and Taiwan ROC in 1964.

Ajinomoto was founded in 1925. In fiscal year 2010, its turnover was US$15,423.95 million, with an operating income of US$886 million (net income US$388.25 million). It has invested about US$471.7 million in R&D both in Japan and overseas, and in total has 28,084 employees.

P&G was established in 1837 in the USA. In 2008, it had subsidiaries in over eighty countries, and a turnover of US$83,503 million; its operating income was US$17,083 million (net profit US$12,075 million), and R&D expenditure US$2,226 million. P&G employs 138,000 staff worldwide. It has 24 global brands, with over US$1 billion sales. P&G's first foreign direct investment was to the UK in 1930.

Although Unilever was officially established in 1930, the original companies that joined forces to create the new company were already well established before the start of the 20th century. In 2008, Unilever's turnover was €40.5 billion, and its operating profit €7,167 million (net profit €5,285 million). It invested €927 million in R&D in 2008. It has 174,000 employees over 270 countries, and thirteen brands, with over €1 billion sales.

Nestlé, established in 1866, had 281,005 employees in 2010, in which year turnover was US$117.251 million (net income was US$36,582 million).

Our five target companies have some common characteristics and variables. Firstly, they all manufacture and sell products in culture-specific industries, such as food and beverage and toiletry products. Secondly, they have constantly maintained increases in global sales over a number of years (see Table 1). As Table 1 indicates, P&G, Unilever and Nestlé have depended over 50% on overseas sales. Although Kao and Ajinomoto figures are well below those of these three, they are considered high in terms of overseas sales among industries from Japan. These figures imply that all three companies are competing globally and regionally through global production and sales networking as well as R&D networking. From their global business activities, they can launch new products (or product ranges and brands) through rapid product-development processes. Thirdly, their R&D expenditures are high enough to compare with sectors such as pharmaceuticals, implying all of them have in-group corporate innovation strategies. Finally, they all started FDI early on, as early as 1930 for P&G, and Kao's 1960s venture was fairly early for Japanese companies. While there are other types of MNE which could be categorized similarly to our targeted MNEs, these common features are only seen in these three companies from different national origins.

Table 1 Overseas Sales Ratio of Five Culture-Specific MNEs

(%)

	1991–1993	1996–1998	2001–2003	2006–2008	2010–2011
Kao	20.76	27.09	25.81	27.90	25.73
Ajinomoto	12.83	19.25	25.42	32.66	60.66
P&G	48.23	50.83	48.63	59.33	70.82
Unilever	44.29	51.86	59.33	64.38	65.95
Nestlé	54.25	62.14	59.05	63.07	33.05

Notes: Overseas sale ratios of Unilever and Nestlé calculated using sales from Western Europe and outside Western Europe.

Source: obtained from online data base (Lexis-Nexis Academic and Mergent online) and Companies' Annual reports.

Data and Methodology

In order to analyze our hypotheses, we use scientific and technological research papers, since many outcomes of innovative activities in R&D laboratories are often published in journals in the form of research papers. In order to clarify how MNEs create and source knowledge strategically during the process of new product development for global or regional markets, we employ methods which analyze research papers as outcomes of knowledge-creation activities by MNEs. We collected technological papers in which the researchers and engineers belonged to Kao, Ajinomoto, P&G, Unilever or Nestlé, for the periods 1986–1988, 1991–1993, 1996–1998, 2001–2003 and 2006–2008, utilizing the JSTPlus database of the Japan Science and Technology Agency on technological papers. Technical and scientific papers were limited to those published in the UK, USA, or Netherlands, where the major English-language scientific journals are published. The total number of papers by these five companies is 5,618, of which 534 were published by Kao, 457 by Ajinomoto, 1738 by P&G, 2268 by Unilever, and 621 by Nestlé. For a dependent variable, we use 'overseas sales ratios' as proxy for 'dependency on overseas market', due to data limitations.

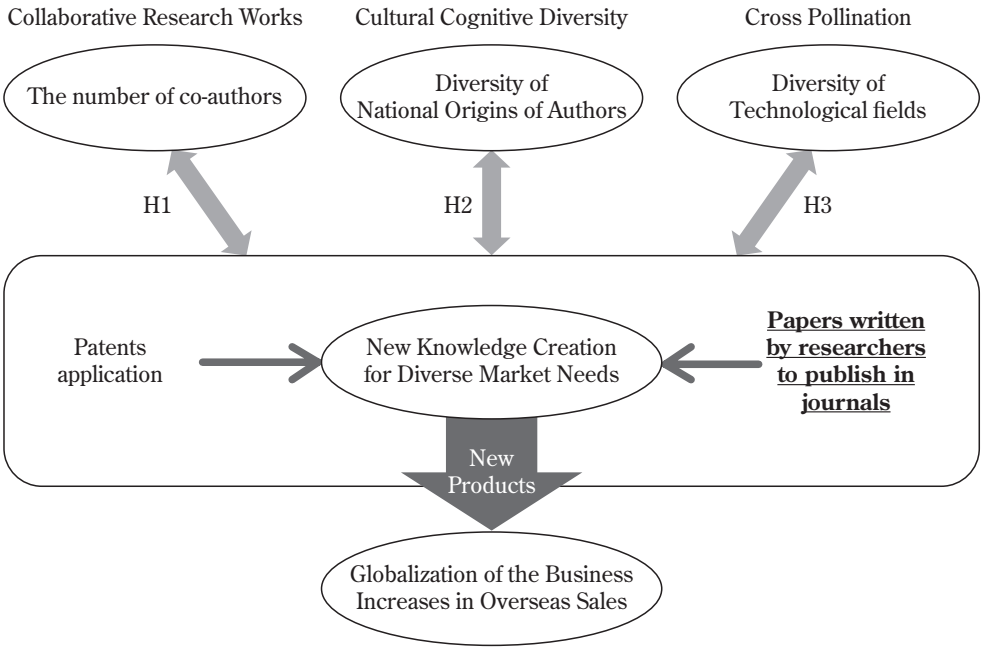
Statistical Results and Discussion

Table 2 reports a two-tailed cross-tabulation of the control variable for Hypothesis 1, the number of authors involving in writing a paper. In the cross-tabulation matrix, we examine how the number of authors correlates with the five time periods, using a chi-squared test[4]. As a result, for our focus MNEs there are correlations between the number of authors and time period at 1% significance level. R&D outputs shift from individual to collaborative projects, with an increasing number of authors, for all five MNEs. Therefore, over the passage of time, all five MNEs show access to larger numbers of researchers on collaborative research projects.

Table 3 reports a two-tailed cross-tabulation of control variables for Hypothesis 2, the number of national origins among the authors involved in a research project. In the cross-tabulation matrix, we examined how the number of national origins correlates with the five

[4]For Tables 2, 3 and 4, for examination purposes, we categorized data (papers) for each MNE, since we cannot test if there are more than 20% of cells with an expected frequency below 5.

Figure 1 Knowledge Creation Systems and the Diversification Mechanism by Five Culture Specific MNEs



time periods, using a chi-squared test. As a result, four MNEs (Ajinomoto, P&G, Unilever and Nestlé) were found to show correlations between the number of authors' national origins and time period at 1% significance level. R&D outputs shift from individual to collaborative projects with an increasing number of national origins among authors for four MNEs, indicating that Ajinomoto, P&G, Unilever and Nestlé have had access to a larger range of national origins through collaborative research projects over time.

Table 4 reports a two-tailed cross-tabulation of control variables for Hypothesis 3, the number of scientific and technological fields involved in a research project. In the cross-tabulation matrix, we examine how the number of technological fields correlates with the five time periods, using a chi-squared test. As a result, four MNEs (Ajinomoto, P&G, Unilever and Nestlé) showed correlations between the number of scientific and technological fields and time periods at 1% significance level; Kao had correlation at 5% significance, i.e. R&D outputs shift from a single to diverse technological fields in implementing collaborative projects for all five MNEs. Therefore, over the whole time period, all five MNEs had access to an increasing range of researchers with different technological expertise for collaborative research projects.

Hypothesis Analysis and Discussion

Table 5 reports Pearson's rank correlation matrix of independent and control variables in this study. For all the dependent variables, a t-test was run to compare the mean differences between number of authors, number of national origins, number of technological fields and

Table 2 Cross-Tabulation of Period of Years and Number of Authors

Kao	1	2	3	4	5	6	7	> 8
1986–1988	4	13	9	9	2	5	2	0
1991–1993	3	20	23	19	6	3	3	0
1996–1998	15	20	27	16	14	16	10	8
2001–2003	13	20	33	27	14	6	5	8
2006–2008	18	9	21	15	24	11	7	21

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	74.988a	28	.000
likelihood ratio test	81.494	28	.000

Ajinomoto	1	2	3	4	5	6	7	> 8
1986–1988	4	3	11	19	18	14	11	9
1991–1993	3	13	16	29	20	21	8	30
1996–1998	6	4	14	15	16	14	9	20
2001–2003	0	6	10	7	16	11	5	13
2006–2008	4	7	6	4	4	1	2	1

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	49.053a	28	.008
likelihood ratio test	49.398	28	.008

P&G	1	2	3	4	5	6	7	> 8
1986–1988	51	59	47	30	10	5	4	2
1991–1993	63	78	68	66	32	25	7	17
1996–1998	33	58	76	76	58	51	27	45
2001–2003	28	24	47	53	45	29	24	39
2006–2008	13	17	30	41	35	23	23	83

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	298.596a	28	.000
likelihood ratio test	299.230	28	.000

Unilever	1	2	3	4	5	6	7	> 8
1986–1988	45	49	59	47	18	6	2	4
1991–1993	67	57	67	82	46	15	12	22
1996–1998	42	65	114	107	77	50	30	47
2001–2003	32	56	91	101	73	53	23	37
2006–2008	17	44	85	97	81	51	17	48

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	161.690a	28	.000
likelihood ratio test	169.215	28	.000

Nestlé	1	2	3	4	5	6	7	> 8
1986–1988	15	17	30	40	35	18	6	13
1991–1993	12	21	17	21	12	9	3	7
1996–1998	9	10	7	7	2	1	1	2
2001–2003	3	0	3	4	1	2	0	1
2006–2008	11	21	16	6	3	2	0	1

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	56.816a	28	.001
likelihood ratio test	62.517	28	.000

Table 3 Cross-Tabulation of Period of Years and Number of National Origins

Kao	1	> 2
1986–1988	42	2
1991–1993	68	8
1996–1998	80	12
2001–2003	64	8
2006–2008	69	12

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	3.261a	4	.515
likelihood ratio test	3.743	4	.442

Ajinomoto	1	> 2
1986–1988	58	10
1991–1993	88	10
1996–1998	116	24
2001–2003	72	17
2006–2008	44	33

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	33.074a	4	.000
likelihood ratio test	29.632	4	.000

P&G	1	2	> 3
1986–1988	195	12	3
1991–1993	321	29	5
1996–1998	369	65	20
2001–2003	205	64	20
2006–2008	171	65	26

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	100.440a	8	.000
likelihood ratio test	103.441	8	.000

Unilever	1	2	> 3
1986–1988	206	16	3
1991–1993	318	39	13
1996–1998	392	117	23
2001–2003	334	111	21
2006–2008	162	120	48

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	183.711a	8	.000
likelihood ratio test	180.225	8	.000

Nestlé	1	2	> 3
1986–1988	8	3	3
1991–1993	25	9	5
1996–1998	45	46	11
2001–2003	84	71	19
2006–2008	107	123	57

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	20.751a	8	.008
likelihood ratio test	21.265	8	.006

Table 4 Cross-Tabulation of Period of Years and Number of Technological Fields

Kao	1	2	> 3
1986–1988	29	9	6
1991–1993	38	28	5
1996–1998	59	50	16
2001–2003	71	42	6
2006–2008	50	35	17

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	15.863a	8	0.044
likelihood ratio test	16.83823324	8	0.032

Ajinomoto	1	2	> 3
1986–1988	36	30	2
1991–1993	48	35	7
1996–1998	62	50	6
2001–2003	30	43	14
2006–2008	18	32	15

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	32.199a	8	0.000
likelihood ratio test	31.97285855	8	0.000

P&G	1	2	> 3
1986–1988	111	82	15
1991–1993	149	117	23
1996–1998	208	133	25
2001–2003	181	36	73
2006–2008	87	78	40

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	119.149a	8	0.000
likelihood ratio test	126.2964398	8	0.000

Unilever	1	2	> 3
1986–1988	144	71	15
1991–1993	185	127	13
1996–1998	252	207	38
2001–2003	204	190	61
2006–2008	140	151	98

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	122.950a	8	0.000
likelihood ratio test	117.3627304	8	0.000

Nestlé	1	2	> 3
1986–1988	8	6	0
1991–1993	20	11	2
1996–1998	56	32	7
2001–2003	79	76	15
2006–2008	87	105	57

	statistic	d.o.f	asymptotic significance probability (two-tailed)
chi-square test	37.454a	8	0.000
likelihood ratio test	39.24667553	8	0.000

Table 5 Spearman's Rank Correlation Coefficient with Overseas Sales Ratio

	H1	H2	H3
	Authors	National Origin	Technological Fields
Kao	−0.200	0.100	−0.500
Ajinomoto	0.100	0.900*	0.500
P&G	0.900*	0.900*	0.100
Unilever	1.000**	1.000**	0.900*
Nestlé	0.600	0.500	0.600

Note: *, $p < 0.05$ (two-tailed) ; **, $p < 0.01$ (two-tailed)

overseas sales ratio. Results are reported in Table 5.

Results for Unilever suggest a strong positive relationship between overseas sales ratio and mean of number of authors at 1% significance level, between overseas sales ratio and mean of number of national origins at 1% significance level, and between overseas sales ratio and mean of number of technological fields at 5% significant level – i.e. these findings support H1 at 1% level, H2 at 1% level, and H3 at 5% level.

Results for P&G suggest positive relationships between overseas sales ratio and mean of number of authors at 5% significance level, and between overseas sales ratio and mean of number of national origins at 5% significance, supporting H1 at 5% level and H2 at 5% level.

Results for Ajinomoto suggest a positive relationship between overseas sales ratio and mean of number of national origins at 5% significance level; H2 is supported for Ajinomoto at 5% level.

We have carefully analyzed our hypotheses using the descriptive data and statistical analysis we collected for Kao, Ajinomoto, P&G, Unilever and Nestlé. The evidence suggests that all five MNEs have the ability to access diverse technological knowledge obtained through collaborative research projects, which were seen to involve over time increasing numbers of authors, national origins and technological fields. Moreover, our results suggest that the ability to access diverse technological knowledge through collaborative research projects is positively associated with better innovative performance (H1) for Unilever and P&G. The ability to access a diverse range of researchers in R&D facilities through collaborative overseas research projects is positively associated with better innovative performance (H2) for three MNEs, namely Unilever, P&G and Ajinomoto. Finally, the ability to access technologically-diverse fields through collaborative research projects is positively associated with better innovative performance (H3) only for Unilever. Our results, however, do not support any of the hypotheses for Kao and Nestlé.

Conclusion

We have tried to investigate how the accession and integration of geographically dispersed and technologically diverse knowledge affects innovative performance at corporate level. We focused on the cases of Kao, Ajinomoto, P&G, Unilever and Nestlé to examine knowledge sourcing and accumulation by MNEs in culture-specific industries. We have also sought to clarify the relationship between mechanisms of global knowledge-

sourcing and knowledge-creation by MNE groups and how they affect innovative activities (and hence global sales figures) and capture sources of global competitive advantages.

Our findings suggest that the knowledge-creation mechanisms and innovation systems of MNEs have evolved from individual-centered research towards an organizationally-collaborative approach, from closed research practices within a single firm towards inter-organizational open-research practices, and from research activities in a single host country towards exploiting global networking systems. Importantly, MNEs' specific strategic knowledge creation systems have evolved from a global R&D network system centered at the home-country headquarters to a subsidiary-driven R&D network system influenced by enhanced R&D capabilities and subsidiary evolution. Thus, MNEs' global strategic knowledge creation systems have developed on the basis of global R&D capabilities networks acquired by an MNE group as a whole. In other words, we have contributed to clarifying the 'global mechanisms of strategic knowledge creation' by MNEs as sources of revised 'global competitive advantages' or 'global dynamic capabilities', which differ from general and conventional views on the sources of competitive advantages and dynamic capabilities in the cases of two MNEs, Unilever and P&G. The findings of this study generate important insights on how the accession and utilization of geographically-dispersed technological knowledge affect innovative performance at corporate level. Recent literature has suggested a positive relationship between firm success and the firm's access to geographically-distant knowledge sources for technologically diverse knowledge at macro level.

Conventional arguments on MNEs' dynamic capabilities from the point of view of R&D capabilities have discussed the research capabilities of the home country or global R&D capabilities in general. However, further analysis of R&D capabilities in overseas subsidiaries and attendant mechanisms of knowledge transfer and creation through global R&D networking has been necessary in order to posit our argument, that the capabilities of knowledge creation are a source of MNE-specific dynamic capabilities, rather than the dynamic capabilities of firms in general.

However, compared to P&G and Unilever, although Kao, Nestlé and Ajinomoto have been developing global knowledge creation networks, only Kao and Nestlé have not fully achieved such networking, which has not affected subsidiary evolution of Kao and Nestlé's own overseas R&D facilities in subsidiaries. This is the determinant of differences between MNEs, i.e. those with a global innovation system involving global knowledge creation (such as P&G and Unilever), and those without. Therefore, this research implies that in order to become a critical source of dynamic capabilities which can be turned into competitive advantages in the global market, knowledge-creation mechanisms centered in the home country and cross-functional knowledge creation within the firm, as observed in Kao, Nestlé and to some extent Ajinomoto, are necessary but not sufficient. This suggests that the scope of a firm's current knowledge base can influence its future innovative performance, which is consistent with our expectations regarding firms' performance in the current knowledge economy in the global market.

This study overcomes some limitations of existing literature which has used data of single country in shorter time period, by the use of longitudinal and cross-sectional views in the analysis. However, some limitations remain. Data constraints means we could not fully analyze the causal relationship between overseas sales ratio, time periods and diversification of knowledge sources. Despite these limitations, our findings demonstrate that some MNEs' ability to integrate technologically-diversified knowledge positively affects their innovative performance, while others do not get statistically positive effects. This

finding contributes to a better understanding of the advantages of cross-border collaborative R&D activities in a firm's knowledge accumulation. These tendencies will enhance the theoretical importance of the management of new knowledge creation as the main resource of MNEs' dynamic capabilities.

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