Chapter 10

What Explains Firms' Innovativeness in Korean Manufacturing? Global Activity and Knowledge Sources

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What Explains Firms' Innovativeness in Korean Manufacturing? Global Activity and Knowledge Sources

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In this paper, we analyze whether there exists a positive relationship between a firm's global activity and its various innovation outputs and, if a relationship exists, what are the major factors that explain the global activity premium in terms of innovation output. By closely following the methodology used by CHS (2010), we find that the global activity premium is accounted for not only by firms' superior access to existing knowledge (especially for foreign MNC affiliates) but also by their active investment in new knowledge (especially for non-MNC exporters and domestic MNC parents). When we analyze product and process innovation separately, we find that for process innovation the information flow from existing knowledge is relatively more important, while for product innovation the investment in new knowledge, and the information flows from existing knowledge are almost equally important. Our analyses show that in Korea the sources of advantage come both from investing in new knowledge and utilizing information flows from existing knowledge. Thus, in Korea, policies that promote both direct R&D activities and information flows should be pursued at the same time to enhance firms' propensity to innovate.

Key Words: Product innovation, Process innovation, Exporting, Multinationality
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1. Introduction

Globalization can take many modalities. From a firm's perspective, globalization means participating in the international market by exporting and/or importing, establishing a production or ownership network in other countries through FDI or portfolio investment, and so on. In recent years, much effort has been devoted to identifying whether this globalization process has been the cause or a consequence of firms' performance. The recent theoretical studies seem to support the direction of causality from firm's performance (measured by productivity) to global activity (measured by export participation or FDI engagement), which is now widely referred to as the 'self-selection' mechanism. Assuming heterogeneity in firms' productivity due to exogenous factors, these studies show that firms with higher productivity can cover the costs of entering export markets, and that firms with especially high productivity can cover even the higher costs of implementing foreign direct investment (FDI) (e.g., Melitz (2003), Helpman, Melitz and Yeaple (2004)).[3]

On the other hand, in contrast to the underlying assumption of exogenous factors of productivity in these models, a large body of theoretical and empirical research has treated productivity itself as endogenous, for example Romer (1990) and Grossman and Helpman (1991) for theoretical development and Griliches (1994) for empirical study. In these models, the increase in firm productivity is mainly determined by the firms' innovation activity (such as investment in new R&D or adopting flows of ideas from existing knowledge). By taking these two strands of work together, it can be inferred is that more innovative firms will be more productive and that in turn they will be engaged in more global activities (innovation → productivity → global activity).

However, there exist also ample theoretical background from which we can also expect the existence of the reverse causal link; that is from global activity to innovation (e.g. Grossman and Helpman (1991), Rivera-Batiz and Romer (1991)). According to this theory, a firm's global activity may generate more innovations for the firm by

[3] These theoretical models were partly motivated by previous empirical studies such as Bernard and Jensen (1999) for the US, Aw, Chung and Roberts (2000) for Taiwan and Clerides, Lach and Tybout (1998) for Colombia, Mexico and Morocco. All find evidence that more productive firms "self-select" into export markets. See Melitz (2003) section 1.

increasing the opportunity of transmission of new knowledge input, which in turn feeds into higher productivity.[4]

Our goal in this paper is to investigate this relationship between global activity and innovation by asking whether global activities make firms more innovative, and whether and what kind of knowledge sources are important in explaining firms' innovations, utilizing Korea's Innovation Survey (conducted three times in 2002, 2005 and 2008).[5] The structure of this Survey is very similar to that of the CIS (Community Innovation Surveys) by the European Union in a sense that it follows the Oslo Manual.[6] There exist a couple of studies that examined the relationship between global activity and innovation using the CIS data. For example, Frenz and Ietto-Gillies (2007) and Criscuolo, Haskel and Slaugter (hereafter CHS, 2010) used the CIS data for the United Kingdom and found that firms' global activity had a positive impact on their propensity to innovate.

The first aim of this paper is to examine whether the positive relationship between a firm's global engagement and its propensity to innovate, (as has been identified in recent empirical studies for specific countries), exists in the case of Korean manufacturing firms. Furthermore, we will examine whether the channeling effect of knowledge sources, which turned out to be important for the firms in UK according to the recent paper by CHS (2010), can also be observed for the case of Korea, and what types of knowledge source are important for the firm's product and process innovation. Korea's Innovation Survey contains information about the major sources of knowledge flows: information within the firm, within the group, from vertical suppliers, from customers, from universities and so on. Documenting the role of knowledge sources in the firms' innovation activities may shed light on the best direction for innovation policy.

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[4] Coe and Helpman (1995) and Keller (2002) provide useful reviews of the country- or industry-level empirical studies based on this theory.

[5] As is well known, there exist many empirical studies examining the causality from globalization (especially export participation) to productivity: the so-called "learning-by-exporting" effect. Although Bernard and Jensen (1999) found little evidence in favor of this effect, more recent works such as Girma, Greenaway and Kneller (2004), De Loecker (2007) and Hahn and Park (2009) found the existence of the learning effect. In this paper, we do not directly deal with this issue and focus instead on the relationship between globalization and innovation.

[6] The Oslo Manual is a guideline for collecting and interpreting technological innovation data proposed by the OECD and Eurostat.

2. Previous Literature

The global engagement of firms can take various forms. One form is participation in international trade through exporting, and another is affiliation with foreign multinational companies (MNCs). Economic theories have suggested that international trade and FDI through MNCs may have positive effects on the productivity of firms involved in these processes (cf. Grossman and Helpman, 1991).

On the basis of theoretical arguments presupposing causality between international trade and productivity, many studies have tried to examine whether this causality is observed in reality and what its direction is. The underlying presumption is that firms involved in global activities are confronted with a wider market than local firms without any global activity, and this experience can facilitate the globally engaged firms' efforts to enhance productivity. In this mechanism, the information about foreign markets or customers obtained through participating in the global market can play an important role.

While it is generally observed that the firms actively participating in exporting tend to be more productive, the results of empirical studies have not been conclusive: though some studies found a positive association between firms' global engagement and productivity (especially for some developing countries), many studies concluded that the higher productivity among firms with global engagement seems to be a result of 'self-selection' (Keller, 2004). In other words, the firms that already showed greater productivity were more likely to participate in the world market and, in this case, the so-called 'learning by exporting' (LBE) effect does not exist.

At the same time, many studies have tried to examine the spillover effect of FDI to the firms in the host country.[7] The channels through which the FDI influences the firms' productivity are regarded as being: *imitation, acquisition of human capital, competition, and export spillovers*. A firm in the host country affiliated with MNCs may have a greater chance of imitating the parent company's products even i when core products are not transferred. They can also expect the inflow of high-quality personnel from the parent company, or skill upgrades for workers through being in contact with

[7] See reviews by Hanson (2000), Saggi (2002) and Görg and Greenaway (2003).

them. The affiliated firms are generally confronted with severe competition from other local firms, since the parent company usually tries to penetrate competitive markets, and this can provide the affiliated firm with incentives for new product development or cost reduction. Lastly, the affiliated firms are more likely to be involved in global production networks, and this exporting experience can induce some spillover effects. However, the results of empirical studies on the effect of FDI are also ambiguous: some studies in developing countries find positive spillover effects from FDI on the productivity of affiliated firms in the host country, while other studies do not identify any significant effects, and even find negative effects in transition countries (Görg and Greenaway, 2003).[8]

However, this paucity of empirical evidence for LBE may be due to various causes (Salomon and Shaver, 2005): (1) the mechanism for LBE described above (knowledge spillovers) may not be realized in the form of enhanced productivity for a variety of reasons. For example, market information about the foreign customers might help the local firms tailor products to meet the specific needs of foreign customers, but have a negligible impact on productivity. (2) If the "intra-national" spillover is great, the firms participating in the global market may have difficulties in gaining real advantage from the learning they derive from exporting. These arguments underscore the fact that the relationship between firms' global engagement and their productivity is more complex than anticipated, and we should consider firms' other investment, such as R&D or human capital-building, that may have endogenous effects on their productivity.

Against this background, some recent studies consider firms' R&D investment or innovation activity as an alternative to the productivity variable (cf. Salomon and Shaver, 2005; Liu and Buck, 2007; Aw *et al*., 2008; CHS, 2010). This relatively new research direction starts from the expectation that firms' global activity will have more prevailing effects on R&D or innovation than on productivity, which can be seen as the end-result of complex interactions between various factors. These studies generally use the 'knowledge production function', in which the flow of knowledge is considered an important factor. Thus, these studies see that the positive spillover effect of firms'

[8] Görg and Greenaway (2003) argue that the contradicting results of previous studies partly resulted from lack of appropriate data sets, which could control time-invariant characteristics, and that they could not identify the positive effects of FDI, if only the studies using appropriate data sets such as panel data were considered.

global engagement is, along with other channels such as increased competition, channeled mainly through increased the accessibility or acquisition of exterior knowledge.[9]

The importance of knowledge flow can be explained from the perspective of firms' strategic behavior. It has already been argued that R&D conducted by a firm has 'two faces', namely the aim of achieving technological competitiveness through the firm's own efforts, and the aim of enhancing its capability to utilize exterior knowledge (Cohen and Levinthal, 1989). Since disruptive innovations are rare and most innovations build on the already existing pool of knowledge, the capability of firms to use exterior knowledge effectively is very important for the successful implementation of innovation.[10] In recent years, which are characterized by an ever increasing speed of technological change and the market environment, firms are increasingly using information or knowledge created externally, and outsourcing a considerable part of their R&D activities to external partners through strategic collaboration.[11] In this 'open innovation' process, the knowledge flows play a pivotal role for firms who are trying to enhance their competitiveness through new product development.[12]

This aspect of knowledge flows may have important implications, especially in the context of developing countries (cf. Kim and Nelson, 2000). It is often argued that late-comers may benefit from their backward position, because they can rely on existing knowledge stocks. International trade and FDI may be channels to facilitate the transfer of knowledge. However, it should be noted that the 'absorptive capacity' of the firms is also very important, because too large a gap to the frontiers may hinder the appropriate utilization of existing knowledge (Furman *et al*., 2002). Increased exposure to advanced exterior knowledge does not necessarily guarantee successful absorption of it,

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[9] See especially CHS (2010) for this theoretical argument.

[10] In the innovation literature, this systemic nature of knowledge production has been captured by researchers who have tried to show the innovation process as interactions of different actors (cf. Nelson, 1993).

[11] See Chesbrough (2003) for the concept of 'open innovation' (cited from Laursen and Salter (2006)).

[12] However, it should be noted that too much effort to collaborate with external partners may increase the firm's costs substantially and, thus, have negative impact on its overall performance. Therefore, it is expected that there exists a curvilinear (inverted-U-shape) relationship between the openness of firms (or the amounts of effort devoted to the networking) and their innovation performance.

and local firms need to build up their own capability in order to appropriate the knowledge properly.

Absorptive capacity is important not only at the national level but also at the firm level. It is theoretically grounded on the tacit nature of knowledge (Keller, 2004). Certain kinds of knowledge are already codified and easily transferable from one place to another. However, there are certain types of knowledge that are hardly transferable. This kind of 'tacit' knowledge has to be internalized in the receiving firms.[13] Therefore, it is required that the firms build their own innovation capability, in order to internalize the knowledge spillovers arising from their global engagement.

Studies addressing the relationship between firms' global engagement and innovation have used various data sets and indicators for innovation. One alternative is patent data on the firm level, and another is micro data collected through directly questioning innovative activities of firms in the form of the Community Innovation Surveys (for European countries) or other CIS-compatible national surveys. These two approaches have advantages and disadvantages respectively, but the latter approach has the advantage that it can directly measure the innovation performance of firms, which is expected to be more closely associated with knowledge spillovers than in the case of patents.

There exists vast literature using European CIS data to explore the correlation between innovation measures and other variables.[14] Most of these studies focus only on the relationship between innovation and export status. For example, Janz and Peters (2002) find a positive but insignificant relationship between the share of innovative products' sales and exporting, and Veugelers and Cassiman (1999) report a significant positive effect of export intensity on a firm's innovation activity. More recently, Damijan, Kostevc and Polanec (2008) examine the bi-directional causality between innovation and exporting, and find evidence supporting the idea that exporting is likely to lead to process innovation.

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[13] An example may be the general trend in the second half of the 20th century, in which many companies tried to internalize and secure their knowledge production through creating in-house R&D units.

[14] We do not describe all the details of this type of literature here. For an excellent review see Hall and Mairesse (2006).

To our knowledge, there exist only two studies that investigate the relationship between innovation and multinationality: Frenz and Ietto-Gillies (2007) and CHS (2010) as mentioned earlier. Frenz and Ietto-Gillies (2007) assess whether multinationality affects the innovation propensity of CIS-surveyed UK firms. They find that the enterprises belonging to a multinational corporation tend to exhibit greater innovation propensity, and that they are also more likely to be engaged in innovation activities on a continuous basis. CHS (2010) also find similar results: they additionally find that the relative importance of knowledge sources varies systematically with the type of innovation. For patents, information flows from universities are important, while flows from customers and suppliers are not. For broader process or product innovations, the reverse is true.

Thus our study is closely related to these two previous works. Since we would like to see whether similar findings can be observed in the firms in Korea's Innovation Survey, we follow the methodological framework suggested by CHS (2010). However, there are some differences between this paper and CHS (2010). First, we are dealing only with firms in the manufacturing sector in Korea, while CHS (2010) encompass both manufacturing and service firms. As firms in the service sector are expected to show quite different innovation patterns or activities compared to the firms in the manufacturing sector, we decided to concentrate on the firms in the manufacturing sector.[15] Secondly, we categorize the types of a firm's global engagement more specifically than CHS (2010) by combining the Innovation Survey data with Korean FDI data. In this way, we could distinguish the affiliated firms of foreign MNCs from the parent companies of MNCs in Korea, and obtain more detail of their types of global engagement. Thirdly, the model used in CHS (2010) includes investment in the production of new knowledge by using the number of R&D personnel, but we explicitly consider the R&D expenditure of firms, since it is widely accepted that capital investment in R&D plays an important role in the firm's innovation activities.

[15] As can be seen in the empirical part of this paper, we think that the aggregation of manufacturing and service firms may be the reason that CHS (2010) shows some ambiguous results.

3. Data and Methodology

3.1. Data

The main data source for this study is the KIS (Korean Innovation Survey) carried out by STEPI (Science and Technology Policy Institute).[16] This survey has been conducted every three years (in 2002, 2005 and 2008) on manufacturing firms' innovation activities for the previous three years (i.e., KIS-2005 contains firms' innovation information for the period 2002~2004). Unfortunately, however, these surveys were not constructed in a panel data setting, which makes it impossible to take advantage of panel data analyses in our study.[17] Thus, the cross-section data of KIS-2005 will be intensively used in our empirical analyses although we will use some information from KIS-2002 in order to mitigate the potential endogeneity problem in the next section.[18][19]

The KIS dataset contains quantitative as well as qualitative information about the following:

1 status of the firm:
   - domestic independent firm/domestic firm within a group/foreign MNC affiliate
   - exporting status

2 innovation output
   - numbers of product and process innovations
   - numbers of patent applications related to product and process innovation

3 innovation input
   - R&D expenditure , number of R&D personnel , existence of R&D department

[16] As mentioned in Section 1, the structure and contents of KIS are very similar to those of the European CIS, following the Oslo manual. KIS was approved as one of the national statistics by the Korean National Statistics Office in 2003.

[17] The number of firms in each survey is 3,775 in 2002, 2,743 in 2005 and 3,081 in 2008. However, the number of firms that participated in all three surveys is only 102.

[18] The number of firms that participated in the surveys both in 2002 and in 2005 is 439. Although the number of individual firms is small, we will utilize this information as much as possible in our empirical analysis.

[19] The reason why we cannot use KIS-2008 is that a domestic firm's multinationality (i.e., whether that firm implemented outward FDI or not) cannot be identified for these firms in KIS-2008. As explained below, the data source for a domestic firm's multinationality is Korea EXIM bank's data set which ends in 2004.

4 knowledge sources

· importance of knowledge flows in innovation activity from self-information, information from group, vertical information (suppliers or customers), commercial information, information from competitors, free information, information from universities and government

The KIS dataset does not provide exact information on whether each firm is a multinational firm or not, since it does not collect the data on foreign direct investment. In order to identify which domestic firm has multinational characteristics, we obtained another data source from the Korea EXIM bank. In Korea, any firm that wants to establish foreign subsidiaries through outward FDI should register with the primary creditor bank. In turn, these registered banks should report to the Korea EXIM bank with information about investing firms, amount of investment, destination country and so on. By merging these two data sets using a common corporate identification number, we identify which domestic firm is also a multinational parent company.

By combining this data from the Korea EXIIM bank and the information about the status of the firm from the KIS dataset, we can divide our sample firms into the following six different categories: ① purely domestic firms, ② non-multinational exporters, ③ foreign MNC affiliates without export, ④ domestic MNC parents without export, ⑤ foreign MNC affiliates with export, ⑥ domestic MNC parents with export.[20] Firms in the first category (purely domestic firms) may have the least experience in terms of global activity, since they are neither exporters nor multinationals. Firms in the second to the fourth categories (non-MNC exporters, foreign MNC affiliates and domestic MNC parents without export) are implementing just one of the two global activities that we consider in this study. Firms in the last two categories (foreign MNC affiliates and domestic MNC parents with export) are exposed to the global environment

[20] One limitation of the Korea EXIM data is that it covers outward FDI activities only between 1990~2004. Thus in principle, if any firm implemented outward FDI before 1990 and did not invest additionally during 1990~2004, this firm will categorized as a purely domestic firm or as a non-multinational exporter in our sample. However, in Korea outward FDI by domestic firms was highly regulated until the late 1980s and it has been liberalized only since 1990. This historical fact may reduce the possibility of this mismatching problem in our sample.

most significantly, since they are dealing with both exporting and multinational business.

In our empirical analyses, we will document whether innovation output, innovation input and the importance of knowledge sources are different according to the different levels of global activities categorized above.

3.2. Methodology

Our main empirical specification follows CHS (2010)'s KPF (knowledge production function) approach developed earlier in Griliches (1979) which can be written as

$$\Delta K_i = f(G_i, H_i, K_i^{'}, K_{-i}^{'}, X_i)$$

where ΔKi represents innovation output (increase of knowledge stock), Gi global activities, Hi investment in innovation input (R&D expenditure, number of R&D personnel), Ki' information flow within the firm, K-i' information flow from outside the firm, Xi other control variables such as firm's size and industry dummies.

In our simplest specification, we will run the regression of innovation output on five different indicators of global activity (i.e., non-MNC exporters, foreign MNC affiliates without export, domestic MNC parents without export, foreign MNC affiliates with export, domestic MNC parents with export). This will tell us whether firms with any global activity generate more innovation output than does the benchmark case (i.e., purely domestic firms).

Suppose that more global activities appear to promote more innovation output with this simplest specification. Then what are the causes of this 'global activity premium' in terms of innovation output? The KPF framework implies that there are two main sources: by investing more in new knowledge (Hi) or by utilizing existing knowledge from inside and outside the firms more extensively (Ki'and K-i'). Thus by adding these variables in the regression and looking at the changes in the 'global activity premium', we can assess the major causes of the premium.

In estimating above equation, we may encounter endogeneity problems. Investment in new knowledge (Hi) or seeking information flows from existing knowledge (Ki' and K-i') may be correlated with the error term if some unobserved firm specific factors

(such as the firm's high evaluation of innovation activity) that can affect innovation output also affect these regressors. Unfortunately, the limitation of our cross-section data means that we cannot provide solutions to this problem with confidence. However, as in CHS (2010) we try to mitigate this endogeneity problem as much as possible in the empirical analyses by using the instrumental variable method and by combining panel information from both KIS-2002 and KIS-2005.

4. Empirical Results

4.1. Summary Statistics

Before we report our regression results, it would be worthwhile to see how innovation-related variables are different depending on the degree of global activities, which are shown in Table 1 through Table 3. First, the mean values of various innovation outputs are reported in Table 1a ~1b, including innovation (either product or process innovation) dummy, patent dummy, number of innovation and number of patent.

Table 1a. Innovation Outputs

	Innovation Dummy	Product Innovation Dummy	Process Innovation Dummy	Patent Dummy
Purely Domestic Firms	0.310	0.249	0.182	0.153
(no. of firms = 1,062)	(0.463)	(0.432)	(0.386)	(0.361)
Non-MNC Exporters	0.587	0.519	0.384	0.355
(no. of firms = 990)	(0.493)	(0.500)	(0.487)	(0.479)
MNC without Export	0.486	0.432	0.243	0.297
: Foreign Affiliates	(0.507)	(0.502)	(0.435)	(0.463)
(no. of firms = 37)				
MNC without Export	0.471	0.382	0.324	0.287
: Domestic Parents	(0.501)	(0.488)	(0.470)	(0.454)
(no. of firms = 136)				
MNC with Export	0.620	0.554	0.457	0.304
: Foreign Affiliates	(0.488)	(0.500)	(0.501)	(0.463)
(no. of firms = 92)				
MNC with Export	0.662	0.599	0.418	0.521
: Domestic Parents	(0.474)	(0.491)	(0.494)	(0.500)
(no. of firms = 426)				
All Firms	0.485	0.420	0.308	0.297
(no. of firms = 2,743)	(0.500)	(0.494)	(0.462)	(0.457)

Note: All figures are means of the variables and standard deviations are in parentheses.

Table 1b (continued). Innovation Outputs

	Innovation Dummy	Product Innovation Dummy	Process Innovation Dummy	Patent Dummy
Purely Domestic Firms	7.4	6.5	0.9	0.6
(no. of firms = 1,062)	(47.5)	(46.9)	(4.3)	(3.7)
Non-MNC Exporters	20.3	18.2	2.1	4.3
(no. of firms = 990)	(118.7)	(116.5)	(8.1)	(24.0)
MNC without Export	10.6	9.4	1.2	8.4
: Foreign Affiliates	(19.1)	(18.4)	(4.0)	(31.6)
(no. of firms = 37)				
MNC without Export	26.4	24.9	1.5	2.7
: Domestic Parents	(105.3)	(105.2)	(3.7)	(10.6)
(no. of firms = 136)				
MNC with Export	41.7	39.0	2.7	3.7
: Foreign Affiliates	(192.1)	(190.8)	(6.5)	(10.2)
(no. of firms = 92)				
MNC with Export	35.0	31.4	3.6	19.1
: Domestic Parents	(156.5)	(146.5)	(18.5)	(114.9)
(no. of firms = 426)				
All Firms	18.5	16.6	1.8	5.1
(no. of firms = 2,743)	(107.9)	(104.5)	(9.3)	(48.2)

Note: All figures are means of the variables and standard deviations are in parentheses.

From these tables we can see that performance in terms of generating innovation outputs is highest when the firm is a domestic MNC parent (or foreign MNC affiliate) with export and the lowest when it is a purely domestic firm. The performances of all other groups are in between these two cases.

For example, 31.0% of purely domestic firms reported that they introduced any (either product or process) innovation, while in the case of domestic MNC parents with export the positive response rate was 66.2% (the first column of Table 1a). At the same time, the number of patent applications was highest with domestic MNC parents with export (19.1) and the lowest with purely domestic firms (0.6) (the last column of Table 1b). On the other hand, foreign MNC affiliates with export have the highest positive response rate in process innovation (45.7%) and the highest number of product innovations (39.0).

For other groups of firms, the performances of innovation output are mixed. In the case of innovation and patent dummies, non-multinational exporters seem to outperform non-exporting multinationals. But in the case of numbers of innovations and patents, non-exporting multinationals have higher values than non-multinational exporters.

Overall, the mean values of innovation output in these tables suggest that there exists a global activity premium in innovation output. (i.e., the performance in terms of innovation output could be ordered as: purely domestic firms <either exporting or multinational firms < both exporting and multinational firms).

Secondly, Table 2 shows that investment in new knowledge, such as R&D expenditure and number of R&D personnel, has a similar pattern to innovation output. It is highest with domestic MNC parents with export and, lowest with purely domestic firms. The number of R&D personnel of purely domestic firms was on average 4.9, while that of domestic MNC parents with exports was 31.7. R&D expenditure of purely domestic firms was 124.8 million Won (around US$0.1 million) and that of domestic MNC parents 1,509.9 million Won (around US$1.2 million).

Table 2. Innovation Inputs

	R&D Expenditure (Mill. Won)	Internal R&D Expenditure (Mill .Won)	External R&D Expenditure (Mill. Won)	Number Of R&D Personnel
Purely Domestic Firms (no. of firms = 1,062)	124.8 (874.7)	104.7 (693.8)	20.1 (216.8)	4.9 (17.5)
Non-MNC Exporters (no. of firms = 990)	642.7 (3,909.2)	569.2 (3,494.3)	73.5 (606.6)	13.6 (41.5)
MNC without Export : Foreign Affiliates (no. of firms = 37)	1,153.6 (3,564.1)	1,011.5 (3,427.4)	142.0 (680.9)	23.2 (35.0)
MNC without Export : Domestic Parents (no. of firms = 136)	441.1 (1,670.0)	413.3 (1,606.7)	27.7 (157.4)	14.1 (28.7)
MNC with Export : Foreign Affiliates (no. of firms = 92)	646.0 (1,585.2)	582.0 (1,456.8)	62.6 (263.6)	20.5 (31.0)
MNC with Export : Domestic Parents (no. of firms = 426)	1,509.9 (6,649.7)	1,372.1 (6,386.4)	137.8 (527.7)	31.7 (75.8)
All Firms (no. of firms = 2,743)	574.2 (3,645.2)	512.9 (3,385.6)	61.2 (453.4)	13.4 (42.4)

Note: All figures are means of the variables, and standard deviations are in parentheses.

Finally, Table 3 shows the mean values of each category of firm on the importance of each knowledge flow in innovation activities, with median values in parentheses.[21] Again we observe that existing knowledge stocks are utilized by purely domestic firms at the lowest level. In fact, the median purely-domestic firm learns nothing from all existing knowledge sources (the median values of all eight knowledge sources in the parentheses are zero). The domestic MNC parents with exports enjoy the most benefit from existing knowledge stocks inside and outside the firm, except the knowledge flow from the group. It seems that the information from the group is most well taken up by foreign MNC affiliates (both with and without exports): the mean values of this indicator are 2.478 and 1.919 for foreign MNC affiliates with exports and without exports, respectively. This is not surprising because this is consistent with the standard knowledge capital model of multinationals: knowledge is created by parents and the direction of knowledge flows is mainly from parents to affiliates.

Table 3. Knowledge Sources

	Self	Group	Vertical	Compe-Titor	Comm-Ercial	Free Info	Univ.	Gov't
Purely Domestic Firms (no. of firms = 988)	0.814 (0.000)	0.310 (0.000)	0.587 (0.000)	0.534 (0.000)	0.338 (0.000)	0.605 (0.000)	0.430 (0.000)	0.318 (0.000)
Non-MNC Exporters (no. of firms = 1,064)	1.729 (1.600)	0.718 (0.000)	1.259 (0.000)	1.123 (0.000)	0.733 (0.000)	1.288 (1.000)	1.044 (0.000)	0.852 (0.000)
MNC without Export : Foreign Affiliates (no. of firms = 24)	1.595 (0.000)	1.919 (0.000)	0.865 (0.000)	0.851 (0.000)	0.505 (0.000)	1.108 (0.000)	0.541 (0.000)	0.486 (0.000)
MNC without Export : Domestic Parents (no. of firms = 108)	1.241 (0.000)	0.735 (0.000)	1.005 (0.000)	1.011 (0.000)	0.667 (0.000)	1.008 (0.438)	0.713 (0.000)	0.507 (0.000)
MNC with Export : Foreign Affiliates (no. of firms = 105)	2.041 (2.400)	2.478 (3.000)	1.496 (1.167)	1.190 (0.000)	0.862 (0.000)	1.450 (1.563)	0.804 (0.000)	0.761 (0.000)
MNC with Export : Domestic Parents (no. of firms = 454)	2.122 (2.400)	1.129 (0.000)	1.543 (1.333)	1.468 (1.500)	0.931 (0.000)	1.623 (1.625)	1.279 (0.000)	1.085 (0.000)
All Firms (no. of firms = 2,743)	1.420 (0.600)	0.700 (0.000)	1.033 (0.000)	0.941 (0.000)	0.609 (0.000)	1.065 (0.125)	0.812 (0.000)	0.656 (0.000)

Note: All figures are means of the variables, and medians are in parentheses. Each variable is a categorical indicator of the importance of each knowledge source in innovation activities. Each variable takes possible integer values from 0 to 5 (higher values indicate greater importance).

[21] For each indicator, firms can respond by taking possible integer values from 0 to 5 with higher values representing greater importance.

In sum, by looking at the simple correlation between innovation output and the global activities of firms, it appears that the global activity premium does exist in our sample. And it seems to be also true that more globally active firms invest more in the production of new knowledge and at the same time utilize existing knowledge capital more extensively. Now we turn to the regression results which may help us to identify the sources of such a global activity premium as explained in the previous section.

4.2. Regression Results

The regression results for various innovation outputs are reported in Table 4 through Table 7. First, probit estimation results of the innovation dummy (a binary response variable which takes 1 if the firm introduced any product or process innovation during three years prior to the survey year, and 0 otherwise) are shown in columns (i)-(iii) Table 4.[22]

In the first column, we run this probit regression only on global activity indicator dummies (foreign MNC affiliate without exports, domestic MNC parent without export, non-multinational exporters, foreign MNC affiliate with export and domestic MNC parent with export) plus unreported other control variables (size measured by number of workers and 23 industry dummy variables). The coefficients for the MNC without exports (both foreign affiliates and domestic parents) are not significantly different from zero: their innovation output is not statistically different from that of purely domestic firms.

[22] In all of these specifications including IV-probit estimation in columns (iv) and (v), marginal effects of each regressor on the probability of innovation (instead of actual coefficients of the probit estimation) are reported.

Table 4. Regression Results for Innovation Dummy

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MNC without Export	0.009	0.090	0.081	-0.066	0.073	1.049
: Foreign Affiliates	(0.086)	(0.096)	(0.095)	(0.075)	(0.097)	(1.812)
MNC without Export	0.073	0.005	0.030	0.042	0.052	-0.678
: Domestic Parents	(0.047)	(0.058)	(0.058)	(0.047)	(0.057)	(1.895)
Non-MNC Exporters	0.211***	0.096***	0.074**	0.113***	0.096***	-1.447
	(0.024)	(0.028)	(0.031)	(0.030)	(0.030)	(1.273)
MNC with Export	0.163***	0.142**	0.090	0.158**	0.089	-2.382
: Foreign Affiliates	(0.055)	(0.070)	(0.077)	(0.063)	(0.074)	(2.086)
MNC with Export	0.227***	0.058	0.015	0.075*	0.051	-1.084
: Domestic Parents	(0.031)	(0.043)	(0.048)	(0.042)	(0.047)	(1.478)
R&D Expenditure		0.106***	0.066***	0.023*	0.029***	0.145
		(0.004)	(0.004)	(0.012)	(0.011)	(0.094)
Self info			0.113***		0.139***	1.259***
			(0.018)		(0.018)	(0.379)
Group info			0.006		0.008	-0.441*
			(0.013)		(0.013)	(0.268)
Vertical info			0.044**		0.049**	0.624
			(0.020)		(0.020)	(0.428)
Competitor			0.044**		0.049***	-0.037
			(0.017)		(0.017)	(0.237)
Commercial info			-0.085***		-0.095***	-0.269
			(0.027)		(0.027)	(0.346)
Free info			0.077***		0.093***	-0.433
			(0.026)		(0.025)	(0.471)
University			0.019		0.030**	0.666***
			(0.015)		(0.015)	(0.211)
Government			0.001		0.004	0.025
			(0.015)		(0.015)	(0.226)
Observation	2,737	2,722	2,722	2,722	2,722	300
Pseudo-R^2	0.104	0.404	0.511			0.730

Note: *, **, and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. All specifications include unreported other control variables: size (measured by number of workers) and industry dummy variables (23 industries at 2-digit industry codes assigned by STEPI). (i)-(iii) are the probit estimation results for KIS 2005. (iv) and (v)are the IV-probit estimation results. (vi) is the result of the fixed effect conditional logit model using both KIS 2002 and 2005. For (i)-(v), marginal impacts for the indicated regressors are reported with robust standard errors in parentheses.

These results may not be surprising if we think about the general business objectives of domestic and foreign MNCs without exports. Presumably, the foreign MNC affiliates without exports are located in Korea largely for distributional purposes (e.g., Dell Computer in Korea). At the same time, the domestic MNC without exports may have only managerial headquarters in Korea and all other production facilities can be located in foreign countries. In these situations, the innovation output of both domestic and foreign MNCs without export have no reason to be generated in the entities located in Korea.[23]

On the other hand, the coefficients on the non-multinational MNC exporters, foreign MNC affiliates with exports and domestic MNC parents with exports are all estimated to be positive and statistically significant. This shows that other things being equal (after controlling for firm size and industry dummies) domestic MNC parents with exports have the highest probability of innovating, followed by non-multinational exporters and then by foreign MNC affiliates with exports.[24] Thus even after firm size and industry characteristics are taken into account, the global activity premium seems to exist in this estimation result.

Next, in specification (ii) we added R&D expenditure as an additional regressor to capture the impact of investment in new knowledge. While the estimated coefficient on R&D expenditure is positively and significantly estimated at 1% level, the magnitude and significance level of the coefficients on non-MNC exporters and domestic MNC parents with exports has been reduced significantly: the coefficient on non-MNC exporter was reduced by more than half and that on domestic MNC parents lost its significance. On the other hand the reduction of the coefficient magnitude on foreign MNC affiliates with exports is relatively moderate: the likelihood of generating innovation in a foreign MNC affiliate with export compared to the benchmark domestic firms (non-multinational and non-exporting firm) has changed only by 2.1%.

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[23] Whether domestic and foreign MNCs without export in Korea have these characteristics cannot be confirmed with our limited dataset. More detailed analyses of this matter must be left for the future research agenda.

[24] Note that the rank in terms of innovation dummy has changed after controlling for firm size and industry dummies. In Table 1a which shows the raw difference without any control, the ranking order in terms of innovation dummy was higher for domestic MNC parents with exports than for foreign MNC affiliates with exports. This means that the innovation output advantage of foreign MNC with exports can be explained by size or industry-specific effects more than that of non-MNC exporters.

Column (iii) adds various indicators regarding the flows of existing knowledge to the regression. In this case, the most substantial change of the coefficients on global activity indicators is observed in the case of foreign MNC affiliates with export: the likelihood of generating innovation has reduced by more than 30% after we take into account information flows from existing knowledge. For non-MNC exporters and domestic MNC parent with export, adding information flow variables in the regression changes the coefficient but at lesser degree than before.

Comparing these results with those of CHS (2000), we find substantial differences in the estimation results between Korea and the UK. In the case of the UK, adding only R&D personnel changed the magnitudes of the coefficients on global activity indicators little, while adding information flow variables reduced them substantially. By these findings, CHS (2000) conclude that the global activity premium comes mainly from utilizing information flows from existing knowledge, but not from investing in new knowledge. But in the case of Korea, both new knowledge and existing knowledge can help explain the global activity premium but in different ways depending on the characteristics of global activities. For non-MNC exporters and domestic MNC parents with export, investing in new knowledge (R&D expenditure variable) seems to be more important than utilizing existing knowledge flows (knowledge source variable) in explaining their innovation output premium. On the other hand, for foreign MNC affiliates with export utilizing existing knowledge flows seems to be much more important than investing in new knowledge.

Thus our finding is in sharp contrast to the results from UK data. In the case of the UK, the majority of the superior innovative output of globally engaged firms is accounted for by their superior access to information from existing knowledge. But in the case of Korea, this global activity premium is accounted for not only by their superior information access to existing knowledge (especially for foreign MNC affiliates) but also by their active investment in new knowledge (especially for non-MNC exporters and domestic MNC parents).

To complete the comparison with the results of CHS (2010), we note the differences between the UK and Korea in terms of the estimated coefficients on information flow variables from existing knowledge capital. In the case of the UK, the coefficient on information from competitors was estimated to be negative and that on commercial

information positive. But in the case of Korea, the reverse is true. In the survey, commercial information means commercial support from a business service such as legal, technical, accounting and consulting services. This may imply that in UK where those business service sectors are much more developed, getting such commercial information may boost the innovativeness of firms, but not in Korea.

For the negatively estimated coefficient on information from competitors, CHS (2010) noted that it was not expected, but that firms learning from competitors might be innovation laggards. But learning from competitors (other firms in the same market) is not inconsistent with productivity studies searching for knowledge spillovers across firms. And such learning from competitors is expected to exist at least in process innovation.[25]

The next two columns (iv) and (v) in Table 4 show the result of probit estimation with instrumental variable. The endogeneity problem of a standard probit estimation may arise due to unobserved firm fixed-effect (such as a firm's culture valuing R&D efforts). Thus as in CHS (2010), we instrumented R&D expenditure by an instrumental variable of industry average R&D expenditure constructed by KIS-2002. These IV probit estimation results are very similar to those of the standard probit estimation in columns (ii) and (iii). Still, we can conclude that for non-MNC exporters and domestic MNC parents with export, investing in new knowledge seems to be more important than utilizing existing knowledge flows in explaining their innovation output premium, and *vice versa* for foreign MNC affiliate.[26]

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[25] In the following analyses of this section where product innovation and process innovation were analyzed separately, we have indeed fond a significantly positive coefficient on information from competitors in the case of process innovation (and an insignificant but positive coefficient in the case of product innovation).

[26] In order to control the endogeneity problem in information flow variables, we run additional regression with a conditional logit model with fixed effect in the specification (vi) in Table 4. This conditional logit regression was run with panel data constructed by using both KIS-2002 and KIS-2005. But because only 439 firms participated in both surveys, the number of observations has reduced significantly. Moreover, since a conditional logit model can be estimated only with firms that responded differently in the innovation dummy variable, the sample size was reduced further: this is why we have only 300 observations in this regression (300 firms mean 150 firms in each panel). Although our sample size in this additional regression is too small, we run this regression for the purpose of comparison with CHS (2010) (where the sample of UK firms was also only 494, meaning 247 firms in each panel). In CHS (2010), only the coefficient on self-information was significantly estimated with a positive sign. In our case, the coefficients on self-information and university info were significantly positive.

The innovation dummy regressed in Table 4 was constructed by using the product innovation dummy and the process innovation dummy. Thus in principle we can run the same probit regression for product and process innovation dummies separately, as shown in Tables 5 and 6. If we look at the changes of the coefficient magnitudes along the specifications (i), (ii) and (iii), we can derive the same conclusion as in Table 4 for both product and process innovation: investing in new knowledge is relatively more important in explaining the innovation output advantage of non-MNC exporters and domestic MNC parents with export while utilizing their existing knowledge stock is relatively more important in explaining innovation output advantage of foreign MNC affiliates.

But if we look at the changes of the coefficient magnitudes along the specifications (i), (iv) and (v), it seems that, for product innovation, investment in new knowledge and information flows from existing knowledge are almost equally important in explaining the global activity premium. On the other hand in the case of process innovation, information flows from existing knowledge are relatively more important, as expected.

One more thing to note is that for the product innovation dummy only self-information and free information are the important information sources while for the process innovation dummy most of the information sources turned out to be important (in specification (v) in Table 6) and more importantly group information is significantly positively estimated.

Table 5. Regression Results for Product Innovation Dummy

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MNC without Export : Foreign Affiliates	0.027 (0.084)	0.101 (0.091)	0.091 (0.073)	0.075 (0.097)	0.084 (0.077)	2.132 (2.275)
MNC without Export : Domestic Parents	0.066 (0.049)	0.005 (0.056)	0.047 (0.056)	0.03 (0.055)	0.064 (0.057)	-0.490 (1.323)
Non-MNC Exporters	0.219*** (0.024)	0.109*** (0.028)	0.084*** (0.030)	0.151*** (0.028)	0.102*** (0.030)	-1.468 (1.016)
MNC with Export : Foreign Affiliates	0.189*** (0.057)	0.181*** (0.069)	0.138* (0.071)	0.162** (0.065)	0.136** (0.068)	-4.053 (2.484)
MNC with Export : Domestic Parents	0.250*** (0.032)	0.094** (0.041)	0.069 (0.043)	0.134*** (0.042)	0.098** (0.044)	-1.239 (1.166)

Table 5 (continued). Regression Results for Product Innovation Dummy

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
R&D Expenditure		0.095***	0.063***	0.063***	0.033***	0.039
		(0.003)	(0.004)	(0.008)	(0.012)	(0.065)
Self info			0.099***		0.122***	1.021***
			(0.016)		('0.017)	(0.284)
Group info			0.001		0.002	-0.240
			(0.011)		(0.011)	(0.190)
Vertical info			0.019		0.024	0.374
			(0.016)		(0.016)	(0.277)
Competitor			0.005		0.010	-0.195
			(0.015)		(0.015)	(0.187)
Commercial info			-0.063***		-0.072***	-0.149
			(0.022)		(0.022)	(0.265)
Free info			0.082***		0.096***	0.147
			(0.022)		(0.022)	(0.384)
University			0.008		0.017	0.436**
			(0.012)		(0.013)	(0.181)
Government			0.010		0.013	0.013
			(0.012)		(0.012)	(0.197)
Observation	2,737	2,722	2,722	2,722	2,722	306
Pseudo-R^2	0.106	0.389	0.469			0.643

Note: *, **, and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. All specifications include other unreported control variables: size (measured by number of workers) and industry dummy variables (23 industries at 2-digit industry codes assigned by STEPI). (i)-(iii) are the probit estimation results for KIS 2005. (iv) and (v) are the IV-probit estimation results. (vi) is the result of the fixed effect conditional logit model using both KIS 2002 and 2005. For (i)-(v), marginal impacts for the indicated regressors are reported with robust standard errors in parentheses.

Table 6. Regression Results for Process Innovation Dummy

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MNC without Export : Foreign Affiliates	-0.054 (0.073)	-0.061 (0.075)	-0.074 (0.073)	0.088 (0.093)	-0.076 (0.074)	1.925 (2.110)
MNC without Export : Domestic Parents	0.075 (0.046)	0.027 (0.045)	0.041 (0.046)	0.025 (0.055)	0.055 (0.049)	-2.379 (1.483)
Non-MNC Exporters	0.152*** (0.023)	0.069*** (0.024)	0.045* (0.024)	0.157*** (0.029)	0.061** (0.026)	-0.117 (0.671)
MNC with Export : Foreign Affiliates	0.147** (0.058)	0.142** (0.063)	0.057 (0.059)	0.197*** (0.066)	0.055 (0.058)	1.924 (2.156)
MNC with Export : Domestic Parents	0.128*** (0.033)	0.014 (0.032)	-0.016 (0.031)	0.162*** (0.042)	0.009 (0.035)	-2.455** (1.066)
R&D Expenditure		0.051*** (0.003)	0.026*** (0.003)	0.059*** (0.009)	0.001 (0.014)	0.163** (0.065)
Self info			0.054*** (0.012)		0.074*** (0.016)	0.299 (0.206)
Group info			0.021*** (0.008)		0.022*** (0.008)	0.235 (0.150)
Vertical info			0.043*** (0.012)		0.047*** (0.012)	0.314 (0.199)
Competitor			0.017* (0.010)		0.022** (0.010)	0.222 (0.160)
Commercial info			-0.023 (0.015)		-0.033** (0.015)	-0.417 (0.261)
Free info			0.025 (0.016)		0.037** (0.018)	-0.247 (0.251)
University			0.015* (0.008)		0.024** (0.009)	0.341** (0.159)
Government			-0.014* (0.008)		-0.011 (0.009)	-0.184 (0.193)
Observation	2,743	2,722	2,722	2,722	2,722	302
Pseudo-R^2	0.0582	0.222	0301			0.461

Note: *, **, and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. All specifications include other unreported control variables: size (measured by number of workers) and industry dummy variables (23 industries at 2-digit industry codes assigned by STEPI). (i)-(iii) are the probit estimation results for KIS 2005. (iv) and (v) are the IV-probit estimation results. (vi) is the result of the fixed effect conditional logit model using both KIS 2002 and 2005. For (i)-(v), marginal impacts for the indicated regressors are reported with robust standard errors in parentheses.

Finally, Table 7 is the estimation results for number of patents. Since the dependent variable of number of patents takes positive integers with many zeros, we used a Poisson regression model.[27] In this case, foreign MNC affiliates with export have no advantage in patent applications after firm size and industry dummies are controlled for. Only non-MNC exporters and domestic MNC parents with export can enjoy a global activity premium in terms of patent applications. On top of that, the advantage of non-MNC exporters in patent applications is mainly explained by investment in new knowledge (decrease of the coefficient from (i) to (iv)) not by utilizing existing knowledge flows (no decrease from (iv) to (v)). On the other hand, in the case of domestic MNC parents investing in new knowledge and utilizing existing knowledge flows are almost equally important.[28] Again this result is in contrast to CHS (2010)'s finding with UK data where information sources rather than investment in new knowledge are much more important in explaining global activity premium in all cases.

[27] The assumption required in a Poisson regression model (no over dispersion) is often too restricted and thus many patent-R&D expenditure literatures use a negative binomial model. But in the case of the negative binomial model, the IV-estimation method is somewhat complicated, while for the Poisson model IV estimation is already established (*ivpois* command in STATA). When we run the specifications (i) to (iii) in Table 7 both with Poisson and negative binomial models, the statistical significance and the magnitudes of all the coefficients did not change much. Thus to compare the results with the IV estimation with the previous tables, we report Poisson results instead of those of negative binomial.

[28] The last column in Table 7 (specification (vi)) is analogous to the same specifications in the previous tables. Here, a panel fixed effect Poisson regression is regressed on the panel constructed by KIS- 2002 and 2005. Again the sample size is only 434 (meaning 217 firms in each panel). Here the results suggest that self-information, information from competitors, free information and information from universities are important knowledge sources.

Table 7. Regression Results for Number of Patents

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MNC without Export : Foreign Affiliates	2.333 (2.182)	2.244 (1.802)	1.890* (1.107)	0.065 (0.522)	0.101 (0.669)	
MNC without Export : Domestic Parents	0.680 (0.633)	0.667 (0.558)	0.382 (0.384)	1.239*** (0.410)	0.680* (0.363)	0.288 (0.232)
Non-MNC Exporters	1.153*** (0.314)	0.818*** (0.289)	0.357* (0.195)	0.922*** (0.191)	0.925*** (0.248)	0.168* (0.098)
MNC with Export : Foreign Affiliates	0.257 (0.401)	-0.007 (0.249)	-0.034 (0.163)	0.275 (0.451)	-0.412 (0.562)	1.295*** (0.336)
MNC with Export : Domestic Parents	1.964*** (0.677)	1.430** (0.580)	0.792** (0.338)	1.186*** (0.247)	0.504** (0.257)	0.097 (0.138)
R&D Expenditure		0.097*** (0.028)	0.038** (0.019)	0.258*** (0.030)	0.177*** (0.045)	0.089*** (0.012)
Self info			-0.114* (0.065)		0.517*** (0.111)	0.130*** (0.036)
Group info			0.012 (0.025)		0.109 (0.068)	-0.014 (0.548)
Vertical info			0.073 (0.048)		0.199* (0.107)	0.019 (0.034)
Competitor			0.025 (0.035)		0.231** (0.090)	0.042* (0.023)
Commercial info			0.040 (0.050)		-0.863*** (0.135)	-0.268 (0.043)
Free info			0.298*** (0.091)		0.533*** (0.147)	0.183*** (0.046)
University			0.072** (0.036)		0.323*** (0.065)	0.220*** (0.031)
Government			-0.030 (0.027)		0.016*** (0.067)	-0.049* (0.026)
Observation	2,737	2,722	2,722	2,722	2,722	434
Pseudo-R^2	0.581	0.611	0.679			

Note: *, **, and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. All specifications include other unreported control variables: size (measured by number of workers) and industry dummy variables (23 industries at 2-digit industry codes assigned by STEPI). (i)-(iii) are the poisson estimation results for KIS 2005. (iv) and (v) are the IV-poisson estimation results. (vi) is the result of the fixed effect poisson model using both KIS 2002 and 2005. For (i)-(v), marginal impacts for the indicated regressors are reported with robust standard errors in parentheses.

5. Summary and Policy Implications

In this paper, we analyze whether there exists a positive relation between a firm's global activity and a variety of innovation outputs and, if it exists, what are the major factors that explain the global activity premium in terms of innovation output. In doing so, we closely follow the methodology used by CHS (2010) in order to see whether there exist substantial difference between the UK and Korea.

In the case of the UK, the lion's share of the global activity premium can be accounted for by utilizing more knowledge flows from inside and outside the firm, not by investing more in new knowledge input. But, in the case of Korea, this global activity premium is accounted for not only by firms' superior information access to existing knowledge (especially for foreign MNC affiliates) but also by their active investment in new knowledge (especially for non-MNC exporters and domestic MNC parents). This means that especially for non-MNC exporters and domestic MNC parents with export, investing in new knowledge seems to be more important than utilizing existing knowledge flows in explaining their innovation output premium. When we analyze the product and process innovations separately, we find that for process innovation, the information flows from existing knowledge are relatively more important while, for product innovation, investment in new knowledge and information flows from existing knowledge are almost equally important.

Given the positive relationship between innovation output and global activity, it is important to know why firms with more global activities have advantages in generating innovation. Our analyses show that in Korea the sources of those advantages come both from investing in new knowledge and utilizing information flows from existing knowledge. The policy implications from our findings are clear: in order for the global players to become more innovative, policies that can enhance information flows from existing knowledge are important just as in the case of the UK. And these types of policy are more effective and relevant for process innovation and for foreign MNC affiliates located in Korea. On the other hand, unlike the case of the UK, industry policies to increase direct R&D inputs (by investing more in new knowledge with more R&D expenditures or by using more skilled R&D personnel) should also be

encouraged, especially for domestic exporters and multinational parents and for product innovation. Promoting both direct R&D activities and information flows at the same time is not an easy task, but they should be pursued at the same time so as to enhance firms' propensity to innovate in Korea.

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