RIETI Discussion Paper Series 07-E-060

Dissecting Offshore Outsourcing and R&D: A Survey of Japanese Manufacturing Firms

ITO Banri
RIETI

TOMIURA Eiichi
RIETI

WAKASUGI Ryuhei
RIETI

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 07-E -060

Dissecting Offshore Outsourcing and R&D: A Survey of Japanese Manufacturing Firms

Banri Ito[*], Eiichi Tomiura[**], and Ryuhei Wakasugi[***]

November 18, 2007

Abstract

This paper summarizes main descriptive results from the survey on a wide range of offshore outsourcing and R&D. This survey covers more than five thousand large-sized firms across all manufacturing industries in Japan. The principal findings are as follows. Merely 21% of the firms are outsourcing offshore. Nearly two-thirds of the cases, firms are outsourcing production-related tasks to East Asia. More than one-third of the cases, especially often in R&D and customer supports, tasks are outsourced to own offshore affiliates within the boundary of multinational firm. Offshore R&D is often integrated with corporate headquarters and is motivated for supporting the production and sales in the local market. The survey also covers firm's evaluation of the intellectual property rights protection in 56 countries.

Keywords: offshore outsourcing; offshore R&D; intra-firm transactions; firm-level data
JEL Classifications: F20, F23, L14, L23, L24

[*] Research Institute of Economy, Trade and Industry
[**] Yokohama National University and Research Institute of Economy, Trade and Industry
[***] Kyoto University and Research Institute of Economy, Trade and Industry

1. Introduction

Firms are outsourcing a wide range of tasks across national boundaries, partly facilitated by trade liberalization and the development of information technologies. How to find low-cost high-skilled suppliers is obviously a vital concern for many firms competing in global markets. In the U.S., the increasing outsourcing of software programming to India attracts political reactions. The theory of offshore sourcing decisions by heterogeneous firms has become one of the hottest research topics in international economics, pioneered for example by Antràs and Helpman (2004, 2006), though empirical investigations of these new models have been seriously constrained by the limited availability of micro-data. Firms have been conducting offshore R&D for searching new technology and adapting it to the local market after the 1990s in developed and developing countries. Such offshore R&D activities, in spite of important issues of corporate offshore activities, have been similarly unexplored due to the restriction of micro-data.

To fill this gap, the Research Institute of Economy, Trade and Industry (RIETI) has conducted *The Survey of Corporate Offshore Activities* (*Kigyo Kaigai Katsudo Chosa*, in Japanese) this year on large-sized firms across all manufacturing industries in Japan.[1] The principal objective of this survey is to document corporate offshore activities, mainly focusing on outsourcing and R&D. This survey has direct information on foreign outsourcing (FO), explicitly distinguished from domestic outsourcing (DO) and from arm's-length purchases at foreign markets. This survey covers not only production outsourcing but also service outsourcing, such as R&D, information services, customer supports, and professional services.

[1] Basic aggregated results are reported in *2006 Report on the Research of Corporate Offshore Activities* (*Heisei-18-nendo Kigyo no Kaigai Katsudo ni kansuru Chosa-kenkyu Houkokusho*, in Japanese) submitted from Tokyo Shoko Research Inc. to RIETI at March 2007. The report is written in Japanese with no English translation. The current paper is based on the survey's firm-level data, which cannot be publicly disclosed. The authors are allowed to access this firm-level dataset as a part of RIETI research project.

Among production outsourcing, we identify final assembly, production of intermediates, and production of jigs/dies. The survey also distinguishes the type of suppliers: own subsidiaries, other Japanese subsidiaries, and foreign-owned suppliers. These data have been largely unavailable in previous datasets used for similar purposes.

The current paper overviews the main descriptive results from the survey and discusses their implications. The main purpose of this paper is to facilitate quick disseminations of valuable survey results in a readily accessible form. More analytical studies of the survey results will appear as separate papers in the future.

The rest of this paper is organized as follows. Section 2 explains the design of the questionnaires in our survey and the definitions of basic concepts. Section 3 describes our sample coverage. Section 4 reports the results on outsourcing, while Section 5 reports on offshore R&D. Section 6 compares firm's evaluation of intellectual property rights protection across countries. Section 7 adds concluding comments.

2. Design of questionnaires in the survey

The survey has two parts: outsourcing and R&D. In the first part on outsourcing, the survey asks whether or not the firm is outsourcing across borders. In this survey, the "outsourcing" is defined as contracting-out (*gaichu* or *itaku*, in Japanese) to other independent legal entities based on explicit contracts specifying specs or other dimensions of the outsourced tasks. This definition is appropriate for investigating the empirical implications of make-or-buy decision models in the contract theory or the theory of the firm. Offshore outsourcing (or foreign outsourcing) is defined as the outsourcing to suppliers located overseas.[2] We also ask each firm on her experience of offshore outsourcing five years ago as a retrospective question to alleviate

[2] The distinction between FO vs. DO is based on the location, not the ownership of suppliers.

the limitation of one-shot survey.[3]

Although no quantitative data are available on how much each firm is outsourcing, the survey has detailed questions on what kind of tasks is outsourced to which type of suppliers in which regions. On the disaggregation on outsourced tasks, the survey distinguishes the following eight categories:

(a) Production of jigs or dies,

(b) Production of parts, components, or other intermediates,

(c) Final assembly or processing of final products,

(d) R&D,

(e) Information services (e.g. software programming),

(f) Customer supports (e.g. call centers),

(g) Professional (legal, accounting, or financial) services, and

(h) Other tasks.

As not only production but also service are covered as tasks outsourced, this survey has a wider coverage of offshore outsourcing than previous surveys. The most popular FO measure based on sector-level intermediate import data derived from Input-Output Tables, which has been widely used since Feenstra and Hanson (1996), focuses on (b) but certainly fails to cover (c) as well as some parts of other categories. Even for the category (b), intermediate import data are inevitably contaminated by the inclusion of standardized inputs purchased at marketplace.[4] At least for Japan, this is the first survey squarely capturing service outsourcing at the firm level.[5] Even in

[3] As the survey was conducted in January to March 2007, "the current year" in the survey is 2006. As a result, "five years ago" in the survey means the year 2001.

[4] Another useful FO measure has been found from inward/outward processing trade (e.g. Feenstra and Hanson, 2005 for the Chinese case), which is unavailable for countries without such a special duty treatment scheme. As still another informative FO measure, Yeats (2001) uses exports of parts and components in trade statistics, readily available but with limited scope.

[5] To the best knowledge of the authors, all the FO data of Japanese firms (*The Basic Survey of Business Structure and Activity* and *The Basic Survey of Commercial and Manufacturing Structure*

other countries, service outsourcing can be captured only through sector-level Input-Output Tables.[6] Since some tasks are supposed to be more tightly integrated with corporate internal activities than other tasks (e.g. production of jigs compared with production of components, R&D compared with software programming), this task disaggregation will reveal the effects of contractibility on offshore outsourcing.

On the outsourcing destinations, the survey identifies the following five regions:

(a) China (including Taiwan and Hong Kong),

(b) ASEAN countries,

(c) Other Asian countries,

(d) U.S.A. and European countries, and

(e) ROW (rest of the world).[7]

The disaggregation by geographical destinations will enable us to discuss the impacts of market institutions or the level of development/costs on outsourcing decisions.

On the outsourcing partners, the survey distinguishes the following three types of firms:

(a) Own offshore subsidiaries,[8]

(b) Subsidiaries owned by other Japanese multinationals, and

(c) Foreign-owned firms.

The firms in the last category are either local firms or subsidiaries of multinationals from third

---

and Activity) capture FO of production only. As a worse point to note, the former survey no longer has questionnaires on FO and the latter survey has not been conducted since 1998.

6 Görg and Hanley (2005) distinguish expenditures on imported services from those on imported materials at the plant level, while Cusmano et al. (2006) disaggregates FO into 3 categories (production-assembling, R&D-design, and services). However, our disaggregation is more detailed than these.

7 India and Middle East are included in "other Asian countries." Eastern Europe is included in "U.S.A. and Europe." Latin America and Australia are included in ROW. These definitions are explicitly given in the survey questionnaire.

8 "Subsidiaries" (*kogaisha*, in Japanese) are defined by the majority ownership.

countries.[9] The comparison of these three categories will reveal how outsourcing decision is affected by the boundary or the nationality of the firms. Furthermore, since the outsourcing defined by contracts includes transactions between the parent firm and offshore subsidiaries as long as they are independent legal entities, it will be informative to identify how much of the outsourcing transactions are within the boundary of multinational firms.

As a comparison, the survey also asks whether or not the firm is purchasing offshore (including standardized goods/services), and whether or not the firm is outsourcing within the home country Japan. When a firm is purchasing standardized goods or services readily available at marketplace overseas without specifying particular specs or other dimensions, our definition classifies the firm as conducting offshore purchases but not involved in offshore outsourcing.[10] The same eight task categories are applied to domestic outsourcing, while the purchase of raw materials is added to the categories for offshore purchases. The retrospective questions for five years ago are also provided for these two questions.

The second part of this survey is designed to ask whether and how the firm is conducting offshore R&D across borders, and how it evaluates the enforcement of intellectual property rights (henceforth IPR) in foreign countries. This part supplements the questionnaire of the first part related to R&D outsourcing. Because of a nature of R&D, it is expected that R&D activities are conducted without contracts specifying the tasks and the results in advance. The offshore R&D defined as contracting-out based on explicit contracts specifying specs and outcomes may underestimate the real offshore R&D activities. This is the reason why we investigate in detail the offshore R&D activities separately. The first question is whether R&D activity is carried out overseas. The following questions about the facility, function, and motivation of R&D activities

[9] Since the category (a) concentrates on the majority-owned subsidiaries, the categories (b) and (c) could include minority-owned affiliates of the outsourcing firm.

[10] Intra-firm imports of specialized components from branch offices/factories are not included in FO as they are not independent legal entities.

have prepared only to the firm which has replied a positive answer to the first question. The second question asks what type of facility is chosen for R&D activity:

(a) Research laboratory,

(b) Plant site, and

(c) Other.

The third question asks the reason to choose the location of R&D base:

(a) Favorable access to local market,

(b) Agglomeration of local firms and research institutions, and

(c) Favorable tax treatment.

The fourth question asks the motivation for R&D:

(a) Support for local production / sales,

(b) Access to abundant R&D resource,

(c) Saving R&D cost,

(d) Collaboration with local R&D, and

(e) Construction of global R&D network.

The fifth question identifies the relationship of offshore R&D with domestic R&D, by asking whether the offshore R&D is independent from or incorporated in domestic R&D.

In this part, we identify the following five regions for each question:

(a) U.S.A.,

(b) EU/EFTA member countries,

(c) China (including Taiwan and Hong Kong)

(d) Republic of Korea,

(e) ASEAN member countries, and

(f) ROW (rest of the world).[11]

Finally, the survey asks the firm the evaluation on protection of IPR in foreign countries. The measurement of IPR has been conducted in two ways. One is based on the evaluation of legislative system of IPR in each country.[12] Another is based on the results of the questionnaire of the enforcement of IPR to individual firms.[13] This survey constructs IPR index using firms' perception of the enforcement of IPR, which is similar to the latter method. Specifically, each firm evaluates the enforcement of IPR protection in each country on the following five stages.

(a) Fully protected,

(b) Protected to some extent,

(c) There are some which are protected,

(d) Only the limited part is protected, and

(e) Not protected at all.

Each stage is given the point from five for the highest protection to one for the lowest protection.

3. Sample description

The questionnaire was sent, in January this year, to 14,062 manufacturing firms in Japan.[14] As the population of firms for this survey is chosen as the same as those used for the previous wave of the annual national legal mandatory survey, *The Basic Survey of Business Structure and Activities* (*Kigyo Katsudo Kihon Chosa*, in Japanese), these 14,062 firms coincide virtually all

[11] India and Middle East are included in "other Asian countries." Eastern Europe is included in "U.S.A. and Europe." Latin America and Australia are included in ROW. These definitions are explicitly given in the survey questionnaire.

[12] For example, see Rapp and Rozek (1990), Ginarte and Park (1997), Javorcik (2004) and Park and Wagh (2002).

[13] For example, see Lee and Mansfield (1996) and IMD (2006).

[14] Sending questionnaires and collecting responses are conducted by a commercial survey company, Tokyo Shoko Research Inc., under the contract with RIETI.

firms with 50 or more employees in all manufacturing industries.[15]

Among these 14,062 firms, we obtain responses from 5,528 firms.[16] This response rate 39.3%,[17] relatively high as an academic survey, implies that our sample covers more than one-third of all mid- or large-sized manufacturing firms, and thus should be regarded as reasonably reliable in deriving implications to the whole manufacturing. Since other previously available firm-level data sets on offshore outsourcing include only a limited number of firms and are not designed to cover the entire manufacturing, this survey has a clear advantage in its coverage.[18]

While a different official statistics (*The Basic Survey of Commercial and Manufacturing Structure and Activity* or *Sho-kogyo Jittai Kihon Chosa* in Japanese) covered the production outsourcing by 118,300 Japanese manufacturing firms without any firm-size threshold at 1998, previous investigations of that survey by Tomiura (2005, 2007) have confirmed that offshoring is actually quite uncommon among small-sized firms.[19] Consequently, in spite of the firm-size threshold, this survey should capture the predominant portion of offshoring activities by Japanese firms.

---

15 We cannot cover firms those entered after 2005, while some firms previously included in the list are no longer accessible (e.g. exits, address changes). While all the firms should have been above the threshold size (50 employees) at the time of the mandatory survey, 10.6% of surveyed firms are below the threshold this time.

16 The questionnaire was sent by postal mail, while the firms were allowed to respond either by filling the printed questionnaire or by clicking checkboxes prepared at the RIETI's website.

17 As firms did not necessarily answer all questions, the response rates for individual questions are inevitably lower.

18 The sample size in previous micro-data FO studies is generally limited: 652 plants within Irish electronics industries by Görg and Hanley (2005), and 1,148 manufacturing firms within Lombardy region by Cusmano et al. (2006), for example. Kurz (2006) documents 34,649 U.S. manufacturing plants, but his FO indicator of foreign content cost of materials could include imports of standard raw materials and fails to include many other forms of FO.

19 Tomiura (2005) reports that only around 3% of the firms are outsourcing production offshore at 1998 among 118,300 surveyed firms, of which nearly 80% are with less than 50 employees. Cusmano et al. (2006) similarly find that merely 7.84% of the firms are outsourcing offshore among 1,148 firms, about half of which belong to 10-49 employee class.

4. Survey results on offshore outsourcing

4.1. Share of outsourcers

As the first notable finding from the survey, foreign outsourcing has spread to more firms over the recent years. Table 1 shows that, among 5,528 firms responded to the survey, 20.55% of them are currently outsourcing overseas. As only 15.2% were outsourcing offshore five years ago, the number of foreign outsourcers increased by more than 35% (from 840 to 1,136 firms) over the last five years. This growth should be regarded as high, considering the recent trend that many firms are trying to replace specialized parts and components by those available at marketplace for cost reduction. This spread of offshore outsourcing is even more remarkable when we consider that the number of domestic outsourcers and the number of firms purchasing abroad increased merely by 4.27% (from 3,252 to 3,391 firms) and 18.73% (from 1,847 to 2,193 firms), respectively, during the same period. As expected, more and more firms are engaged in outsourcing to suppliers in the same country and in procurement from foreign sources, but the growth of offshore outsourcing clearly outpaced these two modes.

In spite of higher growth of foreign outsourcing, however, the share of firms active in foreign outsourcing remains lower than those active in domestic outsourcing and offshore procurement. Nearly 40% of the surveyed firms are purchasing raw materials or standardized or specialized goods/services abroad, while more than 61% of them are outsourcing within the national border. This gap in participation may indicate that entry costs may differ across foreign outsourcing, foreign procurement, and domestic outsourcing.

By combining various questionnaires in the survey, Table 2 displays cross-tabulations. Several findings should be noteworthy. First, purchasing offshore is naturally more common than outsourcing offshore.[20] Second, the firms outsourcing offshore without outsourcing to

[20] By definition, all FO firms should automatically be purchasing offshore. While 1.22% of the

domestic suppliers are quite exceptional, possibly reflecting different levels of contractibility and/or entry costs.

Finally, while 1% exited, other 6% of the firms have newly entered into FO contracts during the five-year period. Though more firms (in net terms) are involved in FO than in the past, not all firms active in FO five years ago continue FO now. To the knowledge of the authors, this is the first evidence on the entry/exit dynamics of foreign outsourcing. This paper will later report the survey results on the firm's evaluation on factors facilitating these FO status transitions in Section 4.5.

4.2. Disaggregation by types of outsourced tasks

The survey contains disaggregated information on the types of tasks outsourced offshore. Before discussing foreign outsourcing, Table 3 summarizes the task distribution among domestic outsourcing cases as a comparison.[21] The three production-related tasks (production of intermediates, final assembly, and production of jigs/dies) occupy more than 70% of the DO cases. The service-related tasks are far less frequently outsourced.

Table 4 presents the task allocations in FO with disaggregation across geographical destinations.[22] As shown in the table, the two types of tasks most frequently outsourced offshore are the production of intermediates and the final assembly, each of which occupies 35%. The third runner-up is the production of jigs/dies (13%). These top three tasks most frequently outsourced are all directly related with production activities. Consequently, combined with these two tables, Japanese manufacturing firms are actively outsourcing production-related tasks both

---

surveyed firms answered that they were outsourcing offshore but not purchasing offshore, their share is very low.

[21] The count is based on the task categories. When a firm is outsourcing R&D, for example, we count it as one case even if many suppliers are involved.

[22] Among 1,136 firms answering affirmatively to the binary FO-or-not question, 17 firms did not report any breakdown data and thus are excluded from the disaggregated tables.

within the home country and across national border.

On the other hand, the foreign outsourcing of service-related tasks remains severely limited, as in DO reported in the previous table. Less than five percent of the firms are outsourcing offshore the customer support (4.51%), R&D (3.58%), information services (3.01%), and professional services (2.13%), respectively. While the serious concerns are expressed in the U.S. over the outsourcing of software programming to India, the offshore outsourcing of services is still limited to a small segment of firms in the case of Japanese manufacturing industries in spite of the general rise of outsourcing to China.[23] Since the share of tasks currently outsourced and that outsourced five years ago do not differ much, the central role of production-related tasks among offshore outsourcing remain untouched for Japanese firms over the recent years.

While the task distributions in outsourcing are largely similar in FO and DO, several differences should be noted. First, among the production-related tasks, jigs/dies are more often outsourced within Japan, while intermediates are more often outsourced abroad. This contrast may be at least partly because the production of jigs/dies is supposed to be deeply integrated into the firm's technology choice and R&D strategy and to require frequent face-to-face interactions for engineering adjustments. On the other hand, the production location of parts and components is supposed to be strongly affected by inter-country cost differentials. Second, among service-related tasks, the customer support and R&D are outsourced more often across borders, but the outsourcing of information processing and professional services are noticeably more often within the home country. This gap may be partly due to the language barriers for Japanese firms.

[23] We must note that the survey does not cover service or commercial industries.

4.3. Disaggregation by geographical destinations

This paper has so far concentrated on the binary distinction between foreign versus domestic outsourcing. However, the survey contains more detailed information on regional disaggregation of outsourcing destination.

First, China (including Taiwan and Hong Kong) occupies more than half of the offshore outsourcing cases, followed by ASEAN (22%). Nearly three quarters of offshore outsourcing cases are within East Asia (China and/or ASEAN). Furthermore, though omitted from the table for the sake of brevity, 72% of the increase from five years ago is due to the outsourcing to China. Other regions are relatively minor as the outsourcing destinations (other Asia 11.58%, U.S.A.-Europe 11.47%, and ROW 2.24%). This share of China is higher than the China's share in offshore purchase of raw materials (35% (11.07/31.66)), as shown in Table 5. Among the goods and services bought in China or ASEAN, intermediates are more often traded than raw materials.

Second, the composition of tasks outsourced to these two major outsourcing destinations is not drastically different from that outsourced within Japan, while the share of intermediate production and final assembly is respectively slightly higher and the share of jigs/dies production is lower. More than half of the three production-related tasks are outsourced to China. Combined with the previously reported figures on outsourced tasks, the offshore outsourcing by Japanese manufacturing firms can be mainly characterized by the outsourcing of production tasks to East Asian developing countries.

On the task composition in outsourcing to other advanced countries (U.S.A. and Europe), the share of service is relatively high. Notwithstanding, even in the outsourcing of information services, professional services and customer supports, China surpasses these high-cost developed countries. On R&D, however, U.S.A. and Europe are the most popular outsourcing

destination (39% (1.39/3.58)). When we compare the task composition in domestic outsourcing, the share of R&D and of customer supports is respectively higher than that among domestic outsourcing. This may be partly due to the high level of R&D and large market size in U.S.A. and Europe. While the share of production of jigs/dies is lower than that in domestic outsourcing, the share of information services and that of professional services are as high as in domestic outsourcing, possibly suggesting high competitiveness of these sectors in U.S.A. and Europe.

4.4. Disaggregation by the type of suppliers

This section identifies the types of partner firms in foreign outsourcing deals. Table 6 compares the task decomposition across three distinct types of suppliers. Several differences must be noted.

First, R&D, customer supports, and final assembly tend to be relatively often outsourced to own subsidiaries within multinationals. This finding appears consistent with our prior as R&D and customer supports are deeply linked with firm-specific inside knowledge. Firms may prefer own subsidiaries in outsourcing of final assembly at least partly due to the brand name concerns. In around half (1.96/3.58, 2.36/4.51, 15.55/35.25) of the cases, these three tasks are outsourced within the boundary of multinationals. Even if all types of tasks are combined, 39% of offshore outsourcing cases are to subsidiaries abroad owned by the outsourcing firms. In other words, more than one-third of the FO cases are intra-firm transactions within multinationals even if they are regarded as FO between legally independent entities. While we cannot estimate the magnitude of these intra-firm transactions from our survey, we must be cautious in claming the spread of FO among independent firms.

Second, subsidiaries owned by other Japanese firms play a larger role in outsourcing of

intermediate production, while their share in R&D outsourcing is substantially lower. Japanese firms have an established reputation for their advantages in manufacturing parts and components. On the other hand, firms may find less incentive to outsource R&D to other Japanese firms, who are often compete in the same industries based on similar advantages.

Third, foreign suppliers other than those owned by Japanese multinationals occupy high shares in outsourcing of any tasks: 42-50% in production-related tasks and 64% in professional services. Even when all tasks are summed, 45% of outsourcing cases are to foreign suppliers without Japanese ownership, while the share of outsourcing to subsidiaries owned by other Japanese firms is as low as 15%. Consequently, the perception that Japanese firms are outsourcing each other within the network of Japanese firms no longer captures the reality of offshore outsourcing today.[24]

The survey contains additional information on the types of partner firms by disaggregating the geographical destination of foreign outsourcing, though omitted from the tables for the sake of brevity. While the aggregate characteristics summarized in the previous table is strongly affected by that of outsourcing to China, the outsourcing to ASEAN is characterized by the high share of outsourcing to own subsidiaries, especially outsourcing of final assembly and R&D within multinationals. On the other hand, in the outsourcing to other advanced countries, more than half of the cases are outsourcing to local suppliers (without Japanese majority ownership), especially in outsourcing of service tasks.

4.5. Important factors facilitating or hindering changes in foreign outsourcing

This section is devoted to the examinations of the factors facilitating or hindering offshore

[24] When we look at the growth from five years ago, the share of subsidiaries owned by other Japanese firms is still high. Hence, we must be cautious in concluding that offshore outsourcing will shift further from Japanese subsidiaries to foreign suppliers.

outsourcing. Identifying these factors must be informative especially for policy discussions. The survey asks sampled firms to choose up to three factors from the given eleven alternatives, which widely range from inter-firm relationships, technology, standards, to regulations, and are listed in the footnote to Table 7. The figures in the table are percentages in terms of the number of the firms citing each choice relative to the total number chosen for each question. Percentages are summed to 100 for each row. For example, if the firm evaluates traditional ties with domestic subcontractors as the serious obstacle not to start FO, or if the firms considers the declining value of traditional ties with domestic subcontractors as the important inducement for starting FO, the firm chooses (A). The firms are asked to choose from the same choice set for each destination region, each type of tasks, and each type of suppliers. Table 7 also disaggregates firms depending on the FO status now and in the past (five years ago).[25] In what follows, we pay particular attentions to the firms switching their FO status during the five-year interval: the firms starting FO (from No to Yes) and the firms terminating FO (from Yes to No). Several informative findings must be noteworthy.

First, (7-1) of Table 7 summarizes the frequency variations across geographical destinations. Firms actively outsourcing (Yes/Yes, No/Yes) to China frequently cite low production costs (I) as the attractive factor, while firms are attracted by suppliers' high technology levels or superior human capital quality (C) in FO to other advanced countries. This contrast should naturally reflect cross-country differences in technology and cost levels. However, as the technology level (C) is chosen by firms continuing FO (Yes/Yes) with high frequency (20-25%) in any destination, the technology level of suppliers should be a critical

[25] As in previous tables, firms are defined as FO firms when they outsource at least one category of tasks to at least one destination or one type of suppliers. Due to this classification, the interpretations of figures in Table 7 require some cautions. For example, in reading the row "China, FO Yes," the firms included in this category actually start FO, but do not necessarily start FO to China, while the answers shown in this row are the firm's evaluation on China. All the firms belong to the same Yes/No category consistently across all questions in Table 7.

condition for continuous FO regardless of the geographical destinations.

Second, as displayed in (7-2), the same factor affects the firm's FO decision differently depending on the tasks outsourced. In outsourcing production-related tasks (jigs, dies, intermediates, or final assembly), the cost factor (I) is the most frequently cited critical factor, though the firms start or stay on FO only if they satisfy with the suppliers' high technology (C). For R&D and various services, the firms evaluate the technology level (C) more important than the cost level (I). FO of professional services is most often facilitated by domestic deregulations in the destination countries (G).

Finally, as shown in (7-3) of the same table, the type of suppliers also appears related with the factors critical for FO, while the cost factor is most frequently cited irrespective of the supplier type or of the firm's FO status. On FO to own subsidiaries overseas, the traditional long-term relationship with domestic suppliers (A) is the most critical factor terminating FO next to unsatisfactory cost reduction. This factor (A) (traditional ties with domestic suppliers less important) appears to exert stronger impacts on starting FO to own subsidiaries (7%) and to other Japanese firms (9%), compared with FO to foreign-owned suppliers (3%). These observations may indicate that Japanese firms still care about long-term relationships within the boundary of the firm as well as the inter-firm networks with other Japanese firms. On FO to foreign-owned suppliers, richer information for candidate suppliers (B) is relatively important in starting FO, next to other common factors (cost (I) and technology(C)).

These findings on the factors affecting FO have valuable policy implications. For example, disseminating information on candidate local suppliers and deregulating professional services should be on the policy priority list. As far as we know, this survey is among the first covering all manufacturing industries on the factors facilitating or hindering FO. However, several notes must be in order. First, these findings depend on the evaluation by outsourcing

firms, and may deviate from the true factors underlying the firm's FO optimizing behaviors. Second, the grouping of FO Yes/No firms does not strictly reflect each firm's status in respective destination/task/supplier-type. For example, the firm citing low costs as an important factor for FO to China is not necessarily outsourcing to China. Third, in investigating the identified factors, we will need to control for relevant factors, such as firm size or productivity at the firm level, though it is beyond the scope of this paper. Finally, we must note that a large number of responding firms, especially among No/No firms, choose the last category "other factors not listed above" (K) for many cases. As the multiple choice set prepared for this question (A) to (J) is supposed to cover virtually most of the possible causes, this high share of "not listed above" forces us to interpret Table 7 with some caution.

5. Survey results on offshore R&D

5.1 R&D facilities

Table 4 presents the offshore outsourcing in R&D is not large. Since the results of R&D activities are not specified in advance, their activities will be underestimated if the offshore R&D activities are limited to the cases with contracts specifying the tasks and results. There is a case where the firm conducts offshore R&D activities without such contracts. In fact, Table 8 presents 209 firms (3.9% of total observations) are conducting offshore R&D in any case, while 80 firms currently are outsourcing offshore R&D with contracts specifying the tasks and results. Offshore R&D activities are actively carried out in the electrical machinery, chemical, transportation machinery and general machinery industry. Almost two thirds of offshore R&D conducting firms hold R&D facilities within their plant site and one fifth establishes research laboratory with a high share in transportation machinery industry (31%) and chemical industry

(28.2%)[26].

Whether or not the function of R&D is independent from the headquarters is an interesting issue for characterizing the offshore R&D. As Table 9 shows, two thirds of offshore R&D (69%) is incorporated in R&D of the headquarters. A major part of offshore R&D appears bundled to headquarter. The heterogeneous independency of offshore R&D to the headquarter between developed countries such as the U.S. and EU/EFTA and developing countries such as China and ASEAN suggests the difference in the purpose of offshore R&D between developed and developing countries.

As shown in Table 10, two factors, the access to local market and the agglomeration of local firms and R&D institutions, are the major factors to decide offshore R&D, while the preferential tax treatment and the government subsidy do not largely affect the decision of offshore R&D.

5.2 Motivation and function

Table 11 presents the motivations of offshore R&D by regions and industries. Although the support of local production and sales is a dominant motivation for offshore R&D in every region, developed countries such as the U.S. and EU/EFTA are different from developing countries such as Asian countries in other motivations such as the recruitment of able researchers, the lower cost of R&D, the collaboration with the local firms and research institutions, and the establishment of global network for research. The R&D facilities in the U.S. and EU/EFTA do not make much of the lower cost of R&D, while those in Asian countries do. The establishment of global network for research is observed as an important motivation in the

[26] Ito and Wakasugi (2007) present a similar result that the number of Japanese affiliates abroad holding local research laboratory is remarkably high in chemical and transportation machinery industry.

U.S. and EU/EFTA . We also note a high ratio of collaboration of R&D activities in the U.S. (23.5%), EU/EFTA (23.8%) as well as Korea (21.4%).

The function of R&D facilities is classified into three types: basic research, applied research and development. Table 12 shows that more than half of R&D facilities are purposed to conduct the development across countries and industries. It is noteworthy that more than one fifth of the R&D facilities are purposed for conducting basic research not only in the U.S., EU/EFTA but also in China. The ratio of basic research is low in Korea and ASEAN. The reason of the high ratio of Chinese basic research, which is almost equivalent to the U.S. and EU/EFTA, must be further examined.

5.3 Relation between offshore outsourcing and R&D

Offshore outsourcing and R&D are closely related. Table 13 shows the results of cross tabulation between domestic outsourcing, offshore purchasing and offshore outsourcing with offshore R&D. 12.7 % of offshore outsourcing firms conducts offshore R&D, while the share of offshore R&D firms is 8.5 % among offshore purchasing firms and only 5.3 % among domestic outsourcing firms. The offshore outsourcing firms appear to be more active in offshore R&D. Such complementarities among various forms of offshore activities must be further examined.

6. Survey results of the protection of Intellectual Property Rights

IPR is an indispensable factor to determine the magnitude of offshore outsourcing and R&D because IPR affects the contractibility and appropriability in the market which influence the corporate decision of offshore outsourcing and R&D.[27] It however is not easy to compare the

[27] Maskus and Penubarti (1995), Smith (2001) and Javorcik (2004) examined how IPR system is related to the international trade and FDI. Branstetter et al. (2006), Ito and Wakasugi (2007) and Wakasugi and Ito (2007) also presented the positive relation between the stronger IPR and the location of R&D facilities and the technology transfer, respectively

level of IPR protection on the common standard across countries since the actual enforceability is different from the legal provisions. Instead of the comparison of legal provisions, it is valuable to observe what protection of IPR the firms perceive in each country. Table 14 presents the result of survey on how each firm evaluates the protection of IPR in 56 countries.

The highest is 4.4 of the U.S., UK, Germany followed by 4.3 of Canada and France. The lowest is 2.3 of Colombia, Ecuador, Guatemala, Bangladesh, China and Iran. Firm's evaluation is different from "Index of Patent Rights" provided by Park and Wagh (2002).[28] For example, the value of our index in 27 countries is lower than those "Index of Patent Rights". Further, 17 countries of them show the large difference between two indices at the margin of more than 10 percent. The gap of two indices implies that there will be a case where actual legal enforcement is weaker than the legal provisions. The evaluation of the IPR enforcement, even if subjective, will be useful to analyze how the enforcement of IPR affects the corporate decision of offshore outsourcing and R&D.

7. Concluding remarks

In recent years, outsourcing of broader ranges of tasks by a larger number of firms has spread across the national boundary. Although the decision of offshore outsourcing by heterogeneous firms has become one of the hottest research topics in international economics, empirical studies have been constrained by the limited availability of micro-data. The increasing offshore R&D activities performed by multinational companies have also attracted the interest of international and industrial economists. Empirical studies on this issue using micro-data are not sufficient as

[28] They allot scores based on the following five criteria: (1) Does the protection of patent right cover major industries such as pharmaceutical, chemical, foods, etc.? (2) How long is the protection of the patent right valid? (3) Is there provision for legal enforcement? (4) Is the country a member to international treaties? (5) Do restrictions exist on patent rights? The score ranges from 0 to 5; a high score implies a stronger IPR system.

well. In order to facilitate direct empirical investigations of these issues, *The Survey of Corporate Offshore Activities* conducted by RIETI collects previously unavailable detailed data on corporate offshore activities, mainly focusing on outsourcing and R&D, from more than five thousand large-sized firms across all manufacturing industries in Japan. This paper summarized the main descriptive results from the survey and discussed their implications.

The principal findings on offshore outsourcing are as follows. Noticeably more firms are outsourcing offshore, compared with five years ago, but still only around one-fifth of the mid- or large-sized firms are active in FO. Production-related tasks outsourced within East Asia occupy the major share in FO, while service outsourcing remains limited. In more than one-third of FO cases, tasks are outsourced to own offshore affiliates within the boundary of multinational firm. These may indicate still serious obstacles for active outsourcing, especially of service tasks, beyond the neighboring low-cost countries, or at the same time, unsolicited ample opportunities of global sourcing ahead of many firms.

With respect to offshore R&D, the number of firms conducting offshore R&D are not large and different across industries. Electrical machinery and electronics, chemical, transportation machinery and general machinery are the dominant industries. The function of offshore R&D is not independent from headquarter. Two thirds of offshore R&D are incorporated in R&D at headquarter. The access to local market and the agglomeration of local firms and R&D institutions are major motivations of offshore R&D. We observe the high ratio of support-oriented R&D in every region as well as the high ratio of R&D collaboration in the U.S., EU and China. Most R&D are purposed to conduct the development, but one fifth is for conducting basic research in the U.S., EU and China.

IPR protection is indispensable factor to determine the magnitude of offshore outsourcing and R&D. This survey presents how each firm perceives the protection of IPR in

each country. The heterogeneous enforcement of IPR based on firm's perception is useful to analyze how the corporate decision of offshoring is affected by the enforcement of IPR.

Acknowledgement

The authors deeply appreciate the financial and administrative supports by RIETI, especially Akira Kawamoto, Kazumi Wakai and Database Group staffs. Remaining errors are those of the authors. The opinions expressed in this paper do not reflect those of RIETI or METI.

Reference

Antràs, P., and Helpman, E. (2004) "Global sourcing," *Journal of Political Economy* 112, 552-580.

Antràs, P., and Helpman, E. (2006) "Contractual frictions and global sourcing," NBER Working Paper No.12747.

Branstetter, L., Fisman, R., and Foley, C. F. (2006) "Do stronger intellectual property rights increase international technology transfer? Empirical evidence from U.S. firm-level panel data," *Quarterly Journal of Economics* 121, 321-349.

Cusmano, L., Mancusi, M., and Morison, A. (2006) "Globalisation of production and innovation: how outsourcing is reshaping an advanced manufacturing area," CEPRI Working Paper No.194.

Feenstra, R., and Hanson, G. (1996) "Globalization, outsourcing, and wage inequality," *American Economic Review* 86, 240-245.

Feenstra, R., and Hanson, G. (2005) "Ownership and control in outsourcing to China: estimating the property-rights theory of the firm," *Quarterly Journal of Economics* 120, 729-761.

Ginarte, J.C., and Park, W.G. (1997) "Determinants of patent rights: A cross-national study,"

Research Policy 26, 283–301.

Görg, H., and Hanley, A. (2005) "International outsourcing and productivity: evidence from the Irish electronics industry," *North American Journal of Economics and Finance* 16, 255-269.

International Institute for Management Development (IMD), (2005) *World Competitiveness Yearbook 2005*.

Ito, B. and Wakasugi, R. (2007) "What factors determine the mode of overseas R&D by multinationals? Empirical evidence," *Research Policy* 36, 1275-1287.

Javorcik, S. B. (2004) "The composition of foreign direct investment and protection of intellectual property rights: Evidence from transition economies" *European Economic Review*, 48(1), 39-62.

Kurz, C. (2006) "Outstanding outsourcers: a firm and plant-level analysis of production sharing," FEDs Working Paper No.2006-04.

Lee, J.-Y., and Mansfield, E. (1996) "Intellectual property protection and U.S. foreign direct investment," *Review of Economics and Statistics* 78, 181-186.

Maskus, K. and Penubarti, M. (1995) "How trade-related are intellectual property rights?" *Journal of International Economics* 55: 161-186.

Park, W. G., and Wagh, S. (2002). Index of patent rights, in *Economic Freedom of the World: 2002 Annual Report*, Chapter 2, pp. 33-43.

Rapp, R.T., and Rozek, R.P. (1990) "Benefits and costs of intellectual property protection in developing countries," *Journal of World Trade* 24, 75-102.

Smith, P. J. (2001) "How do foreign patent rights affect U.S. exports, affiliate sales, and licenses?" *Journal of International Economics* 55: 411-439.

Tomiura, E. (2005) "Foreign outsourcing and firm-level characteristics: Evidence from Japanese

manufacturers," *Journal of the Japanese and International Economies* 19, 255-271.

Tomiura, E. (2007) "Foreign outsourcing, exporting, and FDI: A productivity comparison at the firm level," *Journal of International Economics* 72, 113-127.

Wakasugi, R. and Ito, B. (2007) "The effects of stronger intellectual property rights on technology transfer: Evidence from Japanese firm-level data," *Discussion Paper* No. 632, *Kyoto Institute of Economic Research, Kyoto University*, and *Journal of Technology Transfer*, forthcoming.

Yeats, A. (2001) "Just how big is global production sharing?" in: Arndt, S., Kierzkowski, H. (Eds.) *Fragmentation: New Production Patterns in the World Economy*. Oxford University Press, 108-143.

Table 1 Percentages of firms

	Currently	Five years ago
Offshore outsourcing	20.55	15.20
Outsourcing within Japan	61.34	58.83
Offshore purchasing	39.67	33.41

Notes: Shown are the percentages of the firms answering affirmatively to the binary question.

Table 2 Cross-tabulations on outsourcing

		Offshore outsourcing		
		Yes	No	Total
Offshore purchasing	Yes	19.73	20.43	40.16
	No	1.22	58.62	59.84
	Total	20.95	79.05	100

		Offshore outsourcing		
		Yes	No	Total
Outsourcing within Japan	Yes	19.78	42.38	62.16
	No	1.20	36.64	37.84
	Total	20.99	79.10	100

Offshore outsourcing		Five years ago		
		Yes	No	Total
Currently	Yes	14.74	6.04	20.78
	No	0.83	78.39	79.22
	Total	15.57	84.43	100

Notes: Shown are the percentages of the firms answering affirmatively to the binary question.

Table 3 Distribution of tasks in domestic outsourcing

Production of Jigs or Dies	16.87
Production of Parts, Components, or other Intermediates	30.68
Final Assembly or Processing of Final Products	25.10
R&D	3.24
Information Services	6.72
Customer supports	1.66
Professional (Legal, Accounting, or Financial) Services	5.92
Other tasks	9.80

Notes: Shown are the percentages of the firms outsourcing each task. As a firm can outsource multiple tasks, the percentage is relative to the total number of choices.

Table 4 Offshore outsourcing disaggregated by geographical destinations

Region / Task	China	ASEAN	Other Asia	U.S.A. & Europe	ROW	World *Total*
Jigs/Dies	7.35	2.64	1.93	0.51	0.09	*12.52*
Intermediates	19.19	7.61	4.37	3.32	0.85	*35.34*
Final Assembly	19.56	8.57	3.52	2.92	0.68	*35.25*
R & D	1.22	0.45	0.40	1.39	0.11	*3.58*
Info services	1.28	0.65	0.20	0.79	0.09	*3.01*
Customer supports	1.79	0.91	0.51	1.16	0.14	*4.51*
Professional services	0.71	0.37	0.31	0.65	0.09	*2.13*
Other tasks	1.70	0.71	0.34	0.71	0.20	*3.66*
Total	*52.80*	*21.91*	*11.58*	*11.47*	*2.24*	*100*

Notes: Shown are the percentages in the total number of FO cases. The outsourcing of the same category of tasks to the same type of suppliers in the same region is counted as one FO case even if multiple transactions are involved.

Table 5 Offshore purchasing

Region / Goods/services	China	ASEAN	Other Asia	U.S.A. & Europe	ROW	World *Total*
Raw Materials	11.07	5.50	4.85	7.22	3.01	*31.66*
Jigs/Dies	3.87	1.35	1.41	0.34	0.09	*7.05*
Intermediates	12.50	5.69	3.99	5.30	0.87	*28.34*
Final Assembly	11.29	5.31	2.84	5.09	1.06	*25.60*
R & D	0.53	0.31	0.20	0.94	0.07	*2.04*
Info services	0.55	0.31	0.09	0.53	0.05	*1.52*
Customer supports	0.51	0.43	0.17	0.43	0.07	*1.60*
Professional services	0.37	0.22	0.15	0.32	0.03	*1.11*
Other goods/services	0.36	0.22	0.10	0.36	0.03	*1.07*
Total	*41.05*	*19.33*	*13.81*	*20.52*	*5.28*	*100*

Notes: See notes to Table 4.

Table 6 Offshore outsourcing disaggregated by types of suppliers

Suppliers / Task	Own subsidiaries	Other Japanese subsidiaries	Foreign-owned suppliers	*Total*
Jigs/Dies	4.06	2.19	6.27	*12.52*
Intermediates	11.92	6.24	17.17	*35.34*
Final Assembly	15.55	4.74	14.96	*35.25*
R & D	1.96	0.28	1.33	*3.58*
Info services	1.11	0.60	1.31	*3.01*
Customer supports	2.36	0.62	1.53	*4.51*
Professional services	0.45	0.31	1.36	*2.13*
Other tasks	1.73	0.43	1.50	*3.66*
Total	*39.14*	*15.41*	*45.44*	*100*

Notes: See notes to Table 4.

Table 7 Factors facilitating/hindering changes in foreign outsourcing

(7-1) Disaggregated by geographical destinations

	FO Past	Now	A	B	C	D	E	F	G	H	I	J	K
China	No	No	6	6	14	1	5	2	4	2	26	6	29
	No	Yes	7	7	16	2	5	1	3	3	51	4	3
	Yes	No	3	6	19	0	6	3	3	3	39	0	16
	Yes	Yes	6	5	20	1	4	3	4	4	44	5	4
ASEAN	No	No	5	5	12	1	4	2	3	1	18	8	43
	No	Yes	4	6	19	1	10	0	5	1	42	7	6
	Yes	No	19	0	6	0	13	0	6	6	31	0	19
	Yes	Yes	6	5	21	2	4	2	2	4	42	5	5
Other Asia	No	No	4	8	11	1	4	2	3	1	16	6	44
	No	Yes	3	5	18	4	5	5	3	1	41	9	5
	Yes	No	0	0	0	0	0	0	0	0	40	20	40
	Yes	Yes	3	7	25	3	4	3	1	1	40	4	9
U.S.A. or Europe	No	No	5	6	7	1	6	2	3	2	9	9	50
	No	Yes	8	10	28	0	5	5	3	0	18	5	20
	Yes	No	0	0	0	0	0	0	0	0	25	0	75
	Yes	Yes	7	4	25	3	14	2	2	2	17	8	17
ROW	No	No	3	7	6	1	3	2	2	2	7	8	58
	No	Yes	17	0	0	0	0	0	0	0	33	17	33
	Yes	No	0	0	0	0	0	0	0	0	33	0	67
	Yes	Yes	6	7	22	0	4	1	3	4	24	6	24

Notes: Surveyed firms are asked to choose up to three factors from the following multiple choices: (A) traditional ties with domestic suppliers, (B) information on candidate suppliers, (C) technology level or human capital quality of suppliers, (D) telecommunication technology development, (E) specs or standards of parts or production methods, (F) frequent face-to-face adjustment, (G) domestic regulations in the destination countries, (H) trade barriers or FDI regulations, (I) production costs or wages, (J) costs of transport or communications, and (K) other factors not listed above. This paper displays the percentage of each choice among the total number chosen for each question. “FO Past/Now Yes” is defined by foreign outsourcing of at least one task five years ago/now.

(7-2) Disaggregated by outsourced tasks

Tasks	FO Past	Now	A	B	C	D	E	F	G	H	I	J	K
Jigs or Dies	No	No	7	4	15	1	6	5	1	1	13	5	44
	No	Yes	6	3	29	3	8	3	1	2	39	3	3
	Yes	No	0	0	0	0	0	0	0	0	40	20	40
	Yes	Yes	4	5	27	2	6	5	1	1	43	2	4
Intermediates	No	No	5	4	16	0	8	4	1	1	21	5	33
	No	Yes	6	6	22	1	6	3	1	2	45	4	3
	Yes	No	8	3	18	3	3	3	3	3	36	8	15
	Yes	Yes	5	5	25	1	9	4	2	1	41	3	4
Final Assembly	No	No	5	3	16	1	7	5	1	1	18	7	37
	No	Yes	5	4	24	1	6	3	2	2	44	5	3
	Yes	No	12	4	12	0	8	4	4	0	32	4	20
	Yes	Yes	6	4	25	1	7	3	1	2	41	5	4
R&D	No	No	3	6	10	4	2	4	3	1	2	2	66
	No	Yes	10	14	24	14	10	0	0	0	10	0	19
	Yes	No	0	0	50	0	0	0	0	0	0	0	50
	Yes	Yes	2	6	31	6	9	4	4	0	15	0	24
Info services	No	No	3	6	8	7	2	3	2	0	2	2	64
	No	Yes	5	11	21	16	5	11	0	0	16	0	16
	Yes	No	0	0	0	0	0	0	0	0	0	0	100
	Yes	Yes	2	11	22	9	0	2	2	0	17	3	33
Customer supports	No	No	5	6	7	3	1	4	3	1	2	3	66
	No	Yes	10	10	25	0	5	15	0	0	10	0	25
	Yes	No	0	0	0	0	0	0	0	0	0	0	100
	Yes	Yes	7	7	21	4	3	11	3	0	10	4	31
Professional services	No	No	4	4	5	2	1	2	6	2	3	3	68
	No	Yes	10	10	20	0	10	0	20	10	10	0	10
	Yes	No	0	0	0	0	0	0	0	0	0	0	100
	Yes	Yes	0	5	7	5	0	0	22	7	7	0	46
Other tasks	No	No	3	5	6	2	1	2	4	1	7	5	64
	No	Yes	8	12	15	4	4	4	4	4	38	0	8
	Yes	No	0	0	0	0	0	0	0	0	50	0	50
	Yes	Yes	3	7	17	2	2	3	3	0	17	3	41

(7-3) Disaggregated by suppliers

Suppliers	FO Past	Now	A	B	C	D	E	F	G	H	I	J	K
Own subsidiaries	No	No	5	2	8	2	3	2	2	1	13	5	59
	No	Yes	7	3	20	2	9	3	3	5	40	4	5
	Yes	No	20	0	0	0	0	0	0	0	40	7	33
	Yes	Yes	6	3	21	2	7	4	4	4	35	6	7
Subsidiaries of other Japanese firms	No	No	5	5	8	1	2	2	1	0	14	4	57
	No	Yes	9	6	24	3	4	1	3	3	41	1	4
	Yes	No	0	0	0	0	0	0	0	0	40	0	60
	Yes	Yes	5	4	23	1	6	5	2	4	37	4	8
Foreign-owned suppliers	No	No	3	6	12	1	4	2	3	1	17	3	47
	No	Yes	3	11	23	1	4	4	1	1	41	4	7
	Yes	No	0	4	22	0	4	0	4	0	39	4	22
	Yes	Yes	3	7	29	1	5	2	2	2	37	3	9

Table 8 Distribution of offshore R&D and foreign R&D facility by industries

Industry	# of firms for offshore R&D	R&D Facility in		
		Laboratory	Plant Site	Other
Electrical machinery (716)	46 (6.4%)	25.0%	62.5%	12.5%
Chemical (624)	37 (5.9%)	28.2%	51.3%	20.5%
Transportation machinery (405)	31 (7.7%)	31.0%	62.1%	6.9%
General machinery (654)	22 (3.4%)	14.3%	66.7%	19.0%
Other industries (2,809)	73 (2.6%)	17.6%	60.8%	21.6%
Total (5,417)	*209 (3.9%)*	*22.7%*	*60.2%*	*17.1%*

Note: The column 2 denotes the number of firms while column 3 shows the share of the number of replies allowed multiple answers. The industry name currently displayed is top four with much frequency on offshore R&D activities.

Table 9 Relation with headquarter by regions and industries

Region / Industry	Relation with Headquarter		Obs.
	Independent	Integrated in Headquarter	
U.S.A.	36.4%	63.6%	77
EU/EFTA	36.0%	64.0%	50
China	25.6%	74.4%	82
Korea	40.0%	60.0%	15
ASEAN	25.0%	75.0%	44
Other regions	28.6%	71.4%	7
Electrical machinery	16.2%	83.8%	68
Chemical	32.3%	67.7%	65
Transportation machinery	30.6%	69.4%	36
General machinery	44.1%	55.9%	34
Other industries	38.9%	61.1%	72
Total	*31.3%*	*68.7%*	*275*

Table 10 Major determinants of offshore R&D location by regions and industries

Region / Industry	Access to Local Market	Agglomeration of Local Firms/R&D Institutions	Government Subsidy	Obs.
U.S.A.	59.7%	38.9%	1.4%	72
EU/EFTA	56.3%	37.5%	6.3%	48
China	53.1%	38.3%	8.6%	81
Korea	62.5%	31.3%	6.3%	16
ASEAN	50.0%	43.2%	6.8%	44
Other regions	57.1%	28.6%	14.3%	7
Electrical machinery	47.9%	40.8%	11.3%	71
Chemical	59.0%	36.1%	4.9%	61
Transportation machinery	74.4%	25.6%	0%	43
General machinery	53.6%	39.3%	7.1%	28
Other industries	49.2%	46.2%	4.6%	65
Total	*55.6%*	*38.4%*	*6.0%*	*268*

Table 11 Motivations of offshore R&D by regions and industries

Region / Industry	Motivations					Obs.
	Support for Local Production/Sales	Recruitment of able human resources	Low R&D Cost	R&D Collaboration	Global R&D Network	
U.S.A.	37.8%	16.8%	2.5%	23.5%	19.3%	119
EU/EFTA	36.3%	17.5%	1.3%	23.8%	21.3%	80
China	36.5%	15.5%	20.9%	17.6%	9.5%	148
Korea	42.9%	21.4%	10.7%	21.4%	3.6%	28
ASEAN	44.6%	15.7%	20.5%	9.6%	9.6%	83
Other regions	33.3%	20.0%	13.3%	13.3%	20.0%	15
Electrical machinery	23.0%	27.6%	15.1%	17.1%	17.1%	152
Chemical	45.3%	8.1%	7.0%	24.4%	15.1%	86
Transportation machinery	50.7%	9.3%	10.7%	18.7%	10.7%	75
General machinery	47.9%	16.7%	18.8%	12.5%	4.2%	48
Other industries	42.0%	13.4%	9.8%	19.6%	15.2%	112
Total	*38.5%*	*16.7%*	*12.1%*	*18.8%*	*14.0%*	*473*

Table 12 Offshore R&D function by regions and industries

Region / Industry	R&D Function			Obs.
	Basic Research	Applied Research	Development	
U.S.A.	16.7%	26.5%	56.9%	102
EU/EFTA	17.6%	28.4%	54.1%	74
China	19.8%	26.7%	53.5%	101
Korea	5.0%	35.0%	60.0%	20
ASEAN	11.1%	20.4%	68.5%	54
Other regions	25.0%	25.0%	50.0%	12
Electrical machinery	18.2%	25.3%	56.6%	99
Chemical	13.0%	15.9%	71.0%	69
Transportation machinery	16.7%	31.7%	51.7%	60
General machinery	5.1%	25.6%	69.2%	39
Other industries	21.9%	32.3%	45.8%	96
Total	*16.5%*	*26.4%*	*57.0%*	*363*

Table 13 Outsourcing and Offshore R&D

		Offshore R&D		
		No	Yes	Total # of firms
Domestic outsourcing	No	98.6 %	1.4 %	2,033
	Yes	94.7 %	5.3 %	3,341
Offshore purchasing	No	99.3 %	0.7 %	3,229
	Yes	91.5 %	8.5 %	2,176
Offshore outsourcing	No	98.5 %	1.5 %	4,230
	Yes	87.3 %	12.7 %	1,130

Notes: Percentages are of the total number of firms in each row.

Table 14 Evaluation of IPR protection (0~5)

Country	IPR Score	Country	IPR Score
North America	*4.4*	*Europe*	*3.8*
U.S.A.	4.4	Germany	4.4
Canada	4.3	United Kingdom	4.4
		France	4.3
South America	*2.5*	Switzerland	4.2
Mexico	2.9	Belgium	4.1
Brazil	2.7	Netherlands	4.1
Argentina	2.6	Sweden	4.0
Chile	2.5	Italy	4.0
Peru	2.4	Denmark	4.0
Venezuela	2.4	Norway	4.0
Colombia	2.3	Austria	3.9
Ecuador	2.3	Ireland	3.9
Guatemala	2.3	Luxembourg	3.9
		Spain	3.8
Asia and Middle east	*2.8*	Portugal	3.8
Singapore	3.4	Greece	3.7
Korea, Republic of	3.3	Finland	3.7
Taiwan	3.1	Poland	3.3
India	3.1	Turkey	3.3
Hong Kong	3.0	Hungary	3.3
Malaysia	2.9	Romania	3.2
Thailand	2.9	Czech Republic	3.1
Israel	2.8	Russian Federation	3.0
UAE	2.7		
Indonesia	2.7	*Other countries*	*3.4*
Saudi Arabia	2.7	Australia	4.0
Philippines	2.6	New Zealand	3.8
Vietnam	2.6	Egypt	3.0
Pakistan	2.5	South Africa	2.9
Sri Lanka	2.4		
Bangladesh	2.3		
China	2.3		
Iran	2.3		

Notes: Each score is calculated as mean value.