2D07 Industry-Academia Linkages based on the Knowledge Incentive model

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1. Introduction

Higher Education in Japan has been going through various structural reforms and major changes in recent years. Under such circumstances, universities are having to cope with a gradual cutback of their budget and pressure to increase competitiveness. Industries on the hand have been under pressure to increase their R&D performance. Cutbacks of R&D expenditures on basic research have resulted in firms to rely more heavily on industry-academia linkages. Furthermore there has been growing expectation by industry on breakthrough innovations generated by academic research. Thus, there has been a surge of interest in industry–academia collaboration from both sides. However, industry-academia collaboration has not been going on smoothly in many instances. In this paper, we aim to analyze industry-academia linkages from the point of view of the structure of knowledge transfer processes.

Kasouf, Aplian and Gummeson(1999) analyzed industry-university alliance at the Metal Processing Institute at Worcester Polytechnic Institute. They also point out that the goals, needs for secrecy, and timelines of the university and industrial sectors are not always consistent. Collins and Wakoh(1999) conclude that merely increasing opportunities for contact between industry and universities does not necessarily lead to technology transfer. Lofsten and Lindelof (2002) conducted a study of academic-industry linkages by distinguishing firms on and off science parks in Sweden. Faulkner and Senker (1995) studied the industry-PSR linkages in 3 sectors of biotechnology, parallel computing and engineering ceramics and pointed out that there were cross sector differences as well as similarities.

2. Industry-Academia Linkages

In Japan, about one fifth of the annual science and technology budget is allocated to universities. Of the total researchers, about 35% belong to universities, so the potential for strengthening basic research performance and creating the seeds for innovation is quite high. For example, basic discoveries in ferrite, magnetic tape, quartz, components for optical communications were made at Tokyo Institute of Technology(Tokyo Tech) and paved the way for radical innovations. Innovations in the production process of Vitamin B2 at Tokyo Tech led to its mass production. A study was carried out to analyze globalization of R&D in electronics and pharmaceutical sector in Japan, based on bibliometric analysis and a questionnaire (Yamada, Miyazaki 1999). Our study revealed that in the 1990s, globalization picked up momentum in these two sectors especially through research collaboration between R&D labs located overseas and local universities. It was also shown by an analysis of co-authorship that research collaboration between the domestic R&D labs and universities has been growing since the 1990s.

3. Methodology

The analysis was carried out in two steps. In the first phase, we carried out preliminary interviews with about a dozen academics at Tokyo Institute of Technology, well recognized for their academic credentials as well as active collaboration with industry. We also contacted their counterparts in industry with whom they were collaborating and performed similar interviews. The main purpose of these interviews was to collect relevant information about the existing structure of industry-academic collaboration, its origin, purpose, organization and scope of research collaboration and the problems encountered. Having completed the initial series of interviews, a web based questionnaire was designed.

The questionnaire consisted of two parts, Part 1 and Part 2. The purpose of the questionnaire in Part 1 was to identify the current situation in industry-academia linkages and the problems or bottlenecks. In this study, we assume the existence of an ideal form of industry-academia collaboration. Much of the problems arising in industry-academia collaboration are related to the institutional environment, especially at universities.

One group of questions relate to the respondent's experience of industry-academia collaboration either in the past or at present. The second group of questions relate to the respondents' views on how an ideal form of

industry-academia collaboration can be attained, for example by changing the incentive system of faculty members.

The questionnaire in Part 2 was designed on the basis of the knowledge incentive model. In this model, we focus on the conditions for knowledge provision or absorption, for both academics and industry respondents. Here we assume that both industry and universities are willing to provide knowledge as well as absorb knowledge. In considering knowledge transfer in university-academia collaboration, there are four cases to consider.
1)Industry requires knowledge: 2) Universities require knowledge: 3)Industry provides knowledge: 4)Universities provide knowledge:

In order to measure the degree of willingness to absorb or provide knowledge, we formed categories for each index. If one was asked to provide some knowledge, then there would be four cases to consider.

A1:   Willing to provide knowledge free of charge
A2:   Willing to provide knowledge if one can expect a return in the future
A3:   Willing to provide knowledge at some cost (determined by a contract etc.)
A4:   One's knowledge is one's own, so that one cannot provide it under any circumstance

If one wished to acquire knowledge, similarly, there would also be four cases to consider (B1-B4)

The knowledge · information was classified into eight categories adopted from the classification of STI put forward by Senker and Faulkner (1995).
Type 1: Knowledge related to new product ideas   Type 2: Knowledge related to the users' needs, societal and market related needs Type 3: Information related to novel research equipment Type 4: Knowledge related to new research methods Type 5: Knowledge related to state of the art technologies
Type 6: Knowledge and skills related to experiments Type 7: Knowledge related to knowledge
Type 8: Knowledge of intellectual property (patents) related to the ongoing research

4. Results: Analysis of Part 1

The results of the questionnaire in Part 1 are presented below.   We will discuss the questions which are particularly interesting, showing some discrepancy between the viewpoints of academics and industry respondents.

The way industry-academia collaboration started could be broken down into five cases. 1) personal connection, 2) network related to a forum or an academic society, 3) an organizational linkage or institution of the university, 4) an organizational linkage or institution of the firm, 5) others. It was found that both types of respondents considered personal networking to be an important motive for starting the collaboration. This was especially evident for academics. In the case of industry respondents, zero percent replied that they had entered into collaboration because of an organizational linkage or an institutional arrangement by the university.

In question (2) the stage of research carried out in the collaboration could be broken down into, 1.basic research, 2.   applied research, 3. technology development, 4. product development, 5.   product testing,   6. others. The results are consistent with the general notion that universities carry out basic research while industries focus on applied research or technology development. Since the ratio of technology development is rather high for industry, it implies that they may look towards universities as a collaborator to develop new technologies and skills. Question (4)-(1) raises the issue of the merits generated by industry-academia collaboration, in particular, being able to gain economic benefits or research funding. 82% of the university respondents considered that it was important while only 17% of industry participants thought it was important.

Question (4)-(2) relates to the merit of being able to gain complementary know-how or learn new approaches in research. Both academia and industry considered that this was a valuable benefit.

In question (4)-(3), we asked the respondents, to what extent they considered that 'being able to use the collaborator's experimental facilities' was important. Here, while 76% of the industry respondents gave an affirmative reply, only 50% of university respondents replied positively.

In question (5), the respondent was asked to specify the demerits of industry-academia collaboration.   In (5)-(1), 29% of the academia pointed out the lack of freedom in conducting research, whereas the percentage of industry respondents was only 3%.

Question (5)-(2) addressed the issue of limitations caused by the time schedule. 59% of the academia found that having to complete the project in a fixed short time frame was a demerit, while the ratio for industry was 38%.

Question (5)-(3) relates to the problem of risk of knowledge leakage. Only 12% of the academia considered that there was a danger of knowledge leakage through collaboration, while 59% of the industry respondents

considered that there was a danger.

Question (6) relates to the outcome of the collaboration. There was little difference in the outcome. Acquisition of new knowledge, skills was valued highly by both (89% for academia, 100% for industry). Formation of networks was another factor valued highly by both type of institutions. Acquisition of tacit knowledge was considered to be important by both (academia, 61%, industry 86%) but the data indicates that it was considered to be more important for industry.

In Question (7) – (1), we asked the respondents if they could afford the cost of filing for patents. 61% of the University respondents replied that they were not able to, while the figure for industry respondents was 10%. Although legally faculty members can own patents, unless there is an institutional mechanism to support faculty members to pay for the cost of filing for patents, it would be difficult for them to own them. This did not seem to be a major problem for industry. When the respondents were asked whether they considered TLOs to be an innovative system for overcoming problems related to intellectual properties at universities, their views diverged. For universities, 53% replied positively, while only 24% replied positively for industry. However, when they were asked if they had expectations for TLOs to play an important role in the future, 70% of both academia as well as industries replied positively. Within the next few years, we may expect to see the TLO system evolve and play an important part in the innovation system. Question 9) was related to the relationship between the knowledge provider and knowledge receiver. They were asked to choose between a) Knowledge transfer will take place smoothly if a contract exists b) If a contract exists, then it is likely to limit the knowledge being transferred and hence hinder the knowledge transfer. c) there is little connection between the structure of the contract and the knowledge transfer. Surprisingly there was little difference between the viewpoints of academia and industry. For both of them, 52-53% chose a), followed by 36% who chose c). In question 11) we tried to assess the views regarding incentives for faculty members. Both academia as well as industry considered that there should be financial incentives for faculty members to engage in collaboration.
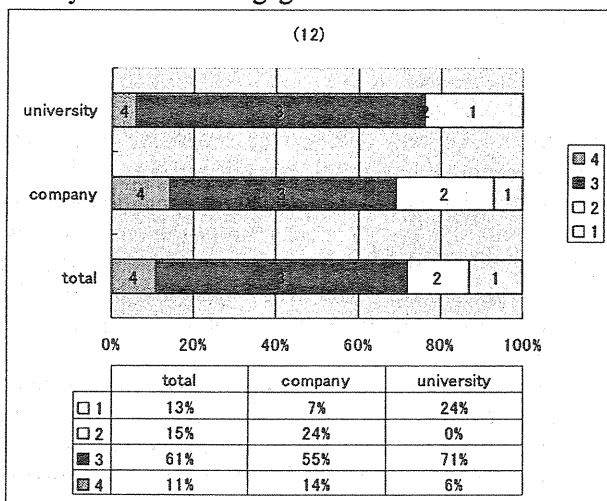

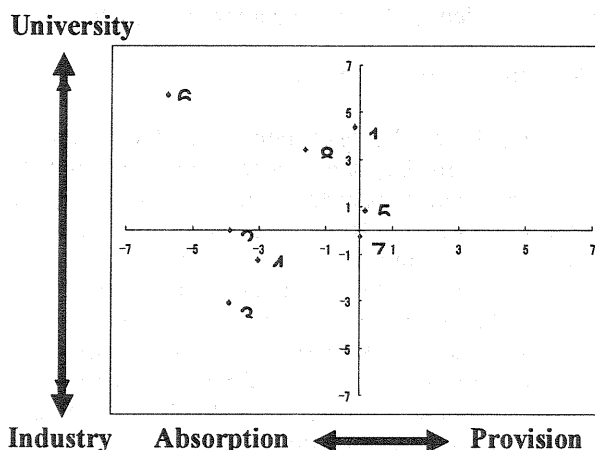Figure 1: Meeting the needs of universities

Figure 2; Plot based on the Knowledge Incentive Model

Question (12) addressed the issue of the needs of universities. In industry-academia collaboration, one tends to consider how universities are meeting the needs of industries, but we wished to explore the extent to which the reverse case was true. In other words, to what extent should companies try to meet the needs of universities? While 24% of academics considered that firms should respond to the needs of universities, only 7% of the industry respondents considered that was the case. 24% of the industry respondents considered that industry's needs were more important than the universities' needs (Figure 1). Zero percent of the academics considered that was the case. Over 50% of both industry and academia respondents thought that it was not relevant which side's needs were more important.

5. Results ~ Analysis of Part 2 based on the Knowledge Incentive Model

Theory of Quantification (Method 2) was used to analyze the questions in Part 2. The range for category item 3 is the largest. We may infer that the third type of knowledge (Knowledge on new type of research equipment) relates to the large size of the gap, caused by the different perceptions between academia and industries. The

category score for provision is the lowest for item 3, -5.78 indicating that the third type of knowledge contributes most to industries. The category score is highest for item 7 at 1.11 followed by item 4, at 0.73445, indicating that the seventh type of knowledge (Knowledge on knowledge) and fourth type of knowledge (Knowledge on new research techniques, skills) are factors contributing most to universities in terms of knowledge provision. From Table 2, which also summarizes the results on absorption, the range for item 6 is the largest, indicating that the gap between the perceptions by academia and industry is most pronounced for the sixth type of knowledge (Knowledge or skills related to experiments). This is followed by item 8, knowledge related to patents. Table 3 shows that the category score for absorption is the highest for item 6, pointing out that knowledge related to experimental techniques is a factor which contributes most to universities. The lowest value for category scores for absorption is -3.228 for absorption, indicating that the fourth type of knowledge (related to new research methodology) is a major contributing factor of knowledge absorption by industries.

The fifth type of knowledge, which is knowledge related to state of the art technologies contributes to provision and the third type of knowledge (knowledge related to new experimental equipment) contributes to absorption. However the figures are mostly negative, implying that knowledge absorption is more frequent than knowledge provision.

Finally, it is possible to combine the results of the two types of analysis based on the knowledge incentive model. Figure 2 shows a plot of the category scores using the knowledge incentive model.

6. Discussion

In this paper, a novel approach was introduced to analyze industry-academia linkages based on the knowledge incentive model. From part 1, while some positive outcome of industry-academia collaboration was identified, it was found that the incentives for academics to collaborate with industry were insufficient. Moreover, industry's understanding of the needs of academia was lacking. On the industry side, merits of collaboration identified included; ability to gain a deeper understanding of theoretical aspects of research leading to increased depth of research, synergy effects and speed-up of research developments. Since industries cannot carry out basic research themselves, there is a tendency to outsource it to universities. Other benefits included the ability to gain personal as well as information related networks through industry-academia collaborations. Merits of being able to gain complementary know-how or learn new approaches in research were identified for both industry and academic respondents. There were some divergent views related to the time schedule, the risk of knowledge leakage, the role of TLOs and geographical proximity.

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