〈日本知財学会誌〉Vol.5 No.2—2008 : 36-50

Large Companies' Preemption of University Inventions by Joint Research Is Strangling Japanese Entrepreneurship and Contributing to the Degradation of University Science

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Joint research collaborations in Japan have increased dramatically. In major universities, most collaborations in advanced science and technology involve large companies. Many have facilitated the development of university discoveries. However, patent law and the system of university IP management have enabled large partner companies to control (preempt) the majority of university discoveries that have commercial value. This limits growth opportunities for new high-technology companies and, by by-passing TLOS and IP management offices, thwarts the development of effective technology management capabilities on the part of universities. This is a problem since new companies are better at early stage innovation than old companies in many new fields of technology. Preemption exacerbates the weakness of Japanese high technology entrepreneurship. Preemption of university discoveries by large companies is the result of policies that make preemption easy, encourage university research in applied fields, and allow findings to be kept secret thereby encouraging more applied research that is likely to be preempted. Whether the short-term benefits for large companies justify the foregone opportunities for pioneering research and the undermining of entrepreneurship and academic freedom is a question that needs serious consideration. This paper offers some recommendations to curb the worst excesses of preemption and to reward pioneering university research.

■KEYWORDS University-industry Collaboration, Joint Research, Joint Patents, Ventures/Start-ups/Entrepreneurship, Science Policy

1. Introduction

Since reforms of the university-industry cooperation framework began ten years ago, the steady expansion of joint research between companies and Japanese universities has been the most striking achievement. This expansion is evident in increases in funding from companies, numbers or projects, numbers of industry and university researchers involved in collaborations, and transfers of university intellectual property (IP) to industry —— usually by joint patent applications. This expansion probably has provided substantial benefits to the partner companies and resulted in the development and commercialization of some university discoveries to the benefit of society.

However, at least in the case of major Japanese universities, large, established companies have benefitted most. Access to university discoveries of small companies, and in particular, new entrepreneurial high technology companies, has been limited. This is due, in part, to large companies being more suited than new companies to develop some university discoveries. However, it is also due to the system of university IP management that enables large companies to preempt university discoveries and thus limit opportunities for new technology-based companies to grow. Here, preemption refers to the joint research partner receiving exclusive control over not only discoveries definitely within the scope of the joint research project, but also a wider

ISSN 1349-421X

penumbra of inventions related to the theme of the project——discoveries that relied mainly on government funding.

Japanese government research projects may themselves facilitate preemption, because many large government projects tend to address applied research questions, and some (particularly consortium projects) are aimed at increasing the international competitiveness of large companies. Thus the discoveries that emerge from such applied projects often fall within the business scopes of large companies. The current system enables such companies to preempt these government funded discoveries. Sometimes preemption extends beyond IP to include the time, interest and energy of Japanese university researchers.

Thus preemption, and the system that encourages preemption, hurts Japanese university science by shifting its emphasis away from pioneering basic research to applied research that is not groundbreaking but that responds to the short to mid-term needs of large companies. However, this may hurt companies in the long term because capable Japanese university researchers probably are focusing less than overseas colleagues on new areas of science that might be the basis of commercial technologies twenty or more years in the future. It definitely hurts high technology entrepreneurship, because few discoveries remain that new companies can exploit. Again, this probably hurts Japanese industry in the long term because new companies have shown that they are often best able to commercialize discoveries in new fields of science.

2. The role of high technology ventures in innovation

In the US and a few other countries, new companies have played a major role in innovation[1] in pharmaceuticals, biomedical devices, mobile telecommunications, internet related technologies, semiconductors, hard disk drives, materials and other industries (Christensen 1993, Goodman and Myers 2005, Hall and Ziedonis 2003, Kneller 2007a). At least in pharmaceuticals, there is clear evidence that new companies are more innovative than established pharmaceutical companies. But only in the US, Canada and Australia do new life science companies account for a substantial percentage of drug discovery.

Particularly in Japan, new companies play a small role in innovation. Outside of about 50 companies in the life sciences and a smaller number in software, the number of new companies that are developing globally innovative technologies, and that have significant prospects for business growth, is small. This applies both to companies created to develop university discoveries (hereinafter startups) and even more so to independent companies "spun-out" of established companies.

The reasons for this difference are complex, but the likely leading causes are as follows:

1. *The continued prevalence of lifetime employment and low worker mobility in high technology manufacturing industries.* This severely limits formation of spinouts, and deprives startups and other high tech ventures of managerial and research talent. High labor mobility is probably one of the fundamental reasons for the success of Silicon Valley. The reasons behind continued low labor mobility in Japanese high tech industries are also complex, but corporate pension policies, corporate job rotation and promotion policies, negative family attitudes towards husbands and children working in ventures, obstacles to two career households, laws against disclosure of trade secrets, and the system of graduate-level university education, probably

all are important factors.

2. *The continuing tendency for autarkic innovation in Japanese manufacturing companies.* This is changing, but only slowly. Chesbrough's (2003) concept of *open innovation* characterized by large companies actively seeking core technologies from many sources, including independent small companies, simply does not apply to most Japanese companies. Japanese manufacturers may practice a variation of *open innovation,* but, as described below, this is limited to collaborative research with universities that allows the companies to exclusively control IP.[2]
3. *Demographics.* Japan's population is aging and its immigration rates are low. In Silicon Valley, immigrants constitute about a third of all researchers and venture company managers, and the proportion of immigrants in high tech ventures elsewhere in the US is also high. In addition, there is evidence that the long hours and frequent job changes (not always voluntary) associated with work in high tech ventures is probably more suited to young persons who either do not have children or whose children have some other source of financial support (e.g., another parent with a stable job). In all these areas, Japan is at a disadvantage.
4. The system of university-industry collaboration in Japan still is characterized by *preemption by large companies of university IP and the energies of academic researchers.*

Other serious problems include a shortage of skilled managers for ventures, immaturity of capital markets and difficulties in raising capital. However, these problems probably originate largely from the first four factors mentioned above. Simply put, much of Japan's best human and financial resources are locked up in large organizations, leaving limited opportunities for new high technology companies to grow (Kneller 2007a).

3. A deeper examination of preemption

Of the four factors listed above, only the fourth might be amenable to change in the short term by government policy. Therefore, it is worthwhile to summarize the evidence that preemption of university discoveries is prevalent and also to consider how and why this preemption occurs.

As for evidence for preemption, in several major Japanese universities, about half of patented inventions are attributed to joint research. Among the inventions that are actually transferred either by license or by joint patent applications, joint research inventions constitute about three-quarters. However, in the case of the University of Tokyo, joint research from private companies accounts for less than 7 percent of that university's research budget *not including salaries of permanent employees,*[3] and the average company funding per project per year is less than $50,000 USD.[4] Interviews with Japanese companies that sponsor research in both US and Japanese universities and with technology transfer officials in US universities indicate that average corporate funding for joint research projects is higher in US than Japanese universities. This is supported by OECD data showing that industry funded only 2.8 percent of Japanese university R&D in 2002 compared to 5.3 percent in the US in 2003 (NSB 2008). The proportion of inventions from major Japanese universities that are transferred as joint patent applications has been rising since 2003, as the total number of joint research projects has risen. Outside of the life sciences, the patent co-applicants are usually large established companies.[5] In other words, in return for a

relatively small amount of research support that could not possibly cover most of the inputs that contribute to discovery (especially salaries and university infrastructure), large Japanese companies are obtaining exclusive control over the vast majority of discoveries in major Japanese universities.

3.1. Preemption of IP

Licenses to large companies have increased, while licenses to small companies have decreased and total university license revenue has barely increased.[6] Licenses of independently invented university discoveries to companies not engaged in joint research are few, and such license to new and small companies are especially few.

But more important than licenses is the lock on IP rights that companies gain by co-owning inventions. Under article 73 of Japan's Patent Law, each co-owner has a de facto perpetual, royalty free, exclusive license that cannot be transferred unless all other co-owners agree. It is very easy for partner companies to co-own joint research inventions. Professors and the companies usually decide whom to list as co-inventors, and company researchers are listed as co-inventors on most inventions attributed to joint research projects. Their role as inventors is hardly ever questioned.

Various other factors contribute to the above phenomenon. Companies probably expect they should co-own inventions arising under the projects they fund (and sometimes also related research) as *quid pro quo* for providing joint research funding. Professors usually support companies' co-ownership claims, partly to maintain good relations with the companies and partly because they believe that allowing companies to become co-owners is the easiest method to transfer their discoveries to industry and thus increase the likelihood of commercialization. Because the research tends to be applied, it is conceivable that in many cases company researchers do actually contribute to the inventions. In addition, university administrations encourage increased commissioned and joint research funding from industry, and while they may demand overhead payments as high as 30 percent, they are loathe to haggle with companies about IP rights. Finally, many university TLOs are not able to market inventions effectively, so letting inventions pass automatically to research sponsors is the most practical method of technology transfer.

In any case, the present system recreates the system of technology transfer that existed prior to the incorporation of national universities in 2004. Under this former system, university inventors passed rights to their discoveries to companies that gave donations to their laboratories. They became used to dealing directly with companies on technology transfer issues. Today, when they directly reach agreements with companies as to which collaborations relate most closely to various discoveries, they are simply recreating the situation that existed before TLOs began to be established in 1998 as intermediaries between them and the companies. However, now that TLOs and IP management offices have been established in most major universities, it is unfortunate that they are being bypassed increasingly frequently and deprived of opportunities to improve their competence.

3.2. Preemption of university researchers' time and energy

In theory startups can also play this game——i.e., they also can fund joint research and obtain exclusive rights to the IP by having their researchers listed as inventors. However, this game is less attractive for new companies because they often have to transfer their technologies to other companies in the course of business deals,

such as outsourcing of manufacturing. Also, the fact remains that, at least in major national universities, large companies engaged in joint research still greatly outnumber ventures. This suggests that more than just preemption of IP is occurring. Joint research with large companies also preempts the interest and energy of university researchers.

More specifically, at least in some cases, it saps any latent entrepreneurial interests of university researchers. Interviews with university entrepreneurs, especially those outside of the life sciences, indicate that the ***demonstration effect*** among a founder's colleagues is small. The founder of a highly regarded startup remarked that few of his colleagues were following in his footsteps, because they saw how hard he and his company have to struggle with issues such as finding competent staff, finding customers, managing IP, and preventing encroachment on the core business of his company from the various large companies that are collaborating with his laboratory. Most of his colleagues prefer to continue their normal university research supported by grants from government and large companies.

In addition, large companies have used their rights under article 73 to cut off business opportunities for startups, particularly to prevent them from dealing with competitors. I know of some cases where large companies engaged in joint research with a founding professor have claimed co-ownership of discoveries made in the founder's laboratory that cover important applications of the startup's technology. Moreover, they refuse to let the university license these inventions (on which the professor is co-inventor) to the professor's startup unless the startup agrees that these inventions will not be transferred to the large company's competitors.

Failure to rigorously uphold principles of academic freedom likely results in increasing numbers of university researchers working on applied topics that are natural targets for preemption. It is easy for companies to restrict publication of information arising from collaborative research. For example, the standard joint research agreement of the University of Tokyo (§30) gives joint research sponsors considerable leeway to review and request/demand changes to manuscripts prior to publication. In addition, it is common for professors and graduate students to sign separate non-disclosure agreements with joint research sponsors, giving the companies additional authority to delete information they consider sensitive. Although I know of only a few cases where deletions have been demanded, many researchers are aware of such provisions. Press reports have confirmed that findings from collaborations between major universities and manufacturers sometimes are not published (Nikkei 2007). I know of cases where joint research sponsors have demanded to university administrations that joint patent applications not be filed, that the results be treated as trade secrets. In summary, it is relatively easy for Japanese companies to turn to universities for applications-oriented research, because they know that information they consider sensitive will probably be kept secret. The more they do so, the more university research is likely to be oriented to the needs of particular companies, rather than being pioneering research that might be the basis for new companies.

3.3. System-wide factors fostering preemption

Although cross national comparisons are difficult, on the basis both of a comparison of major funding programs and an examination of individual projects in cutting edge fields of science, government funded research projects

probably are generally more applied in Japan than the US (Kneller 2007a&b), at least with respect to those funded by NIH and NSF. Because the potential commercial applications of large applied projects usually are fairly obvious, the companies that are most likely to develop such applications will be, in most cases, large companies.

Moreover, Japanese government funding for consortium projects involving large established companies and universities accounts for a substantial portion of government funding in pioneering fields of science (Kneller 2007a). Again, the results of such projects are more likely to be of interest to a few established companies.

Peer review of grant applications is not as careful or expert-based as that conducted by NSF and especially NIH. Although the NIH and NSF systems are not perfect, more careful peer review, is probably more likely to detect innovative, promising proposals, especially from younger researchers and researchers from less prestigious universities. Reforms to the system of peer review might include larger numbers reviewers with expertise in the fields of proposals, open discussion among the reviewers and meaningful feedback to applicants. Effective peer review cannot be done "on the cheap," as is the case with many Japanese government funding programs. It requires appropriate budgeting of administrative and financial resources and reviewers' time.

In addition, competitive funding for young researchers that would enable them to have their own laboratories and to pursue independent research is inadequate (CSTP 2003, Normile 2004). Recruitment and promotion in major universities is still largely based upon patronage, with little reliance on assessments by outside experts (Coleman 1999, Kneller 2007a). Finally, the concentration of Japanese government funding in a small number of universities[7] probably results in less diversified approaches to scientific problems than in the US where research funding is more evenly distributed over about 100 research intensive universities (Takeuchi 2003, Kneller 2007b).

Together these factors probably result in lower priority being placed upon innovative scientific research in Japanese universities. Again, the results are more likely to meet the needs of established companies than to be pioneering discoveries that might be more suited to development by new companies.

4. Making joint research more pro-science and pro-innovation

In light of all the barriers to the growth of new high tech companies, as well as the extent to which the present system probably benefits established companies, maybe it is foolish to even contemplate trying to change it. The arguments in favor for maintaining present policies are strong and possibly overwhelming.

But as mentioned at the beginning, in some industries, startups and spinouts are innovation leaders. Also a university system that provides a favorable environment for startups is probably also an environment that promotes pioneering scientific discoveries (provided conflicts of interest issues are appropriately managed). In contrast, a university environment that is oriented to serving the research needs of large established companies probably is not conducive to pioneering, Nobel-level research.

Finally, approximately fifteen recent interviews with large established Japanese companies have detected a surprising degree of ambiguity about the value of collaborations with universities. If large companies are not benefitting from a system that is so partial to their needs, is maintaining the system worth the costs in terms of stifled

entrepreneurship, limitations on academic freedom, and foregone opportunities to pursue pioneering science?

The problems listed in 3.3 should be addressed for the sake of improving university science. A likely side effect will be greater entrepreneurship and more opportunities for world class startups to emerge. In addition, it might make sense to make the following changes, not out of expectation that ventures would suddenly begin to flourish in Japan, but to level somewhat the playing field for access to university discoveries between large companies and would-be entrepreneurs and also to improve the quality of science.

1. The ability of sponsoring companies to restrict publication by university researchers should be very limited. Of course, confidential information that comes from companies should not be published. However, information arising in university laboratories using company funding should in general be publishable without restrictions, other than allowing the companies one or two months to make sure their internal confidential information is not revealed and to decide whether to apply for patents. If companies insist on the right to censor publications, they must pay almost all costs (including salaries and fair market value for use of university infrastructure) and students' thesis research cannot be subject to censorship. ***The fundamental missions of universities are research and education for the public good. Research that needs to be kept secret violates these objectives and ought to be performed by companies in-house, rather than subsidized by taxpayers.***
2. The requirement of Patent Law §73 that all co-owners must agree to any transfer should be irrevocably overridden in all joint research contracts. It is all right for companies that sponsor research in universities to have an automatic non-exclusive license to inventions directly arising from the research. But if they desire exclusive rights, they ought to negotiate for such rights on a case by case basis. Permanently overriding §73 would also mitigate the current sweet-heart practice of professors inserting the names of company researchers as co-inventors, because without the §73 requirement that all co-owners agree to any transfer, co-inventorship would have much less importance for companies.[8]
3. Continuing efforts must be made to strengthen the invention management capabilities of Japanese TLOs and university IP management offices. Their main missions should be to decide which inventions need patent protection to encourage private sector development, and then to find companies that are willing and able to pursue development. They also ought to be able to determine which inventions fall within the scope of joint research projects, to make sure that inventors are not erroneously included or excluded, and to determine which inventions are suitable for development by ventures. Building these capabilities will take time, but in the long run, universities and academic researchers should benefit by receiving a more equitable share of returns from their inventions, by ensuring greater rewards for ground breaking discoveries, and by encouraging entrepreneurship.

Acknowledgement

Robert Knellre gratefully acknowledges grants-in-aid from the Japan Society for the Promotion of Science and that faciliated research reflected in this article.

Note

1 "Innovation" is here defined as commercially relevant discoveries and their development to approximately proof of concept stage.

2 This insistence on exclusive control also contrasts with the *open collaboration* concept advocated by the Kauffman

Foundation and companies such as IBM, under which the results of sponsored research in universities will be made freely available for any company to use. So far, however, the open collaboration movement is limited mainly to open source software.

3 In other words, if salaries for administrators and faculty that are attributable to research are included among total R&D expenses, corporate joint research funding would constitute considerably less than 7 percent.

4 University of Tokyo Data Book, 2007.

5 As shown in Kneller 2006, preemption by joint research is less frequent in the case of life science inventions, and when such inventions are attributed to joint research, the partner is equally likely to be a startup or another SME, as a large company.

6 The increase in licenses to large companies is probably due, in large part, to companies negotiating for exclusive rights to universities' share of joint research inventions, as provided for example under article 17 of the standard joint research contract of the University of Tokyo.

7 Where, for example, the Universities of Tokyo, Kyoto and Osaka typically account for at least one quarter of total funding for any particular program.

8 Some universities have demanded that joint research partners compensate them for giving up their right under Patent Law §73.2 to commercially exploit jointly owned inventions (so-called fujishi hoshou). This article does not support such compensation agreements.