Characteristics of University Startups in Japan

Analysis of startup companies at The University of Tokyo

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***Abstract*—Although university startup companies are expected to be a source of innovation around the world, economic effects of university startups have not been investigated thoroughly, especially outside of the United States. As described in this paper, we analyzed the characteristics and economic effects of companies started at The University of Tokyo, a world-recognized research university. Results show that very few successful startup companies account for most of the economic value created by all university startups. If the startup companies are expected to be a source of innovation, then it is necessary to have a large number of startup companies, assuming that most of them will end in failure. University-related startups are of two types: student-driven startups and faculty-driven research-based startups. The economic value created by student-driven startups is roughly equal to that created by faculty-driven research-based startups. To achieve economic development, promoting student entrepreneurship is equally important as promoting commercialization of the outcomes of academic research at universities.**

Keywords—university startup; student startup; technology transfer; entrepreneurship education

I. INTRODUCTION

University startups are anticipated as a source of innovation throughout the world today [1][2][3][4]. Because the economic development in developed countries depends increasingly on the commercialization of advanced technologies and intellectual assets, it is natural for society to expect universities to become a birthplace of innovative companies because universities are usually the focal point of the most advanced technologies and intellectual talent in society. Because large enterprises are forced by capital markets to focus increasingly on short-term gains, it has become increasingly difficult to invest in basic research and even in the development of products and services that do not directly contribute to the corporate revenue in a few years. Universities are expected to fill this void of R&D. University startups are expected to serve as a bridge to industry.

Japan is no exception. University startups have continually received strong attention nationwide, especially since 2001, when the Japanese government initiated the so-called Hiranuma Plan[1], which set a policy goal to create 1,000 startup companies from Japanese universities so that these companies can affect the economy through job and wealth creation [5]. Since then, the government has established various systems and schemes to promote and stimulate the creation and growth of university startups. Each university also established its own initiatives to foster and support startups and entrepreneurship at their institutions.

Although the goal of creating 1,000 university startups was achieved in 2004 [6], few reports of the relevant literature have described studies of the economic effects of university startups in Japan [7][8]. The current study analyzes university startup characteristics and their economic effects in Japan.

II. FOCUS OF THE STUDY

A. The University of Tokyo

As described herein, we examined startup companies of various types started around The University of Tokyo. The University of Tokyo was established in 1877 as the first national university in Japan. With more than 28,000 students both in undergraduate and graduate levels and more than 5,000 researchers, it is the largest national university in Japan. The university comprises 10 faculties, 15 graduate schools, 11 affiliated research institutes, and 13 university-wide centers. Academic research activities at the university are conducted fundamentally in all academic disciplines including all areas of natural and social sciences, humanities, medicine, engineering, agriculture, and public policy. Startup companies have emerged from every area. Many startup companies based on academic research in the laboratory are from the Faculties of Engineering, Sciences, and Medicine, but startup companies formed by student entrepreneurs are from all departments including humanities, letters and agriculture, and are decidedly not limited to engineering and information technologies.

Although the discussion presented in this paper cannot be overly generalized because the scope of this paper is limited to one university, the results reported herein greatly contribute to elucidating university startups outside of the United States because The University of Tokyo receives almost 10% of all

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[1] A plan named after the Minister of Ministry of Economy, Trade and Industry (METI) at the time.

academic research budgets allocated in Japan. It is regarded as among the world's top research universities.

B. Data Source

The authors of this paper are responsible for supporting and promoting university startups at The University of Tokyo and are also engaged in entrepreneurship education to various university community members ranging from undergraduate students to post-doctoral researchers [9]. The discussion of this paper is based on the combination of publicly available data from commercial databases and internal data that the authors accumulated through university efforts to support related startups.

Because we require companies of our on-campus incubation facilities to disclose certain corporate information under a Non-Disclosure Agreement, we can obtain some confidential corporate information such as financial statements and capitalization tables for companies that use our incubation facilities. However, such companies are few. We cannot have access to corporate information for most other companies that do not use our incubation facilities. For such companies, the data used for this study were obtained from several sources including copies of registration certificates, a database from Japan Venture Research (JVR), and databases from Teikoku Databank and Tokyo Shoko Research. Registration certificates and data from JVR were mainly used for information related to corporate status, capitalization, and private funding information. Data from Teikoku Databank and Tokyo Shoko Research were used for financial information of the companies. Market capitalization of publicly traded companies is based on the market value as of Nov. 18, 2016.

III. Company Attributes

A. Types of Startup Companies

Although some universities have an official system to endorse or certify a specific company to be a startup company originated at the institution, The University of Tokyo has no such system. The university therefore has no official definition of which companies are University of Tokyo startups. As described herein, we define the company as a University of Tokyo related startup if the company meets any of the following six conditions. Although the details are slightly different, these conditions are fundamentally the same as the definition of university startups used by the Japanese government in their published statistics [10][11].

- (i) Company was founded based on patents and/or software copyrights legally transferred from the university to the company.
- (ii) Company was founded based on technologies transferred from the university to the company in the form of knowhow and/or trade secrets.
- (iii) Company was founded with a strong engagement from a faculty member of the university, sometimes in the form of becoming a member of the Board of Directors of the company, but most likely as a scientific advisor.
- (iv) Company was founded by students who were attending the school at the time the company was founded.
- (v) Company was founded by former students or researchers who have participated in the entrepreneurship education program officially organized and administered by the university.
- (vi) Company used on-campus incubation facilities managed by the university.

B. Number of companies

At the end of fiscal year 2015, 237 startup companies[2] appear to have met one or more of the six conditions[3] presented above. Table I presents a summary of the number of companies that satisfy each condition.

TABLE I. Number of Companies for Each Condition

Condition	*Number*	*%*
(i) Patent-based relationship	64	27%
(ii) Knowhow-based relationship	62	26%
(iii) Faculty engagement relationship	104	44%
(iv) Student relationship	87	37%
(v) Education-based relationship	49	21%
(vi) Incubation facility relationship	59	25%

Although a simple classification is not easy because many companies satisfy more than one condition[4], it is noteworthy that the number of student-driven startups, 87 of category (iv), is comparable to the number of faculty-driven startups, 104 of category (iii).

C. Current Status of the Companies

Table II presents the current status of the 237 companies. There are 13 public companies and 22 acquired companies. Compared with the fact that acquisition is a far more common exit route for U.S. startup companies than IPO exit[5], it is clear that the acquisition exit is not common in Japan.

[2] This number might include some error because it is difficult to eliminate the ambiguity associated with each condition entirely. Error also occurs when a startup company remains on stealth and does not appear on our radar screen for many months, sometimes years, after the company is established.

[3] We usually recognize the company that received capital funding from the university related venture capital firm to be a University of Tokyo related startup. In this paper, however, we did not include them if the relation with the university is only the funding relationship through the university related venture capital firm. If we were to include them, the number of University of Tokyo related startups would be 276.

[4] Most of the patent based companies (i) are faculty startups (iii), but there are some student startups (iv) that involve invention by the students. Knowhow based startups (ii) include both faculty based companies (iii) and student based companies (iv). Companies in the incubation facilities (vi) include both faculty-driven startups and student-driven startups.

[5] According to the National Venture Capital Association (NVCA) data [12], there were 77 venture-backed IPO and 360 venture-backed M&A in 2015 in the U.S.

TABLE II. CURRENT STATUS OF THE COMPANIES

Company status	*Number*	*%*
Public companies	13	6%
Acquired companies	22	9%
Closed companies	14	6%
Private and independent companies	188	79%

It is also notable that the number of companies that ceased operations is extremely small. Although we assume that this number is somewhat underestimated because some of the companies counted as private and independent might practically be already out of business even if they are not formally closed, the survival rate is still unusually high[6].

The high survival rate, however, might not necessarily be a good sign for the economy if we expect the university startup to be a source of innovation. Because an innovative startup that makes an important economic impact to society must grow rapidly, it should be managed as a high-risk high-growth scalable startup rather than as a stable small business. If a company survives as a small business for a long period of time, it might be an indication that the company is not a scalable startup company. If a company is a high-risk scalable startup, then the odds are high that the company will fail. Although all scalable startups aim for great success, in reality, many startup companies fail. Additionally, in many cases, the company does not fail, but does not scale as fast as it should. In this situation, the startup company will usually be acquired by established companies rather than remaining as an independent small business. As a consequence of these characteristics of startup companies, long-term distribution of the status of startup companies is expected to converge, as shown in Table III.

TABLE III. EXPECTED LONG-TERM DISTRIBUTION OF COMPANIES

Company status	*Number*
Public companies	Some
Acquired companies	Many
Closed companies	Majority
Private and independent companies	Constant number

The current distribution (Table II) has probably not converged as in Table III because we have not observed the companies for sufficiently long time. Because most of the 35 companies which achieved exit either by IPO or acquisition took five to ten years before the exit, at least ten years might be necessary to observe the fate of these companies. Since we started this study six years ago and because almost half of the 237 companies we studied are less than five years old, it would be too early to accept or reject the convergence hypothesis for startup companies as shown in Table III.

[6] In Japan, 20% of newly established companies are said to cease operations within five years of their inception [13].

Nevertheless, the possibility exists that the distribution in Table II results from the fact that many university startups are actually managed as small businesses that are not willing to scale as a high risk startup[7]. We believe it is not the case because most of the companies examined in this study are backed by venture capital firms. However, the company sometimes reluctantly survives as a small business for a long time despite a desire to scale as a startup. Because the companies are still young, long-term research is necessary to assess these companies from these perspectives.

IV. ECONOMIC IMPACT OF THE COMPANIES

This chapter presents analyses of several metrics to evaluate the economic effects of companies that we identified as University of Tokyo related startup companies in the previous chapter.

A. Market capitalization

Market capitalization is one of the most direct metrics that measures the economic value of the company. The total market capitalization of 13 publicly traded companies is $9.6B[8]. Three companies which have more than one billion dollar market capitalization account for more than 70% of the total market value.

The market value of private companies that are not listed on any stock markets is usually measured by the company valuation at the most recent equity financing round. Although these valuations are usually not disclosed, judging from publicly available information, it is unlikely that any of the 188 private and independent companies are unicorn companies, i.e., which have more than one billion dollar valuation. We estimate that the total market value of the 188 private companies to be approximately 10–30% of the market capitalization of 13 public companies.

Most market values of the acquired companies at the time of acquisition are also not disclosed. Judging from the scale of the business and the funding history of the acquired companies, we estimate that most of the acquisition value is in the range of a few million to a little more than ten million dollars. The total market value of the 22 acquired companies would be one or two orders of magnitude smaller than the market capitalization of 13 public companies.

It is noteworthy that the market values of the three public companies accounts for most of the market value of all 237 companies. Very few successes account for a large share of the economic impact of many companies. If we expect the startup companies to be the source of innovation, it is necessary to have a large number of startup companies, assuming that most

[7] That does not mean that a high risk startup is good and small business is bad. Both in the U.S. and in Japan, more than 90% of businesses are small businesses, which are important components of the economy. However, high risk startups and small businesses are different. Measures directed to promote startups are different from those directed to promote small businesses. We believe that the goal of large-scale research universities, such as The University of Tokyo, should be the promotion of scalable startups, but not small businesses.

[8] For these analyses, the exchange rate is assumed to be US$1 = 100 Japanese Yen.

of them will end in failure. A very few successes among a large number of efforts will offset the failures of almost all of those efforts.

B. Fund raising

To evaluate the economic effects of the university startup companies, we also calculated the capital that the 237 companies raised through private equity financing. All funding to date from venture capital firms, angel investors, friends and family, and corporate investors are included in the calculation, but the funds raised from the public market at the IPO or after the IPO are not included. Financing information for the companies not in the incubation facilities are obtained mainly from the Japan Venture Research (JVR) database. We also used the company's registration certificate to estimate the funding amounts of companies for which we cannot obtain funding information from the JVR database. Although the capital amount stated in the company's registration certificate does not always equal the actual fund amount raised, it is useful to estimate the lower bound of the fund raising amount. From these calculations, we estimate that 237 companies raised at least 950 million US dollars in total. 97 companies receive funding from various types of investment organization including venture capital firms and accelerators. Also, 70 companies received funding from operating companies, usually large enterprises listed on a stock market.

C. Revenue

Although a company's revenue and profit are obvious metrics to measure the economic effects of the companies, it is not easy to obtain these numbers because private companies are not required to disclose corporate financial information.

We were able to obtain financial data from about half of the companies either through direct communication with the companies in our incubation facilities or from Teikoku Databank / Tokyo Shoko Research database for the other companies. The total revenue amount was approximately $2.5B. However, this number includes the revenues of one public company with $2.1B revenue. After excluding this company, we estimate that the total revenue of the remaining companies, including those for which we were unable to obtain financial data, as slightly more than $500M. This is another example underscoring that a very few successful startup companies account for most of the economic effects generated by startup companies. We can reaffirm the characteristics of the economic impact of startup companies discussed in Section A.

D. Employment

We also estimated the number of employees of these startup companies because job creation is another metric of the economic impact of the companies to the society. However, we were able to obtain employment data from about half of the companies. Judging from data showing 2,700 employees, we estimate 3,000–3,500 people are employed by the 237 companies. Four companies employ more than 100 employees.

E. Economic Effects of the University Startups to the Society

As we described in earlier sections, the estimated market value of 237 startup companies created around The University of Tokyo is approximately $10–$13B, which is approximately 0.2% of the total market capitalization of all exchange-listed companies in Japan. These companies raised about $1B through private equity financing. This number is meaningful because the total annual venture capital investment in Japan has only been in the range of $1B the past few years [14].

In contrast to the remarkable amounts of market value and fund raising amounts, revenues and employment created at these companies are not so large. Because the fund raising amount and market value can be regarded as indicators of investors' expectations about the growth potential of the company, these numbers might be leading indicators of job creation and revenue generation, which are the indicators of outcomes of a company's operation. It is common for a university startup to operate for many years in R&D before generating any revenue. Long-term research must be conducted to ascertain whether these companies can generate the expected economic outcome as reflected in market value and fund raising amounts.

V. Discussions

In earlier chapters, we analyzed characteristics of the startup companies created around The University of Tokyo as well as several metrics to evaluate economic impact of these companies. In this chapter, we present a detailed discussion of several aspects of the data.

A. Faculty startup vs. Student startup

Although academic studies [15][16] sometimes narrowly define a university startup as a company created based on the university's academic research, typically with patent licensing from the university, we included student startups[9] in university startups in this paper. As discussed in Chapter III, the number of student-driven startups is comparable to the number of faculty-driven startups.

To analyze the effects of student-driven startups, we categorized 237 companies into two groups: faculty startups and student startups. In some cases, both faculty members and students are involved in a company. If the business is based on the technology that has been developed for years in a researcher's group, then we classify the company as a faculty startup even if the student serves an important role in the company. However, if the company is created around the idea of a student, then we classify the company as a student startup even if the student uses the technology the student developed in the laboratory under the supervision of a faculty member.

Using these definitions, 237 companies were divided into faculty-driven startups and student-driven startups. Table IV presents characteristics of companies in each group.

[9] Statistics from Japanese government [10][11] also include student startups in university startups.

TABLE IV. FACULTY STARTUP VS. STUDENT STARTUP

	Faculty startup	*Student startup*	*Total*
Number of companies	112	125	237
Number of public companies	9	4	13
Number of acquired companies	13	9	22
Number of closed companies	9	5	14
Number of private and independent companies	81	107	188
Total market value of the public companies	$4.8B	$4.8B	$9.6B
Estimated total fund raised through private equity financing	$750M	$200M	$950M
Estimated average fund raised through private equity financing	$7.0M	$1.6M	$4.1M

The number of student-driven companies is almost equal to that of the faculty-driven companies. The total market value of the student-driven companies is also almost equal to the total market value of faculty-driven companies. These statistics indicate that the economic value created by the student-driven startups is roughly equal to the economic value created by the faculty-driven research-based startups. To achieve economic development, promoting student entrepreneurship is equally important to promoting commercialization of the researcher's academic outcome in the universities.

Table IV shows that the numbers of IPO and M&A are higher in faculty-driven companies than in student-driven companies. However, the total number of exits is small. It would be too early to conclude that the student-driven companies are harder than faculty-driven companies to achieve exits, either by IPO or by M&A.

A notable difference in Table IV is the fund raising amount between the faculty-driven startups and student-driven startups. Whereas 112 faculty-driven startups raised $750M in total, 125 student-driven startups raised only $200M. The average fund raising amount is $7.0M for a faculty startup and $1.6M for a student startup. This is primarily because of the different technology bases of the companies. Faculty-driven companies are more likely to be based on hard technologies such as material science, biotechnology, robotics, and device technology that have been researched in laboratories for many years. Startup companies created around such heavy technologies usually require many capital investments even in the early stage of a startup. However, student-driven companies are more likely to be based on student ideas about a new service or a new business model. In many cases, the student ideas were realized using technologies that they acquired in the laboratory work during graduate school, but even in such cases, the core technologies are usually software technology or IT technologies that require little capital investment when starting a company. The difference of funding amounts between faculty startups and student startups can be attributed to the differences of underlying technologies.

B. Financial contribution to the university

The motivation for the universities and government to promote and support university startups is to achieve economic development through creation of innovative companies. However, university startups are sometimes also expected to be a new revenue source for the university because universities must explore new revenue streams because of financial difficulties in the use of taxpayer funds.

Fig. 1 portrays the technology transfer revenue [10] for the past fifteen years at Todai TLO Ltd., a wholly owned subsidiary of The University of Tokyo, specialized in licensing university technologies to industry.

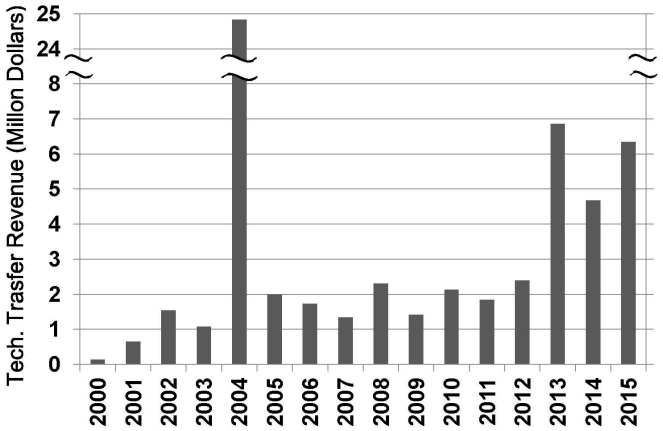

Fig. 1. Technology Transfer Revenue at Todai TLO Ltd.

Revenues in 2004, 2013, 2014, and 2015 are markedly greater than revenues in other years. Revenues in these years are realized by stock options that the university obtained as compensation of patent licensing to the startup companies. Because the startup companies usually cannot afford to pay appropriate licensing fees in cash in the early stage of the company, companies often pay the licensing fees in the form of equity. Because most of the revenue in other years, which is in the range of $1M to $2M, derives from technology licensing fee to large established enterprises, it is clear that licensing to university startups in exchange for equity has a far greater economic impact to the university than licensing to existing enterprises.

Although licensing revenues to the startup company are important, they are small compared with the university's annual budget, which is in the range of $2B. Furthermore, it is impossible to predict when the stock option value will be realized and contribute to the university's income. Therefore, it is unrealistic for the university to rely on such revenues as a stable and sustainable budget.

If we expect financial contributions from startup companies to universities, donations will become the key component. At top-ranked U.S. research universities, the largest financial contributions to the university that the university startups make are donations from successful entrepreneurs. For example, gift revenue to Stanford University [19] was ten times greater than technology licensing revenue [20] in 2015. Although the

[10] Data are from the Annual report from The University of Tokyo [17] and from statistics from Todai TLO Ltd.[18].

donations from successful entrepreneurs are not significant at The University of Tokyo at this point, it has been only 15 years since university startups became popular in Japan. We believe that donations from successful entrepreneurs to the university will become a major element of the economic contribution of startup companies to the university in the future.

In terms of comparison between faculty-driven startups and student-driven startups, faculty-driven startups dominate the licensing revenues to the university because most of the university patents are based on outcomes of the research of faculty members. In the future, however, when donations become a major component of the revenue source of the university, it appears probable that student startups will play a major role in the financial contribution to the university. Investment in entrepreneurship education will be an important and effective investment for the university in the long run.

VI. Conclusions

As described in this paper, we analyzed the characteristics and economic effects of startup companies started at The University of Tokyo, which is among the top research universities in the world.

Out of the 237 startup companies we identified as University of Tokyo related startups, 13 companies achieved IPOs; 22 companies were acquired. We can confirm that the acquisition exit is not common in Japan compared with the situation in the U.S., where acquisition is a far more common exit route for startup companies than IPO. The total market value of the 237 companies is estimated as being somewhere between $10B and $13B. It is noteworthy that the market value of the three public companies accounts for most of the market value of 237 companies. A very few successful startup companies account for most of the market value created by the university startups. If we expect the startup companies to be the source of innovation, it is necessary to have a large number of startup companies, assuming that most of them will result in failure.

We estimate that 237 companies raised at least 950 million US dollars through private equity funding. In contrast to the large market value and fund raising amount, jobs and revenues created at these companies are not great at this point. Long-term research will be necessary to study whether these companies can actually generate economic outcomes to meet the expectations of capital markets.

Dividing the 237 companies into faculty-driven startups and student-driven startups reveals that the number of student-driven companies is almost equal to that of faculty-driven companies. The total market value of the student-driven companies is also almost equal to the total market value of faculty-driven companies. These data indicate that, as a source of innovation, the student-driven startups are equally important to the faculty-driven research-based startups.

In terms of financial contributions to the university, revenues from faculty-driven startups play an important role in technology transfer activities of the university, but donations from successful student entrepreneurs are expected to become more important as a university revenue source in the future. To achieve economic development, promoting student entrepreneurship is equally important to promoting commercialization of the outcomes of academic research at universities.

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