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Determinants of Quantitative and Qualitative Employment Growth: A Comparison between R&D-oriented and Other Start-ups in Japan

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Abstract

Start-ups are expected to contribute to innovation and job creation. Several studies have been conducted so far on the determinants of employment growth, but still little is known about the differences between R&D-oriented and other start-ups. Moreover, we argue that not only the quantitative, but also the qualitative employment growth (changes in workforce composition) matters in evaluating the contributions by start-ups. We empirically examine the determinants of quantitative and qualitative employment growth in Japanese start-ups based on a unique panel dataset, comparing between R&D-oriented and other firms. Empirical results show that 1) founder's human capital (education and work experience) does not significantly affect quantitative employment growth, while work experience positively affects the share of regular workforce, 2) R&D-oriented start-ups do not differ from the other start-ups in quantitative and qualitative employment growth, and 3) public subsidies at start-up increase both quantitative and qualitative employment growth of the R&D-oriented, but not of the other start-ups.

Keywords: Start-up, R&D-oriented firm, employment growth, workforce composition, Japan.

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1. Introduction

Start-ups promote competition in the markets and play a key role in innovation. Start-ups are also expected to contribute to job creation. Indeed, several previous empirical studies find higher employment growth in start-ups as compared to incumbent firms. According to Morikawa and Tachibanaki (1997), new establishments created a half of the employment in the Japanese manufacturing industries. However, it is also widely known that only a small portion of new businesses demonstrates high growth and greatly contribute to job creation, while most firms remain small even when they survive. In this respect, it is a fairly important issue to understand what type of start-ups generates more employment.

According to the Global Entrepreneurship Monitor (GEM) reports, Japan consistently exhibits remarkably low rates of perceived entrepreneurial opportunities and capabilities. Indeed, in Japan, the start-up ratio has been considerably low and even lower than the closure ratio since the 1990s. In addition, as the Japanese economy has faced low economic growth since the collapse of the bubble economy in the early 1990s, fostering entrepreneurship has been a fairly important policy issue for economic growth. Evidence derived from Japan may provide clues on how we should support entrepreneurs, and some important suggestions to the other countries with ``limited entrepreneurship''.

In this paper, we empirically examine the determinants of employment growth and the changes in workforce composition (qualitative employment growth) in Japanese start-ups based on a unique panel dataset. Numerous studies have been conducted so far on the determinants of firm growth and job creation, but still little is known about R&D-oriented start-ups. Some studies focus on the determinants of growth of high-tech firms, but it has not been clearly shown how different are the determinants of employment growth between R&D-oriented and other start-ups. Moreover, it is also important to investigate the qualitative changes in the employment of start-ups, i.e. changes in the share of regular workforce, on which few studies have been done to date. Thus, we compare the determinants of quantitative and qualitative changes in employment between R&D-oriented and other start-ups.

The remainder of this paper is organized as follows. In Section 2, we describe the background and overview related literature to this study. Then, we develop our hypotheses in Section 3. We describe the data and models for the estimation of the determinants of employment growth in Section 4. Section 5

provides the estimation results and discussion. The final section presents some concluding remarks.

2. Background and related literature

A large number of empirical studies have been conducted on the determinants of employment growth in start-ups, especially with regard to the effect of initial size (Gibrat's Law) (Evans 1987, Hall 1987, Lotti, Santarelli, and Vivarelli 2003, Storey and Greene 2010). Audretsch and Elston (2006) find that firms in R&D-intensive industries show a different growth pattern from those in the other industries.

Storey (1994) argues that business resources are important sources of firm growth. Based on the resource-based view of the firm, Colombo and Grilli (2005, 2010) suggest that founders' human capital is the most important business resource of start-ups and thus the most important factor for post-entry performance.

Some previous studies on the post-entry performance focus on R&D and innovation as major factors of firm growth (Freel 2000, Del Monte and Papagni 2003, Stam and Wennberg 2009). They imply that active R&D induces better growth opportunity, and thus results in higher growth. However, as Honjo, Kato, and Okamuro (2013) argue, funding of high-risk R&D projects may be difficult for most start-ups. Therefore, it is crucial to examine if and to what extent R&D investment matters for start-up growth and whether the determinants of growth differ between R&D-oriented and other start-ups.

Among the empirical studies on the growth of small businesses, some papers address the effects of support policies. For example, Lerner (1999) points out that the US firms that obtained public support by the "SBIR Program" grow faster than the other firms. Focusing on the Japanese SMEs, Honjo and Harada (2006) show that the firms supported by the government program for innovative SMEs have higher growth rate than the other firms. However, these studies target small businesses in general rather than start-ups. Koski and Pajarinen (2013) compare the impact of public subsidy on job creation across start-up, high-growth (gazelles), and established firms, whereas our paper will compare the effect of public support on employment growth between R&D-oriented and other start-ups.

Empirical studies on the determinants of start-up growth concentrate on the quantitative increase in the number of employees (or workforce). Few papers address qualitative changes in employment in start-ups, such as the share of

regular workers in the entire workforce, although the quality of created employment is also important. A recent paper (Baptista, Lima, and Preto 2012) theoretically and empirically examines the complimentary relationship between the founder's and the employee's skills, but it does not directly discuss the determinants of workforce composition or its changes. Therefore, major contributions of this paper are that it directly addresses and compares between the determinants of quantitative growth and qualitative change of employment.

3. Hypotheses

In this section, we present our hypotheses on the determinants of the quantitative and qualitative employment growth in start-up firms. As discussed before, previous studies consider firm size and age, industry, and founder's human capital (education, work experience and managerial experience) to be major determinants of start-up growth. In this paper, we follow these studies and examine on the one hand the effects of these firm and founder characteristics, but also analyze the effects of the R&D investment and public subsidy on the other, which has hardly been addressed in the previous literature. Specifically, we focus on the differences between R&D-oriented and other start-ups with regard to the determinants of firm growth. Moreover, we investigate not only the factors of the quantitative, but also the qualitative employment growth, namely what types of firms increase the ratio of regular workers.

First, regarding founder's characteristics, several previous studies show the positive relationship between the founder's education level and work experience (experience in related fields or management) and firm growth after start-up. Honjo (2004), for example, finds for the Japanese manufacturing sector that the growth ratio of start-up firms is significantly correlated with the founder's education level. However, no studies in Japan confirm such positive correlation between the founder's human capital and the growth of start-ups for the entire sectors including service sectors (Yasuda 2004; Honjo 2005; Suzuki 2007).

Using panel data of Italian start-up firms, Colombo and Grilli (2005) demonstrate that the founder's specialization (whether he or she studied natural science and engineering or economics / business) rather than the founder's education level affects firm growth. In this regard, we argue that the impact of the founder's education may differ between R&D-oriented and other firms. Honjo (2004) shows a contrasting finding to other empirical studies regarding the effect

of education, maybe because it focuses on the manufacturing sector where relatively many firms engage in R&D. In order to develop new and original products or processes, R&D-oriented firms require a high-level technology, which is based on advanced knowledge and research capability at the graduate course level, while in other firms non-technical factors may matter, such as management knowhow and marketing skills.

Baptista, Lima, and Preto (2012) argue that the abilities of firms' managers and employees are complimentary. Managers with high ability require highly skilled employees, and can attract them to their firms by offering them higher salaries and better working conditions than others. Based on their argument, we assume that, especially with regard to R&D-oriented firms, the higher the education level of the founder, the more the needs for the people with advanced knowledge and rich experience for R&D and its support area, and the higher also the possibility to offer talented people good job opportunities that are worth doing. Moreover, the higher the founder's education level, the better the access to the talented, and the easier to distinguish talented people. Because talented people are more likely to be employed as regular workers, we assume that the correlation between the founder's education level and the ratio of regular workforce is especially higher for R&D-oriented firms.

Thus, we propose the following hypotheses, which we consider particularly apply to graduate school education.

Hypothesis 1a: Founder's high education level positively affects employment growth of R&D-oriented firms, but not that of other firms.

Hypothesis 1b: Founder's high education level enhances the ratio of regular employees and executives to the entire workforce of R&D-oriented firms, but not that of other firms.

Second, we consider the effects of founder's work experience in the related fields and managerial experience prior to start-up. Several studies (e.g., Colombo and Grilli 2005; Stam et al. 2008) have confirmed that the founder's work experience has a positive effect on start-up growth. Work experience of a founder

is a proxy for his or her ability and knowledge. Moreover, as Stam and Wennberg (2009) suggest, work experience in the same business field may be closely correlated with networking and alliances with other firms. Therefore, such founders may find various growth opportunities and also may be advantageous in recruiting talented people.

Similar argument would apply to the founder's managerial experience: Founders with managerial experience are expected to have useful management knowhow and thus to have positive effects on firm performance. The above argument would apply to the start-up firms in general, regardless of their R&D activities.

The concept of Baptista, Lima, and Preto (2012) is also applicable to the relationship between the founder's work experience and the workforce composition. That is, if the abilities of the founder and the employees are complimentary, then we can expect that the founders with richer experience in the same or related fields or in management have higher demand for people with richer work experience, and tend to employ them as regular workers. These arguments lead to the following hypotheses with regard to the effects of the founder's work experience prior to start-up.

Hypothesis 2a: Founder's work experience positively affects employment growth of start-ups.

Hypothesis 2b: Founder's work experience enhances the ratio of regular executives and employees to the entire workforce of start-ups.

Third, we consider the effects of R&D investment. As mentioned before, it is not easy for start-ups to be successful in innovation. Therefore, at least in the early stage, R&D-oriented firms may perform worse, and thus show lower employment growth than the firms that do not conduct R&D. However, some empirical studies confirm positive effects of R&D on firm growth. For example, Freel (1999) demonstrates that growth patterns significantly differ between R&D-oriented and other firms. Using micro data of a Japanese census including large incumbent firms, Yasuda (2006) shows that the employment growth is the

higher, the larger the per head R&D investment.

R&D-intensive firms demand researchers and engineers who are usually employed as regular staff. Excellent senior researchers may even be invited as full-time executives. Therefore, we expect that the ratio of regular staff be higher, the more R&D-intensive the start-up. The following hypotheses can be derived from this argument.

Hypothesis 3a: Start-up firms achieve higher growth in employment, the more they engage in R&D.

Hypothesis 3b: Start-up firms achieve higher ratio of regular executives and employees to the entire workforce, the more they engage in R&D.

Finally, we discuss the effects of public subsidies. We consider that many start-up firms are faced to liquidity constraints and that especially the financing of R&D expenditures is strongly constrained because of information asymmetry with external investors (Honjo et al. 2013). Public subsidy is expected to mitigate financial constraints, and we expect such effects to be larger for R&D-oriented firms because of stronger financial constraints in R&D funding. Moreover, we expect that start-up firms that obtain public subsidy can expend more to invite highly qualified managers or employ skilled workers as regular staff, and thus enhance the ratio of regular executives and employees. Such effects would be larger for R&D-oriented firms because they need qualified researchers and engineers. Based on these arguments, we postulate the final hypotheses as follows.

Hypothesis 4a: Start-up firms that obtained public subsidy achieve higher growth in employment than those without public subsidy. The effect of public subsidy is larger for R&D-oriented firms.

Hypothesis 4b: Start-up firms that obtained public subsidy enhance the ratio of regular executives and employees to the entire workforce more than those without public subsidy. The effect of public subsidy is larger for R&D-oriented firms.

4. Data and models

4.1. Data sources

Our empirical analysis is based on an original panel dataset of Japanese start-ups. To the best of our knowledge, there exist no publicly available data sources for R&D activities by start-ups in Japan. In order to construct a panel dataset of start-ups, we conducted four waves of postal questionnaire surveys in November-December 2008, 2009, 2010, and 2011. The list of firms for the surveys was obtained from a database of new corporations compiled by Tokyo Shoko Research (TSR), a major credit investigation company in Japan.

In the questionnaire surveys, we asked the founders about firm-specific characteristics, including R&D activities, as well as their personal attributes. In this paper, we examine the determinants of quantitative and qualitative employment growth based on the first and fourth questionnaire surveys. In the first survey, we sent questionnaires to 13,582 firms in the Japanese manufacturing and software industries, which had been incorporated between January 2007 and August 2008. The number of effective responses was 1,514 (approximately 11 percent of the target). Among the responses, we selected 1,060 "real" start-ups that had started their businesses during 2007 and 2008, by excluding the firms that were founded before 2006 and incorporated later. One third of the 1,060 start-ups responded to our repeated surveys from 2008 to 2011. After excluding missing values, we obtained a final sample of 280 firms.

The average amount of capital for the sample firms is 12.7 million yen, which is below the average for population but above the average for the responded firms in the first survey. It means that larger-sized firms tend to respond repeatedly to our surveys.

In this paper, we distinguish between R&D-oriented and other start-ups, and compare the estimation results between these groups. R&D-oriented start-ups are defined as those that fulfill at least one of the following conditions based on the response to the first survey in late 2008: 1) at least a regular employee or a full-time executive engages in R&D activities when the firm was founded or when the survey was conducted, 2) before start-up, the founder engaged in R&D that was directly related to the current business, and 3) the founder has engaged in R&D since start-up.

Among 280 firms in the final sample, 170 firms (61%) are classified into R&D-oriented start-ups. Such a high share of R&D-oriented firms may be attributed to our focus on manufacturing and software industries in which private R&D activities are concentrated and to our broad definition of R&D-oriented start-ups that can contain informal R&D. We also checked the

representativeness of our sample firms.

4.2. Models and Variables

The empirical models to estimate the quantitative and qualitative employment growth are described as follows:

$$GROW_i = \beta' \boldsymbol{X}_i + \epsilon_i \quad (1),$$

where $GROW_i$ indicates the dependent variable, which is employment growth or the changes in workforce composition, $\boldsymbol{X}_i$ is a vector of independent variables composed of founder- and firm-specific characteristics, β is a vector of estimated parameters, and ϵ_i is the error term.

We use an econometric approach to investigate the determinants of quantitative and qualitative employment growth. Applying ordinary least squares (OLS) and using a unique panel dataset of Japanese start-ups, we test our hypotheses on the effects of founders' education and work experience, firms' R&D investment and public subsidy on both employment growth and the changes in workforce composition (measured as the share of regular executives and employees). We estimate the models with the entire sample and the sub-samples of R&D-oriented and other start-ups.

4.2.1. Dependent variables

Dependent variables of our estimation models are (1) the growth rate of employment measured as the difference in the numbers of employers and employees in natural logarithm between the dates of start-up (in 2007 or 2008) and the last survey (2011) and (2) the change in workforce composition measured as the difference in the shares of regular workforce to entire workforce between the dates of start-up and the last survey. We control for the variation of observation period that depends on the date of start-up) by including the founding year dummy in the estimation models.

As shown in Table 2, the average number of workforce (employers and employees) increased from 4.7 to 7.7 from 2008 to 2011. That is, the average increase in the number of workforce is 3.0 (the median is 1), indicating that many of the sample firms have grown during this period. The average share of regular workforce to entire workforce increased from 27.6% to 35.2% within

three years from 2008 to 2011. That is, the average change in workforce composition was 7.5% (the median value is 0).

4.2.2. Independent variables

Independent variables comprise founder- and firm-specific characteristics.

As the variables of founder-specific characteristics, we use education, work experience, willingness to grow, age and gender (male dummy). These variables are often used in the previous studies. Founders were on average 47 years old when they started up the business, and were mostly male (93%). Education variables are the dummies for bachelor and graduate course degrees. 51% and 6% of the founders in the sample have bachelor and graduate course degrees as the final degrees, respectively. Regarding work experience, we use the dummies for job experience in the related fields and for managerial experience. 89% of the founders have job experience in the related fields, while 31% have experience of management. A precondition of the growth of start-ups is the founder's willingness to grow. Following Suzuki (2007), we define this variable directly based on the response to the first survey. 74% of the founders want to enlarge business size.

Firm-specific characteristics include initial size, co-founder dummy, R&D dummy or R&D intensity, independent start-up dummy, public support dummies, dummies for funding from private or public banks, founded year, and industry dummy. Among them, initial size, founded year (or firm age), industry dummies are usually used in the empirical studies on start-up growth.

Initial size is measured as the natural logarithm of the number of employers and employees. The average size at start-up is 4.7 persons (median is 2). Our sample firms are all in the early stage of start-up, thus there are no variations in firm age, but we control for the effects of founding years by including the founded in 2007 dummy. 57% of the sample firms were founded in 2007. Moreover, we control for the differences between manufacturing and software firms by using the software dummy (37% of the sample firms belong to the software industry). We also use the independent start-up dummy to distinguish them from subsidiaries of incumbent firms. 84% of the sample firms are independent start-ups. 42% of the founders in the sample had one or more co-founders at start-up. Therefore, in order to control for the contribution by the co-founder's human capital, we use the co-founder dummy in the estimation.

In order to examine the differences in employment growth between

R&D-oriented and other start-ups, we include the dummy variable for R&D-oriented firms in the full-sample estimations. As mentioned before, 61% of the sample firms are classified into R&D-oriented firms. Moreover, we employ the annual R&D expenditures in natural logarithm in the sub-sample estimation for R&D-oriented firms in order to measure the effect of R&D expenditures.

We test the effects of public support with three variables: 1) the dummy variable for public subsidy to start-up funding, 2) the dummy variable for public subsidy after start-up (before the first survey), and 3) the dummy variable for other public funding after start-up (before the first survey). Moreover, we use the dummy variables for borrowing from public or private financial institutions at start-up. We include the variables for financing at start-up and for public support after start-up separately in the estimation considering high correlations between these variables.

Tables 1 and 2 describe the definitions and summary statistics of variables, respectively.

5. Estimation results

5.1. Determinants of employment growth

Estimation results on the determinants of employment growth are presented in Table 3.

Regression analysis with OLS shows that, different from our expectation, the human capital variables of founders do not have any impact on quantitative employment growth. This result is similar to those in previous studies for Japanese firms. For non-R&D-oriented firms, employment growth is even significantly lower when the founders have graduate course degrees. It is noteworthy that intention of business growth strongly affects employment growth of both R&D-oriented and other start-ups.

With regard to firm characteristics, initial size has a negative and significant effect on employment growth, while independent start-ups tend to grow more slowly than subsidiaries. These results are common to R&D-oriented and other start-ups. The dummy variable for R&D-oriented start-ups has no significant effects on firm growth, indicating that growth rates of R&D-oriented start-ups are on average not higher than those of the other start-ups. However,

for R&D-oriented start-ups, the amount of R&D expenditures matters for employment growth.

With regard to the effect of public support, we find that public subsidies both at and after start-up significantly increase employment growth. Interestingly enough, subsidies at start-up affect only the growth of R&D-oriented start-ups, while those after start-up affect only that of the other start-ups.

5.2. Determinants of Changes in Workforce Composition

Estimation results on the determinants of the changes in workforce composition are presented in Table 4. We can confirm some similar patterns also regarding the changes in workforce composition measured as the share of regular workforce (qualitative employment growth). Founders' education and age do not change the share of regular workers. Initial firm size negatively affects the share of regular workers, while R&D-oriented start-ups do not significantly differ from other start-ups in qualitative employment growth. Public subsidies at start-up significantly increase the share of regular workers only for R&D-oriented start-ups.

There are also some differences between the determinants of quantitative and qualitative employment growth. Founder's work experiences positively and significantly affect the share of regular workforce. R&D expenditures do not affect workforce composition of R&D-oriented start-ups. Public subsidies after start-up have no significant effects on the qualitative growth in employment at R&D-oriented start-ups.

In sum, we have the following major findings from empirical estimations: 1) Founder's human capital (education and work experiences) does not significantly affect quantitative employment growth, while work experiences positively affect the share of regular workforce. 2) R&D-oriented start-ups do not differ from the other start-ups in quantitative and qualitative employment growth. 3) Public subsidies at start-up increase both quantitative and qualitative employment growth of R&D-oriented start-ups, but not of the other start-ups.

These results support Hypotheses 2b, 3a (only for R&D-oriented firms), 4a and 4b, but not 1a, 1b, 2a, and 3b.

6. Conclusions

Start-up firms, especially R&D-oriented start-ups have attracted attention with

the expectations for promoting innovation and job creation. However, due to data constraints, relatively few empirical studies have been carried out on R&D-oriented start-ups, especially in Japan. Using an original panel dataset of Japanese start-ups, this paper investigated the determinants of quantitative and qualitative employment growth, comparing between R&D-oriented and other start-ups. Empirical examination of the determinants of qualitative employment growth (changes in workforce composition) at the start-up stage is an especially interesting research topic with a high practical value. In fact, we found not only several similarities, but also remarkable differences between the determinants of quantitative and qualitative employment growth and between the R&D-oriented and other start-ups.

The empirical findings of this paper have the following policy implications. First, start-ups without R&D activities are as important as R&D-oriented start-ups with regard to job creation as a whole and high-quality employment (regular workers). Second, public support programs for start-ups should be different according to their purposes: promotion of employment as a whole or improvement of the quality of employment). Third, public support programs should also be differentiated according to their main targets (R&D-oriented or other start-ups). For example, for the purpose of promoting employment and improving the quality of employment, public subsidy at start-up is effective only for R&D-oriented start-ups.

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Table 1: Definitions of variables

Variable	Definition
（Dependent variable）	
Employment growth	Difference in the numbers of employees at stat-up and the time of the fourth survey.
Change in workforce decomposition	Difference in the shares of regular managers and workers at stat-up and the time of the fourth survey.
（Independent variable）	
Undergraduate education	Dummy variable: 1 if the founder had undergraduate-level education, 0 otherwise.
Graduate education	Dummy variable: 1 if the founder had graduate-level education, 0 otherwise.
Work experience	Dummy variable: 1 if the founder had work experience in the related field before start-up, 0 otherwise.
Managerial experience	Dummy variable: 1 if the founder had managerial experience before start-up, 0 otherwise.
Age	Logarithm of the founder's age at start-up.
Gender	Dummy variable: 1 if the founder is male, 0 if female.
Growth intension	Dummy variable: 1 if the founder has an intention to expand the business, 0 otherwise.
Initial firm size	Logarithm of the firm's number of employees at start-up.
R&D-oriented firm	Dummy variable: 1 if the firm is R&D oriented one (see the text for the definition), 0 otherwise.
R&D expenditure	Logarithm of annual R&D expenditures at the time of the first survey.
Multiple founders	Dummy variable: 1 if the firm has multiple founders, 0 otherwise.
Independent firm	Dummy variable: 1 if the firm is founded as an independent firm, 0 otherwise (as a subsidiary or an affiliated firm).
Public support: finance and investment	Dummy variable: 1 if the firm received any public finance or investment until the time of the first survey after start-up.
Public support: subsidy	Dummy variable: 1 if the firm received any public subsidy until the time of the first survey after start-up.
Financing from public financial institution at start-up	Dummy variable: 1 if the firm financed from public financial institution at start-up.
Financing from private financial institution at start-up	Dummy variable: 1 if the firm financed from private financial institution at start-up.

Public subsidy at start-up	Dummy variable: 1 if the firm received any public subsidy at start-up.
Software sector	Dummy variable: 1 if the firm was founded in the software sector, 0 otherwise.
Firms founded in 2007	Dummy variable: 1 if the firm was founded in 2007, 0 if founded in 2008.

Table 2. Summary statistics of variables

Variable	N of obs.	Mean	Standard deviation	Minimum	Maximum
(Dependent variable)					
Employment growth	280	0.461	0.775	-1.609	3.597
(Change in the number of employees)	280	3.004	8.983	-47	71
(Number of employees at start-up)	280	4.725	7.473	1	60
(Number of employees at the fourth survey)	280	7.729	11.744	1	82
Change in workforce decomposition	255	0.075	0.293	-0.875	0.889
(Share of regular workforce at start-up)	255	0.276	0.317	0	0.976
(Share of regular workforce at the fourth survey)	255	0.352	0.334	0	0.986
(Independent variable)					
Undergraduate education	280	0.504	0.501	0	1
Graduate education	280	0.064	0.246	0	1
Work experience	280	0.893	0.310	0	1
Managerial experience	280	0.311	0.464	0	1
Age (Logarithm)	280	3.826	0.238	2.996	4.290
(Age)	280	47.143	10.605	20	73
Gender	280	0.929	0.258	0	1
Growth intension	280	0.743	0.438	0	1
Initial firm size (Logarithm)	280	1.021	0.921	0	4.094
(Initial firm size)	280	4.725	7.473	1	60
R&D oriented firm	280	0.607	0.489	0	1
R&D expenditure (Logarithm)	157	2.663	2.745	0	8.294
R&D expenditure	157	217.452	502.427	0	4000
Multiple founders	280	0.418	0.494	0	1
Independent firm	280	0.843	0.365	0	1
Public support: finance and investment	280	0.271	0.445	0	1
Public support: subsidy	280	0.118	0.323	0	1
Financing from public financial institution at start-up	250	0.168	0.375	0	1
Financing from private financial institution at start-up	250	0.088	0.284	0	1
Public subsidy at start-up	250	0.024	0.153	0	1
Software sector	280	0.375	0.485	0	1
Firms founded in 2007	280	0.568	0.496	0	1

Table 3. Estimation results: employment growth

	Full sample		R&D oriented firm		Other firm	
変数	(1)	(2)	(3)	(4)	(5)	(6)
Undergraduate education	0.104	0.098	-0.047	-0.022	0.196	0.212
	(0.086)	(0.094)	(0.128)	(0.128)	(0.136)	(0.154)
Graduate education	0.055	0.064	0.114	0.227	-0.649	-0.927
	(0.214)	(0.266)	(0.245)	(0.286)	(0.326)**	(0.362)**
Work experience	0.209	0.204	0.066	0.223	0.289	0.127
	(0.131)	(0.138)	(0.193)	(0.222)	(0.149)*	(0.220)
Managerial experience	0.061	0.073	0.092	0.119	0.117	0.188
	(0.094)	(0.100)	(0.129)	(0.138)	(0.163)	(0.200)
Age (Logarithm)	0.185	0.280	0.164	0.174	0.318	0.117
	(0.195)	(0.211)	(0.277)	(0.291)	(0.330)	(0.379)
Gender	-0.244	-0.254	-0.027	-0.254	-0.458	-0.248
	(0.123)**	(0.108)**	(0.155)	(0.166)	(0.224)**	(0.180)
Growth intention	0.363	0.368	0.415	0.375	0.378	0.386
	(0.084)***	(0.092)***	(0.115)***	(0.121)***	(0.134)***	(0.170)**
Initial firm size (Logarithm)	-0.286	-0.333	-0.314	-0.337	-0.373	-0.376
	(0.055)***	(0.063)***	(0.076)***	(0.078)***	(0.084)***	(0.110)***
R&D oriented firm	-0.070	-0.056				
	(0.088)	(0.094)				
R&D expenditure (Logarithm)			0.046	0.048		
			(0.022)**	(0.023)**		

Multiple founder	0.109	0.085	0.136	0.045	0.015	0.129
	(0.090)	(0.096)	(0.122)	(0.125)	(0.143)	(0.169)
Independent firm	-0.486	-0.545	-0.462	-0.567	-0.444	-0.590
	(0.134)***	(0.144)***	(0.204)**	(0.211)***	(0.184)**	(0.251)**
Public support: finance and investment	0.096		0.154		0.088	
	(0.087)		(0.131)		(0.141)	
Public support: subsidy	0.251		-0.220		0.756	
	(0.133)*		(0.197)		(0.178)***	
Financing from public financial institution at start-up		0.089		0.154		0.093
		(0.125)		(0.156)		(0.264)
Financing from private financial institution at start-up		0.161		0.371		-0.051
		(0.161)		(0.174)**		(0.392)
Public subsidy at start-up		0.247		0.374		0.200
		(0.123)**		(0.148)**		(0.306)
Software sector	0.199	0.242	0.137	0.214	0.186	0.206
	(0.099)**	(0.106)**	(0.142)	(0.160)	(0.145)	(0.162)
Firms founded in 2007	-0.032	-0.025	-0.051	-0.132	-0.023	0.034
	(0.084)	(0.090)	(0.114)	(0.116)	(0.132)	(0.167)
Constant term	0.035	-0.242	-0.076	0.062	-0.371	0.425
	(0.756)	(0.823)	(1.026)	(1.103)	(1.346)	(1.523)
Number of observations	280	250	157	143	110	98
Adjusted R-squared	0.235	0.252	0.251	0.280	0.38	0.320

Note: Robust standard errors are in parentheses. Significance level : * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 4. Estimation results: change in workforce composition

	Full sample		R&D oriented firm		Other firm	
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Undergraduate education	0.002	0.010	-0.010	0.019	0.039	0.008
	(0.034)	(0.038)	(0.045)	(0.047)	(0.066)	(0.071)
Graduate education	-0.071	-0.077	-0.041	-0.044	-0.265	-0.350
	(0.095)	(0.106)	(0.114)	(0.119)	(0.140)*	(0.171)**
Work experience	0.118	0.140	0.101	0.121	0.067	0.073
	(0.052)**	(0.053)***	(0.090)	(0.099)	(0.055)	(0.070)
Managerial experience	0.103	0.106	0.085	0.076	0.089	0.115
	(0.042)**	(0.045)**	(0.062)	(0.066)	(0.068)	(0.072)
Age (Logarithm)	-0.051	-0.083	-0.010	-0.006	-0.262	-0.357
	(0.082)	(0.081)	(0.092)	(0.091)	(0.191)	(0.186)*
Gender	0.134	0.134	0.093	0.052	0.301	0.390
	(0.056)**	(0.063)**	(0.070)	(0.077)	(0.078)***	(0.066)***
Growth intention	0.073	0.050	0.078	0.070	0.073	0.013
	(0.035)**	(0.036)	(0.048)	(0.050)	(0.059)	(0.061)
Initial firm size (Logarithm)	-0.082	-0.078	-0.070	-0.062	-0.092	-0.102
	(0.025)***	(0.026)***	(0.032)**	(0.033)*	(0.054)*	(0.054)*
R&D oriented firm	-0.021	-0.035				
	(0.038)	(0.040)				
R&D expenditure (Logarithm)			0.006	0.005		
			(0.009)	(0.010)		

Multiple founder	-0.008	-0.014	-0.045	-0.062	0.066	0.093
	(0.036)	(0.039)	(0.048)	(0.051)	(0.063)	(0.071)
Independent firm	-0.097	-0.121	-0.021	-0.038	-0.244	-0.319
	(0.059)	(0.065)*	(0.093)	(0.105)	(0.084)***	(0.087)***
Public support: finance and investment	0.072		0.082		0.084	
	(0.044)		(0.066)		(0.074)	
Public support: subsidy	0.082		0.052		0.119	
	(0.057)		(0.094)		(0.080)	
Financing from public financial institution at start-up		0.100		0.062		0.119
		(0.063)		(0.092)		(0.092)
Financing from private financial institution at start-up		0.037		-0.016		0.099
		(0.072)		(0.083)		(0.134)
Public subsidy at start-up		0.260		0.358		-0.111
		(0.130)**		(0.136)***		(0.112)
Software sector	0.021	0.035	-0.022	-0.017	0.057	0.067
	(0.040)	(0.041)	(0.051)	(0.057)	(0.070)	(0.066)
Firms founded in 2007	0.037	0.020	0.039	0.024	0.023	0.046
	(0.037)	(0.040)	(0.052)	(0.053)	(0.066)	(0.076)
Constant term	0.075	0.230	-0.105	-0.077	0.848	1.234
	(0.323)	(0.326)	(0.391)	(0.389)	(0.717)	(0.720)*
Number of observations	255	229	147	134	99	89
Adjusted R-squared	0.16	0.181	0.14	0.181	0.26	0.308

Note: Robust standard errors are in parentheses. Significance level : * $p<0.10$; ** $p<0.05$; *** $p<0.01$.