The impact of entrepreneurial human capital on initial funding: evidence from Japan

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Introduction

RIETI Research Project (since October 2017)
- **Creation and Development of High-tech Startups** (Program IV: Innovation)

Purpose of this project
- We survey high-tech startups and venture capital, and address issues for the entrepreneurial (start-up) ecosystem in Japan.
- In particular, we focus on high-tech start-ups’ linkages with external organizations and examine the performance of spin-offs and corporate venture capital, while taking into account the role of existing organizations in industries.

Cf. Members of this project
- Academic scholars
- Professional researchers
- Policymakers
- Venture incubators
Introduction

Policy discussions
- How do we construct the entrepreneurial ecosystem in Japan?
- How do we promote innovations through entrepreneurship in Japan?

Cf. Entrepreneurial ecosystem
- Entrepreneurial ecosystem is a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory (e.g., Stam and Spigel, 2016).

However...
- Indeed, the level of entrepreneurship, including angel investment, is very low in Japan.
Actors and factors in the entrepreneurial ecosystem

- University
- Entrepreneur (start-up)
- Investor (incl. VC)
- Labor market
- Corporation
- Insurance
- Pensions
- Financial institution
- Household
Entrepreneurship and angel indices (GEM Report)

Source: APS Global Individual for 2001-2012 (See Honjo (2015))
Note: Targets for individuals aged 18-64
Introduction

Target in the present study
◦ We highlight the relationship between technology and entrepreneurship.

Research question
How do inventors raise funds when they become entrepreneurs?

What does this study examine?
◦ We explore how entrepreneurs, including inventors, raise initial funding.
◦ We provide evidence that some entrepreneur-specific characteristics are significantly associated with initial funding.
Introduction

Research framework

Major findings

- Start-up firms managed by entrepreneurs with technological skills are more likely to rely on equity financing.
- Start-up firms managed by entrepreneurs with university education are more likely to have significant financing.
- Start-up firms managed by older entrepreneurs are more likely to have significant financing.
- Start-up firms located in entrepreneurs’ hometowns are more likely to rely on debt financing.
- Start-up firms relying on debt financing are less likely to grow faster.
Research background 1: Heterogeneity in business start-ups

Individuals’ heterogeneous preferences

- The purpose of business start-ups differs across entrepreneurs.
- While some entrepreneurs are inventors, others are not.
- Some entrepreneurs may start businesses according to their own interests.

In our sample

- 107 (approximately 8%) entrepreneurs applied patents before founding their firms.
- 409 (approximately 29%) entrepreneurs started their businesses in their own birthplaces, except for Tokyo, Yokohama, Nagoya, and Osaka cities.
Research background 2: Impact of entrepreneurial human capital

Different demand for financing
- Entrepreneurs with higher human capital tend to seek large-sized businesses.

Signaling effect
- Under information asymmetry, entrepreneurial human capital may be a signal to external suppliers of capital.

Cf. Importance of human capital
- Cressy (1996) argued that human capital is a true determinant for post-entry performance.
Research background 3: Do initial conditions determine the fate of firms?

Importance of initial conditions

◦ Initial conditions determine the fate of firms.

Do initial financial conditions matter for post-entry performance?

◦ Because start-up firms’ capital is limited, post-entry performance depends on initial financial conditions.

◦ Because information asymmetry between entrepreneurs and external suppliers of capital is more likely to occur during the start-up period, most entrepreneurs cannot easily access capital markets.
Debt and equity balance

- Two types of financing: debt and equity.

Debt financing

- In Japan, bank loans, including those from government-affiliated financial institutions (i.e., Japan Finance Corporation) are prevailing as initial funding.

⇒ Start-up firms tend to rely on debt financing (see the following figure).
Debt finance ratios of start-up firms: Japan and Euro countries

Note: The numbers of firms are 4032, 95244, 8571, 42950, 41093, and 2561 for Japan, France, Germany, Italy, Spain, and the UK, respectively. Debt finance ratio is defined as debt finance divided by the sum of equity finance, debt finance, and trade credit. Debt finance is measured by the sum of short-term financial debt plus long-term liabilities, equity finance is measured by issued share capital, and trade credit is measured by debt to suppliers and contractors.
Financial assets held by households: Japan, Euro area, and the US

Japan
- Currency and deposits: 52.3%
- Debt securities: 8.6%
- Investment trusts: 8.6%
- Equity: 29.8%
- Insurance, pension and standardized guarantees: 2.9%

Euro area
- Currency and deposits: 34.6%
- Debt securities: 8.6%
- Investment trusts: 16.3%
- Equity: 34.2%
- Insurance, pension and standardized guarantees: 2.5%

United States
- Currency and deposits: 13.9%
- Debt securities: 10.7%
- Investment trusts: 35.4%
- Equity: 32.1%
- Insurance, pension and standardized guarantees: 2.8%

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Source: Bank of Japan Survey and Statistics Bureau "Funds Circulation: Comparative Analysis of Japan, US and Euro Area".

Note: 2016 December 22 data.
Research background 5: Equity finance for high-tech start-ups

Equity financing for high-tech start-ups

- High-tech start-ups tend to seek equity financing, rather than debt financing.

⇒ This is due to uncertainty and information asymmetry between entrepreneurs and external suppliers of capital

Equity financing in Japan

- While loan markets are well developed in Japan, private equity markets, including angel investors, seem undeveloped (e.g., Honjo and Nagaoka, 2018).

Is it desirable to improve the financial system for technology-driven entrepreneurship in Japan?
Theoretical argument

Analytical framework
◦ We examine the impact of entrepreneur human capital on initial funding.

Theoretical arguments
◦ Entrepreneurial human capital is significantly related to external financing because of the signaling effect.
◦ Entrepreneurial human capital has a significant impact on the cost of financing.
Cf. Wealth effect
Theoretical argument

Types of entrepreneurial human capital

- The effects of entrepreneurial human capital on the cost of financing differ from those on equity financing, according to the type of human capital.

Generic and specific human capital (e.g., Colombo and Grilli, 2005, 2010)

- **Generic human capital**: Fundamental knowledge and skills
  → Measured by education, age, and work experience
- **Specific human capital**: Special knowledge and skills in the field
  → Measured by technological skills
Theoretical argument

Different effects of entrepreneurial human capital

- While generic human capital is associated with the cost of debt financing, specific human capital is associated with the cost of equity financing.

→ Initial funding is determined by the type of entrepreneurial human capital.
Hypotheses

Entrepreneurial human capital
  ◦ Specific human capital
  ◦ Generic human capital

Specific human capital
  ◦ Technological skills (measured by patent applications) = inventor

Generic human capital
  ◦ Education
  ◦ Age (experience)

Other characteristics and preferences
  ◦ Gender
  ◦ Local business
  ◦ Rural business
Hypotheses

(Initial funding)
- H1: Start-up firms managed by entrepreneurs with technological skills are more likely to have significant financing at founding.
- H2: Start-up firms managed by entrepreneurs with higher educational level are more likely to have significant financing at founding.
- H3: Start-up firms managed by older entrepreneurs are more likely to have significant financing at founding.

(Debt and equity balance)
- H4: Start-up firms managed by entrepreneurs with technological skills are less likely to rely on debt financing.
- H5: Start-up firms managed by entrepreneurs with higher educational level are more likely to rely on debt financing.
- H6: Start-up firms managed by older entrepreneurs are more likely to rely on debt financing.
- H7: Start-up firms located in rural regions are more likely to rely on debt financing.
Data

Data source
- Teikokoku Data Bank Service
- Patent database

Sample
- Joint-stock companies founded during the period from January 2003 to December 2010 in Japan.
- Those firms founded in the manufacturing and ICT sectors of Japan.
- Subsidiaries, affiliated firms, and firms with no less than 100 employees or those with no less than paid-in capital of 1 billion yen in the first accounting year were excluded from the sample.

Observations: Start-up firms
- Total number 1397
- (Manufacturing) 511
- (ICT) 886
## Variables

### Definitions of variables for financial capital

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt finance</td>
<td>Sum of short- and long-term loans payable to inside and outside creditors, commercial paper, and corporate bonds (billion yen).</td>
</tr>
<tr>
<td>Equity finance</td>
<td>Sum of paid-in capital, deposits for subscriptions to shares, capital surplus, treasury shares, deposits to subscriptions for treasury shares, share warrants, and convertible and warrant bonds (billion yen).</td>
</tr>
<tr>
<td>Total finance</td>
<td>Equity finance + Debt finance</td>
</tr>
<tr>
<td>Debt finance ratio</td>
<td>Debt finance divided by total finance</td>
</tr>
</tbody>
</table>
### Variables

Definitions of variables for entrepreneurial human capital

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological skills</td>
<td>Dummy variable for the entrepreneur who experience patent application as an inventor before founding the firm</td>
</tr>
<tr>
<td>University education</td>
<td>Dummy variable for the entrepreneur who experienced education at university</td>
</tr>
<tr>
<td>Age</td>
<td>Logarithm of the entrepreneur’s age at founding</td>
</tr>
<tr>
<td>Female</td>
<td>Dummy variable for a female entrepreneur</td>
</tr>
</tbody>
</table>
# Variables

## Definitions of variables (for others)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local business</td>
<td>Dummy variable for the firm in the same prefecture of the entrepreneur’s birthplace, except for prefectures in four major metropolitan cities (Tokyo, Yokohama, Nagoya, and Osaka)</td>
</tr>
<tr>
<td>Rural business</td>
<td>Dummy variable for the firm located in regions, except for four metropolitan cities (Tokyo, Yokohama, Nagoya, and Osaka), and not in the same prefecture of the entrepreneur’s birthplace</td>
</tr>
<tr>
<td>Firm size</td>
<td>Logarithm of the number of employees plus one</td>
</tr>
<tr>
<td>Industry dummies</td>
<td>Dummy variable for the industry of the firm: chemicals, pharmaceuticals, machinery, electrical machinery, transportation equipment, precision instruments, and ICT.</td>
</tr>
<tr>
<td>Entry cohorts</td>
<td>Dummy variable for the year when the firm was founded</td>
</tr>
</tbody>
</table>
## Summary statistics

### Descriptive statistics of covariates

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>25%</th>
<th>Median</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological experience</td>
<td>0.077</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>University education</td>
<td>0.503</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Age (level)</td>
<td>45.7</td>
<td>11.2</td>
<td>37.0</td>
<td>47.0</td>
<td>54.0</td>
</tr>
<tr>
<td>Female</td>
<td>0.044</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Local business</td>
<td>0.293</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Rural business</td>
<td>0.162</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
</tbody>
</table>
Estimation results

Estimation

- OLS
- Tobit model

Dependent variables

- Initial funding
- Debt finance ratio (debt and equity balance)
## Estimation results

### Total finance (Table 7): OLS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Initial funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological skills (inventor)</td>
<td>++</td>
</tr>
<tr>
<td>University education</td>
<td>+++</td>
</tr>
<tr>
<td>Age (older)</td>
<td>+++</td>
</tr>
<tr>
<td>Female</td>
<td>− −</td>
</tr>
<tr>
<td>Local business</td>
<td>No significance</td>
</tr>
<tr>
<td>Rural business</td>
<td>No significance</td>
</tr>
<tr>
<td>Pharmaceutical industry</td>
<td>No significance</td>
</tr>
<tr>
<td>ICT industry</td>
<td>− − −</td>
</tr>
</tbody>
</table>

*Generic human capital*
Estimation results

Debt finance ratio (Table 8): Tobit/OLS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Debt finance ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological skills (inventor)</td>
<td>− − −</td>
</tr>
<tr>
<td>University education</td>
<td>No significance</td>
</tr>
<tr>
<td>Age (older)</td>
<td>No significance</td>
</tr>
<tr>
<td>Female</td>
<td>No significance</td>
</tr>
<tr>
<td>Local business</td>
<td>+ + +</td>
</tr>
<tr>
<td>Rural business</td>
<td>+ + +</td>
</tr>
<tr>
<td>Pharmaceutical industry</td>
<td>− − −</td>
</tr>
<tr>
<td>ICT industry</td>
<td>− − −</td>
</tr>
</tbody>
</table>
Estimation results

Major findings
- Start-up firms managed by entrepreneurs with technological skills are more likely to rely on equity financing.
- Start-up firms managed by entrepreneurs with university education are more likely to have significant financing.
- Start-up firms managed by older entrepreneurs are more likely to have significant financing.
- Start-up firms located in entrepreneurs’ hometowns are more likely to rely on debt financing.

Summary
- Specific human capital is associated with equity finance.
- Generic human capital is associated with debt and equity finance (total finance).
- The start-ups of local businesses depend on debt financing.
Estimation results

Estimation
  ◦ 2SLS (GMM)

Dependent variables
  ◦ Total asset growth
  ◦ Sales growth

Notes: These variables are defined as differences in the logarithms of total assets and sales between the first and second accounting years, respectively.
Estimation results

Firm growth (Table 9): 2SLS (GMM)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Firm growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total asset growth</td>
</tr>
<tr>
<td>Debt finance ratio</td>
<td>− − −</td>
</tr>
</tbody>
</table>

Major findings

- Start-up firms relying on debt financing are less likely to grow faster.
Concluding remarks

What did this study explore?

◦ The results reveal that some entrepreneur-specific characteristics are significantly associated with initial funding.

New evidence

◦ While generic human capital, measured by education and age, is associated with debt and equity finance, specific human capital, measured by patent applications, is associated only with equity finance.

How do inventors raise funds when they become entrepreneurs?

Inventors do not require debt financing when they become entrepreneurs.
Concluding remarks

Policy implications

- The Japanese financial system’s legacy of reliance on debt financing might decrease the proportion of start-up firms with innovation and growth potential, although such legacy helps local businesses to raise funds at founding.

- To promote technology-driven entrepreneurship, policies shifting away from the current financial system that relies heavily on debt financing would be required by inventors.

It would be desirable to shift the flow of funds to equity financing for high-tech start-ups in Japan.
Flow of funds in the financial system of Japan

- **Investors/VC** → **Start-ups** → **Incumbents**
- **Households**
- **Insurance/Pensions**
- **Financial institutions**
- **Labor market**
References


