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Venture capital and economic growth in Japan

Jiayuan Wang
Graduate School of Economics, Nagoya University

Abstract

This study analyzes the effects of venture capital on Japan's regional economy by using region-level panel data. Results of this study show that an increase in venture capital has positive effects on the establishment of start-up firms and employment. This study expands on prior macro-level research on the relationships between venture capital and economic growth. It reveals that on a regional level in Japan, venture capital still has a stimulating effect on economic growth.

1. Introduction

Venture capital (VC) is considered an engine for accelerating economic growth worldwide. In certain regions such as Silicon Valley in the United States and Old Street in the United Kingdom, local economy has experienced significant growth in the venture industry (Mason & Pierrakis, 2013). Not only the governments of developed countries but also those of developing countries have formulated relevant policies to attract VC and promote the local economy toward the country's overall economic development. For example, in China and India, the emergence of numerous high-tech industries has been accelerated due to the participation of VC (Ahlstrom, Bruton, & Yeh, 2007; Dossani & Kenney, 2002).

Although there are many cases around the world indicating that VC has a stimulating effect on economic growth, there is not much empirical evidence. However, we can potentially find a positive correlation between VC and economic growth. Past studies have accumulated causal evidence on entrepreneurship and economic growth. (Carree & Thurik, 2010; Wennekers & Thurik, 1999) As an important source of entrepreneurs' funds, VC obviously has an indirect causal relationship with economic growth by supporting emerging industries.

Since VC firms and investors' investment activities tend to be concentrated in the metropolitan area, some studies have expanded relevant research to the metropolitan level. A metropolitan-level research directly investigating the relationship between VC and economic growth found that VC has a positive effect on metropolitan economy (Samila & Sorenson, 2011). From past research, we can find that the impact of VC on its startups is positive, not only on the company, but also on the entire industry and even the metropolitan economy. Since VC has the characteristic of focusing on cities, whether there is a significant role in promoting economic growth in the broader economy remains an open question.

To verify whether VC has positive effects on a wider area of the economy, this study used regional panel data to investigate the relationship between VC and economic growth in Japan. As a developed country, Japan is often criticized for its backwardness in emerging industries. However, the scale of VC investment in Japan was once the same as that of the United States. In recent years, the Japanese government has begun to vigorously support entrepreneurship, trying to catch up in the development of high-tech industries. Japan has a completely different entrepreneurial culture and financing model from Europe and the United States. Therefore, whether the relationship between VC investment and economic growth that has been verified in Europe and the United States can be applied in Japan needs further verification.

An analysis of the standard production function under the fixed-effect model shows that VC has a positive impact on regional economic development particularly in stimulating employment and businesses in the region. The findings indicate three potential mechanisms by which VC impacts the economy. First, potential entrepreneurs incorporate the availability of VC into their startup-plan before starting a business. Second, startups that receive investment from VC firms become the inspiration and role model for potential entrepreneurs. Third, a phenomenon of community formation among startup companies exists. Companies often share experiences and conduct businesses with each other. VC firms focus on these communities, expand their investment, and encourage the establishment of more startup companies.

This study expands on the work of Samila and Sorenson (2011). It also confirms results of prior researches that were carried out only at the firm and metropolitan levels. For instance,

one study found that VC stimulates the growth of startups and the establishment of new startups (Bertoni, Colombo, & Grilli, 2011; Davila. A, Foster.G, & M, 2003), potentially stimulating regional and even national economic development. Even though in a smaller scale, the company-level study showed significant effects of VC; however, there is no similar evidence at the regional level (Samila & Sorenson, 2011). As such, this study fills this gap by examining VC's effect on the regional economy of Japan.

2.Venture Capital and Economic Growth

VC is a form of private equity investment that provides financial support for start-ups and obtains shares in the company. As a form of financing, VC has existed in the United States for more than 60 years. Until the 1980s, apart from a few successful cases, the impact of VC has not been noticed by society (Gompers & Lerner, 1998). Since then, the fourth industrial revolution has arisen, a large number of high-tech start-up companies have emerged, and VC has also grown dramatically. According to the National Venture Capital Association, from 1978 to 2007, the total funds raised by VC firms in the United States grew from $549 million (in 2007 dollars) to $35.9 billion. Due to the great success of VC in emerging industries, people began to consider the role of VC in promoting industrial innovation and economic growth. Research shows that VC has the potential to stimulate economic growth, and three hypotheses concerning this potential can be summarized from existing research.

Such hypotheses are considered from the financial aspects of the company. In some firm-level researches, people have found evidence that firms financed by VC shows higher growth rates than average. Davila, Foster, and Gupta (2003) found that startups with VC financing have higher employment growth rates. Additionally, SMEs with VC financing exhibit better performance in the aspect of annual profit growth and internationalization (Smolarski & Kut, 2011). Gifford (1997) and Keuschnigg (2004) explained that VC investors participate in the development of the startup's business strategy to help them achieve higher performance growth. These studies imply that if a region concentrates on the VC industry, the startups in this region will show above-average growth with the participation of VC, thus promoting the economic growth of the whole region.

Potential entrepreneurs consider funding sources as a very important factor before deciding to start a business and therefore take into account the availability of VC as one of the important sources of funding. Consequently, when there is a large supply of VC in a region, potential entrepreneurs are encouraged to implement business plans. The establishment of firms in the region will also be positively affected, driving regional economic growth. This hypothesis is also supported by researches in firm-level financing. Many entrepreneurs become entrepreneurs as influenced by their surroundings. The more people there are starting a business, the more perfect the capital environment becomes and the higher is the people's tendency to start a business (Sorenson & Audia, 2000).

The last hypothesis is that VC can be seen as a source of R&D for the company. By stimulating the company's innovation activities, spill-over effects consequently promote the economic growth of the industry and the region. As a recipient of VC funds and technology, the startup company enables VC to indirectly stimulate R&D and foster regional economic growth (Gilson, 2003; Zider, 1998) as illustrated in the cases of Silicon Valley in the United States, Zhongguancun in China, Old Street in London, among others. In these areas, due to various reasons such as government policies, the world's most famous emerging high-tech industries have become concentrated (Gilson, 1999). Due to abundant capital and policy

support, a large number of high-tech companies have chosen to start businesses in these areas and have achieved great success in the short term. Emerging high-tech companies export innovation to the society, and the effects spillover to the entire region.

From the above studies we can infer that VC has a stimulating effect on the economic growth of startups and regions. Regarding the relationship between VC and regional growth, Samila and Sorenson (2011)'s study showed that VC in the United States has a stimulating effect on entrepreneurship in the region and has a positive impact on income and employment.

3. The Venture Capital in Japan

Japan's VC industry started relatively late, and the first company to provide venture capital financing was established in Kyoto in 1972, named Kyoto Enterprise Development. After that, the VC industry developed tepidly. With the economic development of Japan, it once reached an annual investment of 1 trillion yen in 2000, which was the same as the US market during the same period. Affected by the US Subprime mortgage crisis, Japanese VC market has also been greatly damaged. In 2008, VC investment from Japan for the whole year fell to 87.5 billion yen.

Figure 1. VC Investment (billion)
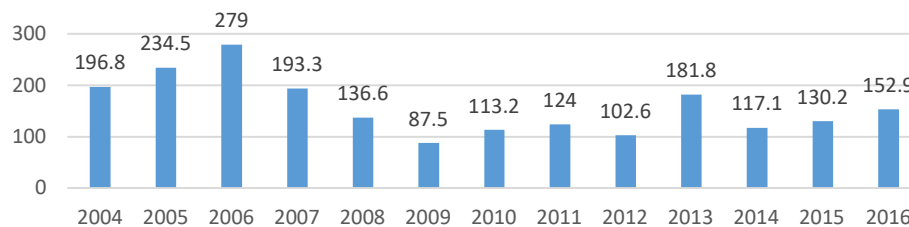
The Japanese VC market has a different entrepreneurial culture and financing tendencies from the mainstream of the world. Compared with emerging companies in the United States and the United Kingdom that pay more attention to entrepreneurs' personal capabilities and financing in the VC market, Japanese startups pay more attention to whether the leaders' social connections will obtain financing from the government and banks. (Suzuki, Kim, & Bae, 2002)

However, VC investment from banks is more inclined to later stage entrepreneurial activities, so it is difficult to obtain sufficient financial support for early stage entrepreneurial activities in Japan. This makes Japan's emerging industries relatively backward.(Mayer, Schoors, & Yafeh, 2005) According to the IMD World Competitiveness Yearbook 2019, VC in Japan ranked 36th among 63 countries.

Therefore, although we have obtained the positive correlation between VC and economic growth in the United States and other places, because of Japan's particularity, we cannot take it for granted that this relationship is equally applicable in Japan. At present, research on the economic effects of Japan's VC industry has not yielded results. This research will verify whether VC has the same effect on economic growth in Japan.

4. Empirical Evidence
4.1 Data

This study used 2011 to 2016 data from both public and private sources to construct a balanced panel covering nine regions of Japan. The nine regions include Hokkaido, Tohoku, Kanto (excluding Tokyo), Tokyo, Chubu, Kinki, Chugoku, Shikoku, Kyushu, and Okinawa (Kyushu and Okinawa are counted as one region). Data on regional economic activities came from several government sectors while Information on venture activities were collected from the Venture Enterprise Center (VEC) Yearbook which is annually published by the private sector. This center is the only institute that investigates the venture industry in Japan.

This study selected Japanese regional data for analysis and expanded on the original urban-level data research. Since 1904, there have been 47 prefectures in Japan divided into eight major regions. In this study, Tokyo was separated from the Kanto region as an independent region since the economy of Tokyo is considered separate. The nine major regions cover the whole of Japan including urban and rural areas. Data from these regions were used to analyze the relationship between VC and the regional economy.

The construction of panel data requires consistent data definition across years. Prior to 2011, VEC surveys on VC were limited to new projects and additional surveys of existing projects were missing. Since 2011, VEC has started a full investigation of domestic VC including those related to existing and new projects. As such, the periods from 2011 to 2016 (a total of 54 region-years) were chosen for the panel data for consistency in the definition of VC.

4.2 Model

Above prior researches imply that VC has a potential impact on employment, real-income, and number of companies in the regional economy. Specifically, above studies showed that VC has contributed to the increase in the number of companies thereby potentially increasing regional employment. The purpose of this study is to verify the relationship between VC and the regional economy. Therefore, this study also uses above three variables to describe the regional economic situation. In particular, the variable used here to describe income is the average annual real-income of the individual where income includes wages, bonuses, salary, and benefits; while for employment, only full-time employees were considered. Data on real income are calculated from the Prefectural Accounts of the Cabinet Office of Japan. The data on the employment and the number of companies are taken from annual reports of Japanese companies which are published by the Ministry of Health, Labor and Welfare.

Considering that regional characteristics may attract VC and affect economic growth the panel estimates in this study starts with specifications that include region-fixed effects to control for the time-invariant characteristics of the regions and includes indicators in different calendar years to control for macroeconomic factors that might commonly influence the outcomes and VC. To capture regional differences in the outcomes over time, estimates were made for scenarios with and without region-specific trends.

For each of these outcomes, effects using a logged form of a standard production function were estimated based on Sampsa (2011) as follows:

$$\ln Y_{i,t} = \beta_1 \ln I_{i,t-1} + \beta_2 \ln Pop_{i,t-1} + \beta_3 \ln Cap_{i,t-1} + \beta_4 \ln VC_{i,t-1} + \varphi_t + \varepsilon_i + v_i t + \epsilon_{i,t}$$

Where i and t index the regions and the year, respectively, and the other variables are represented as follows:

$Y_{i,t}$: The various outcome measures including aggregate real-income, firms, and employment
$I_{i,t-1}$: Innovation (patents and inventors)
$Pop_{i,t-1}$: A control for regional population
$Cap_{i,t-1}$: A control for regional capital
$VC_{i,t-1}$: Indicators for supply of VC
φ_t: A series of indicator variables for each year
ε_i: Region fixed effect
$v_i t$: Regional specific growth trend (in some models)
$\epsilon_{i,t}$: Error term

Some studies have pointed out a close relationship between innovation and economic growth. In areas where innovation is flourishing, there is often a high rate of economic growth. This study considers that innovation can increase the opportunities of starting a business in an area and affect the number of employees and companies. To control for these opportunities, the number of patent applications eventually approved for each region was used as a measure. Inventors are defined in this study as the number of inventors registered when applying for a patent. According to the characteristics of patents in different industries, the number of inventors also has a big gap, so the number of patents and the number of inventors are separately controlled by variables in this model. Additionally, the number of inventors was also considered since an increase in this number may indicate positive effects on the regional economy given that the inventors are likely to start new businesses based on their patents (i.e., the number of inventors may have a potentially stimulating effect on regional economic growth).

The measurement of VC activities was based on information from VEC's database. The VEC database, implemented by VEC, is the only database that focuses on investigating the VC industry in Japan. The first measure of VC activity used in this study is the annual total amount invested by VC firms and funds. This measure determines whether larger investments have larger effects. The second measure is the number of investment projects including new ones and those continuing support for companies that have already received VC. This measure is used to determine whether more investment projects mean larger effects for the economy.

The data used to control regional population came from the Statistics Bureau of Japan and includes estimates on the annual population based on the national census conducted every five years. The data on the number of patent applications and the number of inventors came from the annual report issued by the Japan Patent Office. Since the data on real capital stock was published only until 2012, the data after 2012 was calculated from the perpetual inventory method by adding the data of the Prefectural Accounts of the Japanese Cabinet Office to the R-JIP database. The formula is as follows:

$$Cap_{i,t} = Cap_{i,t-1} + F\_Cap_{i,t} - D_{i,t}$$

Perpetual inventory method is a commonly used method to estimate capital stock. Calculate the capital stock of the current period by calculating the changes in the capital stock of the current period on the basis of the capital stock of the previous period. Here, $F\_Cap_{i,t}$

represents the formation of fixed capital in the current period, and $D_{i,t}$ represents the depreciation of fixed capital.

In the panel data, except for the data on VC, other information is at the prefecture level and were thus recalculated to the regional level and summarized in Table 1.

Table 1.-Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Real income	54	3.012	.943	1.852	5.6
Firms	54	3370.556	2545.105	705	8611
Employment	54	1649766.3	1787318.1	207651	6435192
VC	54	5947.481	10725.596	81	46812
VC counts	54	72.111	104.196	3	463
Patents	54	20997.241	30739.799	351	117970
Inventors	54	68325.204	75071.6	1529	243023
Population	54	14162.907	8323.676	3818	29508
Capital	54	1.282e+08	70644779	34661627	2.421e+08

5.1 Fixed Effects

Tables 2 reports the results of these fixed-effects regressions without region-specific trends. However, only partial results support the hypothesis that VC has positive effects on regional economic growth.

(9) to (12) report the results of VC's effect on employment. We can know that VC investment positively and significantly relates to overall employment. When controlling for the number of patent applications or inventors, results show similar effects on employment. For instance, a doubling in the amount invested in a region corresponds to a 1.26% increase in total employment under the control of number of patent applications. While controlling the number of inventors, the effect is 1.30%. As another measure of VC, the number of venture investment projects also positively and significantly relates to employment. The effects are greater than investment, reaching 1.92% and 2.04%, under the control of patent and inventors separately.

Table 2.- Impact of VC on regional economy: OLS fixed effects

VARIABLES	(1) Ln R_income	(2) Ln R_income	(3) Ln R_income	(4) Ln R_income	(5) Ln Firms	(6) Ln Firms	(7) Ln Firms	(8) Ln Firms	(9) Ln Empl	(10) Ln Empl	(11) Ln Empl	(12) Ln Empl
Ln Patents	0.0133	0.0134			0.0282	0.0282			0.0753*	0.0751		
	(0.0220)	(0.0216)			(0.0198)	(0.0201)			(0.0442)	(0.0447)		
Ln Pop	-0.302*	-0.284*	-0.265**	-0.259*	0.262*	0.230	0.287*	0.253*	0.152	0.0499	0.214	0.108
	(0.153)	(0.151)	(0.129)	(0.128)	(0.138)	(0.141)	(0.142)	(0.144)	(0.308)	(0.313)	(0.321)	(0.325)
Ln Capital	0.176	0.199	0.325***	0.331***	0.266**	0.227**	0.328***	0.287**	-0.431*	-0.556**	-0.292	-0.414
	(0.119)	(0.119)	(0.105)	(0.105)	(0.107)	(0.111)	(0.116)	(0.118)	(0.239)	(0.246)	(0.263)	(0.265)
Ln VC	-0.000730		0.000270		0.00426		0.00448		0.0126**		0.0130**	
	(0.00282)		(0.00239)		(0.00255)		(0.00263)		(0.00568)		(0.00597)	
Ln VC count		-0.00456		-0.00221		0.00577		0.00636		0.0192*		0.0204*
		(0.00457)		(0.00395)		(0.00426)		(0.00443)		(0.00946)		(0.0100)
Ln Inventors			-0.0859***	-0.0831***			-0.0185	-0.0200			-0.0342	-0.0407
			(0.0248)	(0.0248)			(0.0273)	(0.0279)			(0.0618)	(0.0629)
Constant	0.523	-0.0713	-1.605	-1.784	0.146	1.175	-0.784	0.303	19.57***	22.87***	17.43**	20.77***
	(3.355)	(3.336)	(2.855)	(2.853)	(3.027)	(3.108)	(3.143)	(3.200)	(6.746)	(6.902)	(7.125)	(7.221)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Trends	No	No	No	No	No	No	No	No	No	No	No	No
Observations	45	45	45	45	45	45	45	45	45	45	45	45
R-squared	0.876	0.880	0.912	0.913	0.497	0.480	0.469	0.454	0.684	0.676	0.655	0.649
Number of Regions	9	9	9	9	9	9	9	9	9	9	9	9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2 Fixed Effects with Trends

Tables 3 present parallel sets of analyses with region-specific trends. The inclusion of these trends increases the magnitudes of all of the estimated relationships. However, there is still no evidence that VC activities affect real income. As we see the effect in the number of firms, with the control of number of inventors, the magnitude of VC's effect became significantly positive. A doubling in the amount of investment in a region corresponds to a 0.69% increase in total number of firms.

(9) to (12) report the fixed effect of VC activities on regional employment with region specific trends. All the measures of VC activities show positive and significant results. The effect of the number of venture investment projects changed to significant unlike the scenario under the control of number of patent applications. All effects increased and became more significant. For example, the magnitude of the effects of the amount of venture investment increased by 58% and 67% respectively. The effect of the number of venture investment projects increased by 75% and 70%.

Table 3.-Impact of VC on regional economy: OLS fixed effects with region trends

VARIABLES	(1) Ln R_income	(2) Ln R_income	(3) Ln R_income	(4) Ln R_income	(5) Ln Firms	(6) Ln Firms	(7) Ln Firms	(8) Ln Firms	(9) Ln Empl	(10) Ln Empl	(11) Ln Empl	(12) Ln Empl
Ln Patents	0.0343	0.0353*			-0.00467	-0.00163			-0.0299	-0.0222		
	(0.0200)	(0.0194)			(0.0268)	(0.0275)			(0.0509)	(0.0543)		
Ln Pop	-0.296**	-0.294**	-0.278*	-0.267*	0.298	0.282	0.219	0.222	0.276	0.214	0.184	0.165
	(0.136)	(0.132)	(0.149)	(0.147)	(0.183)	(0.188)	(0.175)	(0.187)	(0.347)	(0.371)	(0.354)	(0.383)
Ln Capital	0.284	0.280	0.357	0.317	-0.0169	-0.0874	0.196	0.0477	-0.353	-0.593	-0.194	-0.544
	(0.287)	(0.277)	(0.325)	(0.311)	(0.385)	(0.393)	(0.381)	(0.395)	(0.733)	(0.775)	(0.771)	(0.810)
Ln VC	-0.00142		-0.000378		0.00434		0.00693**		0.0200***		0.0218***	
	(0.00234)		(0.00281)		(0.00314)		(0.00329)		(0.00597)		(0.00667)	
Ln VC counts		-0.00535		-0.00416		0.00476		0.00811		0.0337**		0.0347**
		(0.00447)		(0.00529)		(0.00635)		(0.00671)		(0.0125)		(0.0137)
Ln Inventors			-0.0154	-0.00345			-0.0947	-0.0688			-0.0831	-0.0344
			(0.0472)	(0.0451)			(0.0553)	(0.0573)			(0.112)	(0.117)
Constant	2.879	4.197	-1.261	0.869	5.313	7.667	-0.229	3.775	9.047	13.43	6.569	13.37
	(8.935)	(8.667)	(9.802)	(9.548)	(11.98)	(12.31)	(11.50)	(12.13)	(22.78)	(24.29)	(23.27)	(24.83)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Trends	No	No	No	No	No	No	No	No	No	No	No	No
Observations	45	45	45	45	45	45	45	45	45	45	45	45
R-squared	0.960	0.962	0.954	0.955	0.639	0.615	0.684	0.641	0.835	0.810	0.836	0.810
Number of Regions	9	9	9	9	9	9	9	9	9	9	9	9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Robustness Check

We can see from the descriptive summary that a large amount of VC investment is concentrated in the Tokyo area, so we can naturally think that the results obtained before are likely to be affected by Tokyo. Therefore, Tokyo will be removed from the database next to test the robustness of the results of this study. Table 4 and Table 5 are the results.

Table 4.- Impact of VC on regional economy: OLS fixed effects

VARIABLES	(1) Ln R_income	(2) Ln R_income	(3) Ln R_income	(4) Ln R_income	(5) Ln Firms	(6) Ln Firms	(7) Ln Firms	(8) Ln Firms	(9) Ln Empl	(10) Ln Empl	(11) Ln Empl	(12) Ln Empl
Ln Patents	0.00652	0.00655			0.0366*	0.0364*			0.0836*	0.0833*		
	(0.0180)	(0.0180)			(0.0188)	(0.0196)			(0.0474)	(0.0480)		
Ln Pop	-0.215	-0.214	-0.241*	-0.241*	0.279**	0.251*	0.279*	0.254*	0.173	0.0956	0.194	0.130
	(0.128)	(0.128)	(0.120)	(0.120)	(0.135)	(0.139)	(0.141)	(0.147)	(0.339)	(0.342)	(0.359)	(0.363)
Ln Capital	0.121	0.122	0.228**	0.236**	0.294***	0.243**	0.410***	0.350**	-0.419	-0.583**	-0.228	-0.430
	(0.0968)	(0.0996)	(0.103)	(0.106)	(0.102)	(0.109)	(0.121)	(0.130)	(0.256)	(0.266)	(0.307)	(0.323)
Ln VC	-0.000252		-0.000149		0.00503*		0.00502*		0.0136**		0.0135**	

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ln VC	(0.00231)		(0.00216)		* (0.00243)		(0.00253)		(0.00611)		(0.00644)	
Ln VC counts		-0.000161 (0.00409)		-0.00103 (0.00384)		0.00658 (0.00446)		0.00589 (0.00470)		0.0224* (0.0109)		0.0215* (0.0116)
Ln Inventors			-0.0550* (0.0289)	-0.0559* (0.0290)			-0.0420 (0.0338)	-0.0350 (0.0356)			-0.0550 (0.0860)	-0.0313 (0.0880)
Constant	0.697 (2.725)	0.654 (2.751)	-0.432 (2.586)	-0.574 (2.613)	-0.727 (2.860)	0.484 (3.001)	-2.140 (3.028)	-0.870 (3.203)	18.87** (7.194)	22.63*** (7.356)	16.40** (7.697)	20.50** (7.923)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Trends	No	No	No	No	No	No	No	No	No	No	No	No
Observations	40	40	40	40	40	40	40	40	40	40	40	40
R-squared	0.928	0.928	0.937	0.937	0.579	0.545	0.542	0.500	0.648	0.639	0.609	0.596
Number of Regions	8	8	8	8	8	8	8	8	8	8	8	8

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5.- Impact of VC on regional economy: OLS fixed effects with region trends

VARIABLES	(1) Ln R_income	(2) Ln R_income	(3) Ln R_income	(4) Ln R_income	(5) Ln Firms	(6) Ln Firms	(7) Ln Firms	(8) Ln Firms	(9) Ln Empl	(10) Ln Empl	(11) Ln Empl	(12) Ln Empl
Ln Patents	0.0219 (0.0163)	0.0220 (0.0150)			0.00778 (0.0258)	0.0108 (0.0275)			-0.0196 (0.0547)	-0.0117 (0.0597)		
Ln Pop	-0.249** (0.109)	-0.242** (0.101)	-0.229* (0.117)	-0.215* (0.110)	0.252 (0.172)	0.236 (0.184)	0.172 (0.156)	0.180 (0.180)	0.239 (0.365)	0.180 (0.399)	0.143 (0.368)	0.136 (0.409)
Ln Capital	-0.107 (0.254)	-0.0926 (0.231)	-0.0975 (0.285)	-0.108 (0.255)	0.354 (0.403)	0.225 (0.421)	0.640 (0.381)	0.389 (0.419)	-0.0578 (0.855)	-0.426 (0.915)	0.188 (0.897)	-0.343 (0.953)
Ln VC	-0.00286 (0.00190)		-0.00252 (0.00226)		0.00585* (0.00301)		0.00912** * (0.00303)		0.0215*** (0.00639)		0.0240*** (0.00713)	
Ln VC counts		-0.00798** (0.00344)		-0.00792* (0.00402)		0.00693 (0.00628)		0.0110 (0.00660)		0.0352** (0.0136)		0.0370** (0.0150)
Ln Inventors			-0.00200 (0.0370)	0.00643 (0.0335)			-0.108** (0.0494)	-0.0755 (0.0551)			-0.0941 (0.117)	-0.0377 (0.125)
Constant	10.79 (7.076)	12.07* (6.511)	9.127 (7.625)	10.95 (7.017)	-4.371 (11.23)	-0.964 (11.89)	-10.88 (10.19)	-5.391 (11.53)	1.256 (23.82)	7.474 (25.83)	-2.560 (24.03)	6.382 (26.23)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40	40	40	40	40	40	40	40	40	40	40	40
R-squared	0.977	0.981	0.975	0.978	0.698	0.656	0.763	0.687	0.821	0.786	0.826	0.786
Number of Regions	8	8	8	8	8	8	8	8	8	8	8	8

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

We can see the results from Table-4 and Table-5, the effects became more significantly and stronger without data on Tokyo-area. Therefore, the results we analyzed out from Chapter-5 are robust.

7. Discussion

This study reveals that an increase in VC in a region potentially stimulates the economic growth in that region. It provides some basis for the study of the relationship between VC and economic growth in terms of two aspects specifically, the establishment of companies and the creation of employment.

Prior research showed that there are three mechanisms through which VC stimulates the establishment of companies. First, potential entrepreneurs consider the availability of VC in their startup-plan before starting a business. Second, startups that receive investment from VC firms become the inspiration and role model for potential entrepreneurs. Third, there exists a phenomenon of community formation among startup companies. Companies often share experiences and conduct businesses with each other. VC firms focus on these communities, expand their investment, and encourage the establishment of more startup companies. The effect on employment relates to VC's effect on the establishment of companies. Some of these employment effects likely stem from the stimulation of VC.

However, this study did not show any evidence that VC boosts regional real income growth. The reason for this result may be that the volume of VC investment is too small relative to the entire regional economy.

As for the impact of VC on the number of companies are not all being significant, the reason may be that the data on the number of companies used in this study is taken from annual reports of Japanese companies which are published by the Ministry of Health, Labor and Welfare. The report is for companies with more than 50 employees. Most startups are smaller than 20, so this research does not reflect the impact of VC on small and medium-sized companies. In future research, it is the author's intention to focus on the impact of VC on SMEs. Considering that the number of patent inventors may vary greatly depending on the patent field, the number of patents and the number of inventors are used separately in this study to control the variables of technological innovation.

The results of this study confirm the conclusion of Samila and Sorenson (2011) although not in terms of income but in terms of the effect (which is significant) of VC on the number of companies and employment. It also verifies that at the firm level, financing from VC can promote companies' high-growth perspectives, providing evidence that VC influences the growth of companies and encourages entrepreneurship, thereby influencing the economy of the entire region. However, considering that VC may be easily concentrated in economically developed regions and have the opposite causal relationship, these results can be further verified by introducing instrumental variable in future research. Considering that the total amount of VC in Tokyo is so large that it may cause bias to the results, the data of Tokyo is removed in the robustness test, and the result are still significant.

Finally, this study provides evidence for VC research in Japan. This study focuses on the relationship between venture capital and Japan's economic growth at the macro-level, and provides evidence for the view that venture capital promotes Japan's economic growth.

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