VC, Where Art Thou?A Case of Japan's Biotechnology Industry

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ABSTRACT

This paper takes a deeper look at the investments made by venture capital (VC) firms in Japan particularly in the biotechnology industry. The trends and performance of Japanese VC are being compared with VCs from other countries. Various arguments are provided to explain the poor performance of Japanese VC in this sector despite the potential promise and gain of biotechnology. The arguments include the nature of the industry, the investment process, exit markets and fund raising.

Keywords: Venture capital, Biotechnology industry, Japan

1. INTRODUCTION

Biotechnology industry is one of the most booming and promising sectors at the beginning of the 21st century. Due to the wide applications of biotechnology and its significance, biotechnology has become a global industry with countries around the world creating and fostering their own bio-industries to capture the economic value offered by this very important technology. Japan has been in the race to develop its biotechnology industry since 1980s. However, the presence of Japan's biotechnology industry is rather small compared to other developed countries such as the US, UK, Germany, France, Switzerland and even Canada. This can be a surprise to some considering that Japan has a rather long history with the development of biotechnology. In the early 1980s, Japanese industrialists and bureaucrats witnessed the growth of modern biotechnology industry led by new biotechnology firms in the US. The biggest difference between Japan and the US during that period of biotechnology development was the industry structure. In the US, hundreds of biotechnology start-ups known as 'dedicated biotechnology firms' emerged to explore and exploit new techniques and research capabilities from universities. In contrast, there were very few of such firms in Japan before 1995.

Biotechnology start-ups such as the likes of dedicated biotechnology firms in the US only started appearing in Japan in the 1990s. During that period, the Japanese government began to introduce new policies to promote the development of a biotechnology industry in Japan. One of the main strategies was the promotion of 'bioventures' as the engine for the industrialization of the biotechnology industry. This move was also part of the initiatives by the Japanese government to focus its investment in science and technology as a key prerequisite to the return of Japan's industrial competitiveness. Hence since late 1990s, Japan's innovation system began to experience profound changes which include the following. 1) Increase in government

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R&D budgets for basic research 2) Changes in legal and policy framework to encourage university-industry linkages 3) Intellectual property reforms 4) Promotion of start-ups such as the creation of stock markets for high growth companies and changes in commercial code law.

Within the span of a decade, Japanese bioventures grew rapidly from 102 in 1994 to more than 500. According to JBA (2013), by the end of 2012, the number of bioventures stood at 552. By the sheer number, this is indeed an accomplishment. However, a closer analysis reveals that despite more than a decade, majority of these bioventures are very small, operating at the seed or start-up stage. In terms of pipelines, none of the bioventures' internally developed pipelines have reached the commercialization stage (either by themselves or by their licensing partners). At the end of 2012, only 25 bioventures were listed. Average sales per listed bioventure was ¥1,252 million or approximately US$14 million. Average market capitalization per listed bioventure based on 2012 year-end market price was ¥15,524 million or approximately US$172 million.

The core activity of bioventures is the development of innovative new products and to innovate, bioventures have to take massive risks. The vast majority of drug candidates fail in development, with only one in thousands of compounds successfully making the journey from early discovery to commercialized product. Because innovation and risk are two sides of the same coin, the only investor willing to take such kind of risk is venture capital (VC). In the US, VC plays a critical role from the very beginning of the development of this industry. Virtually all the US biotechnology firms are initially funded by VC. In fact, one can say that biotechnology has emerged as an industry largely because of one economic institution: VC.

However, the above statement does not hold true in Japan. The contribution of VC in the biotechnology industry has not been widely acknowledged. Thus, this paper takes a deeper look at the biotechnology investments made by VC firms in Japan. This paper begins by comparing the trends and performance of Japanese VC with VCs from other countries. Next, various arguments are provided to explain the poor performance of Japanese VC in this sector despite its potential promise and gain. The arguments include the nature of the industry, the investment process, exit markets and fund raising. Many literatures also noted that a successful biotechnology industry requires a developed national innovation system that goes beyond VC. It is not the purpose of this paper to examine the other factors such as entrepreneurship, university-industry linkages, labor-mobility, intellectual property rights protection, and drug regulatory system that made up that innovative ecosystem. Rather, this paper seeks to examine why VC performance in the biotechnology industry has been poor.

2. GLOBAL TRENDS OF VC INVESTMENT

Figure 1 shows the trend of VC investment in the US, Europe, and Japan from 1995 to 2012. The amount of investment by Japanese VC is tremendously small compared to the US and Europe. Even during the heyday of irrational exuberance, Japan's VC investment was only under US$3 billion per year. According to Japan Venture Capital Association, average VC investment per investee in Japan is around US$1.13 million vs US$10.42 million in the US (JVCA 2007).

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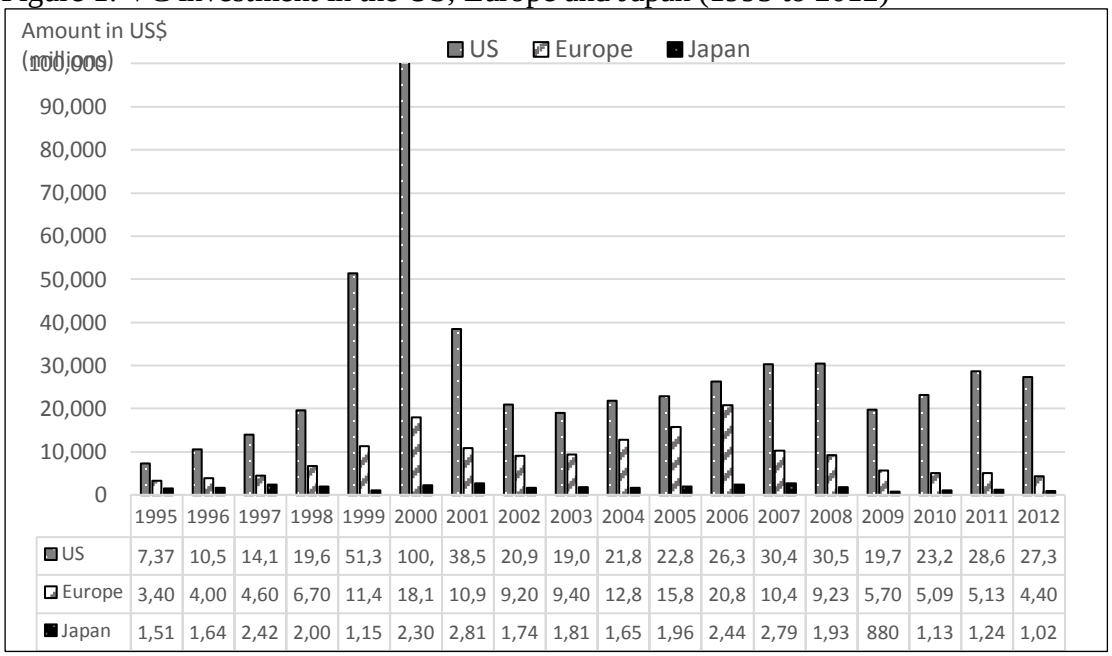
Figure 1: VC investment in the US, Europe and Japan (1995 to 2012)

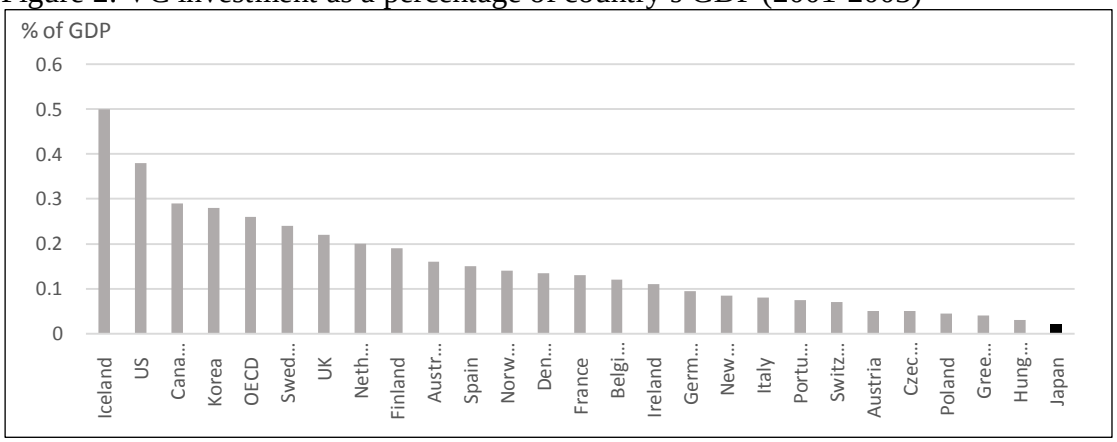


	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
US	7,37	10,5	14,1	19,6	51,3	100,	38,5	20,9	19,0	21,8	22,8	26,3	30,4	30,5	19,7	23,2	28,6	27,3
Europe	3,40	4,00	4,60	6,70	11,4	18,1	10,9	9,20	9,40	12,8	15,8	20,8	10,4	9,23	5,70	5,09	5,13	4,40
Japan	1,51	1,64	2,42	2,00	1,15	2,30	2,81	1,74	1,81	1,65	1,96	2,44	2,79	1,93	880	1,13	1,24	1,02

Source: VEC annual reports, NVCA, EVCA websites

Figure 2, 3, 4 and 5 show that VC investment as a percentage of a country's GDP for selected years from 2001 to 2012. It demonstrates that Japan has one of the lowest percentage of VC investment per GDP among OECD countries (OECD, 2005; 2008, 2012).

Figure 2: VC investment as a percentage of country's GDP (2001-2003)



Source: OECD Science Technology and Industry Scoreboard, 2005

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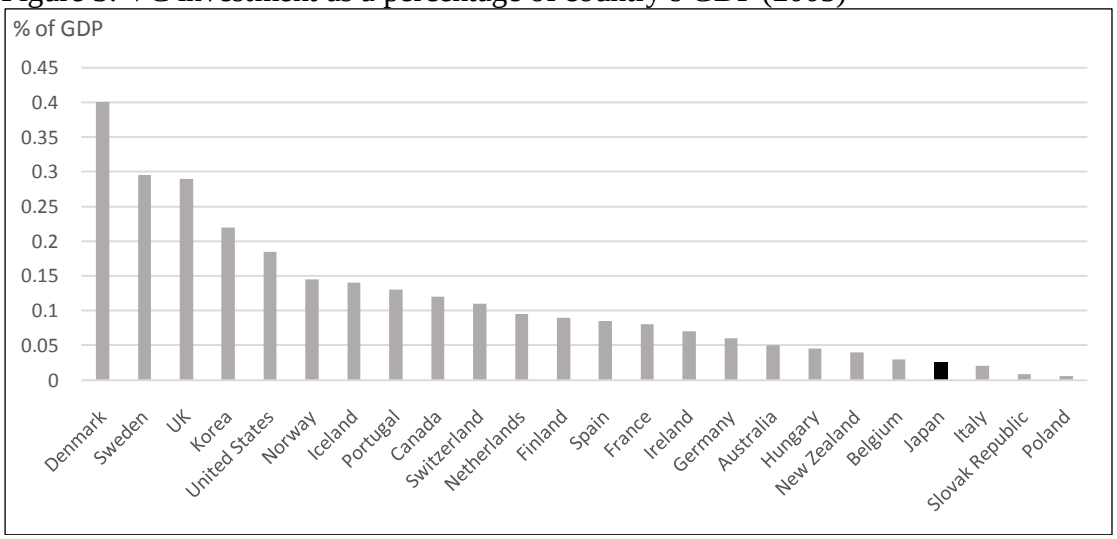
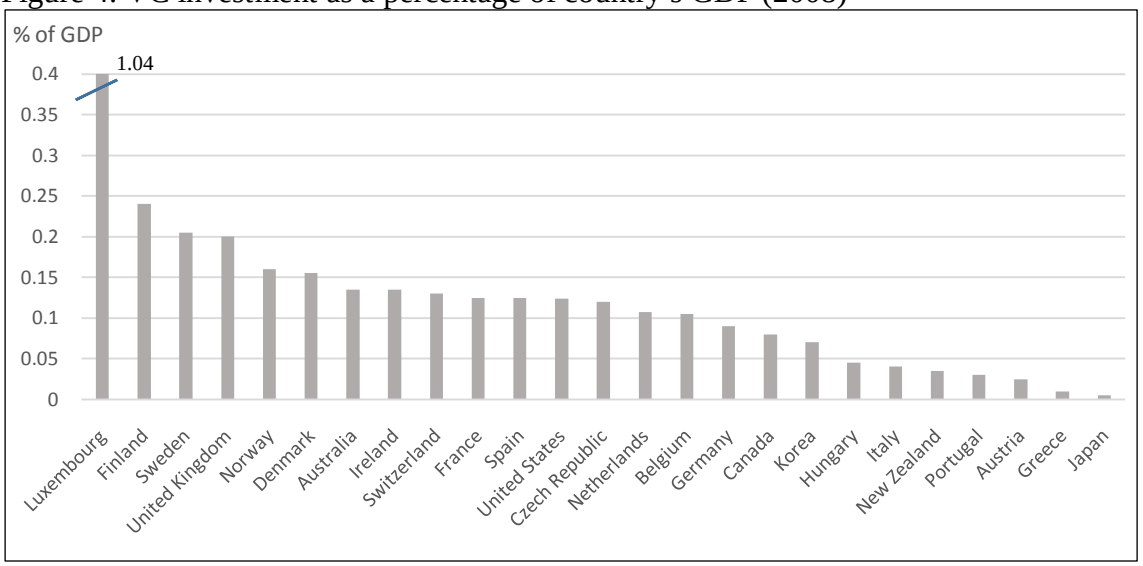
Figure 3: VC investment as a percentage of country's GDP (2005)



Source: OECD Science Technology and Industry Scoreboard, 2007

Figure 4: VC investment as a percentage of country's GDP (2008)



Source: OECD Science Technology and Industry Scoreboard, 2010

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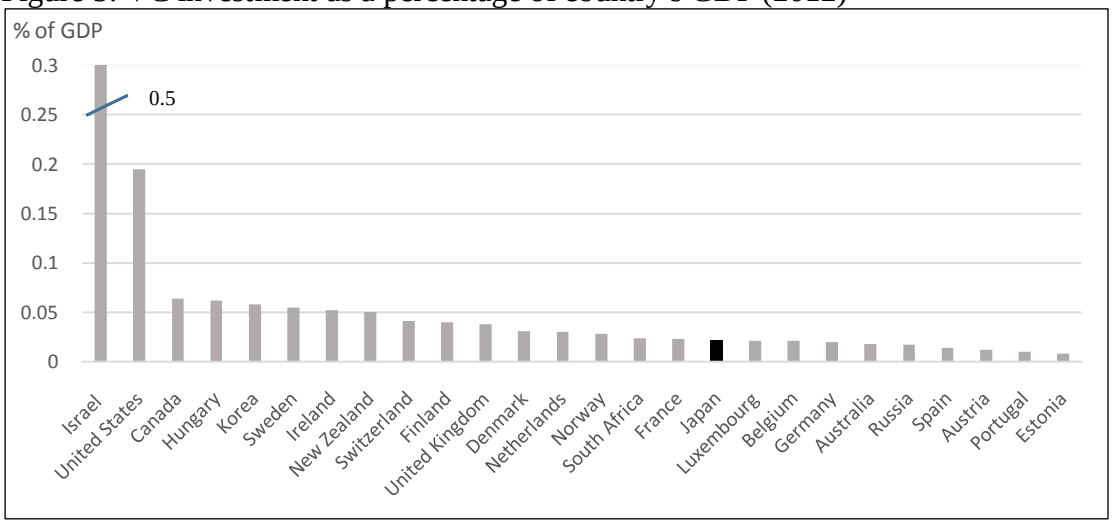
Figure 5: VC investment as a percentage of country's GDP (2012)

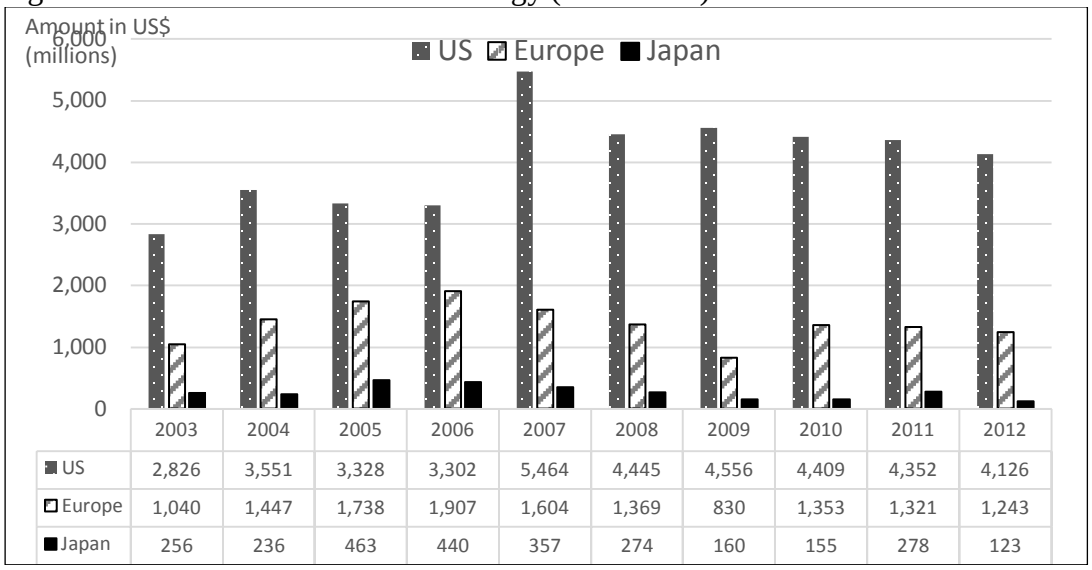


Source: OECD Entrepreneurship at a Glance, 2013

2.1 Performance of Japanese VC investments in the biotechnology industry

Figure 6 shows the trend of VC investment in the biotechnology industry among the US, Europe, and Japan from 2003 to 2012. Home to the some of the biggest biotechnology companies in the world and with the largest number of biotechnology companies, it is no surprise that the US has the largest VC investment. Despite billions of VC dollars, for many companies out there the picture is not nearly as rosy as suggested by the overall numbers. While aggregate VC fundraising and investments are high, the number of rounds fell and average capital raised per round increased over the years. More money may have been available, but it went to fewer companies. In the last few years, VC continued to focus on late-stage companies, raising questions about how young biotechnology companies will attract the capital needed to move to the next level.

Figure 6: VC investment in biotechnology (1995-2012)



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
US	2,826	3,551	3,328	3,302	5,464	4,445	4,556	4,409	4,352	4,126
Europe	1,040	1,447	1,738	1,907	1,604	1,369	830	1,353	1,321	1,243
Japan	256	236	463	440	357	274	160	155	278	123

Source: VEC annual reports, NVCA, EVCA website

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3. THE SUPPLY SIDE

This section seeks to examine the low supply of VC investments in Japan's biotechnology industry. The arguments include the nature of the industry, the process of investment, exit markets and fundraising.

3.1 The nature of the biotechnology industry

Perhaps it is the nature of biotechnology that discourages the risk-averse Japanese VC from investing into this industry. According to Pisano (2006), biotechnology confronts level of risk and uncertainty well beyond what is entailed in 'normal' R&D. While other science-based industries such as semiconductors; high-performance computers; missiles and aircraft, etc. are risky, they rest on a foundation of technological feasibility based on existing principles, methods, causal theories, and heuristics evolved from years of experience for commercial R&D. In contrast, in biotechnology, R&D confronts fundamental questions about the technical feasibility. Attempts to answer these questions lead to more questions or even unexpected results. Thus, biotechnology deals with primary uncertainty or the 'unknown unknowns'.

The uncertainty of technical feasibility in biotechnology (pharmaceutical drugs) leads to the long and costly drug development process. Research conducted by DiMasi, Joseph, Hansen et al. (2003), conclude that only 0.02% of compounds at early research successfully reached the market and became approved drugs. According to a team of researchers at Sagient Research System and Biotechnology Industry Organization, even at Phase III clinical stage, the failure rate for drugs is still too high – around 40% (Ernst & Young 2013). Tufts Center for the Study of Drug Development estimated that a new drug generally takes 10–15 years from discovery to approval and costs around US$802 million per approved drug.

In addition to sheer challenge of biological complexity, the biotechnology industry also faced regulatory risk. Biotechnology started with simple, low-risk targets such as human growth hormone and insulin. However today, the regulatory has to tackle with the complexity of stem cells, tissue regeneration, gene therapy, systems biology and so forth. These complex techniques require larger, longer clinical trials and greater expertise not just from the company but also from the regulatory. To add to this, the FDA has become increasingly conservative on the safety issue after the Vioxx's withdrawal in 2004. The R&D expenditures by biotechnology and pharmaceutical companies have increased geometrically over the past 15 years yet FDA approvals remained relatively flat, if not fewer (See Figure 7).

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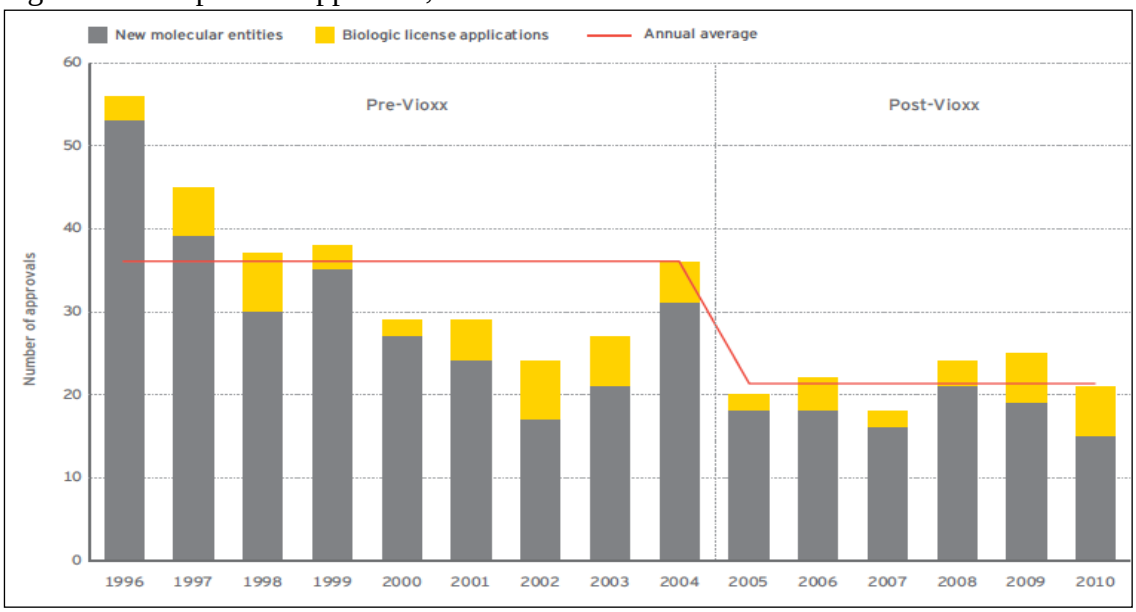
Figure 7: FDA product approvals, 1996-2010

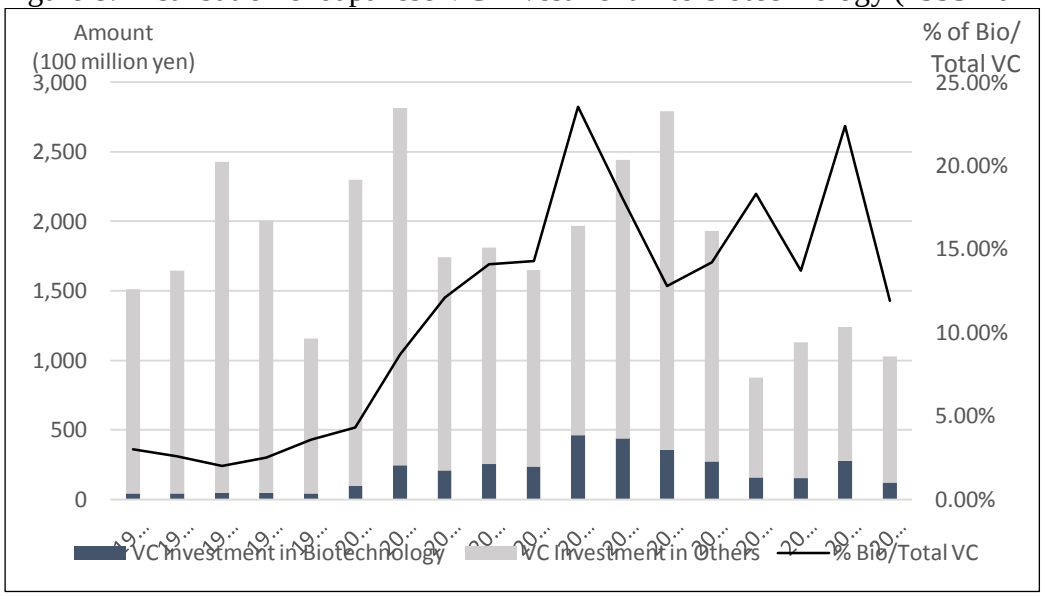


Source: FDA website

3.2 The investment process

Figure 8 shows the aggregate amount of VC investment made into the biotechnology industry. VC investments reached a peak in 2005 and 2006 but has since decreased to half of its amount after the global financial crisis. From 1995 to 2012, the average distribution of VC investment into biotechnology is 11.3%. The distribution is small compared to VC investment in other fields such as IT (average 40%), services (average 27%) and manufacturing (average 20%) during the same period. Even though the distribution into biotechnology has increased from 3% in 1995 to the peak of 23.55% in 2005 and 22.4% in 2011, the question is whether such funding amount is adequate taking into account the number of bioventures in Japan and the amount of funding needed for R&D.

Figure 8: Distribution of Japanese VC investment into biotechnology (1995-2012)



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Source: VEC annual reports

In 2012, there are more than 100 VC firms in Japan. Among the 100 VC firms, over 70% are subsidiaries of financial institutions, security houses, insurance companies and other large corporations (VEC 2013). According to Schaede (2008), the largest 30 VC firms in Japan, in terms of outstanding investment, represent 91% of the total estimated domestic VC investment. Table 1 shows the top 20 VC firms in Japan as of 2010.

Not all of the VC firms shown in Table 1 invest in biotechnology start-ups. For example, Softbank Investment Holdings focuses on IT companies and Tokyo Marine Capital focuses on private equity. Thus, actual dollar amount invested in bioventures is smaller than the average investment per firm as shown in Table 1. According to Japan External Trade Organization, the average "A Series" biotechnology investment in Japan is about ¥10-50 million or approximately US$100,000 – 500,000 (Ernst & Young 2009). On the other hand, according to PricewaterhouseCoopers Money Tree Report, the average start-up/seed investment for biotechnology in the US is US$2.6 million from 1995-2008 and the average early stage investment for biotechnology in the US is US$6 million from 1995-2008 (NVCA 2010). Thus, funding is spread more thinly in Japan than in the US.

Table 1: Top 20 VC Firms in Japan (as of March 2010)

Rank	Name of VC	Affiliation	Total Outstanding Investment (in million yen)	Total Investee	Average investment per firm (in million yen)	Staff	Number of investee per staff
1	JAFCO	publicly traded	199,675	1,044	191	216	5
2	Softbank Investment Holdings	publicly traded	181,172	441	411	-	-
3	Daiwa Corporate Investment (NIF SMBC Ventures)	publicly traded	117,569	1,083	109	109	10
4	Japan Asia Investment	publicly traded	63,074	980	64	152	6
5	Mizuho Capital	bank	49,641	1,149	43	85	14
6	Ant Capital Partners	securities	36,942	336	110	92	4
7	SBIC Tokyo	government	29,527	958	31	94	10
8	Tokyo Marine Capital	insurance	29,447	25	1,178	17	1
9	SBIC Osaka	government	27,616	895	31	55	16
10	Mitsubishi UFJ Capital	bank	27,354	943	29	85	11
11	Orix Capital	corporate	22,376	709	32	29	24
12	Nihon Venture Capital	independent	16,255	215	76	31	7
13	Future Venture Capital	independent	16,218	208	78	42	5
14	Yasuda Enterprise Development	insurance	14,760	407	36	46	9
15	SBIC Nagoya	government	13,724	561	24	31	18
16	Biofrontier Partners	independent	6,366	30	212	8	4
17	Globis Capital Partners	independent	6,065	33	184	14	2
18	Tsunami Network Partners	independent	5,272	32	165	18	2
19	MU Hands-On Capital	securities	4,266	96	44	20	5
20	Aozora Investment Co. Ltd	bank	2,532	105	24	6	18

Source: VEC annual reports, respective VC firms' websites

Related to the investment process is the investment approach practiced by Japanese VC. Japanese VC are known to be more risk averse compared to their western counterparts. Majority of the VC firms in Japan practice portfolio investment rather than 'true VC' style. Their investment strategy is to invest in a small amount into many companies and invite other VC firms to make similar investments. By doing so,

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risks including risk of a failed investment to the investment manager's reputation, will be limited.

The above investment approach is very similar to another distinguished characteristic of Japanese VC firms known as 'yoko narabi'. This is a Japanese term, literally means 'do as others do' approach. "Yoko" means horizontal and "narabi" means side by side. 'Yoko narabi' is an old traditional business practice in Japan. Yoshimura and Anderson (1997) provided some explanations to the rationality of the 'yoko narabi' culture. According to them, Japanese companies seek to avoid social embarrassment and thus adhere strictly to the group's norm, rules, and expectations. In order not to appear inferior to other companies, they 'match each other's move and try to do the same thing'.

When a VC firm invests in a bioventure, the rest of the VC community tends to follow because they do not want to miss out on the opportunity if the investment turns out to be good. On the other hand, if the investment fails, they minimize their risk by investing as a group. Because of the "yoko narabi" culture, most of the VC firms in Japan are less motivated to conduct their own extensive due diligence. They prefer to depend on the lead VC firm's evaluation or other VC firms who have already invested into the bioventure. This leads to fewer number of VC 'specialists' in Japan.

There is another reason why Japanese VCs tend not to conduct their own due diligence. As one of the bioventures puts it, "In Japan, people with Ph.D. in life sciences usually choose their careers in pharmaceutical companies or research institutes, but not in VC firms. Hence, most of the Japanese VC firms are operated by finance people without a life science background. As such, they do not have the expertise to conduct due diligence and they are not able to determine the risk they need to take in biotechnology investments." Disclosure rules for VC firms in Japan are limited and therefore it is hard to verify the number of investment professionals that specialized in biotechnology. However, it is also claimed that Japanese VCs more commonly have a background in finance while US VCs tend to have a science/engineering degree or ex-entrepreneurs.

Interviews conducted with bioventures revealed that majority of the Japanese VC firms tend to invest more at a later stage or prior to an initial price offering (IPO), hoping to make a quick capital gain through IPO. Furthermore, interviewees revealed that the goal for many of the VC firms is not to achieve the highest return on investment, but rather to increase the business of their parent company. For example, bank-backed VC firms invest into bioventures hoping to provide or extend loan services to them and securities-backed VC firms invest into bioventures hoping to underwrite their IPOs or to offer other investment banking services at a later date. It is not uncommon to find a bioventure with at least 20 VC firms invested into it. For example, M's Science Corporation – a bioventure specialized in R&D of central nervous system drug, received funding from 42 Japanese VC firms from 87 different VC funds. However, the total amount of VC investment is US$42 million.

3.3 Exit markets

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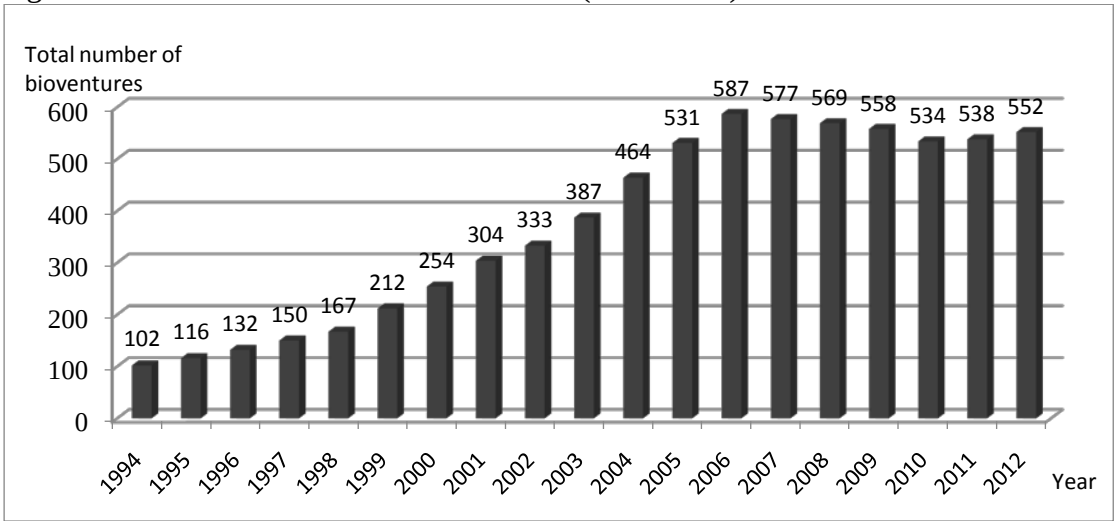
Another explanation for the weak performance of Japanese VC in the biotechnology industry is investors are reluctant to invest due to poorly developed exit markets. At the end of 2012, there are only 25 bioventures that successfully exited through IPO (see Table 2). This represents only 4.5% of the total number of bioventures in Japan (see Figure 9).

Figure 9: Cumulative number of bioventures (1994-2012)



Source: JBA, 2013

Table 2: Listed Bioventures in Japan (end of 2012)

No	Company Name	Establishment Year	Listed	Exchange
1	AnGes MG, Inc.	Dec-1999	Sep-2002	Mothers
2	Trans Genic Inc.	Apr-1998	Dec-2002	Mothers
3	MediBIC Group	Feb-2000	Sep-2003	Mothers
4	MEDINET Co., Ltd	Oct-1995	Oct-2003	Mothers
5	OncoTherapy Science, Inc.	Apr-2001	Dec-2003	Mothers
6	Soiken	Dec-2001	Dec-2003	Mothers
7	DNA Chip Research	Apr-1999	Mar-2004	Mothers
8	Sosei Group Corporation	Jun-1990	Jul-2004	Mothers
9	ECI, Inc. (formerly Effector Cell Institute, Inc.)	Jun-1999	3/1/2005 Delisted Nov 2012	Centrex (Nagoya)
10	Pharma Foods International Co. Ltd	Sep-1997	Jun-2006	Mothers
11	GNI, Ltd	Nov-2001	Aug-2007	Mothers
12	Japan Tissue Engineering Co. (J-TEC)	Feb-1999	Dec-2007	Jasdaq
13	NanoCarrier Co., Ltd.	Jun-1996	Mar-2008	Mothers
14	Carna Biosciences	Apr-2003	Mar-2008	Jasdaq
15	JCL Bioassay	Apr-2005	Mar-2009	Hercules (Osaka)
16	Tella	Jun-2004	Mar-2009	Jasdaq
17	CanBas	Jan-2000	Sep-2009	Mothers
18	D.Western Therapeutics Institute	Feb-1999	Oct-2009	Jasdaq
19	Cell Seed, Inc	May-2001	Mar-2010	Jasdaq
20	Raqualia	Feb-2008	Jul-2011	Jasdaq
21	Mebiopharma	Jul-2002	7/15/2011 Delisted June 2013	Tokyo Aim
22	SymBio Pharmaceuticals	Mar-2005	Oct-2011	Jasdaq
23	3D Matrix	May-2004	Oct-2011	Jasdaq
24	Chiome Bioscience Inc	Feb-2005	Dec-2011	Mothers
25	Gene Techno Science	Mar-2001	Aug-2012	Mothers
26	UMN Pharma	Apr-2004	Dec-2012	Mothers
27	Euglena	Aug-2005	Dec-2012	Mothers

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Source: TSE website, Compustat database

In addition to the low number of biotech IPOs, the average amount of IPO raised in Japan is also smaller compared to the US and Europe (see Table 3). Since the listing of the first bioventure, Anges MG in 2002 until the end of 2010, the average amount of IPO raised by a bioventure is ¥2,653 million or approximately US$26 million.

Table 3: Biotechnology IPOs

Year	2004		2005		2006		2007		2008		2009		2010	
	Average IPO raised (US$ million)	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*	*Average IPO raised (US$ million)*	*# of biotech IPOs*
US	59.99	28	48.15	13	47.20	20	56.27	22	6.00	1	232.00	3	73.13	15
Europe	51.88	8	38.90	21	32.76	25	48.10	21	37.00	3	48.00	3	21.90	10
Japan	49.54	5	34.48	1	24.33	1	42.45	3	7.18	1	6.85	4	23.00	1

Source: TSE website, Ernst & Young reports

One of the reasons that contributed to the poor IPO performance is, there is no single small cap market facilitating exit, along the lines of Nasdaq. While there are several small cap markets in Japan, individually they lack the liquidity that is associated with a unified market, making exit more difficult. The lack of large participation by institutional investors in Japan's emerging markets such as Mothers, Jasdaq and Hercules are partly to be blamed. In 2007, the biggest group of investor for Mothers, Jasdaq and Hercules was individual investors whereas the biggest group of investor for Nasdaq was institutional investors (see Table 4).

Table 4: Composition of investors in Japan's emerging market vs Nasdaq (2007)

	Japan			US
Exchange	Mothers (TSE)	Jasdaq (TSE)	Hercules (Osaka)	Nasdaq
Type of investors	*unit is percentage*			
Institutional investors	8.7	8.0	8.7	77.0
Foreign investors	14.8	12.6	12.6	12.0
Individual investors	76.3	78.9	78.5	6.0
Others	0.2	0.5	0.2	5.0

Source: TSE (2010)

3.4 Fundraising

Before 1998, Japanese VC firms could not legally be structured as limited liability partnerships (a common practice in the US and Britain). Thus, many were established as stock company subsidiaries or affiliates of larger securities companies, banks, and other financial institutions. Even though modifications were made to allow the establishment of Limited Liability Partnerships in 1998, many of the VC firms which are subsidiaries of financial institutions, security houses, insurance companies or other large companies remained. Such VC firms are used to giving 'loans' rather than 'equity investment'. Although this ratio is now almost zero, in some VC firms, the old

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attitude remains. Equity investments are often treated as functionally equivalent to loans and being evaluated the same way.

Lastly, the biggest difference between VC in Japan and the US is fund raising. In Japan, the largest investors of VC funds are conventional financial organizations, such as banks, securities houses, and insurance companies. On the other hand, in the US, pension funds are great contributors to VC funds. The importance of pension funds for VC investment in the US has been directly impacted by changes in legislation, including the relaxation of the 'prudent man' rule which allowed them to invest up to 15% of their assets in riskier investments and the safe harbor rule in 1980, which resulted in pension funds becoming the largest source of VC funding in the US (see Table 4). By contrast, in Japan investment rules were changed to allow pension funds to invest in VC in 1997. However, the change in investment rules did not alter the contribution of VC funding from pension funds. Even though more than 10 years have passed since the legislation was implemented, the contribution from pension funds in Japan remained limited (see Table 5).

Table 5: Sources of VC funds in the US

Year	1978	1979	1980	1982	1984	1986	1988	1990	1992	1994
Sources of VC Funding	Amount in percentage									
Corporations	10.0	17.0	19.0	12.0	14.0	11.0	12.0	7.0	3.0	9.0
Individuals	32.0	23.0	16.0	21.0	15.0	12.0	8.0	11.0	11.0	12.0
Pension Funds	**15.0**	**31.0**	**30.0**	**33.0**	**34.0**	**50.0**	**47.0**	**53.0**	**42.0**	**47.0**
Foreign	18.0	15.0	8.0	13.0	18.0	11.0	13.0	7.0	11.0	2.0
Endowments	9.0	10.0	14.0	7.0	6.0	6.0	11.0	13.0	18.0	21.0
Insurance Companies	16.0	4.0	13.0	14.0	13.0	10.0	9.0	9.0	15.0	9.0

Source: Brav and Gompers, 1997

Table 6: Sources of VC funds in Japan

Year	2001	2003	2005	2007	2008	2009	2010	2011
Sources of VC Funding	*Amount in percentage*							
Bank, trust, credit unions	29.00	35.00	17.60	12.00	15.20	28.30	18.40	22.00
Security Company	2.00	6.60	4.70	5.60	4.30	0.10	0.00	7.50
Insurance	3.00	5.30	8.80	6.70	11.70	0.20	66.40	3.20
Corporate investors	23.00	12.70	20.10	24.00	18.90	2.80	7.90	14.90
General Partner	6.00	15.90	21.50	13.90	36.60	39.90	4.30	7.60
Pension	**2.00**	**2.40**	**0.00**	**1.20**	**2.40**	**0.00**	**0.00**	**0.00**
Family/ Private individual	8.00	0.30	14.40	14.60	5.50	0.80	0.00	0.20
Other domestic including government/local public authority (non pension)	24.00	20.70	11.40	8.60	5.20	16.60	3.00	31.10
Overseas	3.00	1.10	1.50	13.40	0.20	11.30	0.00	13.50

Source: VEC annual reports

4. THE DEMAND SIDE

On the basis of this argument, rather than being a supply side issue, perhaps the problem lies on the demand side, namely there are simply fewer quality bioventures being generated in Japan. It may be that the supply side issues outlined above such as lack of exit markets, is a red herring: the low level of liquidity arose simply because there was very little demand for IPO due to fewer quality bioventures ready to be

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taken to market. However, Japan does not seem to lack good seeds from the life science sector. Japan ranked second in the world after the US in terms of world's share articles in biomedical research, biology, clinical medicine and overall fields in natural sciences (OECD 2009). Japan was the only country among the top five countries in the production of scientific knowledge (US, Japan, Germany, UK and France), to increase its share from 8.5% to 8.6% between 1996 and 2003 (Okamoto 2008).

Another demand side argument could be the lack of entrepreneurship. For a nation that once boasted the likes of Sony, Toyota and Mitsubishi as its entrepreneurial heralds, Japan's entrepreneurial record in the new millennium is surprisingly sparse. The key issue here is the highly risk averse culture. Many university graduates, as well as skilled researches and scientists, are reluctant to move away from stable jobs with large companies or public research institutes to establish their own bioventures. Although there are some signs of entrepreneurship (as evident by the increasing number of bioventures), entrepreneurs in Japan is still an exception rather than the norm.

5. DISCUSSION

Many of the above arguments can be summarized by saying that unlike in the US, Japanese VC failed to transform Japan's biotechnology industry. While it is true that some bioventures received VC investments, as a whole, VC's contribution has been limited. Bioventures particularly those at the early- stage continue to struggle with the funding issue. The lack of funding causes a vicious cycle to develop. The limited amount of VC investments compels some of the bioventures to seek an early IPO. Since most of the early-stage bioventures have only seed or early-stage pipelines, funding raised from an IPO is insufficient to cater to their R&D needs. Hence, they continue to experience delays in their R&D. This lead to unachievable milestones and sales projections. Investors react to this event by dumping bioventures' stocks. Low stock prices and falling market capitalization discourage further VC investments and the whole vicious cycle become more entrenched.

Bioventures suffering most from this funding gap are usually in their critical development phases, where product candidates have emerged, but financial support for 'proof of concept' clinical studies is lacking. At the same time, proof of concept has become the most important decision factor for any potential investments. If solutions are not found to fund these bioventures, sustainability of Japan's biotechnology industry could be challenged in future years.

There are two ways to look at this. Firstly, the current Japanese VC model needs to be readdressed. Secondly, bioventures need to look for other alternatives besides VC to meet their funding requirements.

In the past, VC funding in Japan's biotechnology industry is driven more by 'venture booms' and 'biotechnology hype' rather than the actual changes in the structure of the VC funds. On this basis, government interventions alone through legislation seem to have only a limited effect. As discussed earlier, the investment rules to allow Japanese

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pension funds to invest in VC in 1997 did very little to alter the composition of VC funds.

In the case of Europe, VC relies much more on funds from government agencies rather than pension funds. Many governments such as Singapore, Malaysia, Canada and Israel have created dedicated VC funds to develop biotechnology start-ups. Singapore's BioOne VC fund is one example. BioOne is established by Singapore's Economic Development Board to solely fund biomedical ventures. In 2007, the fund's total capitalization equaled approximately US$800 million, the largest such fund in the Asia region. While not many governments are as bold as Singapore to conduct a direct investment, another frequently used approach is through co-investment funds or 'fund of funds' model in which government invests along with private actors including VCs and the fund is privately managed. Governments using this approach includes Australia, Canada, France, Germany, UK and New Zealand.

There are some hopeful signs in Japan. In 2009, the Japanese government established Innovation Network Corporation of Japan (INCJ) to fund various innovative investment opportunities. According to its website, INCJ is capitalized at 300 billion yen or approximately US$2.94 billion with the Japanese government injecting 286 billion yen and 26 private corporations including the likes of Asahi Kasei, Sumitomo Chemical, Toshiba, Hitachi and Takeda Pharmaceutical providing a further 14 billion yen. INCJ plans to invest in the areas of green energy, electronics, IT, biotechnology to infrastructure-related sectors. To date, INCJ has invested/co-invested in only a handful of bioventures such as Anaeropharma, Pharma8, NapaJen Pharma, Megakaryon and Create Vaccine. The amount of investment per round ranged from approximately US$550,000 to a US$8.4 million.

The success of government playing the role of VC is debatable. Some scholars argued that government's effort in venture investment has been plagued by poor program design and implementation. A number of studies have shown that purely from a performance perspective, the track record of the public sector as a direct investor is weak, largely due to the pursuit of other non-financial objectives with their investing. Profit maximization is not necessarily the goal of public sector investment (Lerner 2009; Wong 2011).

However, there is reason to believe that when done properly, government VC funds help to address critical market gaps, thereby boosting the country's innovation ecosystem. The best way is perhaps for government to form dedicated VC funds that co-invest with private investors thereby ensuring that the fund is not detached from the realities of the market. In addition, government VC funds must also work to attract highly talented staff, to set them up with enough independence to avoid political pressures in the investment process and to align incentives for fund managers.

Finally, the familiar path trodden by western biotechnology start-ups that relied on VC funding may had to be replaced by new innovation solutions such as developing 'hybrid' business models, making R&D more lean and efficient, leveraging the strengths of IP and forming strategic alliances with research institutes and pharmaceutical companies. The 'hybrid' business models involved combining contract service activities with innovative drug development. In order to make R&D more lean and efficient, some biotechnology experts are advocating precision

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medicine (increase the utilization of biomarkers and targeted therapies); adaptive clinical trials (preplanned alterations generated via simulations and scenario planning) and precompetitive consortia (participation in holistic open learning networks). Other early stage biotechnology companies are staying lean and focused, even though, their technology and IP platform is suitable for a wide range of applications. In short, bioventures have to be more proactive to seek other alternatives besides relying on VC funding.

6. CONCLUSION

Perhaps more than any other sector, the biotechnology industry depends on innovation for its very survival. While the term ‘innovation' is usually applied to scientific or technological advance, financial innovation has also played a critical role in shaping the industry. Specifically, VC played a crucial role in making the US's biotechnology industry a success. The same cannot be said for Japan. In this paper, we have seen that the VC industry in Japan is deeply rooted with its own idiosyncrasies, culture, and social patterns. Because institutions and organizations exist within a complex, intertwined web of relationships, making small changes, one at a time may be costly and inefficient. Perhaps it is necessary to make bold simultaneous reforms or to think out of the box for innovative solutions to cultivate Japanese bioventures. The goal should not stop at merely creating a large number of small bioventures but to create sustainable, globally competitive biotechnology companies.

REFERENCES

[1] BIO (2014). Biotechnology Industry Organization website, accessed 10 March, 2013 <http://www.bio.org/industry-intelligence/publications>

[2] Brav, Alon and Gompers, Paul A. (1997). Myth or Reality? The Long-Run Underperformance of Initial Public Offerings: Evidence from Venture and Nonventure Capital-Backed Companies. *Journal of Finance*, 52, (5), 1791-1821.

[3] DiMasi, Joseph, Hansen, Ronald and Grabowski, Henry. (2003). The Price of Innovation: New Estimates of Drug Development Costs. *Journal of Health Economics*, 22, (2), 151-85.

[4] Ernst & Young (2006). *Beyond Borders: Global Biotechnology Report*. Ernst and Young, London.

[5] Ernst & Young (2007). *Beyond Borders: Global Biotechnology Report*. Ernst and Young, London.

[6] Ernst & Young (2009). *Beyond Borders: Global Biotechnology Report*. Ernst and Young, London.

[7] Ernst & Young. (2010*). Beyond Borders: Global Biotechnology Report*. Ernst and Young, London.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM)

[8] Ernst & Young. (2013). *Beyond Borders: Global Biotechnology Report*. Ernst and Young, London.

[9] EVCA (2014). European Venture Capital Association website, accessed 1 August, 2014 <http://www.evca.eu/research/activity-data/annual-activity-statistics/>

[10] FDA (2012). U.S. Food and Administration website, accessed 20 December, 2012 <http://www.accessdata.fda.gov/scripts/cder/ob/default.cfm>

[11] JBA (2013). *2012 Bioventures Statistic Report.* Japan Bioindustry Association. [2012 nen baibencha toukei chousa houkokushou] (in Japanese).

[12] JVCA (2007). *The Supply of Venture Capital*. Japan Venture Capital Association. [Bencha kyapitaru wo tsujite shikin kyoukyuu] (in Japanese). Accessed: November 21, 2010. Retrieved from http://www.meti.go.jp/committee/materials/downloadfiles/g71025a04j.pdf

[13] Lerner, J. (2012). *Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed and What to Do About It*. New Jersey: Princeton University Press.

[14] NVCA. (2010). PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report. Accessed: June 2, 2010. Retrieved from https://www.pwcmoneytree.com/MTPublic/ns/index.jsp

[15] NVCA (2014). National Venture Capital Association website, accessed 24 July, 2014 <http://www.nvca.org/index.php?option=com_content&view=article&id=344&Itemid=103>

[16] OECD. (2005). *OECD Science, Technology and Industry Scoreboard*, 2005. Paris: OECD Publishing.

[17] OECD. (2007). *OECD Science, Technology and Industry Scoreboard*, 2007. Paris: OECD Publishing.

[18] OECD. (2009). *OECD Biotechnology Statistics*, 2009. Paris: OECD Publishing.

[19] OECD. (2010). *OECD Science, Technology and Industry Scoreboard*, 2010. Paris: OECD Publishing.

[20] OECD. (2013). *OECD Entrepreneurship at a Glance*, 2013. Paris: OECD Publishing.

[21] Okamoto, Yumiko. (2008). *Paradox of Japanese Biotechnology: Can the Regional Cluster Development Approach be a Solution* (Working paper). Doshisha University.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM)

[22] Pisano, G. (2006). *Science business.* Boston: Harvard Business Press.

[23] Schaede, Ulrike. (2008). *Choose and Focus: Japanese Business Strategist for the 21st Century.* New York: Cornell University Press.

[24] TSE. (2010). *Mothers Exchange Monthly Report - May 2010.* Tokyo Stock Exchange. Tokyo

[25] VEC (2014). Venture Enterprise Association website, accessed 1 August, 2014 <http://www.vec2.jp/report_statistics/vec_whitepaper_dt3>

[26] Wong, J. (2011) *Betting on Biotech: Innovation Beyond the Developmental State*, Ithaca: Cornell University Press.

[27] Yoshimura, Noboru and Anderson, Philip. (1997). *Inside the Kaisha: Demystifying Japanese Business Behavior*. Boston: Harvard Business Press.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM)