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Abenomics and Japan's Entrepreneurship and Innovation:
Is the Third Arrow Pointed in the Right Direction for Global Competition in the Digital Era of Silicon Valley?

Kenji E. Kushida, Stanford University

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Introduction

As Japan's political economy evolves over time, a critical question is whether or not it is adjusting effectively to dynamics of global competition. The relative position that Japanese firms occupy in global value added activity has serious implications for not only the country's economy, but also its internal political dynamics and international relations. For example, are electoral dynamics shaped by a backdrop of economic growth and dynamism, or stagnation and crisis? Or in the regional context, for example, is Japan, an economically strong nation next to massive and fast-growing China, capable of some regional leadership on select issues, or is it a weak follower in a new regional order? While macroeconomic factors certainly play a key role in economic growth, the underlying competitiveness of firms in global markets is critical.

Corporate strategies of industries and firms are, in turn, shaped by national contexts. Markets do not exist in a vacuum, but are shaped by regulatory architectures, local economic contexts, social factors, political dynamics, and the underlying institutions that coordinate activities in any national context.[1] Domestic contexts can significantly influence firms' international strategies, which can in turn shape global competition—global markets are often

[1] See, for example, Zysman, J. (1983). Governments, Markets, and Growth: Financial Systems and the Politics of Industrial Change. Ithaca, NY, Cornell University Press, Granovetter, M. (1985). "Economic action and social structure: The problem of embeddedness." American journal of sociology **91**(3): 481-510, Perez, C. (2009). "Technological revolutions and techno-economic paradigms." Cambridge journal of economics: bep051, Vogel, S. K. (2018). Marketcraft: How Governments Make Markets Work, Oxford University Press.

national markets that play out on a global stage.[2] Winners and losers in global competition are therefore influenced by domestic contexts.[3]

Historically, Japan shifted decisively from its status as one of many countries aiming to catch-up to global leaders, to becoming a leader in many areas of global competition, and then to being disrupted and commoditized in key areas. Global leadership can be thought of in general as firms (1) shaping the technological trajectories of industries; (2) re-organizing global competition by transforming industries or creating new industries; and (3) introducing new paradigms of industrial production. In the 1970s and 80s, Japanese firms shaped technological trajectories by successfully commercializing various technologies not necessarily invented in Japan, but whose inventors had been unable to successfully commercialize them, and setting trajectories of miniaturization with high manufacturing quality.[4] These firms re-shaped global competition by becoming strong global competitors in areas such as semiconductors, consumer electronics, and automobiles. With the "lean production" model of manufacturing, they forced manufacturers around the world to adjust to new information flows by holding little inventory and utilizing factory floor workers to enhance production quality.[5]

More recently, global leadership has shifted to the economic ecosystem of Silicon Valley. Driven by a comeback in the 1990s fueled by the computer industry, American firms reshaped technological trajectories by shifting value to constituent elements of final assembly in products and enabling software to add value.[6] Such firms reshaped global competition as they created whole new industries surrounding information technology (IT), and became the world's most valuable companies and cash holders.[7] New models of production, designed in Silicon Valley with outsourced manufacturing, and "open" innovation in the form of purchasing startup firms to replace or augment traditional in-house R&D became a new production paradigm to which the

[2] Breznitz, D. and J. Zysman, Eds. (2013). The Third Globalization: Can Wealthy Nations Stay Rich in the Twenty-First Century?, Oxford University Press.
[3] Dosi, G., L. Tyson and J. Zysman (1989). "Trade, technologies, and development: a framework for discussing Japan." Politics and productivity: how Japan's development strategy works. NewYork: Harper Business.
[4] Johnstone, B. (1999). We were burning : Japanese entrepreneurs and the forging of the electronic age. Boulder, Colo., Basic Books.
[5] Womack, J. P., D. T. Jones and D. Roos (1991). The machine that changed the world : the story of lean production. New York, N.Y., HarperPerennial.
[6] Borrus, M. and J. Zysman (1997). "Globalization with Borders: The Rise of Wintelism as the Future of Industrial Comptetition." Industry and Innovation **4**(2): 141-166, Baldwin, C. Y. and K. B. Clark (2000). Design rules. Cambridge, Mass., MIT Press.
[7] See appendix for SMBC graphs

rest of the world had to adjust.[8] By the 2000s, Silicon Valley emerged as the decisive area giving rise to firms that commoditized others around the world, including Japan.

Beyond a place, Silicon Valley represented a model, a specific set of complementary institutions that mutually enhanced each other – a core model in comparative institutional analysis.[9] From this model emerged yet more new principles of competition that accelerated commoditization elsewhere. Platforms, in which third parties could utilize the resources provided by the platform player, which enhanced both the value of the third parties as well as the platform provider, but conferred greater benefits to the platform provider, emerged as a critical driver of global competition since the 2000s.[10] Once platforms were established, network effects enhanced their value until they were disrupted by a separate set of platforms – computer operating systems to mobile operating systems with integrated app store markets and ecosystems, for example.[11]

As Japan was hit in the 1990s by the bursting of the asset bubble and the new dynamics of competition in global markets delivered by the US computer industry, both the overall Japanese economy and firms' global competitiveness suffered. Electoral politics took place in the context of economic and corporate challenges. From the mid-to late 1990s, the Japanese political economy began to adjust and transform.[12] Regulatory changes shifted industry dynamics, enabling the rapid entry and expansion of foreign firms into previously protected areas, and shifts in corporate law, employment law, and industry-level regulations allowed new models of corporate governance and employment structures. A useful concept is "syncretism," in which traditional, new, and hybrid forms of organization and practices coexist.[13]

During the first decades of the 2000s and through 2012, Japanese political dynamics entailed rapid turnover of Prime Ministers, as well as a historic, though brief change in the ruling coalition as the Democratic Party of Japan (DPJ) unseated the Liberal Democratic Party (LDP)

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[8] Sturgeon, T. J. (2002). "Modular production networks: a new American model of industrial organization." Industrial and corporate change **11**(3): 451-496, Chesbrough, H. W. (2006). Open innovation: The new imperative for creating and profiting from technology, Harvard Business Press.

[9] Aoki, M. (2001). Toward a comparative institutional analysis. Cambridge, Mass., MIT Press.

[10] Gawer, A. and M. A. Cusumano (2002). Platform leadership : how Intel, Microsoft, and Cisco drive industry innovation. Boston, Mass., Harvard Business School Press, Kenney, M. and J. Zysman (2016). "The rise of the platform economy." Issues in Science and Technology **32**(3): 61.

[11] Microsoft and Amazon, though headquartered in Seattle, should be considered part of the Silicon Valley model, as they were venture capital backed startups and draw from similar pool of human capital for software programming, and have significant presences in Silicon Valley to tap into the human resource pool.

[12] Vogel, S. K. (2006). Japan Remodeled: How Government and Industry are Reforming Japanese Capitalism. Ithaca, NY, Cornell University Press.

[13] Kushida, K. E., K. Shimizu and J. Oi, Eds. (2014). Syncretism: Corporate Restructuring and Political Reform in Japan, Shorenstein APARC.

for the first time in almost 50 years. Yet since the late 1980s, prime ministers rarely served more than two years, and after Koizumi Junichiro stepped down in 2005, Japan experienced seven Prime Ministers in seven years. Policy continuity, let alone a cohesive structural reform plan, was difficult. Lack of a strategic aspect or concrete direction for policies was an often lamented aspect of Japanese policymaking during this era.

Then, since 2012, when the LDP returned to power, the Abe administration has retained power—one of the longest prime ministerships in the postwar era. As it assumed power, the Abe administration put forth a remarkably well branded and enthusiastically promoted economic reform package, "Abenomics," consisting of "three arrows": 1) aggressive expansionary monetary policy (printing much more money than in previous efforts); 2) fiscal stimulus (government expenditures to boost the economy); and 3) a set of economic structural reforms.

The third arrow, in particular, was a comprehensive reform strategy that recognized Japan's need to restructure many aspects of its economy to compete in the current digital, globalized era. It was, put simply, an unusual opportunity for a comprehensive reform program.

Given that much of the global leadership in value creation over the past couple of decades has been driven by the Silicon Valley model – not only a geographic region but a distinct ecosystem of complementary characteristics – the basic question this paper asks is how far Japan's Abenomics reforms are pushing Japan towards being able to compete in an era dominated by Silicon Valley firms.

To answer this, the first section of this paper looks at content of the third arrow of Abenomics. The second section then distills the Silicon Valley ecosystem into its key characteristics, sorts each of these characteristics according to the underlying institutions to put forth a model, and briefly evaluates whether third arrow reforms move Japan closer to a Silicon Valley model of entrepreneurship and innovation.[14]

It is important to note that in this line of inquiry, it would be naïve to proceed on the assumption that if Japan can simply duplicate the institutions of Silicon Valley, it will be more successful in global markets. Moreover, piecemeal adoption of one or more institutions is unlikely to succeed since the institutions are complementary and dependent on each other, and

[14] Institutions, in this case, are "rules of the game" that actors agree upon to follow for their own benefit, thereby sustaining the rules Aoki, M. (2001). Toward a comparative institutional analysis. Cambridge, Mass., MIT Press..

Silicon Valley evolved through historically specific conditions. In fact, the world is littered with failed attempts at initiatives to create local versions of Silicon Valley.[15]

Thus the goal for Japan should not be piecemeal adoption but, instead, the strengthening of the institutional underpinnings that enable Silicon Valley model entrepreneurship and innovation. Even if it is limited to a specific portion of the political economy—with a syncretic arrangement of the coexistence of traditional, hybrid, and new—ensuring that part of Japan's new political economic model develops greater compatibility with that of the Silicon Valley model will likely help firms harness the dynamics created by Silicon Valley.

Put differently, since it is undoubtedly the set of institutions of the Silicon Valley model that have produced wave after wave of cutting edge services, technology, and strategies for competing and creating value in the global economy, the question for Japan is whether some parts of its economy are moving towards institutions similar to those observed in Silicon Valley—to better align Japan to not simply duplicate, but also harness value from Silicon Valley. The premise here is that if Japan's economic model diverges greatly from the Silicon Valley model, it will be difficult even to find mutual benefit between high growth startups and the talent within large Japanese corporations. In the past, the Japanese model was widely considered an impediment to adopting and adapting to the Silicon Valley model.

Are Abenomics third arrow reforms moving Japan closer to a Silicon Valley model of entrepreneurship and innovation? If so, to what degree was Japan already on this trajectory, and are the Abenomics third arrow reforms helping or hindering Japan's evolution along this trajectory?

The conclusion, up front, is that Japan was already on a trajectory to better harness Silicon Valley model innovation. Its financial system, labor market, industry-university-government ties, industrial organization, social system encouraging entrepreneurship, and professional services ecosystem have evolved significantly since the late 1990s. Many of the factors seen as impediments in the previous Japanese model have shifted to better embrace the growing startup ecosystem and its necessary ties to large firms and venture capital finance. These changes grew out of piecemeal regulatory shifts and normative changes since the mid- to- late 1990s. The Abenomics third arrow reforms spell out the need for further developments along this

[15] Lerner, J. (2009). Boulevard of broken dreams: why public efforts to boost entrepreneurship and venture capital have failed--and what to do about it, Princeton University Press.

new trajectory, but many of the specific measures seem to be targets that would already have been achieved regardless of whether they were stipulated. While some traditional-style industrial policy initiatives remain, particularly in energy, other broader targets, including implementing robotics and sensor technologies in areas such as healthcare, have the potential to turn Japan's domestic conditions into opportunities for firms to achieve international competitiveness. Arguably the most important contribution of the Abenomics third arrow reforms is an unambiguous commitment to support and promote a startup ecosystem in Japan, along with the partnerships between large firms, government-university-industry ties, and R&D efforts in technology to legitimize startups as necessary drivers of innovation.

1. The Third Arrow of Abenomics

The third arrow of Abenomics was articulated in its entirely in a June 2013 document called the "Japan Revitalization Strategy," with the alluring subtitle, "Japan is BACK." It began with the recognition that Japan had experienced two decades of slow growth and set out a roadmap to regain GDP growth and increase productivity growth. The roadmap entailed general principles, followed by "three action plans."

Roadmap

1. Unleashing the power of the private sector to the fullest extent
2. Participation by all & fostering human resources who can succeed in global competition
3. Creating new frontiers
4. Redistributing the fruits of growth to peoples' lives

The roadmap's first point, "unleashing the power of the private sector to the fullest extent," including restructuring industries and accelerating venture businesses, with language such as "the government will boldly promote capital investment and creation of new businesses at unprecedented speed." It also explicitly aimed at international competition, specifying that "…to ensure that shareholders and other stakeholders proactively support the forward-looking initiatives by company managers, corporate governance will be reviewed so that Japanese companies will excel in international competition." (p.4) Regulatory and institutional reform are also targets, recognizing that in many areas such as medical care, nursing care, childcare, and agriculture, energy, and public services, regulations hindered dynamism in the private sector.

The second point, fostering greater human resources who can succeed in global competition, includes bringing the hitherto underutilized power of women into the workforce, activating the healthy elderly and youth, and developing Japanese youth into globally competitive human resources.

The third point, creating new frontiers, articulates the idea that the only way to sustain growth is to either create entirely new markets by developing pioneering products, services, and systems, or by growing and expanding into international markets. It articulates the need for a "Made by Japan" approach, which includes revising Japan as a "technology-driven" and "intellectual property based nation" through an "all-Japan" effort by mobilizing R&D efforts of the government, universities, and private sector into strategic areas. It points to drastically

increasing the functions of the Council for Science and Technology Policy, and pledges government support for innovative research. The other areas of the new frontiers are identified as "leaping into the world" and "attracting the world" with efforts to facilitate the expansion of both large companies and small-medium enterprises (SMEs) abroad, as well as attracting foreign companies and skilled human resources.

The final point is focused on redistribution, to ensure the equitable distribution in society of whatever gains are made. This includes improving corporate productivity while increasing flexibility of labor mobility, diversity and workstyles, and new approaches to human resource development.

In the strategy, the methodology is noted as "implementing policies at an unprecedented speed" and "accelerating reforms with national strategic special zones services as the gateway."

Critically, and in a new effort for Japanese policymaking, the third arrow strategy calls for specific key performance indicators (KPIs), with numerical targets, target end-dates, and periodic review of attainment levels.

The second part of the document outlines extremely detailed goals in "Three Action Plans," which include 1) "Industry Revitalization Plan," 2) Strategic Market Creation Plan, and 3) Strategy of Global Outreach. The Industry Revitalization plan includes categories such as accelerating the structural reform plan by stimulating private investment, promoting investment in startups, facilitating restructuring and reorganization. Another plan to reform the employment system addresses shifting from "excessive employment stability to labor fluidity (realizing labor movement without unemployment)," and promoting diversity in the workforce and workstyle.

The Strategic Market Creation Plan includes specific areas such as expending the nation's "healthy life expectancy," promoting clean and economical energy and efficiency, building next generation infrastructure, and "building regional communities that use their unique local resources to appeal to the world."

The Strategy of Global Outreach focuses on building strategic trade relations, such as the TPP, and strategic initiatives such as exporting infrastructure, supporting SMEs to go abroad, and promoting culture-related content industries through "Cool Japan" initiatives.

Table 2: Abenomics Third Arrow 2013: **Three Action Plans (selected reforms)**

I. Industry Revitalization Plan: revitalizing human talent, goods and funds	
1. Accelerating structural reform program (vitalizing industries)	
1.1	Stimulating private investment
1.2	Promoting investment in business ventures and investment to challenge businesses to fully utilize resources in and outside of Japan
1.3	Promoting business restructuring and reorganization
	Etc.
2. Reforming the employment system and reinforcing human resources capabilities	
2.1	Policy change that promotes labor fluidity (realizing labor movement without unemployment)
2.2	Realizing flexible and diversified ways of working
2.3	Promoting increased labor force participation by women
2.4	Promoting increased labor force participation by the young/the elderly
2.5	University reforms
	Etc.
3. Promoting Science, Technology and Innovation	
3.1	Enhancing the functions of national research institutes
3.2	Securing funds for research support personnel
3.3	Increasing R&D investment by the public and private sectors
3.4	Strengthening intellectual property strategies/standardization strategies
	Etc.
4. Becoming the world's leading IT society	
4.1	Promoting private sector access to public data and developing innovative electronic administrative services
4.2	Developing the world's top-level telecommunication infrastructure
4.3	Promoting cyber security measures
	Etc.
5. Further strengthening Japan's international competitiveness as a business hub	
5.1	Realizing "National Strategic Special Zones"
5.2	Improving infrastructure such as airports, ports and harbors
5.3	Considering ways to manage public and quasi-public funds
	Etc.
6. Innovation of small and medium-sized enterprises (SMEs)	
6.1	Using, mobilizing, and commercializing regional resources as brands
6.2	Accelerating the restructuring of small and medium-sized enterprise (SMEs)
6.3	Supporting small and medium-sized enterprises (SMEs) which expand internationally
	Etc.

II. Strategic Market Creation Plan	
1. Extending the nation's "healthy life expectancy"	
1.1	Realizing a society with the world's most advanced medical care by activating medicine-related industries
1.2	Realizing a society where people who are out of work due to illness or injury can return to work as quickly as possible by access to better medical care and nursing care
	Etc.
2. Realizing clean and economical energy demand and supply	
2.1	Efficient distribution of energy through competition
2.2	Wise consumption of energy
	Etc.
3. Building safe, convenient and economical next-generation infrastructures	
3.1	Provide safe and resilient infrastructures at low cost
3.2	Provide safe and convenient transportation for people and goods
	Etc.
4. Building regional communities that use their unique local resources to appeal to the world	
4.1	Strive to produce the world's best quality agricultural, forestry, and fishery products and food produce
4.2	Increase tourism to regional communities
	Etc.
III. Strategy of Global Outreach	
1. Building strategic trading relations and promoting economic partnership	
2. Strategic initiatives for obtaining overseas markets	
2.1	Exporting infrastructure and securing natural resources
2.2	Intensive support to potential small and medium-sized enterprises (SMEs)
2.3	Promoting Cool Japan
3. Improving infrastructure concerning funds and human resources to support economic growth	
3.1	Activating inward direct investment
3.2	Strengthening human resources capabilities for global operation activities

Compiled from: https://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/en_saikou_jpn_hon.pdf

The strategies as initially laid out evolved over time. By the fourth year, 2017, the focus had compressed, but the number of specific KPIs had grown. The 2017 document was titled the "Future Investment Strategy 2017: Reforms Towards Realizing Society 5.0." Table 1 shows a

large sample, which can be skimmed to get a flavor for the specifics, along with status reports on progress.

[See Table 1 in Appendix 1]

The Abe administration made much of its third arrow of Abenomics, but there is a surprising lack of comprehensive listing or discussion, both in the Japanese press and English language analyses. One reason for the lack of English language analyses may be that, while an almost 400-page Japanese document is published every year by the Prime Minister's office, there is no official English translation. (The unofficial translation on the Prime Minister's office website is remarkably poor, offering translations of key issues that are not only somewhat unintelligible, but sometimes wrong.)

The newest release was in June 2017. In the Lower House election later that year, the administration could point to this new document, which begins by showing that the government has maintained awareness of the challenges of competition in the current global, digital era in which software can provide value over manufacturing, and massive commoditization poses a serious threat to a broad array of Japan's industrial base.

2. The Silicon Valley Model and Japan's Transformation

For Japan's continued economic growth, it is critical that Japanese companies be competitive in global markets. A wide range of Japanese companies were highly successful in global markets from the 1970s onward, contributing to a surge of Japanese products into global markets. Yet beginning in the 1990s, at the same time that Japanese companies were reeling from the aftereffects of the asset bubble burst, the nature of global competition shifted dramatically. Japanese companies were disadvantaged in many areas they had once dominated, and the global center of gravity for competitiveness and the creation of value shifted to Silicon Valley.

Domestic industry dynamics are shaped by national-level rules and regulations in important ways, which can affect the nature of global competition—who wins and loses in global markets. This becomes a critical issue for politics; what is the economic backdrop for any electoral competition? Is it rapid economic growth, driven and buoyed by competitive firms, for which the incumbent party can take credit, whether deserved or not? (This was the LDP from the 1960s through the 1980s.) Is it economic stagnation with struggling firms and a wave of disruptions, in which the incumbent can be blamed for lack of decisive or effective policy? (This resembles the LDP of the 1990s, the brief opposition coalition in power during 1994, and the DPJ during its tenure in power from 2008 to 2012.) Or is it a profound crisis that can sweep away the incumbent? (The LDP lost power for the first time in an electoral competition in 2008 during the global financial crisis.) Many other scenarios are possible, including one witnessed by the US presidential election in 2016, with a swath of competitive firms that were not seen to be benefiting much of the old industrial heartland.

The question that ties Abenomics to Japan's future economic performance, and therefore a set of likely possibilities for future electoral competitions, is whether the third arrow reforms help to put Japanese firms on a trajectory of competitiveness in global competition.

It is from this vantage that we focus on Silicon Valley, which has become critical to global competition as it has moved to the forefront of economic leadership in the past few decades, by (1) shaping the technological trajectories of industries; (2) re-organizing global competition by transforming industries and creating firms that become global leaders; and (3) introducing new paradigms of industrial production.

In the 1970s and 1980s, Japan was a leader on all three fronts: setting new technological trajectories with the successful commercialization of various semiconductor technologies, quartz, and liquid crystal displays; rising to top tier firms in a wide array of industries ranging from semiconductors to precision equipment, consumer electronics, automobiles, materials, and heavy equipment; and creating a new production paradigm of "lean production" that fundamentally shifted inventory practices and transformed information flows within factories.[16]

The leadership in these areas, however, decisively shifted to the US in the 1990s and beyond, driven by venture capital backed startups that grew into large firms. In setting technological trajectories, Microsoft and Intel dominated the value created in computers with the operating system and core processors in the 1990s (Borrus and Zysman 1997), and firms such as Google, Amazon, and Tesla redefined technological trajectories.

Silicon Valley model companies led by Apple, Google, and Facebook have risen to the top of US corporations as measured by not only market capitalization, which could be an artifact of a bubble, but also cash accumulations – real wealth that will withstand cyclical or bubble valuations of stock prices.[17] Amazon and Microsoft, headquartered in Seattle, but sharing much of the Silicon Valley model based on venture capital investments, and drawing from the same pool of computer science talent in Silicon Valley, round out the top 10 list of market capitalization and cash holdings.

Production paradigms of outsourced and offshored manufacturing, in which high value-added design takes place in Silicon Valley, with cross-national production networks enabling low cost manufacturing, as well as a model of rapid M&A and obtaining ideas from abroad to create "open innovation", with advantages of competition based on platforms, also hailed from Silicon Valley and software startups in the 1990s and 2000s (Sturgeon 2002, Breznitz and Zysman 2013).

Areas of Japanese strength, ranging from semiconductors to consumer electronics, were disrupted by Silicon Valley firms. More recently, with the advent of automated driving pioneered by Google, Tesla, and Uber coupled with sharing economy solutions such as Uber and Lyft, are

[16] For a detailed account of some historical Japanese technological trajectory-setting successes, see Johnstone, B. (1999). We were burning : Japanese entrepreneurs and the forging of the electronic age. Boulder, Colo., Basic Books. For the production paradigm shift that Japan delivered, see Womack, J. P., D. T. Jones and D. Roos (1991). The machine that changed the world : the story of lean production. New York, N.Y., HarperPerennial.

[17] Data from SMBC, publically available at http://www.canon-igs.org/event/report/20171219_Kushida_presentation.pdf

threatening the incumbent automobile industry and entire supply industries as a correlated shift to electric vehicles accelerates. Thus, the Silicon Valley model as a benchmark for innovation and entrepreneurship is worth considering in evaluating Japan's future economic pathways.

Attempting to simply duplicate Silicon Valley, of course, is not the answer. Many regions have tried, but the historical specificity of how the region developed is not easily duplicated. (Lerner 2009).

A more realistic view is consideration of how portions of the Japanese economy can develop sets of institutions similar to those of Silicon Valley, without necessarily entailing a transformation of the entire economy (Dasher, Harada et al. 2015). Japan's political economy has been evolving in a pattern of "syncretism," in which traditional, new, and hybrid forms of organization and strategy coexist (Kushida and Shimizu 2014). Not everything is hybridized, since traditional areas remain, but with new areas such as foreign firms and a startup ecosystem developing rapidly.

Dasher et al (2015) have identified the key characteristics underpinning Silicon Valley as an economic ecosystem, sorted into underlying institutions.

Table 15.2: Characteristics of the Silicon Valley Ecosystem, Sorted into Core Institutions

A) Finance
- Finance and governance of startups by venture capital
- High financial returns for successful entrepreneurs and startups' early employees

B) Human Capital
- High level and diverse human resources for all stages of startups
- High labor mobility

C) Industry-University-Government Interactions
- Top class universities
- Diverse and multifaceted industry-university ties
- Supportive role of government in setting basic research trajectories

D) Industrial Organization
- Dual ecosystem of large firms and small, fast-growth startups
- Highly competitive industries, balancing between "open innovation" and secret protection
- Extensive government role in shaping technological trajectories and basic science

E) Entrepreneurship Culture
- Acceptance of failures

F) Business Infrastructure
- Business infrastructure (law firms, accounting firms, mentors, etc.)
  Legal platform

Source: Adapted from Dasher, Harada et al. 2015

The six institutions include: (A) finance, (B) human capital, (C) industry-university-government interactions, (D) industrial organization, (E) entrepreneurship culture, and (F) business infrastructure (Dasher, Harada et al. 2015).

How much has Japan been evolving to embrace a Silicon Valley model along these institutions? How much do the Abenomics reforms contribute to this evolution?

Japan's political economy has been evolving significantly to embrace Silicon Valley model institutional characteristics. Observers of Japan's nascent startup ecosystem in the late 1990s noted the numerous hindrances, but by the mid 2010s, the changes were significant (Kushida 2017). Below is a simple table summarizing the changes, before discussing each in detail, with a section on Abenomics reforms.

Table 2: Silicon Valley Ecosystem Characteristics Compared to Japan's Impediments in the 1990s, Changes by 2016

Silicon Valley Startup Ecosystem Characteristic	Japan in the mid-1990s: impediments	Japan in 2016: changes that facilitate startup ecosystem
Financial System: Venture capital	Bank-centered, traditional financial markets	New small cap financial markets, growing VC industry, rise of independent VCs
Labor Market: fluid, diverse, highly skilled	Long term employment with seniority ties creating illiquid labor markets. Best and brightest locked into large firms for entire career	Increasing labor mobility, especially in IT sector and with foreign firms. Lower prestige and opportunity with large firms
Industry-University-Government Ties	Numerous formal regulatory constraints on universities, lack of brain circulation	Active efforts by universities, private venture capital, and government to spin out successful startups with university technology
"Open" innovation with large firms and small firm symbiosis	Closed innovation with large firms in-house R&D and uninterested in business with startups	Firms more interested in open innovation, participation in VC funds, business with startups
Social system encouraging entrepreneurship	Entrepreneurship seen as low prestige vis-à-vis large firms and government, financially risky	Rising attractiveness of entrepreneurship as large firms enter competitive crises, increases cases of successful startups
Professional services ecosystem	Small size of professional ecosystem	Law firms and accounting firms setting up startup-focused practice areas to foster and benefit from growing startup ecosystem

A) Finance:

Silicon Valley

Venture capital (VC) is at the core of the Silicon Valley model, one of the core innovations of Silicon Valley that enabled it to grow into a distinct economic ecosystem. As financial intermediaries that invest in private companies, VCs take equity stakes, and commonly take active roles in monitoring and helping portfolio companies. The goals of VCs are to

maximize financial return by exiting investments, which are accomplished through either Initial Public Offerings (IPOs) or M&A (Metrick and Yasuda 2010).

Venture capital in Silicon Valley evolved as a distinct, prominent investment mechanism in the 1970s and grew rapidly after American regulatory shifts. The relaxation of US Labor Department restrictions enabled pension funds to invest in venture capital funds.

The venture capital industry grew symbiotically with the US postwar electronics industry. As each wave of technologies stabilized into a dominant design and stable set of firms, new firms appeared, shifting to a new technology or business model, and disrupting the incumbents. This pattern repeated numerous times (Kenney and Florida 2000).

Japan

The Japanese postwar financial model was centered around banks. Banks were the primary financial intermediary that took household savings and provided industrial and household loans. The "main bank" system entailed large banks who continuously monitored the firms to which they extended loans—a mechanism of governance in which bankers would step into firms that were performing badly and take over management (Aoki and Patrick 1994). Until financial markets and international currency exchanges were liberalized in the 1980s, Japan's financial system was largely closed off from international markets, and household savings were limited to the banking system rather than bonds or equities.

Japan's VC industry began to grow in earnest in the 1990s, especially as the Silicon Valley "tech boom" gained attention in the latter part of the decade. Until then, a common critique of Japan's startup ecosystem was that entrepreneurs had to take bank loans, often with personal assets as a guarantee; firm failure led to personal bankruptcy, making it extremely risky to embark on entrepreneurial efforts (Imai 1998).

Through much of the 2000s, although an increasing number of venture capital firms were being set up in Japan, many were branches of traditional financial firms. Their employees were financial institution employees rather than independent individuals who shared in investment return upsides. Since personnel evaluations within banks were on a "point subtraction" system, errors were seen as negative to the career prospects of employees. This led to risk-averse investment behavior of Japanese venture capitalists, who were unwilling to invest in riskier, but potentially higher growth startups.

Japan's venture capital industry remains tiny compared to that of Silicon Valley—less than 1/28th since 2015. However, anywhere else compared to Silicon Valley looks small, so another useful comparison is with other major G-7 economies and its neighbor, South Korea. Here Japan looks larger than most of the others, except South Korea, which experienced a sudden boom.

The most important recent qualitative shift in Japan's venture capital industry has been the rise of independent VCs. The historical dominance of financial institution funds was criticized for not incentivizing investors to pursue high returns. By 2015 and 2014, however, the largest amounts of capital invested in new funds were for independent funds. In 2015, it was 35%, followed by corporate venture capital (CVC) at 28% and financial institution VCs at 18%. For the previous year, independent VCs received 42%, with CVCs receiving 43%. Some examples of independent VCs include World Innovation Lab, Globis Capital Partners, B Dash Ventures, and others.

An important driver of Japan's VC growth was the creation of small capitalization markets in the late 1990s. Two competing small cap markets were created in 1999, providing a stable source of exits in which VCs could realize returns from their investments. The relative cost of listing in Japan's small cap markets, Mothers and JASDAQ, is far lower than in other Asian markets, and the scale is far smaller than the US NASDAQ.[18] On the one hand, this hinders truly large high-growth firms from emerging, since once firms are listed at a smaller scale, they tend to become more risk averse and pursue stable rather than exponential growth. On the other hand, since it is easier to IPO in Japan than in the US, Japanese VCs may actually face a more predictable exit strategy environment.[19]

Abenomics

A specific goal of Abenomics is to double the proportion of VC investments as a percentage of nominal GDP. While this does not address the quality of VC, it does provide explicit normative support.

[18] Riney, J. (2016). "7 Things Investors & Founders Need to Know about the Japan Startup Ecosystem." Retrieved 2016, June 1, from http://500.co/japan-startup-ecosystem-founders-investors/.
[19] Ibid.

B) Human capital:

Silicon Valley

Silicon Valley draws upon the best and brightest from around the world, and is characterized by high labor mobility and employment fluidity. Top firms attract employees from around the world who settle locally, and top universities such as Stanford, University of California Berkeley, and UC San Francisco Medical School are fed by global talent pools of students and professionals.

The Silicon Valley labor force includes people who have deep expertise in every stage of a startup, from initial startup to rapid growth, to increasing maturity. Silicon Valley is also a focus point for people with cutting edge skills in high demand areas, and this has been the case for various waves of technologies, from semiconductors to various types of software.[20]

The positive role of immigrants, particularly those with high-end skills, has been a dramatic feature of Silicon Valley. To take a recent snapshot, the percentage of foreign born population in Silicon Valley was 36.4% in 2012, exceeding that of California overall (27%), and is almost three times that of the US average (13%). Silicon Valley has continually benefited from flows of immigrants from various areas of the world that create bridges with the economies of their home countries (Saxenian 1994, Saxenian 2006). Cross-national production networks with places like Taiwan and software outsourcing to India also evolved through human interpersonal networks.

Japan: Foreign Labor

A discussion of human capital in Japan should be divided into immigration and labor mobility.

In terms of immigration, Japan's postwar economic model was largely closed to outside immigration. When labor shortages led to a limited relaxing of immigration, particularly in the mid 1980s, they were mostly limited to unskilled workers for assembly lines and construction.

[20] An interesting study shows that software programmers versed in a general programing language, SQL, could be found all over the world, but that those versed in Hadoop, a big data framework, was concentrated dramatically in Silicon Valley right as it started to become mainstream and highly valued by companies around the world. Tambe, P. (2014). "Big data investment, skills, and firm value." Management Science **60**(6): 1452-1469.

More recently, in the 2000s, labor shortages arose in areas such as healthcare and eldercare led to implementation of limited special visa programs to bring in temporary skilled workers for a few years at a time, but the scale remained small.

Abenomics

In the Abenomics third arrow, only two KPIs involve immigration or bringing foreign workers to Japan. One is a goal of having 1500 full time university faculty positions for young and foreign applicants by 2016. This was achieved, as measured by the number of new, fully funded faculty positions by mid-2016.[21] Here, however, by combining young and foreign, and by specifying applicants rather than positions filled, the third arrow avoids numerical targets of foreign university faculty.

There is also a numerical target for foreign students in Japan, with a KPI of doubling the number of foreign students studying in Japan from around 140,000 in 2013 to 300,000 in 2020. This was on track, with approximately 267,000 in May 2017.[22] The question is the proportion of these students who are high end students who are likely to contribute in some way, or the widely criticized hidden mechanism to increase foreign labor through "training programs" in which the students end up working almost full time in various service jobs.

In terms of skilled immigration, there is a numerical target of 10,000 highly skilled foreign professionals to be recognized by 2020, doubling it to 20,000 by 2022. In the 2016 version, an additional KPI of 5,000 such workers by the end of 2017 was added. Given that the potential labor shortage in a variety of sectors is projected to be orders of magnitude greater than these numbers, with the Ministry of Health, Labor and Welfare projecting a shortage of 377,000 people in caregiving alone by 2025,[23] it is safe to say that Abenomics is not looking seriously at bringing in foreign human capital in a meaningful way.

Japan: Labor Mobility and Human Resource Pool

Let us now turn to labor mobility. Japan's human resources pool of entrepreneurs and startup firm employees was traditionally severely constrained by norms of lifetime employment offered by large firms, which took much of the top talent. Low labor mobility among mid-career

[21] http://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/dai4/siryou5_3.pdf
[22] http://www.mext.go.jp/a_menu/koutou/ryugaku/1345878.htm
[23] http://www.mhlw.go.jp/stf/houdou/0000088998.html

hires choked off potential labor force for startups as they grew, and the lack of labor fluidity and experienced people led to a lack of human capital depth in growing the startup ecosystem.

Regulatory shifts from the late 1990s, such as the ability for companies to offer stock options as compensation, and shifts in labor laws that allowed greater flexibility for employers (Vogel 2006) did improve conditions facing the startup ecosystem. At the same time, significant restructuring at large Japanese companies, as well as large manufacturers such as Sharp and Toshiba entering into deep crises helped release some of the talent traditionally "locked up" in large firms. Increasingly many startups are finding mid-career employees from large companies who could have advanced further within the company, but decided to pursue opportunities by leaving—a relatively rare pattern until the 2000s. The influx of foreign firms into Japan also increased the choices available to elite college graduates, creating a pathway for many of them to pursue entrepreneurship after some years of working at foreign firms (Kushida 2017).

The Japanese startup ecosystem has evolved to the point that the startups raising the most funding in 2015 had as their founders an overwhelming proportion of graduates of Japan's elite universities. Notably, however, they are almost all domestic universities and the founders are Japanese—if not citizenship, then by name. Moreover, most of the previous employers of the entrepreneurs were foreign firms, notably consulting and financial firms. (See table in Appendix 2)

Abenomics

Abenomics does take on labor mobility as an issue, focusing on increasing the number of people changing jobs without becoming unemployed. It also includes numerous measures aimed at creating specific skills in people—cybersecurity certifications and other IT-related skills [14.1]. However, the focus here is more on general skills for the population rather than on the startup ecosystem.

C) Industry-University-Government interactions:

Silicon Valley

In the Silicon Valley model, industry-university-government relationships are anchored in intellectual property development and transfers, but reach far beyond it to include licensing, academic spin-offs, collaborative research, contract research, consulting, ad-hoc advice and networking for practitioners, teaching, personnel exchanges, and student supervision (Grimaldi, Kenney et al. 2011).

Japan

Until the late 1990s, Japan's university system faced numerous challenges in collaborating with industry. For example, professors at national universities were considered public servants, and were not allowed to take outside jobs, such as positions on startup company boards. Since the 1990s, however, a surge of interest in creating stronger linkages between universities to spin out intellectual property, as well as nurture entrepreneurs, led to the creation of various organizations and centers. While the level of industry-university collaboration and degree of entrepreneurship encouraged from universities is far lower than top universities in the US, the situation is markedly different from twenty years ago.

The Abenomics third arrow measures have specific KPIs focused on increasing university-industry research, increasing industry investments into university research, increasing the amount of commercializable intellectual property from universities, and increasing the level of collaboration between universities and SMEs.

Specific measures read as the following: "doubling the number of large-scale industry/university or research institute joint research projects by 2020" (11.6); to "triple investments from corporations into universities/national research institutes by 2025" (11.4); to "increase the number of patents granted to universities by the end of FY2020" (11.1); and a plan to concretely support strategic reform initiatives at universities, offering operation cost subsidies (11.2). These are all relatively conventional measures, and may very well be following existing trajectories, so that not much needs to be done to achieve them.

In the areas of university-SME collaboration, however, there is an interesting measure. In the strategy section on "vitalization and productivity enhancements of SMEs," a goal is to

"create industry-academia-government collaboration to provide support to 200 pioneering projects that utilize locally developed technology by 2021, with approximately 1000 projects over the subsequent 5 years" (15.3). A generous interpretation of this is that it offers an interesting focus to enhance the competitiveness of SMEs. A more cynical view is that it is simply a continuation of existing support to prop up less competitive SMEs as a social welfare measure, especially for regions lacking large firms as major employers.

Silicon Valley

Historically, the US government – particularly the Department of Defense, played an instrumental role in the development of Silicon Valley. By focusing research activities in areas such as semiconductors and sourcing technology from startups, acting as a "lead buyer," shaping university research through organizations such as the National Institute of Health and National Science Foundation, and developing the basis of the Internet as a communications network for national defense, the US government has been critical in shaping US innovation trajectories (Kenney 2000). A large influx of research into universities during the Cold War era led to industry spinouts from university-led research, which fed into the semiconductor industry and other related industries.

More recently, strategic DoD efforts in the form of contests have been a driver of certain important areas of technology in Silicon Valley, as universities and companies competed against one another, then joined forces as researchers moved across university-industry boundaries. The most dramatic recent case has been self-driving vehicles, which were sparked by DoD competitions (Markoff 2016).

Japan

Strategic industrial policy, including infant industry promotion, technological selection, and government orchestration of industrial consortia, along with the promotion of dense information exchange among industrial actors has been one of the longstanding themes of Japanese government policy in the modern era. Japan's style of traditional industrial policy, though its effectiveness is much debated, has been quite different from that of the US government policies that shaped Silicon Valley. The Japanese policies were far more strategic and specific. One upside was that specific technologies could be pursued, but a downside was

that the selection of technologies could lead to domestic isolation if global markets shifted in a different direction (Kushida 2011).

The Abenomics third arrow measures contain numerous specific technological targets. These range from developing new technologies surrounding electricity generation to deploying robotics and advanced sensors in healthcare, infrastructure maintenance, and agriculture. On the one hand, Japan's rapidly aging demography can provide opportunities for technological deployment in areas such as robotics for healthcare, agriculture, and infrastructure. Initiatives such as "increasing the proportion of large hospitals utilizing electronic medical records to 90% by 2020" (1.2), "increasing the market size for robotic devices in nursing care to 50 billion yen by 2020" (1.6), and "increasing the number of robotic devices for nursing care to 8000 units by 2030)" (1.7) have the potential for taking Japanese demographic challenges and making them into internationally competitive value added products and services. However, some of the specifics, such as aiming for 8000 units by 2030, seem modest for such a long time horizon.

In Japanese-style industrial policy, there is, of course, the inherent risk of government policies choosing what turns out to be the wrong technology, and Japan's industrial policy history is littered with such examples. Moreover, Japanese-style industrial policy runs the risk of morphing into protection for industries or firms that are no longer globally competitive—a shift from promotion to protection. Specific numerical targets for technologies such as fuel cell vehicles, fuel cell charging stations, commercializing "the world's first floating wind turbine," establishing the basic technologies for "integrated gasification fuel cell cycle power generation, and next generation gas turbines, seem ambitious, but risky.

For example, "establishing approximately 160 commercially operated hydrogen automobile fueling stations by 2020, increasing to approximately 320 by 2025" (6.5.2) is a specific technology selection that risks isolating Japan. A costly hydrogen fueling station network is needed to enable a hydrogen vehicle market viable, and if solely Japan invests in such a network, any hydrogen vehicle market will remain limited to Japan – the familiar "Galapagos phenomenon." (Kushida 2015)

Others, such as "commercialize the world's first floating wind turbine by 2018" (6.8) is an extension of the current demonstration project off the coast of Fukushima, led by a ten-member consortium that includes Mitsubishi Heavy Industries and Hitachi. This may be seen as

assistance to the manufacturers of Japan's nuclear facilities, which have been mostly halted since the 2011 earthquake, tsunami, and Fukushima nuclear disaster.

There may be more industrial opportunity in broader goals, such as the promotion of robotics and sensors in maintaining and inspecting infrastructure (4), and targets for upgrading commercial office buildings and housing to become more energy efficient (6).

Many of the specific targets, such as raising the productivity of supply chains (3.1) and the use of digital data in factories (3.2) can possibly lead to increased international competitiveness, but they are likely to be targets that firms are moving towards anyway.

Measures such as contests, as seen in the DoD cases that turned out to be beneficial to Silicon Valley, are not a part of the Abenomics measures.

D) Industrial organization:

Silicon Valley

In Silicon Valley, the ecosystem supporting large companies, which engage in open innovation by buying startups, funding them, and existing in the same labor force and technology environment, coexists with the ecosystem to foster high growth startups (Kenney 2000).

Japan

One of the often-cited common challenges for the startup ecosystem in Japan has been the lack of collaboration between large and smaller firms. The dominant historical model was large, elite firms with SMEs that were suppliers, with the latter squeezed during economic downturns, and the large firms taking leadership in technological and strategic directions. As a result, Japanese large firms lacked know-how on how to deal with startups that had high potential technological or strategic value—either from a standpoint of not treating them as lower-tier suppliers based on their side or considering various strategic collaboration possibilities including M&A.

This situation has shifted markedly over the past decade, as waves of new startups are collaborating with large firms in new ways. Even in the financial industry, startups offering accounting services to SMEs, for example, are partnering with large and local banks, some of the most traditional and conservative actors. (See Kushida 2016 for examples).

For example, Preferred Networks, founded in 2014 by a Tokyo University computer scientist, provides machine learning algorithms and tools. Japan's top manufacturers including Toyota and factory robot producer Fanuc have partnered with Preferred Networks to jointly develop systems for factory robotics that enable the robots to learn new movements and tasks by themselves without operators programming them.

Part of the new ease of collaboration is that many of the new startups are created by people with the same elite backgrounds as large company leaders and employees, which is a contrast with the past.

Abenomics

There are no concrete provisions in Abenomics directly aimed at facilitating large-firm and startup collaborations. However, many of the IT adoption and technology oriented goals do create opportunities for startups to partner with large corporations. For example, for infrastructure, a goal is to "use sensors, robots, and other non-invasive technologies to examine and analyze critical and aging domestic infrastructure, with a 20% utilization by 2020, and 100% by 2030" (4.3). This opens the opportunity for startups to provide technologies and services that large firms may not have or be able to develop quickly enough. Startups on their own may not be able to scale their offerings fast enough, leading to potential partnership opportunities.

Another Abenomics measure is to aim for 80 banks to adopt open APIs (Application Protocol Interfaces), which allows third parties to connect directly to banks' IT systems, by 2020 (5.1). Some banks may enable direct tie-ups with startups that are already integrating their offerings with such ventures as Money Forward and Freee, which provide accounting services for SMEs and personal finance management tools for individuals. Other areas, such as the adoption of robots in nursing care, may be fruitful for collaboration between startups and large firms.

E) Entrepreneurship culture:

Silicon Valley

In Silicon Valley, entrepreneurs are celebrated, and there is knowhow for monitoring and evaluation so that failures, although unfortunate, are considered positive experiences if it was a "good failure" (Dasher, Harada et al. 2015).

Japan

Japan's early postwar period saw a flourishing of entrepreneurs who built large, globally competitive companies; Honda Soichiro of Honda, Akio Morita and Ibuka Masaru of Sony, and Inamori Kazuo of Kyocera, for example. However, by the 1980s, large firms dominated Japanese industry, not only in terms of technological and market leadership, but also in terms of prestige and cultural position. Graduates of elite universities streamed to long-term employment positions in large firms, while entrepreneurs tended to be those who could not get positions in large firms.

This has shifted significantly in the past ten years. As early as the early 2000s, many of Japan's entrepreneurs were still seen with suspicion, fed by such scandals as that caused by Horie Takafumi, who founded a company Livedoor in the mid-1990s, which eventually went on to attempt purchasing one of Japan's traditional broadcasters—but Horie was later arrested, sentenced, and jailed for accounting fraud. His lavish and public lifestyle, which was often seen flaunted on television, his uniform of jeans and casual shirts, and his outspoken criticism of large firms, led subsequent entrepreneurs to become more soft spoken and avoid the limelight (Asakura 2016).

However, after 2010, there was a decided shift towards celebrating entrepreneurship. Major newspapers such as the Nikkei, which were criticized earlier for not carrying stories of entrepreneurs or the startup ecosystem, favoring instead the traditional large firms, began focusing more on the startup ecosystem.

Numerous startup pitch contests and major events celebrating high growth startups have been taking place in recent years. Audiences number in the thousands, some are focused on having policy recommendation arms, and they often receive national news coverage. These organizations and events help legitimize and popularize a culture of high growth startups. Some include the annual New Economy Summit, launched in 2013, organized by the Japan

Association of New Economy, and set up by Japan's largest, listed online commerce company, Rakuten. The New Economy Summit invited prominent Silicon Valley entrepreneurs such as Larry Ellison, founder of Oracle, and the founders of startups such as Dropbox, Lyft, Box.com, and Andy Rubin whose company was bought by Google and became the Android platform. The Infinity Ventures summit, which began in 2009, brings hundreds of companies to Kyoto annually, and is a hub for investors, entrepreneurs, and large firms to meet. Less business focused and intended to inspire community building, events such as Slush Asia, orchestrated by the Finnish firm, Slush, took place in Tokyo in 2016. From the government, the New Energy and Industrial Development Organization (NEDO), which subsidized the R&D of science and technology-based startups, pitch contest, the NEDO Technology Commercialization Program, featured startups that entered several rounds of pitch competitions around the country. The first program took place in 2015.

Abenomics

The Abenomics goal of doubling Japan's position on a survey of entrepreneurship mentality, measured as the number of people who answered that they are "entrepreneurs or prospective entrepreneurs" is interesting. Although the target date is 2025, it is, at minimum, a baseline provision of government support of entrepreneurship.

F) Business infrastructure:

Silicon Valley

In Silicon Valley, the ecosystem is comprised of law firms, accounting firms, headhunting firms, and interpersonal networks of angel investors and other mentors who underpin the ecosystem (Kenney 2000).

Japan

In Japan, until recently, there was relatively little of a support ecosystem for startups, with accountants and lawyers having little if any experience with high growth startups, and little ability to the play the roles of deal-maker, advocate, advisor, and other functions that Silicon Valley professional firms provide. Within the past decade, the business infrastructure began to

develop significantly, with law firms and accounting firms, along with human resources development and placement firms increasingly focused on startups.

Abenomics

In the Abenomics third arrow, cultivating "a positive feedback loop to foster innovative startups" is the title of an entire category. The various measures inside the category are focused on university patents, increasing investments into startups, and establishing business entry and exit rates comparable to those of the UK. There is no real focus on fostering the business infrastructure for a startup ecosystem in Japan.

Conclusion

The sheer volume and specificity of Abenomics third arrow reforms has been impressive. Many of the key performance indicators are set at 2020 and beyond, likely beyond the Abe administration's tenure and therefore insulating him from blame if they are not attained. Others are achievable without extra measures, and are likely an easy mechanism of taking credit (Hoshi 2018). Yet, the contrast with previous administrations, which all suffered short tenure and were criticized for the lack of policymaking continuity, let alone the ability to think longer term or strategically, is stark.

Will the third arrow reforms propel Japan into competitive footing in the global economy moving forward? In light of the Silicon Valley model, which has disrupted a range of previously competitive Japanese industries ranging from semiconductors and computers to consumer electronics, and which is poised to disrupt more, such as automobiles and industrial equipment, the Abenomics third arrow reforms are not a cohesive strategy to combat the potential disruptions, and many of the goals extend far beyond the current Abe administration's likely tenure. However, they do amplify trajectories already underway to facilitate a segment of Japan's economy to embrace Silicon Valley model-type institutional opportunities. Much of the specific industrial technology targeting resembles previous historical industrial policy, with the advantages of being able to move quickly, but the inherent risks of running in the wrong direction, or creating a situation in which Japanese technologies become "leaders without followers" in global markets.

Arguably the most important contribution to Japan's transforming economic model in facilitating a Silicon Valley model of entrepreneurship and innovation is the explicit normative support for many of the underlying institutions of the Silicon Valley model in finance, human capital, university-industry-government ties, and social support of entrepreneurship. They represent a clear recognition of the need for explicit change in various aspects of the Japanese model, providing legitimacy to an area that long suffered a lack of it. The good news is that there seems little that will actively hinder Japan's trajectory towards developing a Silicon Valley model segment of the economy – something that observers would not have expected during the years during the years when Prime Ministers rotated on an almost annual basis, with an opposition party in power for a few years, each putting forth various piecemeal reforms that did not encompass an underlying vision or strategy.

It is, of course, still far from obvious that Japanese firms will successfully cope with the looming disruptions that new technological advances in areas such as artificial intelligence are likely to deliver, redefining and challenging industrial structures and incumbent firms around the world in a wide range of industries. However, while one can criticize the Abenomics third arrow for not providing enough focus or extra momentum, it is difficult to find active hindrances—something that is, unfortunately, not to be taken from granted given the past couple decades.

Appendix 1: Abenomics Third Arrow

Selected Abenomics Third Arrow KPIs and Progress So Far

1. Health, Medicine, and Caregiving		
1.1*	By 2020, extend the 'healthy life expectancy' from the 2010 level (male=70.42, female=73.63) by one year. (Revised in 2014 to "extend two years by 2025)	⇨ 2013: Life expectancy for males=71.19, for females=74.21
1.2+	By FY2020, increase the proportion of large hospitals (with over 400 beds) utilizing electronic medical records to 90%	⇨ 2014 (October): 77.5%[24]
1.3	By 2020, implement 20 cases of clinical trials and studies based on registered data of patients and diseases	⇨ 2015: 31 doctor-initiated clinical trial notifications[25]
1.4+	By 2020, establish around 20 Japanese medical centers abroad (revised in 2017 from 10 by 2020. There was 1 in 2013)	⇨ 2016: 13[26]
1.5	By 2030, increase the overseas market for Japanese medical technology and services to 5 trillion yen (4.5 billion yen in 2010)	⇨ 2015: The export value of pharmaceuticals was about 153.5 billion yen, and about 622.5 billion yen for medical equipment.[27]
1.6	By 2020, increase the market size for robotic devices in nursing care to 50 billion yen	⇨ 2015: 2.47 billion yen
1.7	By 2030, increase the number of robotic devices for nursing case to 8000 units	⇨ Unclear
2. Advancement of mobility services, eliminating "mobility disadvantaged" people, and transforming logistics		
2.1	By 2020, increase the share of new passenger cars equipped with automated braking system to over 90%	⇨ 2015: Share of new passenger cars for equipped with automated braking system=45.4% **New KPI
2.2* (partial)	Increase the share of vehicles (stock) with driving safety support devices/systems to 20% by 2020, and obtain 30% of the world market	⇨ 2015: Share of vehicles equipped with safety support devices/systems= 6.5% ⇨ 2014: 40.5% of the world market
2.3	Increase the share of vehicles with driving safety support features/systems to approximately 100% of Japan's entire domestic stock of vehicles	⇨ 2015: New cars equipped with driving safety support features/systems=42.4%

[24]https://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo2018/health/dai1/siryou2.pdf
[25] http://www.jmacct.med.or.jp/about/h28/files/act20170204_3.pdf
[26] http://www.kantei.go.jp/jp/singi/kenkouiryou/suisin/suisin_dai19/siryou1_2.pdf
[27] ibid.

		⇨ Domestic stock of vehicles equipped with driving safety support features/systems= 6.5%
3. Realize Smart Supply Chains		
3.1	Improve the labor productivity in manufacturing industries by more than 2% per annum	⇨ 2013-2015: Average growth rate=1.4%
3.2[+]	By 2020, increase the proportion of companies that collect data in their factories and facilities to 80%, with 40% of firms using the collected data to solve concrete management issues.	⇨ 2016: 67%, 40% **New KPI
4. Increasing the Productivity of Infrastructure and Increase the Competitiveness of Metropolitan Areas		
4.1	By 2025, improve the productivity of construction sites by 20%	**New KPI
4.2[*]	By 2020, enable Tokyo to achieve a top 3 ranking in the Global Power City Index	⇨ 2016: 3rd
4.3	For critical/aging domestic infrastructure, use sensors, robots, and non-invasive inspection technologies, with 20% utilization by 2020, and 100% utilization by 2030	⇨ Underwater field experiments were launched in 2016. Site verification is underway for the implementation of monitoring technologies using sensors etc.
5. Promoting Fintech (added 2017)		
5.1	By 2020, aim for over 80 banks adopting open APIs (Application Protocol Interfaces)	**New KPI
5.2	By 2027, double the ratio of electronic (cashless) payments to 40%	**New KPI
5.3	By 2022, quadruple the proportion of Small Medium Enterprises utilizing information technology such as cloud services to increase the efficiency of their back office operations (finances, accounting, etc), to 40%	**New KPI
5.4	By 2020, increase by 5% the efficiency of the circulation of funds in Japan's supply chains (Supply Chain Cash Conversion Cycle)	**New KPI
6. Overcoming Resource Limitations in Energy and Environmental and Promoting Investments		
6.1	On 4/1/2020, implement the legal unbundling of electricity transmission and distribution as the final stage of Japan's electricity system reform	⇨ "Organization for Cross-regional Coordination of Transmission Operators" established on April 1, 2015. ⇨ Passed revision of the Electric Utility Operator Law on June 17, 2015 that included unbundling of

		transmission capabilities. ⇨ In Sept 1, 2015, established the Electric Power Trading Surveillance Committee ⇨ Liberalized retail electricity sales on April 1, 2014.
6.2	By 2030, new houses and buildings will comply with energy saving standards ZEH and ZEB	
6.3	By 2020, double the number of housing renovations for energy-savings	
6.3.1	(supplement to above) By 2020, attain 100% compliance of new buildings with energy saving standards, and for new public buildings, attain "net zero energy buildings"	
6.3.2	(supplement to above) By 2020, attain 100% compliance of new houses with energy saving standards, and attain a majority of orders of new houses through house makers to be "net zero energy houses"	⇨ 2017 (October): 6179 companies nationwide, (5507 housemakers and 639 general construction shops) nationwide are registered ZEH builders[28]
6.4	By 2020, attain a 100% diffusion of newly sold lighting to be energy efficient, such as LEDs	⇨ 2015: Domestic shipment amounts for general lighting sources: LED lamps, 40% of the total[29]
6.5	By 2030, attain a 50-70% ratio of next-generation automobiles for new automobiles sales	⇨ 2016: Proportion of next-generation automobiles for new automobiles sales=35.8%
6.5.1	(supplement to above) By 2020, increase the number of electric or plug-in hybrid vehicles in use by one million	⇨ Electric car stock (BEV and PHEV): 40,580 (2012), 151,250 (2016); Battery electric car stock: 29,600 (2012), 86,390 (2016) Plug-in hybrid electric car stock: 10,980 (2012), 64,860 (2016)[30]
6.5.2	(supplement to above) By 2020, increase the number of fuel cell vehicles in use to 40,000 vehicles, and 800,000 by 2030.	⇨ 2016: 194,710 fuel cell vehicles in use (SOFC and PEFC) in Japan[31]
6.6	By 2020, establish approximately 160 commercially operated hydrogen automobile fueling stations, increasing to approximately 320 by	⇨ 2017 (March): 90 hydrogen automobile fueling stations established

[28] http://www.meti.go.jp/committee/sougouenergy/shoene_shinene/sho_ene/pdf/016_01_02.pdf
[29] http://jlma.or.jp/tokei/jishu_old.htm
[30] https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf
[31] "Dissemination of Ene-Farm" http://www.meti.go.jp/english/report/downloadfiles/2017_outline.pdf

	2025	
6.7	By 2020, gain 70% of the world market share for geothermal electricity generating turbines	⇨ 2015: Japan ranked 10th out of the top 10 countries per geothermal generating capacity[32]
6.8	By 2018, commercialize the world's first floating wind turbine	⇨ Japan is currently conducting a demonstration project off the coast of Fukushima Coast, led by a 10-member consortium including Mitsubishi Heavy Industries and Hitachi. The project consists of a 2MW turbine, a 7MW turbine, a substation, and a 5-MW model.
6.9	By approximately 2025, aim to established next generation thermal power generation technologies step by step, according to the "next generation thermal electricity generation technology roadmap"	
6.10	(numerous highly technical temperature and efficiency gain targets)	
6.10.1	(Supplement to above) By 2025, establish the basic technologies for IGFC (integrated gasification fuel cell cycle) power generation, and realize its practical use by 2030	⇨ Current power generation efficiency: 39%
6.11+	By around 2020, aim for the practical use of 1700 degree level gas turbines for LNG (liquid natural gas) electricity generation (increasing the current efficiency of around 52% to around 57%)	⇨ 2013 (August): 1600 degree level gas turbines for LNG electricity generation started operation domestically
6.12	By 2020, aim for a complete penetration of smart electricity meters to homes and business according to the smart meter diffusion plans of each power electric company	⇨ 2016 (February): 39,000 smart meters installed[33]
6.13*	By 2017, establish a "negawatt power transaction market" in which saved energy is transacted (disappeared in 2017 as a KPI)	⇨ Established in April 2017
6.14	By 2020, aim for Japanese firms to attain about 50% of the world market (or 500 billion yen) of advanced electricity storage batteries	
6.15	By 2020, halve the cost of electricity storage batteries (less than 23000 yen/kWh)	⇨ 2015: Storage battery for mainly domestic use: 22,000yen/kWh; Storage battery for industry use: 36,000yen/kW[34]

[32] https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Geothermal_2016.pdf
[33] http://www.meti.go.jp/committee/sougouenergy/denryoku_gas/kihonseisaku/pdf/005_03_02.pdf
[34] http://www.meti.go.jp/committee/kenkyukai/energy_environment/energy_resource/pdf/005_08_00.pdf

7. Robotics Revolution/Bio and Materials Revolutions		
7.1	By 2020, increase domestic robot production market size to 1.2 trillion yen in manufacturing industries and 1.2 trillion yen in non-manufacturing industries. (revised in 2016. The 2014 version read double in manufacturing, 20x in non-manufacturing)	⇨ 2015: Approximately 689 billion yen in manufacturing industries and 123.9 billion yen in non-manufacturing industries (In 2014: 590.1 billion yen in manufacturing industries and 61 billion yen in non-manufacturing industries)
8. Creating the Foundations for Data Utilization		
8.1	By 2020, offer 100% of data in machine readable file formats according to the needs of private sector firms, based on deliberations of the private-public roundtable	**New KPI
8.2	By 2020, ensure that 100% of municipalities are taking action to make data open and available	** New KPI
8.3	By the end of 2018, utilize Cloud technologies for government information systems to reduce the number of government information systems by 725 (halving the number), and by the end of 2021, reduce the operational cost by 30%	⇨ 1235 IT systems in 2015[35]
8.4	Retain Japan's number 1 ranking in the OECD in offering the lower broadband fees per unit speed	
8.5*	During 2016, attain 15 million MVNO (mobile virtual network operator) subscribers. (Deleted in 2017)	⇨ 2016: 16.36 million subscribers[36]
8.6	By 2019, aim for WiFi availability in around 30,000 sites of tourism and disaster prevention or recovery sites.	⇨ 2016 (October): WiFi installed in 14,000 areas (47% completion)[37]
8.7	By 2020, attain over 800 success cases by municipalities and regional organizations	⇨ The "Regional IoT implementation status survey" conducted by the Ministry of Internal Affairs and Communications in March 2017 showed that out of the 773 public entities surveyed, 16.6% responded that they were actively taking measures to implement IoT solutions in their regions (in 2014, only 5.9% of entities (N=733) responded that they

[35] http://www.itdashboard.go.jp/Statistics/system
[36] http://www.soumu.go.jp/main_content/000508722.pdf
[37] http://www.soumu.go.jp/main_content/000456095.pdf

		were actively taking measures to implement IoT solutions in their regions).[38]
9. Fostering Intellectual property/standardization strategies, ensuring an environment of fair competition		
9.1+	By end of 2020, increase Japan's presence as a secretariat in international standardizations organizations by 100	⇨ 2016: 97[39]
9.2	By 2020, standardize 100 excellent technologies and products from SMEs and medium-sized companies	⇨ 5 cases as of mid-2016
9.3+	By 2023, reduce the time to acquire patent rights by half, attaining an average of 14 months	⇨ 2015: Average of 15 months
9.4+	By 2019, aim for 15% of patent applications to be from SMEs	⇨ 2015: 14%
10. Strengthening Human Capital growth and Effective Utilization		
10.1	By 2022, aim for 1 million enrolled in adult school (professional school) programs at universities or vocational skill schools.	⇨ 2015: Approximately 490,000 enrolled **New KPI
10.2	By 2022, aim for 5000 courses aimed for professional or specialized skills	⇨ 2017: 2417 courses **New KPI
10.3	By 2020, raise the proportion of teachers who can utilizing IT tools in the classroom to 100% (Fiscal 2014 was 61.4%)	⇨ 2015: 73.5% (71.4% in 2014)
10.4	By 2020, aim for 100% of prefectures and municipalities have an IT environment improvement plan	⇨ 2014: 31.9%[40]
10.5	By 2020, aim for 100% of regular classrooms with Wireless LAN access	⇨ 2015: 29.8% (27.2% in 2014)
10.6	By 2020, increase the number of full time teachers for domestic schools below the age of 40 by 10%	⇨ 2016: 43,600 teachers (a decrease from 43,800 in 2013)[41]
10.7	By 2020, increase the number of researchers who move jobs within the domestic sector by 20%	⇨ In 2015 the number of researchers who moved jobs within the domestic sector was 11,192, up from 9,856 in 2013[42]
10.8*	By 2020, increase the employment of the young (20-34 years old) to 78% (74% in 2012)	⇨ 2016: 78%

[38] https://www.kantei.go.jp/jp/singi/it2/detakatsuyokihon/dai7/siryou2.pdf
[39] http://www.meti.go.jp/information_2/publicoffer/review2016/saishupdf/27002700METI.pdf
[40] http://www.mext.go.jp/b_menu/shingi/chousa/shotou/110/shiryo/__icsFiles/afieldfile/2016/11/07/1378984_8.pdf
[41] https://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo2018/innov/dai1/siryou2.pdf
[42] https://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo2018/innov/dai2/siryou3-1.pdf

10.9	By 2018, reduce the number of long-term unemployed (more than 6 months) by 20%	⇨ 2013: 142,000 ⇨ 2015: 109,000
10.10[+]	By 2018, increase new employment transfers (mid-career hires of general employees, excluding part-time work) by 9%	⇨ 2016: 2,936,700 transfers (8%)[43]
10.11[*]	By 2017, increase the number of job changes without unemployment to 2 million workers. (In 2013, was 1 million workers)	⇨ 2016: 3.3 million[44]
10.12	By 2017, have 100% of private job training operators that are subcontracted by public sector job training operators take job training service guideline courses	
10.13	By 2019, establish schemes to evaluate and improve job training in all 47 prefectures	
10.14[+]	By 2020, increase the employment rate of ages 20-64 to 81%	⇨ 2016: 79%
10.15	By the end of FY2020, reduce the proportion of involuntary non-regular workers to below 10%	⇨ 2016: 15.6%[45]
10.16	By FY2020, double the number of Japanese college students studying abroad (60,000 to 120,000)	⇨ 2016: 96,641
10.17[+]	By FY2020, double the number of foreign students studying in Japan (140,000 to 300,000)	⇨ 2017 (May): 267,042 foreign students[46]
10.18	By 2017, increase the proportion of English language teachers who score higher than approximately 80 on TOEFL from 28% to 50% for junior high schools and from 52% to 75% for high schools	⇨ 2015: 30.2% for Junior high, 57.3% for high school[47]
10.19	By FY2018, increase the number of school accredited as International Baccalaureate to 200	⇨ 2017: 51
10.20	By 2023, aim to have more than Japanese 10 colleges/universities ranked in the top 100 of university rankings	⇨ 2 Japanese Universities (Tokyo University, Kyoto University) in top 10 according to the Times Higher Education ranking in 2017[48]
10.21[*]	By FY2020, increase the employment rate for women aged 25-44 to 73% (68% in FY2010)	⇨ 2016: 73%
10.22	By 2020, increase the proportion of male workers taking childcare leave to 13% (2.6% in 2011)	⇨ 2015: 2.65%

[43] http://www.mhlw.go.jp/toukei/itiran/roudou/koyou/doukou/17-2/dl/gaikyou.pdf
[44] http://www.mhlw.go.jp/file/05-Shingikai-12602000-Seisakutoukatsukan-Sanjikanshitsu_Roudouseisakutantou/0000190839.pdf
[45] http://www.mhlw.go.jp/file/05-Shingikai-12602000-Seisakutoukatsukan-Sanjikanshitsu_Roudouseisakutantou/0000190839.pdf
[46] http://www.mext.go.jp/a_menu/koutou/ryugaku/1345878.htm
[47] http://www.mext.go.jp/component/a_menu/education/micro_detail/__icsFiles/afieldfile/2016/06/15/1372389_3.pdf
[48] https://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo2018/innov/dai1/siryou2.pdf

10.23	By 2020, increase the male workers taking paternity leave immediately after wives' deliveries	⇨ A research project carried out by the Cabinet Office showed that in 2015, 55.9% of new fathers had taken time off after their wives' deliveries[49]
10.24	By 2020, increase the proportion of women in leadership positions to 30%	⇨ 2015: 9.8%
10.25	…more related to childcare	
10.26	By 2020, aim to recognize 10,000 highly skilled foreign professionals, and by 2022 a further 20,000	⇨ Between May 2012 and December 2016, 6669 highly skilled foreign professionals were recognized
11. A Positive Feedback Loop to Foster Innovative Startups		
11.1	By the end of FY2020, aim to increase the number of patents granted to universities by 50%	⇨ 2012: 4831 University TLO patents granted[50] ⇨ 2016: 3685 University TLO patents granted[51]
11.2	Between FY2016 and FY2021, aim to allocate resources to strategic reform initiatives for strengthening each university and maintain the operation cost subsidies at around 40%	**New KPI
11.3	By the end of FY2017, attain a number one ranking in the innovation ranking (technology section, published by the World Economic Forum)	⇨ 2017-2018: 8th
11.4	By 2025, aim to triple the investments from corporations into universities and national research institutes	⇨ 2015: 120.9 billion yen
11.5+	By FY2020, increase the ratio of R&D investment, including both public and private sectors, to 4% of GDP	⇨ 2015: 3.56%
11.6+	By the end of FY2020, double the number of large-scale joint research project between corporations and universities/research institutes	⇨ 2015: 1004 joint research projects reported(x1.5 gain)[52]
11.7	By FY2016, increase both the new business establishment rate and exit rate to an equivalent level of the US and UK (in the 10% range), with net positive levels of entry (the 2004-2009 average was 4.9%)	⇨ 2015: business establishment rate for Japan was 5.2%, exit rate was 3.8%[53]
11.7.1	(supplement to above) By 2025, double Japan's position on the entrepreneurial activity index (the percentage of respondents in a survey of	⇨ 2018: Japan ranks 28th on the Global Entrepreneurship Index, with a score of 51.5

[49] http://www.gender.go.jp/kaigi/senmon/jyuuten_houshin/sidai/pdf/jyu11-08.pdf
[50] https://www.jpo.go.jp/cgi/link.cgi?url=/shiryou/toushin/nenji/nenpou2013_index.htm
[51] https://www.jpo.go.jp/shiryou/toushin/nenji/nenpou2017/toukei/all.pdf
[52] https://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo2018/innov/dai2/siryou3-1.pdf
[53] http://www.chusho.meti.go.jp/pamflet/hakusyo/H29/h29/html/b2_1_1_2.html

	entrepreneurial mentality who answered that they are "entrepreneurs or prospective entrepreneurs"	(the US, ranked number 1, scored 83.6)
11.8	By 2022, aim to double the proportion of venture capital investments into startups as a proportion of nominal GDP	⇨ 2013-2015: Average of 0.029%
12. Regulatory reform, Simplification of Administrative Procedures, Integrated facilitation of IT Adoption		
12.1	By March 2020, aim to reduce administrative procedure costs in priority fields by more than 20% (field include national tax, local tax, enabling of electronic tax submission, etc.)	**New KPI
12.2	By 2020, make Japan as a top three country in the World Bank's "Business Environment Report"	⇨ 2016 (October): 26th (2 ranks down from previous year)
13. Drastic Regulatory Reforms in National Strategic Special Economic Zones		
14. Cyber Security		
14.1	By 2020, aim for over 30,000 registered IT security support providers	⇨ 2017 (April): 4172 registered providers
15. "Sharing Economy"		
15.1	During 2017, establish a minimum of 30 local public or municipal examples of sharing economy utilization	**New KPI
15.2	For Vitalization and Productivity Enhancements of SMEs, middle sized enterprises, and small enterprises	
15.3	By 2021, create consortia of industry-academia-government-financial sector collaboration to provide support to 200 pioneering technological development projects utilizing locally developed technologies every year, with approximately 1000 projects over 5 years	
15.4	By 2020, increase the number of profitable SMEs and small businesses from 700,000 (in 2013) to 1.4 million	⇨ 2015: 923,037 businesses (859,753 businesses in 2014)
15.5+	By 2020, aim to raise labor productivity growth rate in services industries to 2% (from 0.8% in 2013)	⇨ 2015: 1.3% growth rate (1.0% in 2014)
15.6	By FY2017, realize initial overseas expansion of 10,000 companies	⇨ 2013-2015 (July): Overseas expansion of 6500 realized[54]
16. Aggressive Agriculture and Fisheries Industries Development		
16.1*	By 2023, reduce the cost of rice production by 40% (16,001 yen/60kg in 2011)	⇨ 2015: Production cost for individual enterprise- 11,397 yen/60kg (29% reduction); corporate enterprise-11,996 yen/60kg (25% reduction)

[54] http://www.meti.go.jp/committee/kenkyukai/external_economy/shin_yushutsutaikoku/pdf/003_02_00.pdf

16.2	By 2025, double the cost efficiency of animal feed rice	⇨ Will be evaluated going forth[55]
16.3	By 2025, quadruple the number of corporate farmers to 50,000	⇨ 2016: 20,800 corporate farmers
16.4	By 2025, almost all farmers will utilize data in their agricultural operations	⇨ 2016: 54%
16.5+	By 2019, increase the export of agricultural, forestry, and fishery products and food produce to 1 trillion yen	⇨ 2016: 750.2 billion yen

* achieved
+ on track if extrapolated linearly
Source: http://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/miraitousi2017_t.pdf , some translations by author. Originally compiled by Takeo Hoshi and research assistants.

[55] http://www.kantei.go.jp/jp/singi/keizaisaisei/miraitoshikaigi/suishinkaigo_dai6/siryou8.pdf

Appendix 2: Japan's Venture Capital Industry

Japan's *venture capital* industry has developed significantly. While the size remains far smaller than that of the US or Silicon Valley, the amounts are actually greater than other notable advanced industrialized countries such as France, Germany, and the UK.

Figure 1. Venture Capital Investment Amounts (billions USD)

FY	2010	2015
Japan	1.29	1.11
EU	4.26	5.91
Germany	0.97	0.87
France	0.80	0.84
UK	0.79	0.62
Israel	0.41	0.65
South Korea	0.96	1.78
US Total	23.52	59.70
Silicon Valley	9.39	27.76

Source: Venture Enterprise Center, GVCA, BVCA, AFIC, IVC Research Center, KVCA
*Note that UK's data is as of 2014.

Figure 2. Amounts Raised in IPO, Small-cap Markets in Japan, US

	Average (million $)		Median (million $)	
	Japan (Mothers/JQ)	US NASDAQ	Japan (Mothers/JQ)	US NASDAQ
2015	7.6	116.0	3.5	75.0
2014	8.7	121.6	5.7	65.0

Source: Tokyo Stock Exchange, NASDAQ

Appendix 3: Top Japanese Startups by Fundraising, 2015

Major Venture Capital Fundraising by Japanese Startups, their founders and education 2015

Company	Amount Raised (billion yen)	Description	Founder	Education
Spiber	10.54	New-generation biomaterial development	Kazuhide Sekiyama	Keio University
Metaps	4.89	Marketing tools and consulting service in mobile business	Katsuaki Sato	Waseda University
Freee	4.49	Cloud-based accounting software	Daisuke Sasaki	Hitotshbashi University
Raksul	3.99	Commercial printing service	Yasukane Matsumoto	Keio University
Megakaryon	2.54	Producing platelet products from iPS cells	Genjiro Miwa	University of Tokyo, Harvard University
Quantum Biosystems	2.4	Commercial DNA sequencer	Toshihiko Honkura	University of Tokyo, Columbia University
Plus One Marketing	2.13	Mobility hardware products made by Japan	Kaoru Masuda	Waseda University
Preferred Networks	1.9	Industrial IoT applications with AI	Toru Nishikawa, Daisuke Okanohara	University of Tokyo, University of Tokyo
AXELSPACE	1.89	Commercial microsatellite imaging and data service	Yuya Nakamura	University of Tokyo
Treasure Data, Inc.	1.77	Cloud data management platform	Hiro Yoshikawa	Waseda University
GLM	1.69	EV Development / providing EV platform	Hiroyasu Koma	Kyoto University
Origami	1.59	Mobile payment service	Yoshiki Yasui	Waseda University, University of Sydney
iPS PORTAL	1.53	Instruments to analyze and measure iPS cells	Syosaku Murayama	Doshisya University
seven dreamers	1.52	R&D of carbon tool and medical equipment	Shin Sakane	University of Delaware
Money Design	1.5	Financial portfolio design with AI	Mamoru Taniya,	University of Tokyo,

			Tomoyoshi Hirose	Yokohama National University
CYFUSE	1.41	3D tissue-engineering technology	Koji Kuchiishi	Keio University
from scratch	1.29	Next-generation marketing platform	Yasuhiro Abe	Nihon University
SmartNews	1.19	News discovery app	Ken Suzuki	Keio University, University of Tokyo
Ptmind	1.1	Data analysis and monitoring	Zheng Yuan, Takashi Ando	Nihon University, Rikkyo University
Money Forward	1.03	Online application for personal accounting	Yosuke Tsuji	Kyoto University, University of Pennsylvania
AnyPerk	1.02	Integrated perks and rewards platform	Taro Fukuyama	Keio University
FOODiSON	1.01	Fresh fish distribution platform	Tohru Yamamoto	Hokkaido University
JOMDD	1.01	Medical device incubator	Takahiro Uchida	Fukushima Medical University, Harvard University
Retty	1.0	Social gourmet site	Kazuya Takeda	Aoyama Gakuin Univeristy
LOCONDO	1.0	Shoes and fashion e-commerce service, buy first and then choose	Yusuke Tanaka	Hitotsubashi University, UC Berkeley

Source: Japan Venture Research Co., LTD

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