

The Kyoto Model of Innovation and Entrepreneurship: Regional Innovation Systems and Cluster Culture

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ABSTRACT *Why is it that Kyoto, ancient cultural capital of Japan, a conservative and traditional place in many ways, manages to produce Japan's most innovative (and profitable) high technology entrepreneurial firms? Further, what causes regions such as Kyoto to create a self-sustaining critical mass, or cluster, of new venture start-ups in emerging sectors? Can this success in 'clustering' entrepreneurial businesses be replicated elsewhere? For example, what are the most effective ways to encourage new start-ups and connect fledgling firms to critical resources? The findings herein are based primarily on original case study survey and interview data from 29 life science start-ups and the entrepreneurs at their helms, representing more than half of all life science start-ups in Kyoto. I identify best practices in firm-level strategy and entrepreneurship policy in what I call the Kyoto Model of Entrepreneurship and Innovation, highlighting entrepreneurial case studies of successful start-ups. I also analyze factors leading to successful new business clusterization through analysis of entrepreneurial social networks and resource environments. Situating the findings within national innovation and entrepreneurship policies in Japan, I present a new model for regional innovation systems (RIS) and cluster emergence. I also include brief comparisons to life science clusters (and want-to-be clusters) in Japan and the United States, based on additional original survey and interview research in other regional clusters in each country.*

Keywords: entrepreneurship; industrial clusters; Japan; Kyoto; life sciences

Introduction

Kyoto, Japan's ancient cultural capital, is a historical center of artisanal textiles and pottery. The culture of the region is socially conservative, insular in many ways, and its inhabitants hold a special reverence for tradition. Kyoto is also a vibrant high technology based region, home to Japan's most famous upstart firms and the entrepreneurs at their helms.¹ Somehow this region has managed to create a critical mass, or cluster, of new life science businesses, that is, enough firms to maintain and produce continued new firm start-ups over time. Kyoto is a city awash in these curious

contradictions—conservative, yet frontier-oriented, old, yet cutting edge. Out of these contradictions the region produces a dynamic mix or balance, a *tsuriawase* of sorts. In sum, the economic dynamism in the region has continuously produced highly profitable entrepreneurial firms² in many high tech sectors, leading to a self-sustaining critical mass of firms, or cluster.³ The term ‘cluster’ has become a popular way of describing the concentration of innovative activity in certain local communities, and much research has sprung up around examining clusters.⁴

Clusters are geographically concentrated economic activities organized around a single or several overlapping fields (e.g. software, nanotechnology). In clusters, the bulk of benefits from local production remain in the region, for example, through supporting high standards of living for the local workforce. Further, industrial clusters have important multiplier effects for the local communities within which they are embedded, such as being an important source of employment in other/supporting sectors as well as a source of tax revenue for local governments. For example, while other regions in Japan continued to falter at the end of the recessionary 1990s, Kyoto’s exports increased, while imports to the region remained stable. This high export to import ratio is one way of quantifying a region’s degree of clusterization, as Figure 1 illustrates.

Why do Kyoto and a handful of regions across the globe create and sustain dynamic clusters of entrepreneurial activity, while so many other regions fail? Looking at the basic ingredients for high technology and life science clusterization—research-oriented universities, existing skilled workforce, presence of incubators, sources of capital, and the like—we might expect to see many more regional clusters than actually exist today. Other regions have the same basic ingredients for clusterization, but have not heretofore been able to translate these ingredients (e.g. scientific and capital infrastructure) into sustained new business creation in growth sectors. In other words, they are lacking in some critical element.

This article has six themes. First, I review the stumbling blocks remaining in using existing methods of examining clusterization, leaving us with a ‘black box’ of unexplained causal relationships at the earliest stages of cluster emergence and start-up formation. Then, I review how the methodology employed in this research—social, spatial and substantive—helps explain the causal connections between firms and their regional environment, particularly during the earliest stages of firm growth. Third, I review the components of what I call the Kyoto Model of Innovation and Entrepreneurship, and comment on lessons that can be drawn for other regions and start-up entrepreneurs. Fourth, I review the characteristics of life science entrepreneurial start-ups in Kyoto and situate them in the

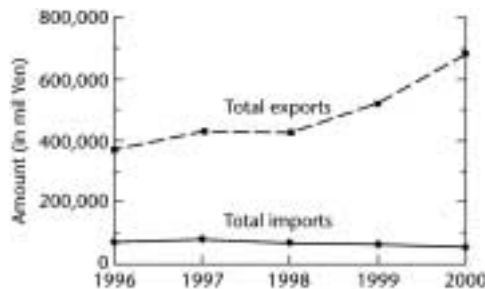


Figure 1. Kyoto prefecture export/import comparison 1996–2000.
Source: 2002 SME White paper (in Japanese).

context of Japan's slow-growing national economy. Fifth, I explain what it is about the dynamics of Kyoto's cluster culture—closed, yet open, traditional, yet cutting edge—that produces so many new businesses, particularly in high technology sectors. The strengths and weaknesses of the region, manifested in its cluster culture, are examined in the context of firm-level case studies in frontier entrepreneurship. Of particular emphasis are how firms have been able to benefit from the innovative coalitions of local stakeholders, such as the role of the Kyoto Venture Forum and the region's vibrant system of 'pocket-money-finance' in encouraging fast-growing and profitable entrepreneurial start-ups. Finally, I compare the local success of the Kyoto Model with less-than-successful national policy efforts. I conclude by reviewing the relationship between policy and other stimuli, organic factors, and time in fostering sustainable clusterization, across regions, and in the long-term.

What is the best way to get a grasp of the best practices and pitfalls to avoid in stimulating new business creation in emerging sectors? Are there certain interstices of people and institutions that lead to dynamic new business creation and regional growth? Together, these people and institutions supporting economic activity can be said to comprise a regional innovation system (RIS). RIS are distinct from clusters, as the former is the socio-political milieu within which clusters are embedded. Successful regional innovation systems provide the right environment from which clusters emerge. On the other hand, weak regional innovation systems can undermine new business creation and growth, for example where a culture of fiscal conservatism prevents venture capital formation. Regional innovation systems should also be contextualized within data on their respective national innovation systems (NIS).

Most studies on clusters, meanwhile, have focused on identifying patterns of VC (venture capital) and other correlates to new business creation—after a critical mass of new start-ups has been reached, and a cluster already established. These studies rely on publicly available information on a small subset of overall start-ups—those firms that have gone public (via an initial public offering, IPO) and therefore have already reached much later stages of firm development.⁵ Unfortunately, identifying regional patterns of VC concentration and IPOs show merely proximate (or intermediate stage) measures of existing clusters, not ultimate (or original stage) sources of cluster creation.

If the ultimate goal is a critical mass of firms, and a proximate goal is the development of VC and new firms, what can stimulate clusterization? Here lies the *black box* of clusterization, illustrated in Figure 2. Is it an organic process, some regions being fortunate by luck-of-the-draw? Or can the process be stimulated by policy, and further, what level of policy—national, regional, local?

Explaining why and how successful regional innovation systems excel at clustering involves tracking and analyzing the process of cluster emergence, in a rigorous,

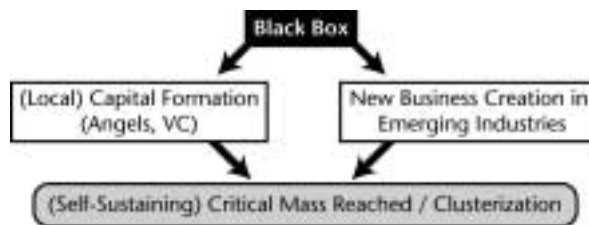


Figure 2. The black box of clusterization.

generalizable manner. A solid methodology goes beyond anecdotes of firms' experiences. Instead, such a methodology must provide replicable (verifiable) and comparable measures of firm-level growth, R&D development state and level and so forth. Further, rigorous measures show not merely correlations, but potential causal relations. The methodology of this research attempts to deal with the shortcomings of existing approaches.

A New Method for Measuring Cluster Emergence

This project has three categories of measures of cluster emergence: social, spatial and substantive. As previously mentioned, the primary level of analysis is the firm, from whose perspectives we can assess how (and if) local, regional and national policies are having an impact on firm level success. First, using *social* network analysis (SNA) methods, we can assess the social links that firms have to resources instrumental to their early growth, as well as rank the resources in order of importance to the firm—and at what stages certain resources are most important. We can also identify which individuals, if any, in local communities are serving as brokers for firms in obtaining R&D, financial, and other resources. One finding is that certain regions have network brokers (local advocates, civic leaders, philanthropists) who serve an informal—and therefore not easily quantified—yet central, role in the early stages of economic development (or rejuvenation) in local communities.

Second, through utilizing *geo-spatial* mapping technologies, we can obtain a bird's-eye view of the degree to which entrepreneurs' social networks coincide with their spatial relationships to useful resources and institutions. This might help identify interstices of opportunity for firms, as well as point to where industrial policy might be targeted in order to obtain the best return on the investment of limited government resources. For example, in Japan multi-billion yen national government techno-plex projects have so-far failed to produce significant new business development and market success. This failure can be explained in part by the sometimes arbitrary (and politically driven) funding of public works' investments into regional infrastructure. Meanwhile local, informal, modestly funded grassroots efforts by loose coalitions of entrepreneurs and local stakeholders (i.e. those with a vested interest in local development, employers, workers, investors, etc.) have had much more success as I demonstrate here and elsewhere.⁶ This contradiction is indicative of the problems inherent in bureaucrat-led entrepreneurship policy, currently the *modus operandi* nationally in Japan.

Thirdly, through a *substantive* case study approach, we can analyze the specific motives, impetus and strategies employed in establishing R&D collaborations, obtaining access to capital, and accessing networks of information important to business success. Further, these narratives of entrepreneurial struggle, including their successes *and* failures, can help illuminate the earliest stages of entrepreneurial growth, enabling the reader to draw lessons for future start-ups and developing regions. Likewise, many a story has been told of a new entrepreneur deciding to start a business in part because of the inspirational success stories (*monogatari sei*) of prior local start-ups, and the entrepreneurs at their helms.

From June 2005 to August 2006, surveys and interviews were conducted with life science start-ups in Kyoto, Osaka and Kobe. Also interviewed were incubator managers, VC firms, local, regional and national Ministry of Economy, Trade and Industry (METI) bureaucrats, as well as university technology managers, among other stakeholders in economic development. The survey was mailed via the post to

all firms identified (via public, government and university sources) (1) in life science (biopharmaceutical, medical device, nano-bio, bio-informatics) and (2) having commenced life science related business within the last 10 years. The postal mailing was followed-up with email and telephone contact. Interviews were obtained with half of all existing start-ups in the region. All surveys were conducted in person by Iyata-Arens in Japanese (with the exception of two start-ups established by English speaking foreigners). The survey instrument was a four section, four page survey assessing specific firm-level R&D, financial, marketing and other activity and related external collaborations and resources; relationship to government policy; and informal network activities. The survey also included questions to measure perceptions of regional characteristics, as well as questions to assess the local cluster culture vis-à-vis entrepreneurial business.

Supplemental data (e.g. baseline measures on education level of founder, time series data on growth in employees and R&D level) were subsequently collected from firms, using an email and telephone follow-up questionnaire in 2006 and 2007. Secondary data were also collected using publicly available sources, including the Nikkei Bio publications, government statistical databases, and evaluation reports (by private consulting firms) on firm and region-level entrepreneurship policy, VC investment activity and relevant university-based activity.

In my 2005 book *Innovation and Entrepreneurship in Japan*, I analyze entrepreneurship policy and strategy in high tech clusters. In the book, I include a number of regions, including St. Louis, Missouri and Kyoto. These regions have also developed successful life science clusters through an interesting combination of will and wherewithal on the part of local people and institutions. My current book, on life science clusterization in the United States and Japan, analyzes how, and how effectively, newer start-ups have become connected to these people and institutions. These social, spatial and productive relationships, together comprise a region's *sufficient conditions* for clusterization, and new business creation in general. Explaining the process of how successful regions have become successful clusters, and drawing lessons from the experience of winning regions is an important avenue of research and policy. This article, excerpted from several chapters of the new book, analyzes the start-up process as it relates to clusterization, from the perspective of 29 entrepreneurial life science firms and their founders, during the earliest stages of the firm, as they struggle to obtain resources in the tenuous first years after start-up.

Through following the firms from the moment of their inception and beyond, we can gain important insights on how these fledgling firms access critical resources (and which resources are indeed the most critical at these early stages, particularly for R&D intensive start-ups) in their environment. For example, who (and what institutions) are acting as central brokers between firms and much needed resources? Further, are there certain patterns of interaction between firms' local resources that can be modeled, and possibly provide lessons for other regions as they attempt to stimulate new business creation, economic development and long term regional growth?

In the past, I have identified what I call the 'Kyoto Model of Innovation and Entrepreneurship' and specified its winning characteristics at the levels of firm, network and region. I have also analyzed case studies in frontier entrepreneurship, drawn from the region's history of producing Japan's most innovative and productive entrepreneurial firms, including Horiba, Kyocera, Murata and Omron.⁷ For example, these and other firms excel at strategies of core competence, niche market focus, international R&D and marketing connections, a keen eye for cash

flow and profit, as well as continually re-investing in R&D. While a number of these strategies may seem obvious, taken in the context of Japan’s national history of nurturing big firms while neglecting, and even suppressing entrepreneurial upstarts—the ability of Kyoto to produce so many entrepreneurial firms is truly remarkable.

In regions like Kyoto, local leaders have done their homework, starting in the mid-1990s if not before, getting the right people (respected, successful, often serial entrepreneurs, scientists and civic leaders and the like) together to make strategic growth plans and follow-through with the will-and-the-wherewithal to stay the course. I call these developmental goal oriented networks of local stakeholders *innovative coalitions*. An important early admission is that not all industries can be winners, and that limited resources should be channeled into the best local bets. How innovative coalitions contribute to a vibrant regional innovation system and cluster culture is discussed below.

The Kyoto Model

As the postwar Japanese vertical production pyramid continues to collapse (albeit while replicating similar structures in its foreign subsidiaries in developing countries), a window of opportunity has opened at local and national levels in Japan for the rise of a broader Kyoto Model of economic development. Figure 3 illustrates how the Kyoto Model relates to the transformation in traditional Japanese production hierarchies. What follows is a brief synopsis of the Kyoto Model, and how it has evolved into stimulating high growth in convergence sectors in the 2000s.

In terms of the basic ingredients (or necessary conditions) for high technology clusterization, the Kyoto region boasts a strong scientific infrastructure, entrepreneurial social networks, collaborative manufacturing, strategic R&D activities and innovative coalitions. In *Innovation and Entrepreneurship in Japan*, I introduced the

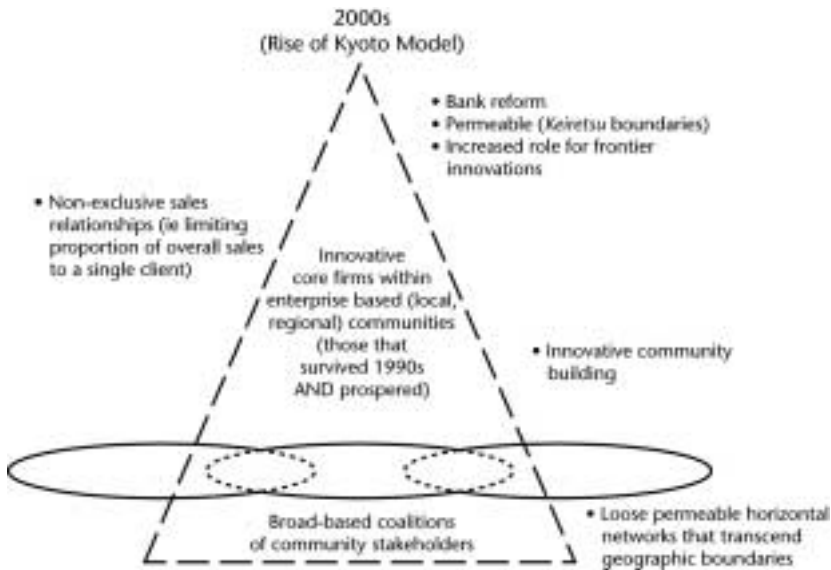


Figure 3. The rise of the Kyoto Model.
 Source: Iyata-Arens, 2005, *op. cit.*, Figure 1.4, p. 14.

early stage activities of the Kyoto Venture Forum (or KVF), which started out as an angel investor network (i.e. a network of venture capitalists) in the mid-1990s, and has since evolved into an innovative coalition of local leading entrepreneurs and city officials. How KVF continues to stimulate entrepreneurial developments and further clusterization is a focus of this article. Another development since the late 1990s in Kyoto is the attempt by local stakeholders to make the transition—through convergence strategies analyzed below—from its base in high technology manufacturing, to frontier fields, particularly biotech and nanotech. Tracking the region's success, from the perspective of the 'life science' entrepreneurs introduced herein provides new insights into the firm and region-level strategies of the Kyoto Cluster as it progresses to the next stage in its development. First, I situate the findings within Japan's recent economic history and current trends.

Snapshot of Life Science Start-Ups in Kyoto: National Context

In the 1990s, the Japanese economy suffered from the worst (and longest) recession in its post-war period. No sector of the economy was left unscathed. Large firms, usually protected by government from having to absorb the shocks of economic downturns, for the first time in postwar Japanese history found themselves exposed. Due to the magnitude and duration of the economic crisis, the government found itself unable to bail out the moribund keiretsu giants. Massive bankruptcies in small- and medium-sized enterprises thus coincided with unprecedented layoffs by some of Japan's largest firms. A credit crunch ensued, growth stagnated and business related suicides skyrocketed. The 1990s has thus come to be referred to as 'Japan's Lost Decade'. In response, the national government has stepped up its attempts to stimulate new business creation, discussed below under the section on 'Policy'.

In contrast, throughout the 1990s, Kyoto continued to churn out new entrepreneurial start-ups, across all sectors. Most promising, in this regard, in terms of potential for rapid growth, are new ventures in the life sciences (e.g. bio-pharmaceutical and medical devices) sector. The Kyoto region has been especially effective at producing new firms in convergence sectors, such as nano-biotechnology. At the same time, life science start-ups are a new phenomena in Kyoto. The firms in this sample (29) were established, on average, after 1998, many later than 2000. These start-ups have an average of five employees and are focused on R&D and product development in analytical equipment, eco-biotechnology and medical devices. A number of firms are working in convergence technologies, such as biosensors and nano-level detection. Product applications include measurement and analysis in industrial biotechnology research and manufacturing as well as for human biological applications. Some technologies have enormous (and not only niche) market potential, from drug discovery to the early detection of environmental toxins in the human body. One of the striking factors of Kyoto's entrepreneurs is that they have had, as a whole, significant (R&D focused, multi-year) international experience abroad, particularly in Germany and the United States.⁸ Another is the prevalent role for informal finance, whereby an entrepreneur relies on his/her broad social network for a number of individual investors. This system is often called 'pocket-money-finance' by the entrepreneurs. Table 1 outlines the firms in the study.⁹

In terms of the market for their goods, the new generation of Kyoto entrepreneurs provides products and services, balanced between the three market sectors of

Table 1. Outline of case study firms: summary statistics

Mean of employees	5	
Median of employees	3	
Mode of employees	2	
Mean of start-up year	1998.2	
Median of start-up year	2000	
Mode of start-up year	2001	
Interviewed firms (29) as a percentage of total number (52) of firms	55.7%	
<i>Non core (e.g. distribution and sales type) biotech excluded</i>		
Sub-field of life science		%
Medical equipment	3	10%
Environment	6	21%
Research equipment	13	45%
Foods	1	3%
Reagent	1	3%
Drug discovery	2	7%
Others	3	10%
Total	29	100%
Degree type of founders		
Bachelor	9	31%
Master	5	17%
Doctorate	15	52%
Total	29	100%
Market		
<i>Percentages do not add up to 100% due to rounding</i>		
IBF	13	45%
EBF	6	21%
HBF	10	37%
Total	29	103%
R&D linkages		
KUNIV 1	13	45%
INHOUSE	6	21%
HUNIV 1	1	3%
KUNIV 2	1	3%
KUNIV 3	1	3%
KUNIV 6	1	3%
OUNIV 1	1	3%
TUNIV 3	1	3%
AUNIV 1	1	3%
All other R&Ds (Hosp, Res Inst)	3	10%
Total	29	100%
R&D level		
1. Research, development and sales of patented technology developed in-house (within the firm)	27	93%
2. Research, development and sales of technology developed elsewhere, but patented by the firm	1	3%
3. Development and sales of licensed technology discovered outside the firm (e.g. use of university-licensed technology)	1	3%
4. Sales of licensed technology that has been developed outside the firm	0	0
5. Other	0	0
Total	29	100%

life science: industrial, human and eco-bio fields (44.8%, 20.6%, and 37%, respectively). Being R&D based, it is no surprise that twenty-first century Kyoto entrepreneurs are highly educated. Of the 29 founders, 20 had advanced degrees, within which the bulk (15) are PhDs, mostly in scientific fields, but also in engineering. As mentioned previously, many have had significant international R&D experience, especially in Germany and the United States. These entrepreneurs are scientists of the highest caliber, with a savvy sense of the global market potential of their products. What is it about Kyoto that makes it produce a plethora of these kinds of entrepreneurs?

Kyoto's Cluster Culture

This article began with a seeming contradiction: between Kyoto's long, ancient history and concomitant traditionalism and conservatism; and its penchant for producing cutting edge science and entrepreneurial start-ups. The cluster culture, or the attitudes and behaviors toward entrepreneurial activities, can be summarized by looking at the way entrepreneurs—on the ground, and engaging in their daily lives with the resources (or lack thereof) of the region—perceive the strengths and weaknesses of the Kyoto region vis-à-vis new business ventures. Insights gained in this manner are much more informative than studies that rely primarily on public relations materials of local governments and business associations.

The top strength, according to respondents, is the availability of many quality scientific and technical resources, particularly those at universities. This is a key characteristic of successful innovative clusters. For example, in the United States new business start-ups that begin with university-linkages survive at much higher rates than those without such collaborations.¹⁰

Respondents were also very pleased with the overall entrepreneurial environment, particularly the ease through which new firms get connected to local, informal networks of firms, due partly in fact to the high number of already successful start-ups in the area. So, the traditional social networks are open in some ways, to certain newcomers (how and why this is so is discussed below).

The third top strength is the long history of the region in producing high quality of (especially high tech) products and services provided by firms of all sizes, particularly entrepreneurial start-ups. In sum, newcomers can rely on advanced scientific and technical infrastructure, as well as the inspiration (and social networks of) successful serial entrepreneurs who call Kyoto home.

No regional cluster is perfect however, even high-flying Kyoto. For example, entrepreneurs complained the most about the small market size in the area, particularly in comparison to Tokyo. This market draw of Tokyo has become a serious problem for Osaka, another region in this research (analyzed in depth in my forthcoming book). The 'star' entrepreneurs in Osaka have, almost without exception, moved their headquarters to Tokyo in order to be closer to the market for their goods as well as potential venture capital.

Table 2 outlines overall attitudes of respondents towards the strengths and weaknesses in Kyoto's cluster culture in this regard.

Curiously, while entrepreneurs complain about the small market size in Kyoto, in contrast to respondents in Osaka (and other mid-size regions in the United States, like St. Louis, Missouri), they rarely express any intent to leave the region. One reason is the prevalence of pocket-money-finance (discussed below in the context of case study examples) and how Kyoto entrepreneurs (related to their

Table 2. Kyoto region: strengths and weaknesses

Strengths (composite)		
<i>total does not add up to 100% due to multiple declarations of top strength/weakness</i>		
1. Resources	19	66%
2. Entrepreneurial environment	12	41%
3. High quality, high tech reputation	11	38%
Weaknesses (composite)		
1. Small market size	14	48%
2. Closed, traditional, difficult to get new info	7	24%
3. Kyoto University too strong	2	7%

high level of practical international experience) have tended to skip the Japanese market altogether and instead focus their marketing efforts on international sales. The second weakness, in interesting contrast to the strengths above, is the closed, traditional attitudes prevalent in the region, which sometimes undermine the free exchange of information and the perception (from the outside) of exclusivism.

So, what is the dynamic of the closed, yet openness of the Kyoto Model of Entrepreneurship and Innovation? Masao Horiba, perhaps the region's most nationally (and internationally) prominent entrepreneur, and founder of Horiba Manufacturing, has a revealing take on Kyoto's reputation for being closed:

It is said that Kyoto is closed, but not from our perspective. You know, the original seeds for Kyoto came from China, for example, the traditional textiles (*orimono*), brewing stock (*jozo no dashi*), all of the old, even ancient, sources upon which our culture is based. By copying technology from the Chinese thousands of years ago, Kyoto's technologists were born. So, naturally, if we respect something from the outside, we accept it accordingly. We do not reject people per se, but reject people with no respect. If people bring to Kyoto things that we do not need, then we do not welcome these people. We appreciate positive people, but people who do bad things are a nuisance. If, on the other hand, you bring things that we do not have, and that we can use, we are extremely grateful. In fact, as you know, many of the founding entrepreneurs of Kyoto are not even from Kyoto. For example, Kyocera's Inamori is from Kagoshima, Murata is from Fukui, and so it continues with a number of our Kyoto Venture Forum 'A Rank' start-ups.¹¹

This closed, yet open attitude is reflected in the wide variety of backgrounds of successful Kyoto entrepreneurs, as Horiba alluded to above. Some of these entrepreneurs are from other Japanese regions, some are born and raised in Kyoto, and a few are even foreigners. So, while the cluster culture of Kyoto reveres old traditions, access is not limited to people born and raised in Kyoto (*Kyoto-jin*), as a number of its historical (and future) entrepreneurial success stories attest. A small minority of respondents (two) in this study complained that Kyoto University was too strong. This is no surprise, as 45% of the entrepreneurs in this study had R&D collaborations with Kyoto University. Further, many of the entrepreneurs (whether *Kyoto-jin* or not) had degrees from Kyoto University.¹² So, viewing the centrality of Kyoto University in the region's entrepreneurial culture and social networks—from the outside—can be particularly daunting. Fortunately, Kyoto is home to 40 universities, colleges and technical schools, with which new entrepreneurs can forge ties.

Ritsumeikan University, for example, has been especially active in supporting and producing new business start-ups in recent years.

Strength and Weaknesses in Context: Case Study Analysis

Strengths

While it is informative to see a bird's eye, aggregate view of what new entrepreneurs think about the Kyoto region, it is often more informative to evaluate the relative strengths and weaknesses of any region in-depth, through exploring case study narratives of the struggles of starting a new business. As discussed above, the three top strengths of Kyoto supporting its potential for further life science clusterization are the availability of scientific and technical resources (particularly university-based), the positive environment for entrepreneurs, and the international reputation for high quality (high tech) products. How successful start-up firms have plugged-in to these resources is the subject of the following discussion of Kyoto entrepreneurial case studies. First, I explore the contradictions of the region: conservative and traditional, yet open to newness and change.

Even Kyoto natives demonstrate a critically introspective view of the sources of regional pride. For example, I-san of Eco Micro Bio, a Kyoto native, biochemist, and more recently, an entrepreneur, says:

You know, we *Kyoto-jin* are really an ill-tempered lot. We were the inhabitants of the ancient political capital of Japan, which has made us unified, confident and proud. At the same time, since losing the political capital to Tokyo, we have earned a reputation for being radically-minded, even 'leftist'. This makes us unafraid of a challenge, a characteristic useful for frontier business. We have learned this from our history.¹³

A highly revered (e.g. by many other entrepreneurs in this study, as well as by local civic leaders) retired professor from the faculty of the Medical School at Kyoto University, who is also a start-up entrepreneur in this study, reflects on the local cluster culture, through his time teaching over the years at the top research university in the region (and locals would say all of Japan):

The historical families of Kyoto, such as the Nishijin [the traditional textile district], the Gion families of the Gion Chonai (Gion Ward Association), as well as successful SME leaders have much wealth. They have the money to give. Our city is also full of rich entrepreneurs, such as from Omron, Kyocera, Shofu, etc., and this is our history from hundreds, really thousands of years before. *Kyoto-jin* are born into this long, proud history of wealth and comfort. So, I have found that at *Kyodai* (Kyoto University), it is the ones from Kyoto that do not have a work ethic. In contrast, the ones that come from *inaka* [the country], come here and become social and career successes (*risshinshusse*), because they are willing to work hard. So, the 'Kyoto Ventures' are mostly from other places. But, on the other hand, we have local, wealthy individuals who will support the next generation. So in the end, it works out well for all.¹⁴

Through matching older, more experienced wealth to younger start-up entrepreneurs, the region excels. Local stakeholders accomplish this through a variety

of informal social and angel investor networks (including the Kyoto Venture Forum, introduced above), as well as a vibrant pocket-money-finance system.

Kyoto Venture Forum

We went to the bank, the Kyoto Bank, to apply for a business loan. They suggested that we apply for A Rank designation by the Kyoto Venture Forum, and they would get back to us about the loan. We had not succeeded yet with any of our product ideas, but believed that we could be successful. So, we took a chance and applied for the interview process. After we were selected as A Rank by the KVF, *then* we got money from the bank. In fact, after we were selected as A Rank it became easier to get money from a number of sources, even the city gave us some government grant money (*hojokin*).¹⁵

In essence the KVF A-Rank imprimatur serves as a powerful signaling device to the financial community, as the latter understands that the ‘A Rank’ is not mere lip-service about ‘firms with potential’, but instead is backed by a network of extremely capable and successful entrepreneurs, including the founders of Horiba, Murata and Samco. ‘A Rank’ firms are selected through a rigorous, several month long pre-application, application, and interview process, culminating in a grueling final interview—before the region’s top entrepreneurs—at which time the finalists are peppered with intricate questions aiming to assess the substance of their entrepreneurial vision, R&D quality, and product potential, among other things. Those firms making the grade, a tiny percentage of the original applicant pool, are awarded ‘A Rank’ status by the KVF.

However, it does not end with the granting of A Rank status to select firms. Horiba and others function as management consultants of a sort, advising new entrepreneurs on product development, market targeting, distribution and financial management. In other words, these entrepreneurial leaders volunteer their time to help new entrepreneurs to succeed, ‘to the extent that we are able’, says Horiba:

If we select a firm as ‘A Rank’ and the firm fails, it doesn’t look so good for us. After all, if we have given these firms the ‘KVF A Rank’ imprimatur, we are seen as supporters of these firms, and we are supporters of these firms. Our expectation is that they succeed, but if they fail, it reflects poorly on the individuals who run the KVP, and this would be bad for us (*komaru*). So, naturally, we try to help the A Rank firms to succeed. We help them look for markets, help them get mechanical technicians, you name it, we help with it.¹⁶

Pocket-Money-Finance

Also interesting is the fact that case study firms—in contrast to respondents in other Japanese and American regions—did not see access to finance as a major problem, despite Japan’s lack of a VC market, and a mere handful of active VC firms in the Kyoto area. Instead, Kyoto firms relied on what is referred to by local entrepreneurs as ‘pocket-money-finance’. In this informal financing system, an entrepreneur can depend on a number of people in his/her broad social network, to contribute and/or lend small amounts of money. Spreading the risk over many

people reduces the burden on individual investors, and the firms that succeed tend to return the favor by investing in even newer start-ups. For example, Bio Make firm has over 109 individual investors, who have contributed slightly less than \$5,000 each: 'We call this our "pocket-money-finance" system, but it is really the "friends around us"—they are our number one supporters (*shiensha*)'.¹⁷

Weaknesses

No region is infallible, however. The top complaints about the region—outlined above—were that the market was small and that Kyoto's social networks were closed and exclusive (*heisateki*), and as a result, outsiders often have difficulty obtaining information. Nevertheless, even those entrepreneurs in this study who were the most likely to concentrate on the negatives of the region (and coincidentally hail from the current politico-financial center of Japan: Tokyo), found that for their new business start-ups, Kyoto was the place to be (see 'Case Study: Peptide', below).

One of the consequences of the small market in Kyoto for high technology goods is that new entrepreneurs must really work to market their products outside the region, as they cannot depend on the local market to support their businesses. Further, start-up firms in general in Japan struggle to find domestic buyers for their products. One case study firm complained about the weakness of Japan's biotech market in general:

This is interesting, the Japanese buyers go to the English/British distributors to buy our product, they *do not* buy it from us, though it would be cheaper and faster. Foreign products are two times as expensive. Japanese think that because it is foreign, it is somehow better. Most Japanese biotech is developed in the US and Europe. So, naturally, Japanese firms in general are in the habit of buying foreign products, and then they re-sell them in Japan.¹⁸

Firm Case Study A: Peptide

O founded Peptide, a leading Kyoto producer of biochip and peptide technologies in 2002. The start-up focuses on molecular recognition systems, and the use of next generation bio-chips, meaning that in addition to monitoring the state of the human body, the chips function like therapeutic agents. He takes a critical view of Kyoto, and is wont to call people who disagree with his visionary ideas 'stupid'. Nevertheless, he finds that he has no problem finding talented scientists in Kyoto to work with in his new venture, so he plans to remain. Born and raised in Tokyo ('I am Edo-ko', as O says), he says that it was serendipitous (*en ga yokatta*) that he started his firm in Kyoto.

O graduated with a degree in chemistry from Tokyo University of Agriculture and Technology in 1971. At the time, he received a scholarship from the US, but was concerned upon learning that the numerous anti-war student protests at the time resulted in American universities often being shut-down. O was fortunate to also have received an offer from a German research institute, where he moved and soon began his life work on bio-molecules. A self-described workaholic, he was disappointed that most of his German colleagues left promptly at 5 p.m. each day. Once, when a German professor asked rhetorically why is it that the best German scientists keep moving to the United States, O replied that if they stayed home,

instead of working, they would be ‘mountain climbing, skiing, attending classical music concerts, and/or going to the opera!’

Before O went to Germany, he had studied chemistry, but the emerging field of biochemistry was alluring. At that time, the term was bio-organic chemistry: an amalgam of physics, chemistry, and bio. O was particularly interested in the role of peptides (molecules consisting of two or more amino acids) in analyzing the function of the human body, in order to find ways to use the discoveries in industrial applications. One of his inspirations has been reading the history of Paul Johnson, who founded Johnson and Johnson. It impressed O that Johnson began as a simple, street doctor, yet had a feeling that his treatments could reach more people. As a medicinal chemist, Johnson started out by developing pain treatment drugs, and the rest is history, as they say.

Remaining in Germany for seven years, until 1979, O had not intended to return to Japan, but he was offered a faculty research position at a large prefectural university. This enabled him to focus on further developments in his peptide research as well as explore interests in immunochemistry. In 1990, he was recruited to be the R&D General Manager of a world-famous scientific instruments maker in Kyoto. A few years later he was asked to lead the development of its Life Science Center. In 1997, he established its Scientific Research Center. O concurs with those who have worked for the scientific instruments maker and left who say that it has always been run like a feudal fiefdom. O says that in the late 1990s, as a result of some kind of intra-management fight, he found his division suddenly out of corporate favor. He found himself being told by upper management, that the ‘accomplishments of the center were not up to snuff (*gyoseki wa warui*), couldn’t you quit?’

So, O decided to take the plunge and start all over—literally—‘from nothing’. His former house was paid for by the company, and he had to find himself a new job and a new residence. Having decided to try to become his own boss, and build a company by getting into the convergence area of using nano-particles in bio-chip development, he found himself in need of a clean room. In 2002, with no capital, other than his retirement money, a serendipitous thing happened. One of the subcontractors of his former company had just vacated an entire floor of its Kyoto building, having moved its operations to another prefecture in order to be closer to its biggest customer. O had developed a relationship of mutual respect with the CEO of the firm during his tenure at the scientific instrument maker, and the subcontractor was more than happy to help O in his new venture. The vacated space happened to house a fully-functional clean room. O moved in right away and soon thereafter his testing lab was up-and-running. Then, after presenting a paper at an international conference, he got really lucky. The conference paper speculated on the ways his technology could be used to control infectious diseases. The US Army expressed interest in his then prototype product, and agreed to kick-in some R&D development money. Now, Peptide’s bio-chip diagnoses specific pathogens within 15 minutes. O ponders, ‘How many US military personnel are stationed abroad? If, for example, each soldier requires one chip ...’.

After those international tie-ups became public knowledge in Japan, he suddenly found himself the recipient of several METI Innovation Cluster and other lucrative grants as well (where previously no government agency seemed interested). Since then, Peptide has never failed to obtain research funding, but O wonders about the government’s ability to evaluate ‘fundable’ research. For example, when a government grant is terminated, O thinks the results should be discussed in public, but the government always curiously reports ‘good results’, and the discussion seems to end

there. Despite being a recipient of national government funds he says that he will not accept *amakudari* (the traditional practice whereby retiring bureaucrats find post-retirement positions at companies that they have ‘supported’), as his people must have the ‘heart to start a company’. They also must be scientists at their core, able to do research. O says that even his secretary is educated as a scientific researcher, and participates in the R&D of the firm.

O has an interesting perspective on what it takes to develop scientific talent. First, he says that where a person gets his/her degree is meaningless, if they are thinking about visionary things, and are willing to work hard, then this is the kind of person he wants to hire. He says that a PhD from a university is not important, and further that the sex, age, educational background is not important at Peptide, rather equal opportunity is based on scientific capability. It also helps if that person has also had some experience conducting research abroad: ‘one excellent guy is equal to 10,000 or more stupid people!’ He reflects on his time at Kyoto’s leading scientific instruments maker as affording him the opportunity to travel extensively and to establish personal links with over 30 universities around the world.

Further, once he attracts international researchers for R&D collaborations, he says that it is important that collaborators are happy. For example, when he hosts research activities in Kyoto, he invites their wives too to the workshops. The beautiful scenery and culture in Kyoto is always a draw: ‘Then everybody is happy, and I can entice first class scientists to come to me in Kyoto. If we collaborate, then together, we can do better, faster work, can simulate the mimic/mimetic that propels a research team to higher levels’.

O also thinks he is ahead of the curve in operating in China—in contrast to those who think that the reason to be there is the cheap labor. O observes that medicinal and healthcare infrastructural growth is extremely rapid there, the market potential is enormous. Right now, his production is based in Okinawa, but in the future, he plans to do these operations in China. When he was offered a visiting professorship at a major Chinese university a few years ago, with a one class a year load: ‘I happily accepted’. He has already used his newly established China connection to hire post-doctoral researchers. Unfortunately, attracting quality researchers from China is a challenge. The ‘first class Chinese scientists go to the US, second class to Germany, and the third class come to Japan’. Nevertheless, these relations were also helpful when he decided that he needed to go to China and collect, for one of the compounds under development, 2,500 scorpions.

O is also critical of so-called leading Japanese university faculty:

It is very important to do research in different environments, but the typical Todai [Tokyo University] scientist has spent four years getting their undergraduate degree at Tokyo University, then gets his Masters, and PhD there as well! He becomes an assistant Professor and has become a stupid guy. The title is all they earn, all they have done is imitation. These people build their careers doing review work, they do corrections and summarize the work of others.

But, as O says, ‘The reality at places like Todai is like the Monkey Mountain, the boss delivers the grants and positions, so he is able to remain the boss’.

O is also critical of the Kyoto prefecture’s approach to life science as:

quite stupid, and also like the other prefectures, their focus is not on scientific things, unfortunately, the local government cannot recognize the difference

between nano, bio, pharm and medical, they would like to offer equal services, but some need more, some need less, but they offer the same for all.

He does not limit his critique to local level bureaucrats: ‘The Japanese government is stupid, especially vis-à-vis science. There is always a 5–10 year delay after international scientific developments. Then they merely imitate the US’.

O is not too full of himself however, admitting that before the bio-chip product really has global market reach, there will be many development barriers to overcome. At the same time, O finds this situation good, ‘because it will be difficult to imitate the technology. The Japanese and the Chinese are very good at this, key technology should not be so easily imitated’.¹⁹

O san of Peptide is quite acerbic, but, as mentioned above, that is just the kind of characteristic that locals proudly share. In other words, O san fits in quite nicely with the proud, sometimes confrontational local business culture. The cluster culture of Kyoto can be closed, yet at the same time open, as discussed above. As Masao Horiba indicated, the local business community welcomes people with scientific and entrepreneurial substance, regardless of who they might appear to be on the outside. The entrepreneurial history of one of its stellar life science start-ups, illustrates this unique openness of the region.

Firm Case Study B: Nutra Bio

Dr M, was born in 1947 in Osaka, but moved to Kyoto for primary school. M graduated from Kyoto University in 1979 with a doctorate in Agriculture. Having an interest in nutraceutical research, M joined a local food manufacturer after graduation, and within a few years, M had the opportunity to continue his studies abroad. In 1983, M left Japan for the US and spent several years at the University of California, Berkeley as a post-doctoral researcher in agricultural science.

M describes this time in California as life changing:

I met lots of different kinds of people when I was doing various research in agricultural products. At that time, there were so many bio firms getting started, I thought to myself that I could do this much easier, I could do this too, I could be the best, due to my human network.

What really pushed M to make plans to follow his dream of starting his own firm was attending a San Diego BioVenture meeting (in the late 1970s):

I went to see and check it out, about 1,000 people attended, it was a great experience seeing the 60 year olds who wanted to invest (*toshi shitai*) being matched with the 20 year olds who wanted to do ventures (*vencha shitai*). I thought to myself, if it is like this, even I can do this.

Returning to Kyoto and the food manufacturer a few years later, M eventually became director of R&D. Soon thereafter, M was asked to lead a spin-out of one of the R&D projects of the company into a separate entity. After getting the new company off the ground, M decided to retire and departed again for a stint in California, this time at the Scripps Institute in San Diego to further his research ideas in human health.

Returning home again, M decided to start Nutra Bio in 1997 with the help of three colleagues at his alma mater: Kyoto University. In retrospect, it wasn't as easy as he first thought. M reflects that 'the first two years were very difficult, I had no lab, only the ideas that existed in my own mind'. A modest research grant from METI enabled M to focus on the core R&D—protein engineering and gene recombination in basic foodstuffs for enhancing the nutritional and therapeutic potential—that would become the basis for his new start-up. Also helpful to M in the early years was the Kyoto SME Support Center, which he found very helpful in getting him and his firm connected to broader support networks, including METI funds.

Nutra Bio is also an 'A Rank' Kyoto Venture Forum Firm, selected in 2004. Later in the same year Nutra Bio went public. By mid-2006 Nutra Bio had more than 60 employees.

M reflects on what it is about Kyoto that makes it the ideal place for him to do business (while he observes that although Kyoto University is the undisputed leader in scientific research, he also says that 'sometimes Osaka University is better at the *business* of science', that is, translating scientific discoveries into commercializable products):

In terms of the coalitions and informal networks, we have benefited from the interactions in a number of locally coordinated study groups and research collaborations that include a number of the research universities, and also other research institutes in the Kansai region. One of the collaborative research networks is particularly productive: 'so far there have been about 50 spin-off projects from the original group'.

In sum M says that Nutra Bio 'has serendipity (*en*) in our human network'. For those that perceive that Kyoto is closed to outsiders, it should be noted that Dr M is Korean-Japanese, and has maintained ties to Korea, for example in serving recently as a visiting professor at a leading Korean University.²⁰

While the stories of O san (Peptide) and Dr M (Nutra Bio) provide newcomer perspectives, even Kyoto natives view the closed, traditional environment as a double-edged sword. On the one hand, local entrepreneurs can rely on tight-knit social networks dating back to their college days. However, as firm owners and managers, they experience that sometimes Kyoto's high-pride society produces a young generation that is a bit lazy (perhaps a problem shared by most other affluent regions, internationally). A number of respondents, who were also university teachers at some point in their career had observed that over the years the students from the small country villages often work harder and smarter than their native Kyoto peers (c.f. Dr L quote, above). Nevertheless, as the findings from Peptide and Nutra Bio, which are representative of the other 27 Kyoto case studies, show, the strengths outweigh the weaknesses of the region. The contradictions of the region's cluster culture have provided dynamism (the Japanese like to call this situation 'Plus Alpha', *purasu arufa*) and avoided stagnation. Key to the region's success has been the multi-generational replenishment of a core group of entrepreneurial leaders, founding and actively maintaining innovative coalitions of local stakeholders (such as the Kyoto Venture Forum) in harnessing the inherent potential of the region. These informal, supportive networks guide talented newcomers on the path to entrepreneurial success and facilitate local economic development. I now turn to how local efforts relate to national policy trends.

Policies Stimulating New Business Creation

As I have written in my 2005 book *Innovation and Entrepreneurship in Japan*, and elsewhere, METI launched its 'Cluster Initiative' and 'Cluster Plan' in 2000 and 2001, respectively.²¹ The Plan intends to promote innovation and new business creation, particularly in high technology industries. Related policies by MEXT (Ministry of Education, Culture, Science, Sports and Technology) are aimed at encouraging more science and technology-based university start-ups via two main measures: establishing technology licensing offices (TLOs) and expanding graduate MBA programs. Within the Cluster Initiative (whose main growth targets are informatics, biotech, nanotech and eco-bio) is an emphasis on promoting the biotech industry, particularly in the Kinki and Hokkaido regions.²² By fiscal year 2002, the national life science budget had grown to 440 billion yen (about US\$ 4 billion).

Other initiatives include the establishment of an SBIR program, modeled on the SBIR program in the US, as well as measures targeting improvements in *jinzai* (personnel skills).²³ The latter includes such activities as the NEDO Fellow program, which places young scientists and other professionals in small businesses, whose salaries are paid for a time by the Japanese government. The most significant change in METI in recent years has been in critical self-reflection and in-depth survey-based and quantitative benchmark analyses of how well they are doing in each target area (though some selection bias can be found in that they tend to survey only firms already involved in METI-sponsored 'Cluster Plan' projects).²⁴

A number of the firms in this study have benefited from METI grants and have been awarded post-doctoral researchers through the NEDO Program, though most remained critical of METI's motives in this regard:

Two years ago at National Diet [legislature] question time (which is broadcast on national TV), a representative of METI's NEDO Program was asked, why is the success rate so low? With all of this money? So, every year the actual implementation of METI policy and their budgets changes, now they look for firms that are already successful.²⁵

I have been tracking METI policy for over a decade, and this tendency to select firms that have already demonstrated a track record of success (rather than true, unproven start-ups), is consistent with METI behavior in the late 1990s. For example, M-san, a METI bureaucrat, who was then a key coordinator of regional policy, reflecting on the potential of METI's ambitious 'Cluster Plan' Initiative said:

If we don't start supporting the smallest of the SMEs—and not just the established medium sized (*chuuken*) which are reaping the most benefits from this project, the Japanese economy will fail.²⁶

Essentially, the national government, in selecting grant recipients, remains risk-averse, and seeks out proven technologies in already successful firms. This careful selection thereby guarantees their ability to report overall success in their investments. Unfortunately this means that the newest, smallest, most cutting-edge firms—the ones who truly need the funds, though they might have incredible potential—are in fact, the least likely to receive support.

A major challenge then, for local governments, is to act as advocates for talented local firms, in obtaining government support for new business creation. How can

local communities get the funds channeled to support deserving local firms that could harness the funds in the most productive way (high growth from early stages versus modest growth at later stages)? This advocacy is not merely important in obtaining government finance, but also in attracting venture capital to the regions. The aforementioned discussions of the successful history of Kyoto, for example via the activities of its innovative coalitions, shows that sustainable clusterization is a multi-generational process. In other words, successful clusterization takes patience, perseverance and time.

To get to clusterization—a concentration of (new) firms that contributes to the health of regional economies and the inhabitants of such communities—we first need sufficient new business creation, which depends broadly on venture capital infusions, less so from venture firms (classic VC) and more from angel investors and other informal sources of VC (i.e. the traditional four Fs: founders, friends, family and fools). Even in the USA, the world’s most developed venture capital economy, angel investors support 90% of new firms in the critical pre-seed, seed and start-up stages, while VC firms increasingly focus on later stage firms. The preliminary findings discussed herein indicate that angels and the four Fs play a much larger role in Japan than previously understood, but that the effectiveness of informal systems of finance varies widely by region.

Conclusion

In conjunction with policy strategies intended to assist Japan in jumping over its competition, Japan’s top regional innovation systems, such as Kyoto, might lead this transformation into a new kind of region-based national innovation system. These local, grassroots approaches to development and growth have taken a long time to take root and flourish, and this is an important caveat for regions hoping to follow the lead of Kyoto in this regard. Figure 4 illustrates the delicate balance between policy and other stimuli, organic factors, and time.

Upstart regions and entrepreneurs around the globe would do well to learn from the lessons the Kyoto Model can provide. The numbers (ROI, increase in the number of start-ups, high export/import ratios, and the like) are the proof that the Kyoto Model works. However, it is the social, spatial and substantive relations

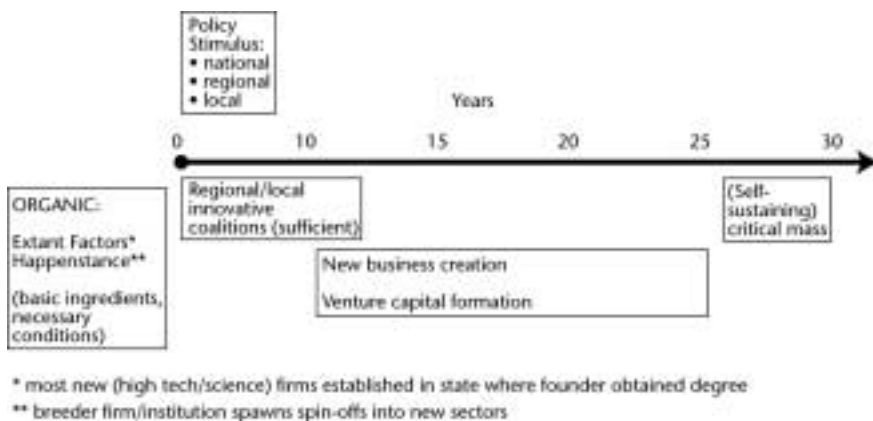


Figure 4. Timeline: from policy stimulus to critical mass.

between certain people, with the will and wherewithal to make things happen—sustainable in the long-term—that truly matter.

Notes and References

1. Of the 12 Japanese Nobel laureates (as of 2006) half (six) have had significant links to the Kyoto region, especially to Kyoto University. That is, laureates have either conducted the research for which they were awarded the Nobel Prize at Kyoto University, in Kyoto, or had received their graduate training at Kyoto University. This number surpasses the Nobel laureates from Tokyo (five); see 'List of all Nobel laureates 2006', available at: http://nobelprize.org/nobel_prizes/lists/2006.html.
2. Studies have found that Kyoto entrepreneurial firms demonstrate a higher ROI (return on investment) than those located in other regions; see C. Suematsu, *Kyoto Yoshiki Mojuruka Senryaku [Kyoto System of Modulization Strategy]*, Nihon Keizai Shinbun, Tokyo, 2002.
3. Pioneering high technology entrepreneurial firms including Kyocera, Shimadzu, Murata, and Horiba were established in Kyoto; see K. Ibata-Arens, *Innovation and Entrepreneurship in Japan: Politics, Organizations and High Technology Firms*, Cambridge University Press, Cambridge, 2005.
4. See, for example, C. DeBresson, 'Why innovative activities cluster', in C. DeBresson *et al.* (eds), *Economic Interdependence and Innovative Activity: An Input Output Analysis*, Edward Elgar, Cheltenham, UK, 1996, pp. 149–64; T. Arita, M. Fujita and Y. Kameyama, *Regional Cooperation of Small and Medium Firms in Japanese Industrial Clusters*, Institute of Developing Economies, JETRO, Tokyo, 2004; P. Cooke, 'Life sciences clusters and regional science policy', *Urban Studies*, 41, 2004, pp. 1113–31; I. Mitsui, 'Industrial cluster policies and regional development in the age of globalization-Eastern and Western approaches and their differences', *30th ISBC*, Singapore, 2003 (mimeo); H. Inoue, 'Activating industrial clusters-RIETI cluster seminar No. 5', Research Institute of Economy, Trade, and Industry (RIETI), Tokyo, 2003, available at: http://www.rieti.go.jp/users/cluster-seminar/pdf/005_e.pdf, accessed November, 2005; F. Bosse, 'Clusters-an effective instrument for industrial policy to support structural change?', in H. Fukushima (ed.), *Globalization, Regional Concentration and Clustering of Industry*, Research Institute of Economic Science, College of Economics, Nihon University, Tokyo, 2003; and OECD, *Innovative Clusters: Drivers of National Innovation Systems*, Organization of Economic Co-operation and Development, Paris, 2001.
5. See, for example, W. W. Powell, K. W. Koput, J. I. Bowie and L. Smith-Doerr, 'The spatial clustering of science and capital: accounting for biotech firm-venture capital relationships', *Regional Studies*, 36, 2002, pp. 291–305.
6. K. Ibata-Arens, 'Alternatives to hierarchy in Japan: business networks and civic entrepreneurship', *Asian Business and Management*, 3, 2004, pp. 315–35.
7. Ibata-Arens, 2005.
8. Of the 29 firms in this study, nearly half had international experience. Half of the life science start-ups in existence in Kyoto (as of December 2006) were interviewed for this study, so the findings herein can be said to represent the broader life science community in Kyoto.
9. The firms in this study shared detailed proprietary information on their core science and technology, R&D and financial relationships, as well as providing details on their experience in participating in various local networks and regional government policy initiatives. Given the sensitivity of this information, in order to protect the identity of the sources, pseudonyms are used for the firms and their founders. In all other, i.e. non-case study firm cases (unless otherwise specified), actual names are used.
10. *AUTM Survey Report 2005*, Association of University Technology Managers.
11. Masao Horiba interview, 13 July 2007.
12. This meshes with findings on entrepreneurs in the United States, that the bulk of new firms are established in the same state as where the founder obtained his/her degree; see *AUTM Survey Report 2005*, *op. cit.*
13. Eco Micro Bio, I-San interview, 24 August 2005.
14. Eco Box, Dr L interview, 6 July 2005.

15. Eco Micro Bio, I-San interview, 6 July 2005.
16. Masao Horiba interview, 13 July 2007.
17. Bio Make, U-San interview, 20 July 2005.
18. Crysta Drug Develop, Dr T interview, 2 August 2005.
19. Peptide, O-San interview, 15 July 2005. Case studies are compiled from survey responses, interviews, proprietary company materials and publicly available information.
20. Nutra Bio, Dr M interview, 29 August 2005.
21. K. Ibata-Arens, *Japan's Quest for Entrepreneurialism: The Cluster Plan*, JPRI Working Paper No. 102, Japan Policy Research Institute, University of San Francisco Center for the Pacific Rim, San Francisco, 2004.
22. Sangyo Kurasuta Kenkyukai Hokokusho (*Gaiyo*) (*Industrial Cluster Study Group 2005*), available at: [http://www.cluster.gr.jp/relation/data/pdf/Cluster_Kenkyu_houkoku\(gaiyou\).pdf](http://www.cluster.gr.jp/relation/data/pdf/Cluster_Kenkyu_houkoku(gaiyou).pdf), accessed July 2007.
23. "Small Business Innovation Research (SBIR)" a federal government supported program for small business.
24. Sangyo Kurasuta Keikaku Monitoring Chosa Hokokusho Heisei 17 Nen 3 Gatsu Kabushiki-gaisha Mistubishi Sogokenkyujo (Mitsubishi Research Institute), March 2005, available at: http://www.cluster.gr.jp/relation/data/pdf/Cluster_Moni_houkoku.pdf, accessed August 2007; Heisei 17 Nendo Sangyo Kurasuta Keikaku Monitoring Nado Chosa Hokokusho Heisei 18nen 3 Gatsu, Kabushikigaisha, Ribetasu Connsarutingu (Libertas Consulting), March 2006, available at: http://www.cluster.gr.jp/relation/data/pdf/17y_cluster_moni_houkoku.pdf, accessed August 2007; Sangyo Kurasuta Kenkyukai Hokokusho Heisei 17 Nen 5 Gatsu Sangyo Kurasuta Kenkyukai (Industrial Cluster Group), May 2005, available at: http://www.cluster.gr.jp/relation/data/pdf/Cluster_Kenkyu_houkoku.pdf, accessed July 2007; Sangyo Kurasuta Dai Ni Ki Chukankeikaku, Heisei 18 Nen 4 Gatsu 1 Nichi, Sangyokeizaisho, Chiiki Keizai Sangyo Gurupu (Regional Economic and Industrial Policy Group, METI 2006), available at: http://www.cluster.gr.jp/relation/data/pdf/2ndplan_outline_ja.pdf, accessed July 2007.
25. Bio Pharm Test, N-San interview, 29 August 2005.
26. M-san, quoted in Ibata-Arens, 2005, *op. cit.*, p. 98.