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Activating precursors of agglomeration: how large is impact of Japanese agglomeration inducing policies on manufacturing employment?

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Abstract: This study assesses effect of Japanese policies that can realize agglomeration against change of employment of Japanese manufacturing. It firstly identifies three precursors of agglomeration from literature review: network of similar companies, organizations with world-class technology and organizations with big demand. It then theorizes agglomeration factors induced by the precursors as well as factors for exploiting the agglomeration factors. Based on the finding, this study conducts cross sectional analysis of Japanese prefectures in order to evaluate influence of three policies that potentially induce the precursors of agglomeration to retention of regional manufacturing employment. The results indicate positive influence of the Japanese Industrial cluster initiatives, which aims at reinforcing network among companies, universities and government, on change of regional manufacturing employment from 2001 to 2006. The results also suggest negative impact of highly subsidized policies to invite companies on change of the employment of small businesses. Further look into the policies indicates that business creation is important for exploiting agglomeration factors of the organizations with world-class technology and that the other policies than the Industrial cluster initiatives likely failed in exploiting agglomeration factors of the precursors. Consideration of the factors for exploiting the agglomeration factors is suggested for policymakers.

Key words: **Japanese regions, types of clusters, process of cluster formation, precursors of agglomeration, agglomeration factors**

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1 Introduction

1.1 Globalization, change of geography of manufacturing and hollowing out of Japanese manufacturing

Progress of globalization, which here means internationalization of production, capital flows, markets and culture, and advent of transnational agents as defined in Wilding (1997), has bestowed significant changes to the world. Value chain of production is de-verticalized and fragmented with help of outsourcing (Faust et. al 2004). Geography of production and trade flow has changed, and emergence of new economic actors have made global competition much more fierce. Emerging countries such as China and India have recently been recognized as countries making manufacturing competitive the most (Deloitte Touche Tohmatsu and The U.S. Council on Competitiveness 2010). Decrease of manufacturing activities in more developed countries is documented, suggesting hollowing out of manufacturing there (Cabinet Office of Japan 2004; Rothacher 2005; Williams et al. 1990).

Hollowing out of manufacturing is also the case for Japan, which rapidly developed itself with export. Domestic employment declined by almost 2 million in 1990s while overseas employment of Japanese companies increased (Bailey 2003). Proportion of export to import for each product, which describes relative superiority of a nation in the product, has been decreased for many products (Cabinet Office of Japan 2004). In regional level, the number of firms in Ota-ku in Tokyo prefecture went down by over a quarter from 1983 to 1995 because subcontractors there faced hardship from outsourcing of production system of their parent organizations (Bailey 2003). Towel industry of Imabari-shi, which is the main industry, in Ehime prefecture decreased employment by 50% and factories by 40% in 1990s (Yutaka 2004). Existing studies have drawn strong evidence of hollowing out of Japanese manufacturing.

1.2 Need of recovery of Japanese manufacturing and conditions for it

The serious hollowing out of Japanese manufacturing should have affected Japanese society negatively. Positive correlation with statistical significance between suicide and bankruptcy or unemployment is identified in recent downturn of Japanese economy, by Economic and Social Research Institute (2006) and Sawada et al. (2010), the former of which corroborated the finding with not only statistics but also cases studies. In addition, unemployment rate even depicts statistically significant positive correlation with crime rates in Japan (Ohtake and Kohara 2010). Those studies indicate that amelioration of Japanese manufacturing and resulting mitigation of unemployment likely leads to prevention of suicides and crimes. Recovery of manufacturing would be beneficial to Japanese society.

For recovery of Japanese manufacturing, Nishizawa et al. (2010) argues necessity of forming new industries in high tech areas for fundamental recovery of Japanese economy. They theorize process and necessary conditions for forming ecosystem to develop new high tech industries (Ibid). While three stages as well as conditions for transition of the stages are identified in the ecosystem formation, this study particularly pays attention to one of the necessary condition in the first stage--agglomeration of human capitals and of technology. Since the agglomeration is required in the beginning of the ecosystem formation, it can be said that it is fundamental base for formation of the ecosystem. The agglomeration would be necessary for recovery of Japanese manufacturing, so this study would ponder mechanism to bring about the agglomeration of human capitals and technology.

1.3 Objective and methodology

Motivated by the hardship of Japanese manufacturing and importance of agglomeration of human capitals and technology for recovery of Japanese manufacturing, this study evaluates effect of policies to initiate the agglomeration. It firstly identifies important factors and policies for initiating the agglomeration, based on literature review of cluster formation, cluster classification and agglomeration factors. Then, it conducts cross sectional analysis of Japanese prefectures. The dependent variable is change of manufacturing employment from 2001 to 2006 while indicators describing intensity of the agglomeration inducing policies are selected as the independent variables. Effect of the policies to increase of the manufacturing employment or agglomeration of human capitals will be quantified from the cross sectional analysis.

After the assessment of impact of the agglomeration inducing policies with statistical method, this study looks into what regional characteristics can reinforce the effect of the policies by comparing regional characteristics of successful regions with unsuccessful ones. Hypothesis behind this analysis is that regions do not gain benefit from the agglomeration inducing policies without owning some regional characteristics. With discussion of broader indicators than those used in the cross sectional analysis, this study looks into regional factors required for making the agglomeration inducing policies beneficial to the regions.

The adoption of regional level in this study can be validated by recent augmented importance of regional level in this knowledge society. Mobile and universal resources, such as unskilled labor and common production facilities, have been easily accessible because of progress of globalization. Skilled labor, sticky information and so on have become crucial as sources of competitive advantage of companies. Spatial proximity and regional activities have gained considerable importance since they enable effective production and sharing of tacit knowledge (Asheim and Gertler 2006). Policies such as promotion of regional clusters and industrial districts have been implemented in reality (Ibid). Investigation of hollowing out in regional level would be legitimate in the current knowledge society.

The research questions based on the objectives are: how large is impact of Japanese agglomeration inducing policies against retention of manufacturing employment in Japanese prefectures? and what characteristics of Japanese prefectures can reinforce the effect of the agglomeration inducing policies?

1.4 Scope of the study

Regarding scope of this study, other industries than manufacturing are out of the scope of this study. Most of services are not subject to export and not vulnerable to globalization directly, dissimilarly to manufacturing industries. Although some would argue that agriculture is vulnerable to globalization, effect of globalization to the industry would be relatively small for whole economy since its share is small--0.9% in 2007-- in Japan (Kasai 2009). In addition, the industry is largely protected by the government. Manufacturing would need investigation of its vulnerability more than other industries.

Finally, this study confines its investigation to Japanese regions. Although the results of this study may be somewhat applicable to regions in other countries, especially in mature economy, the generalization must require discussion of how difference of national characteristics affects the results. This study does not discuss the difference and restricts its scope to Japanese economy

2 Theoretical framework

As mentioned earlier, this study looks into factors realizing agglomeration of human capitals and technology, one of the conditions for ecosystem formation for high tech industries development described in Nishizawa et al. (2010). Here, this study firstly explains detail of the paper of Nishizawa et al. It then refers to studies of cluster formation, types of clusters and factors producing agglomeration, in order to identify factors required for accomplishing agglomeration of human capitals and technology. Policies to be investigated as well as factors to be controlled in the analysis are chosen on the basis of the findings.

2.1 Process and conditions of ecosystem formation for developing new high tech industries

The paper of Nishizawa et al. (2010) attempts to model development process of ecosystem to arouse new high tech industries. In the paper, they discusses both cluster models, such as Porter's and Saxenian's, and ecosystem models of Triple Helix Model of Etzkowitz, Knowledge Cluster Model of Doutriaux and Bio-capital Cluster Model of Feldman. Base on the discussion, they formulate three stages and several conditions for formation of ecosystem for development of new high tech industries. The three stages, chiefly derived from Knowledge Cluster Model of Doutriaux, consist of preparation, institutionalization and establishment periods. As to conditions needed for transition from the preparation stage to institutionalization, they mention agglomeration of human capitals and technology, which is accompanied by existence of entrepreneurial university or research institutions. Agglomeration of human capitals and technology makes regions transform from the preparation stage to institutionalization stage by being supplemented by occurrence of external impact such as fear of regional economic crisis. The next transition from the second stage, institutionalization stage, to the third stage, establishment stage, requires emergence of supporting institutions like financial institutions, incubation centers, related business service providers and assurance of first customers. The transition thus calls for investment of regional resources preferentially into establishment of the supporting institutions. As a result, the transition also necessitates approval of the region for the prioritization. So-called influencers play a significant role for the approval, and the supporting actors here form Economy two advocated by

Kenny, where they can share benefits of raising high tech ventures. Finally, by advent of successful high tech ventures and regional actors' sharing benefits of the advent of the ventures, regions finally complete development of the ecosystem for raising new high tech industry. (Nishizawa et al. 2010)

In summary, the conditions needed for development of the ecosystem for new high tech industries are: agglomeration of human capitals and technology associated with entrepreneurial research institutions, and occurrence of external impact for the 1st transition from preparation to institutionalization stage; emergence of influencers and of supporting institutions forming Economy two, and advent of successful new ventures for the 2nd transition from institutionalization to establishment stage. This model is tested against several cases such as Austin and Cambridge in the same paper, Nishizawa et al. (2010), and its legitimacy seems assured to large extent.

While Nishizawa et al. (2010) shows importance of agglomeration of human capitals and technology for regional economic development, similar assertions are made in Saito et al. (2004) and Sasano (2006). Saito et al. confirms that intellectual agglomeration is one of critical factors for formation of a cluster and Sasano lists agglomeration of firms as early process of cluster formation. Those papers certify importance of agglomeration of human capital and technology for regional economic development. Because of the importance, this study investigates factors required for the agglomeration. This study firstly reviews papers discussing process and conditions for cluster formation and classification of clusters in order to obtain insights about the factors. Formation of clusters can be considered as progress of agglomeration. Thus, factors required for cluster formation can be applied to factors needed for agglomeration. After understanding process and factors for cluster formation, this study looks at literatures about factors bringing about agglomeration force. The literatures are not examined at first, since which of the agglomeration factors work in pre-agglomeration of human capitals and technology phase would become obscure without understanding process of cluster formation. The literature review overall leads this study to identification of important factors and policies to realize agglomeration of human capitals and technology.

2.2 Process and factors of cluster formation

To begin with, this study introduces Sasano (2006) as a paper discussing process and conditions for cluster formation. In the paper, he conducts literature review of papers about industrial agglomeration and clusters, especially of management researchers. On the basis of the literature review, he argues that there are five processes in formation of a cluster: improvement of innovation environment, progress of firm agglomeration, emergence of an anchor corporation that conducts demand abroad or information of the demand to the cluster, improvement of entrepreneurial environment and establishment of reputation. While order of occurrence of the processes is random to some degree, the last two usually follow the others. He also argues that improvement of innovation environment likely comes first in the processes. Moreover, the processes embrace mutually reinforcing relationship. For example, improving innovation environment through installment of universities or research institutions may bolster interest of firms to the cluster, leading to firm agglomeration. The firm agglomeration in turn can lead to increase of innovators and reinforce the environment for innovation. The processes are interacted each other as such. After developing those hypotheses, he implements a historical case study of Oulu, Finland, in light of the hypotheses. In the case of Oulu, innovation environment was firstly enriched by establishment of Oulu University as well as by following invitation of another research institution and improvement of infrastructure. Nokia as an anchor corporation was invited to the place later on and innovation environment was further strengthened. As relations among the three processes particularly relevant in early phase of cluster formation, he identified that influence of improvement of innovation environment led to both firm agglomeration and emergence of the anchor corporation. He also ascertains positive effect of the emergence of the anchor corporation to improvement of innovation environment. (Sasano 2006)

While the paper of Nishizawa et al. (2010) focuses on post-agglomeration period, scope of the paper of Sasano (2006) seems to extend over pre-agglomeration period. The Sasano's paper emphasizes that improvement of innovation environment is a chief factor initiating agglomeration of firms. Since the agglomeration of firms must be accompanied by some degree of agglomeration of human capitals and technology, improvement of innovation environment should be able to lead to agglomeration of human capitals and technology. Moreover, the paper insinuates that emergence or invitation of anchor corporations can initiate agglomeration of firms through improving innovation environment. Even in the case study, invitation of Nokia as an anchor corporation had big impacts on formation of the cluster. In fact, both existence of research facility and invitation of high tech companies before formation of a cluster are also reported in a case study of a cluster in Austin (Kurashiki Syoukou Kaigisyo 2002). Efforts to establish and/or invite research institutions, high tech companies and anchor corporations seem significant for realizing agglomeration of human capitals and technology.

2.3 Necessary conditions and types of clusters

Meanwhile, Saito et al. (2004) and Maeda et al. (2003) look into necessary conditions for cluster formation. Saito et al. (2004) inquire into success factors of formation of Japanese clusters and claim that, for formation of a Japanese cluster, existence of one or two of the six components are necessary: intellectual agglomeration, world-class high technology, industries or technology rooted in the region, medium companies that can be core in the cluster, start-ups that can be core in the cluster and sense of economic crisis. They in fact confirm validity of their argument from investigation of Japanese clusters. Moreover, they compare the success factors of Japanese cluster formation with those of cluster formation in Europe and U.S. discovered in Maeda et al. (2003). In the comparison, similar aspects of all of the six conditions above are found in the success factors of pre or beginning of cluster formation in Europe and U.S. Yet, clusters in Europe and U.S. hold additional success factors of: existence of visionary leaders; collaboration among companies, universities and government; and supporting institutions, in pre or beginning of the cluster formation. (Saito et al. 2004)

Likewise, conditions for cluster formation can be derived from literatures of types of clusters. First, Maeda et al. (2003) classify Japanese clusters according to four initial factors of cluster formation. The four categories are clusters configured by: government policy to create clusters; invitation of universities, companies and research facilities; collaboration of regional actors; and active spin-off ventures (Ibid).

Second, Markusen (1996) discusses four types of industrial districts articulated with investigation of actual clusters. The four types are: Marshallian industrial districts, hub-and-spoke districts, the satellite industrial platforms and state-anchored districts. Marshallian industrial districts are agglomeration of small companies embedded in the region. The districts are characterized by flexible, shared labor market and possession of specialized services in accord with the regional companies. In turn, both hub-and-spoke districts and satellite industrial platforms come from large companies. While parent large firms are the core of Hub-and-spoke industrial districts and connect the region with outside of the district, branches of such large firms, which tend not to connect to outside, are main actors of the satellite industrial platforms. Finally, state-anchored districts are formed near public facilities with big expenditure such as defense plants and universities. Industrial districts of the type may resemble hub-and-spoke districts or satellite platforms. The difference of the four types of industrial districts produces difference of their labor market, long-term prospects, ability to reap scale economies, cooperation between companies inside and outside, and so on. (Markusen 1996)

Third, Dunning (2002) develops six categories of clusters with reference to the paper of Markusen. Four of the six categories are apparently corresponding to all of the four industrial districts types of Markusen though companies in Marshallian industrial districts are not restricted to small companies but instead to similar companies of all size in his framework (Ibid). On the other hand, one of the remaining two types of clusters is a cluster where firms producing similar goods and services are located similarly to Marshallian (Ibid). Yet, the cluster focuses on research and development (R&D) activities with exchange of tacit knowledge (Ibid), dissimilarly to Marshallian. The last type of clusters is a cluster that enables activities to augment all of assets of firms, such as recruitment of potent human capitals (Ibid). While he takes examples of science park as such clusters, difference from the clusters focused on R&D described above seems not perfectly clear.

An important contribution of Dunning (2002) is their discussion on roles of foreign multinationals in formation of each type of clusters. According to them, foreign multinationals play chief roles in formation and development of R&D focused Marshallian clusters, asset augmenting clusters, and satellite platforms. They also may contribute to emergence of spoke-and-hub clusters. (Ibid)

2.4 Theorization of precursors of cluster formation

The three papers regarding cluster classification indicate four precursors of formation of clusters, each of which seems to be able to play a significant role in cluster formation. The precursors are: network of similar companies, existence of large public facilities with big demand, active spin off ventures and/or presence of multinationals. The precursors contain almost all of the categories described in the three papers of cluster classification. The precursors however do not encompass the two policy related categories of Maeda et al. (2003) because the two categories do not specify who of regional actors play a crucial role in cluster formation. While the precursors for cluster formation seem valid in light of the three studies of cluster classification, the literatures of cluster formation imply other precursors of cluster formation. The discussion of literatures of cluster formation in Section 2.2 suggests that research institutions, high tech companies and anchor corporations can be other precursors of formation since they, through improving innovation environment, can initiate agglomeration of firms. Moreover, the six conditions for cluster formation of Saito et al. (2004) instruct one more precursor of agglomeration: existence of companies with world-class high technology. Consequently, six precursors of clusters are identified. However, the precursors discussed above seem to overlap in part. Scrutiny of the precursors enables elaboration of the categorization of precursors, breaking them down into three categories plus producing new precursors. The new categories are: network of similar companies, organizations with world-class technology and organizations with big demand. With respect to relations of the six precursors firstly developed above to the newly devised three precursors, large public facilities with big demand and anchor corporations are corresponding to the third category while research institutions and high tech companies fall under the second category. Active spin off ventures and multinationals are very likely qualified as either organizations with world-class technology or those with big demand. Other companies with world-class technology are included in the second category. In turn, other companies with big demand are newly produced from the third category.

Since this study derives three general precursors for cluster formation from literatures looking into actual clusters, the precursors should be legitimate to a considerable extent. However, it is natural to suspect that other precursors are possible. In particular, the paper of Saito et al. (2004) detected two other precursor-like conditions for cluster formation: industries or technology rooted in the region and medium companies that can be core in the cluster. They may entail none of the three general precursors: big demand, world-class technology and network with similar companies. However, this study would claim that they are not the precursors because they probably require network of similar companies for giving rise to cluster formation. If the two conditions for cluster formation came to fruition without network of similar companies, the paper of Markusen (1996) would have identified other types of clusters describing just the two conditions. For instance, the paper would have detected a type of clusters where medium companies holding technology rooted in a region play significant roles without forming network with similar companies, but it does not. It seems that they do not have power to realize cluster formation without forming network.

Another nominee for the precursors is research institution without world-class technology. The candidate is derived from the discussion in Section 2.2 over the papers of cluster formation. Case studies of Oulu in Sasano (2006) and of Austin in Kurashiki Syoukou Kaigisyo (2002) both report existence of both research institutions and high tech companies before cluster formation. However, either of them likely possessed world-class technology or the high tech companies may have formed network in order to strengthen their innovative ability each other. For all the reasons above, this study assumes that organizations without both big demand and world-class technology necessitate network of similar companies for causing cluster formation. That is to say, this study postulates that any one of the three general precursors is necessary for cluster formation. It keeps the classification of precursors of cluster formation as it is.

When discussion is directed toward factors required for natural emergence of the precursors, each precursor would need different factors (Table 2.1). First, for natural emergence of organizations with big demand, growth of incumbents or start-ups must be necessary. Theories pertaining business management should help identification of more detailed factors. Second, upgrading of research institutions would be key ingredient for natural emergence of organizations with world-class technology. Success of the upgrading may rely on individual's accidental invention or may call for policy support to fund researches. In addition, learning of companies can be another incubator of the precursor. However, this case very likely requires the companies to connect with outside of the region because they cannot acquire world-class technology in the region. Finally, in order to establish network of similar companies, networking by third party or so-called influencer (Nishizawa et al. 2010) should be crucial. Although the network may be formulated by accumulation of collaboration between companies, it should be difficult for the collaboration to spread over many companies owing to search costs and collision of interest. Deliberately designed win-win networking as well as establishment of trust would be necessary for inartificial development of network of similar companies. Thus, persons trustable and influential to the region or neutral third party that hold deep understanding of regional actors and network design skill would play a crucial role for the development of the network.

Table 2.1. Precursors of cluster formation and activities for their emergence

Precursors of cluster formation	Examples of precursors	Activities needed for emergence of the precursor
Organizations with big demand	Defense industries, multinationals or subsidiaries of them	Invitation of the precursor, growth of incumbents
Organizations with world-class technology	Universities, high tech ventures	Invitation of the precursor, upgrading research institutions, companies' learning from outside
Network of similar companies	Regional industrial unions	Win-win networking designed by third party or by influencers

While all of the three general precursors can emerge spontaneously without policy intervention, policies can play important role to induce the precursors. Policies can realize the precursors by for example inviting multinationals with both big demand and world-class technology by high subsidy. Or policies can activate the precursor of network of similar companies by facilitating networking of companies. They can also improve innovative environment by financing big research projects, with aim at upgrading research institutions and attracting firms. The precursors activated by such policies may spark cluster formation. Making the most of policies activating precursors would be of significance for cluster formation.

Although this study has identified the precursors of cluster formation, what factors work behind the cluster formation and what factors can accelerate the cluster formation are not clear. This study relies on literatures of factors giving rise to agglomeration force in order to identify factors behind the cluster formation and important factors to accelerate the cluster formation.

2.5 Review of factors producing agglomeration force

What factors grow or agglomerate regions has been discussed in literatures of economic geography, regional development and regional competitiveness. In particular, a trade theory developed by Krugman (2000) suggests many factors causing agglomeration. He creates a trade model with transport cost and increasing returns, which are neglected in past trade theories. The model assumes two regions with different sizes of market and immobile production factors. In such a model, goods associated with increasing return tend to be produced in the region with larger market and then exported from the region. That is to say, concentration of production happens in larger market. Krugman calls force behind the concentration of the production 'home market effect'. The home market effect becomes at play through interaction of difference of size of market, transport costs and increasing return. Furthermore, when labor, one type of production factors, becomes mobile, the concentration of production is promoted more. The advent of labor mobility encourages workers to move near larger market. Consequent immigrants to the larger market produce demand for goods, further increasing the size of the market. Agglomeration force of the home market effect gains more strength and the agglomeration continues until competition and immobile production factors inhibit it. Until now, agglomeration of not only producers but also suppliers has been shown by trade models taking vertical structure of production into account. (Krugman 2000)

The new trade theory from economic geography describes five factors causing agglomeration force: increasing return, transport cost, difference of size of market, forward linkage from increase of production through inducing migration to increase of demand and backward linkage from the increase of demand to further increase of production. Interaction of the first three can generate concentration of production in larger market. As production increases in the market, labor demand and wage also increases, arousing migration of workers. The migration brings increase of demand and the increased demand finally elicits further increase of production. That is to say, increase of production gets into self-reinforcing process by inducing migration. The self-reinforcing process also implies that the forward linkage always associates the backward linkage.

However, the self-reinforcing process does not occur if migration is inhibited by some factors. Also, the process does not occur by forward linkage and backward linkage. That is to say, incentive of production in a particular region must be firstly created by other factors than the linkages such as the home market effect. Detection of factors motivating companies to produce near the source of the factors, like large market of the home market effect, is needed. Actually, one more agglomeration factor, knowledge spillover, should be one of the factors because it can attract companies through generating increasing return and superiority of proximity similarly to larger market.

Knowledge spillover is often treated as one of main benefits of agglomeration (Audretsch 2002; Porter 2000). Production of knowledge has positive externalities and increasing return since knowledge is nonrivalrous goods (Jones

2002). However, reach of knowledge spillover may be limited and reaping the spillover may require personal interactions (Audretsch 2002; Ottaviano and Puga 1997). The need of interaction for the knowledge exchange is specially the case for tacit knowledge (Asheim and Gertler 2006; Audretsch 2002; Dunning 2002; Hotz-Hart 2000). All of those facts apparently imply that knowledge spillover generates agglomeration force--attractiveness of proximity so as to exchange knowledge.

Importance of knowledge spillover is also shown in so-called Marshallian externalities. Marshall argued that agglomeration enabled mitigation of three kinds of transport costs, goods, human resources and knowledge (Ellison et al. 2007). Additionally, he identified four benefits of agglomeration: reveal of mysteries of trade; economic use of expensive machinery such as sharing; growth of subsidiary trades; and stable market for skill (Press 2006). The four types of the agglomeration benefits seem to be largely related to the mitigation of the three kinds of transport costs. In usual analysis, the four types of the benefits are transformed into three types of externalities: information spillovers, common production factors and pooled labor market (Ibid). What to note here is that knowledge spillover is discussed in the context of transport costs. Knowledge spillover seems to have similar characteristics to those of larger market.

In summary, agglomeration factors can be categorized into five categories: increasing return; market size; forward and backward linkages; transport costs and knowledge spillover. When so-called congestion costs caused by agglomeration, such as increase of wage and degradation of environment (Audretsch 2002; Martin R 2005), overcomes agglomeration force caused by interaction of the agglomeration factors, agglomeration will stop. Before moving on to further discussion of the agglomeration factors, it should be mentioned that, while companies possess incentive to agglomerate by decreasing transport costs, transport costs decrease in regional level has ambivalent implication for agglomeration: companies may be attracted by the decrease or they instead may choose export to the region with help of the cheap transport costs. Because of the difference of the implications, this study will mean decrease of transport costs as that in corporate level when it introduces decrease of transport costs as an agglomeration factor.

2.6 Agglomeration factors induced by the precursors

Until now, this study has detected three precursors of agglomeration of network of similar companies, organizations with world-class technology and organizations with big demand, as well as five types of agglomeration factors: increasing return; difference of market size; forward and backward linkages; transport costs and knowledge spillover. The forward and backward linkages do not set up agglomeration; Instead, they reinforce agglomeration produced by the other agglomeration factors. Advantage in the other agglomeration factors is necessary for initiating agglomeration. When this study looks into relationship between the precursors and the agglomeration initiating factors, different agglomeration factors seem to play a significant role for initiating cluster formation according to precursors. Content of increasing return and of transport costs decrease are resultingly different for each of the three cases (Table 2.2).

Table 2.2. Precursors of cluster formation and agglomeration factors

Precursors of cluster formation	Key agglomeration factors (*1)	Strength and difficulty (*2) of increasing return	Size and difficulty of transport costs decrease (*3) by agglomeration
Organizations with big demand	Large market	STRONG, MODERATE difficulty, on production of goods	SMALL, EASY, of transport of goods
Organizations with world-class technology	Knowledge spillover	STRONG, DIFFICULT, on production of knowledge	BIG, DIFFICULT of transport of knowledge
Network of similar companies	Decrease of transport costs (*3)	WEAK, MODERATE difficulty, on production of goods and/or knowledge	MODERATE to HUGE, MODERATE to DIFFICULT, of transport of goods, knowledge and/or human capitals

*1: As drivers of forward and backward linkages

*2: The difficulty is mostly derived from difficulty of transport

*3: The decrease can be renamed as increase of transport productivity

First, cluster formation by organizations with big demand seems to be launched by the agglomeration factor of difference of size. Advent of the organizations creates large market in the region and the large market would enable related companies in the region to exploit increasing return of production of goods. Decrease of transport costs by agglomeration assists the regional companies, motivating the organizations with big demand to conduct transaction with companies in the region. All the advantages of regional companies may encourage companies in other regions to move to the region, setting off forward and backward linkages. In terms of difficulty to exploit the increasing return and transport costs decrease, both decrease of transport costs and utilization of increasing return are seemingly easy because they do not call for special facilities. However, decrease of transport costs in current globalization should make the organizations with big demand prefer transaction with competent or less costly companies to transaction with adjacent companies. Companies located in the region of the big demand may need to equip special facilities or competency such as quick delivery in order to exploit the big demand.

Second, knowledge spillover plays a crucial role to initiate cluster formation by organizations with world-class technology. As argued in the previous section, knowledge spillover can generate superiority of proximity and lure companies. Increasing return in this case is related to production of knowledge. The increasing return can be strong since knowledge is nonrivalrous and unlimited number of companies can hypothetically draw on knowledge spillover. Meanwhile, transport costs decrease in this case is accomplished by decrease of costs or increase of productivity of knowledge exchange. By frequent personal interaction, knowledge, especially tacit knowledge, should be exploited relatively easily. The easy exploitation would bolster productivity of transport of knowledge and allow regional companies to accomplish increasing return of production of knowledge. The superiority of proximity attracts companies in other regions and can activate forward and backward linkages. Yet, transport of knowledge must be costly because it requires the receivers to hold capacity of digest it, as expressed in concept of absorptive capacity (Cohen and Levintbal 1990). The costly transport would be especially the case for the world-class technology. As a result, decrease of transport costs and utilization of the increasing return must be difficult in this case.

Finally, main drivers of cluster formation by network of similar companies must be decrease of transport costs. The network can enable simple share of production factors--labor, capital and knowledge. The three types of transport decrease in accord with Marshallian externalities are possible. The more production factors the network shares, the higher decrease of the transport costs or increase of the transport productivity becomes. Realization of all the three types of Marshallian externalities should lead to huge increase of productivity of transport of production factors. However, difficulty of the sharing rises according to growth of number of the shared production factors. At the same time, the difficulty depends on what and how the network shares. While common use of goods would be easy, common use of human capitals and knowledge likely requires careful framework of sharing, such as rules and supporting organizations. Lack of persons with sharing design skill or lack of establishment of supporting organizations may inhibit exploitation of transportation costs decrease. In turn, increasing return would not be strong since there exists neither organizations with big demand nor those with world-class technology. However, the network can produce weak increasing return by sharing demand and/or knowledge. Both the big Increase of transport productivity and weak increasing return would attract companies in other regions to the network.

As described above, more or less difficulty exists against exploiting agglomeration factors induced by the precursors. The difficulty comes from difficulty of transport of production factors and of exploiting increasing return. Thus, this study ponders factors needed for solving the difficulty and making the most of the agglomeration factors. It also cogitates factors required after the utilization of the precursors for arriving at agglomeration of human capitals and technology, the necessary condition of high tech ecosystem development of Nishizawa et al. (2010).

2.7 Factors required for leading to agglomeration of human capitals and technology

As discussed in the previous section, each of the three kinds of cluster formation likely faces different difficulty for exploiting the agglomeration factors induced by the precursors. When regions do not solve the difficulty, the precursors do not contribute to agglomeration anymore; instead, they distribute benefits that they produce to other regions. For example, organizations with big demand deal with companies in other regions when they do not find suitable suppliers in the region where they stay. That is probable in this globalized world with cheap transportation and with many potent economic actors. One can however argue that the suitable suppliers will move near the organizations with big demand and promote agglomeration without staying far from them. Yet, initial costs of the move likely hampers their migration. In order to receive full benefit of agglomeration factors induced by the precursors, regions should prepare factors able to make the most of the agglomeration factors by themselves by for example encouraging existing organizations to equip such factors or subsiding migration of organizations possessing the factors.

The paragraph above indicates importance of identification of factors for exploiting agglomeration factors of the precursors. As this study describes the factors according to the precursors, first, for exploiting agglomeration factors induced by organizations with big demand, regions should have suppliers that can meet the demand of the precursor properly. Not only good product but also quick delivery of it may be required for the suppliers. When the suppliers hire product designer who can propose new products and/or bargainers who can make a convincing appeal to the organizations with big demand, possibility of occurrence of their transaction will increase. Even if the suppliers do not employ those human resources, third party such as bankers inspecting the suppliers may play the roles of product designer and bargainers.

In the second place, human capitals adept in technology would contribute to exploitation of agglomeration factors of organizations with world-class technology. They may start-up high tech ventures or invent new products in a company by using the world-class technology. Moreover, persons good at explaining technology like technological consultants must exalt productivity of knowledge exchange as understanding the world-class technology should be very difficult. Existence of suppliers is also useful because they might take a hint of new products from the world-class technology. Also, existence of customer companies may be beneficial owing to the same reason--possibility of theirs developing new products. Yet, the related companies would need to employ similar technology to the world-class technology as well as human resources familiar with technology, in order to make the most of the opportunities of increasing return from the world-class technology.

In the last place, factors required for exploitation of agglomeration factors of network of similar companies are those heightening increase of productivity of transport of production factors in the network. As argued in the previous section, sophisticated framework for sharing production factors, such as rules and supporting organizations, are necessary for attaining huge increase of transport productivities. For instance, the network can establish a training center for educating fired people about technology needed by companies in the network. When the training center function as a recruitment broker, necessary personnel are easily circulated in the network, improving productivity of the companies. In addition, it can launch research group of market and/or technology so as to efficiently transport knowledge. Secondhand market meanwhile contributes to cheap transport of capitals. The network can conduct various activities to increase transport productivity of production factors. In terms of establishment of rules, persons with some kinds of competence must be needed because the rules should meet complicated conditions: not only fair and satisfactory for all but also productive. Trustable persons with understanding of actors in the network and with good design skill would be required. The supporting institutions shown above also likely need skilled persons to facilitate effective transport of production factors.

After having discussed exploitation of agglomeration factors of the precursors, this study delineates factors and activities accomplishing agglomeration of human capitals and technology. Agglomeration of human capitals and technology may be achieved just with exploitation of agglomeration factors related to each precursor. However, the exploitation may not be enough because each agglomeration case tends to lack in human capitals and/or technology. Table 2.3 describes the missing factors and important activities for agglomeration of human capitals and technology, in addition to the factors required for exploitation of agglomeration factors of the precursors discussed above. While agglomeration by organizations with big demand is apt to lack in technology, accumulation of human capitals is inclined to be missing in agglomeration by organizations with world-class technology. Consequently, they each call for similar activities to those required for emergence of the other precursor (Table 2.1). More specifically, agglomeration by organizations would need development or invitation of research facilities in order to move to agglomeration of human capitals and technology. Or it can learn from organizations outside the region in order to amass technology. Utilization of knowledge spillover is favorable though not necessary, as the region probably has already accumulated some degree of technology. In turn, lack of human capitals of agglomeration by organizations with world-class technology would be complemented by accumulation of human capitals through business creation. The accumulation of human capitals can be accomplished by invitation of companies in other regions. In this case, the invited companies do not have to be large as the region likely has stored up some degree of human capitals. At last, both human capitals and technology may be deficient in agglomeration by network of similar companies. As argued in the previous section, exploitation of agglomeration factors of the network is difficult because it calls for fine framework for sharing production factors. Thus, the agglomeration may not be fully utilized, and human capitals and technology may not be agglomerated enough. In this case, regions can invite companies and research institutions, similarly to the other cases, for arriving at agglomeration of human capitals and technology. At that time, it is preferable that the invited companies join in and grow the network. Moreover, the network can make new connections with outside. By connecting with outside, the network may find opportunities to grow. When it succeeds in the growth, it may amass human capitals and technology at the level of agglomeration of human capitals and technology in Nishizawa et al. (2010).

Table 2.3. Precursors of cluster formation and factors required for leading to agglomeration of human capitals and technology

Precursors of cluster formation	Size and difficulty of transport costs decrease (*1) by agglomeration	Regional production factors to exploit increasing return and transport costs decrease	Factors and activities needed for agglomeration of human capitals and technology
Organizations with big demand	SMALL, EASY, of transport of goods	Factors able to exploit big demand (Ex. Competent suppliers, product designer, bargainer)	Technology; developing research facilities or inviting them, learning from outside
Organizations with world-class technology	BIG, DIFFICULT of transport of knowledge	Factors able to exploit world-class technology (Ex. Companies with similar technology, technicians, technological consultants)	Human capitals, business creation or Invitation of companies
Network of similar companies	MODERATE to HUGE, MODERATE to DIFFICULT, of transport of goods, knowledge and/or human capitals	Factors strengthening decrease of transport costs (*1) (Ex. Training center, research group, secondhand market)	Both human capitals and technology; inviting companies and research facilities, new connection with other regions

*1: The decrease can be renamed as increase of transport productivity

As summary of this section, Figure 2.1 gives overview of the important factors and the process from emergence of each precursor to agglomeration of human capitals and technology. Regions can attain agglomeration of human capitals and technology by firstly exploiting agglomeration factors induced by the precursors and secondly-- when the agglomeration is not enough-- conducting the activities described in the figure. By doing so, regions meet requisite for initiating ecosystem formation for high tech industries development advocated in Nishizawa et al. (2010). From the present moment, this study calls the factors required for agglomeration of human capitals and technology after emergence of the precursors 'the factors for exploiting the precursors'.

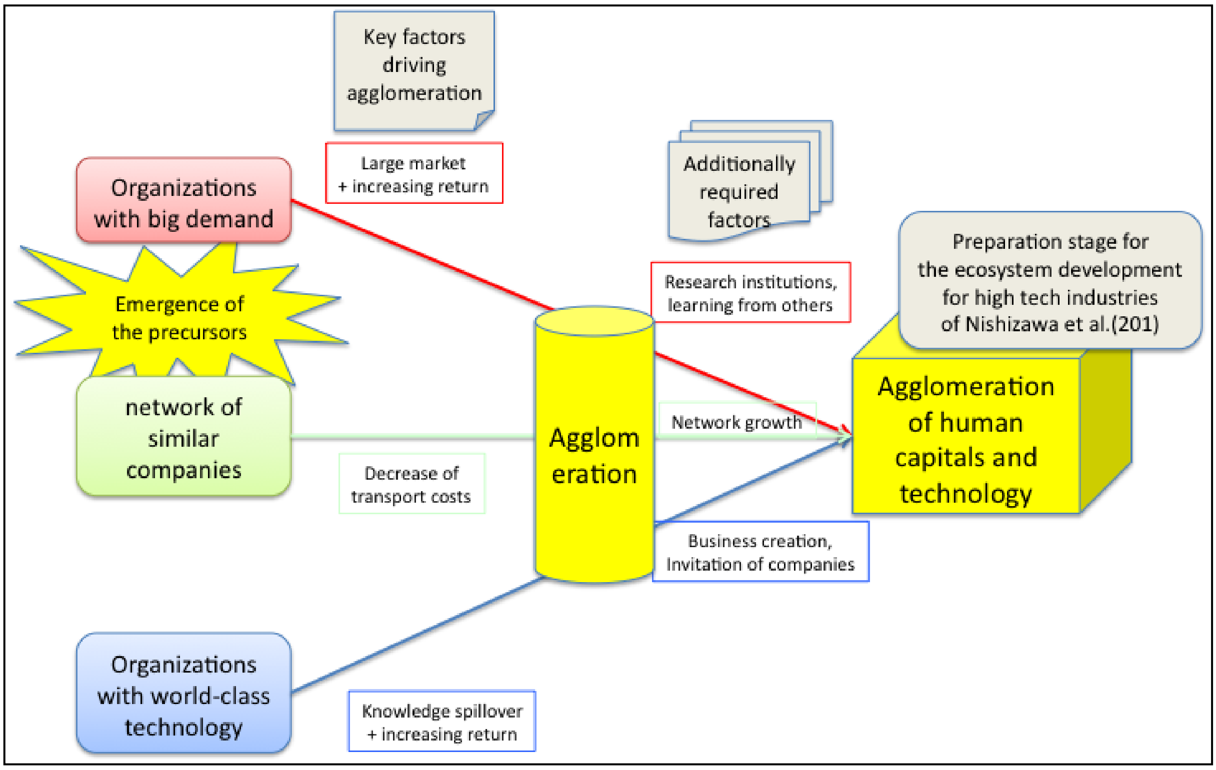

Figure 2.1. Pathway from emergence of the precursors of cluster formation to agglomeration of human capitals and technology

Now that this study elucidates path from emergence of the precursors of cluster formation to agglomeration of human capitals and technology, this study turns to identification and analysis of agglomeration inducing policies in Japan.

2.8 Agglomeration inducing policies and factors

Before starting examination of agglomeration inducing policies in Japan, It should be noted that the three precursors of cluster formation are regarded as precursors of agglomeration as argued in Section 2.1. Likewise, policies inducing cluster formation accordingly can also be those inducing agglomeration.

There were three promising policies in Japan for inducing agglomeration through activating the three precursors of agglomeration. The policies are: Knowledge cluster initiatives for improving regional research ability, Industrial cluster initiatives for creation of regional networks, and policy of prefectures to invite large companies such as multinationals with high subsidy. Each policy has different organizers and objectives. While policies for inviting large companies are composed by prefectures, the two cluster initiatives are administered by the central government. While Ministry of Economy, Trade and Industry began the Industrial cluster initiatives from 2001 with aim at establishing networking among companies, universities and so on (Industrial cluster project 2011b), Ministry of Education, Culture, Sports, Science and Technology started the Knowledge cluster initiatives from 2002 for establishing regional base for research and development with putting research institutions in the core (Ministry of Education, Culture, Sports, Science and Technology of Japan 2002).

For the three agglomeration inducing policies, this study firstly conducts cross sectional analysis of manufacturing employment of Japanese prefectures so as to measure general effect of those policies on the employment. When the analysis does not lead to finding of the positive effect of the three policies, this study takes a close look at characteristics of successful prefectures and of unsuccessful ones according to each policy, in order to detect what factors can make the policies more effective. In the cross sectional analysis, this study will set up different variables describing each of the policies. However, control of other important factors for agglomeration would be necessary for production of true coefficients. This study again rests on the factors for exploiting the precursors, in order to detect the control variables. Table 2.3 would help the detection.

A commonly identified factor in the factors for exploiting the precursors is a human resource engaged in technological activities such as product development. The human resources would contribute to agglomeration by organizations with big demand by proposing attractive products to them. They also can promote agglomeration by organization with world-class technology by starting up businesses by borrowing the world-class technology. Even in network of similar companies, their existence may improve quality of knowledge transport in the network and induce increasing return of knowledge, which leads to agglomeration. Technological human capitals seem important for all the types of agglomeration. Importance of technological human capitals is in fact advocated in literatures about competitiveness. Manufacturing CEOs rate Talent-driven innovation at very high ranks as drivers of global manufacturing competitiveness (Deloitte Touche Tohmatsu and The U.S. Council on Competitiveness 2010). Knowledge and innovativeness have become the most important factor engendering competitive advantage (Audretsch 2002; Edmonds 2000; Hotz-Hart 2000; Martin L 2004; Porter 1990). Those arguments corroborate significance of technological human capitals, which must largely drive innovation, in this globalized, knowledge intensive world. In addition, the arguments indicate importance of environment to foster innovation and knowledge intensive industries. They should be included in the control variables of this study.

Potent suppliers are also common factors needed for the three types of agglomeration of human capitals and technology. However, it seems difficult to operationalize existence of potent suppliers into variables. Furthermore, variable for technicians would more or less connote existence of potent suppliers. Therefore, this study just includes factors denoting technological human capitals, innovative environment and knowledge intensive industries in its independent variables, in addition to variables representing the three policies corresponding to the three precursors of agglomeration: Knowledge cluster initiatives for raising organizations with world-class technology, Industrial cluster initiatives for creation of networks among companies, and policy of prefectures to invite large companies with big demand or world-class technology. Details of variables of the statistical analysis and of reasons behind the choice of the variables are depicted in the next section.

3 Cross sectional analysis of Japanese prefectures

In this section, this study investigates effect of the three agglomeration inducing policies to change of manufacturing employment from 2001 to 2006 with cross sectional analysis of Japanese prefectures. This study depicts detail of variables, reasons behind the choice of the variables, results of the cross sectional analysis of Japanese prefectures and discussion of the results. Before moving on to selection of variables, this study depicts geographical characteristics and basic statistics of the Japanese prefectures.

3.1 Prefectures in Japan

To begin with, 47 prefectures exist in Japan, which is composed of several islands (Figure 3.1). The biggest island is called Honshu, where 34 prefectures belong. It extends from northeast to southwest and most of the main cities such as Tokyo, Osaka and Kyoto reside in the island. The islands of Kyushu, Shikoku and Hokkaido are adjacent to Honshu island, located in west, south-west and north of Honshu, respectively. They each contain 7, 4, 1 prefectures. While Kyushu and Shikoku islands have both train and road connection with Honshu, just train connection exists between Hokkaido and Honshu. The last prefecture of Japan is Okinawa, another island. It is located in south of Kyushu island, and just air flight and seaway are available to arrive at the island. Okinawa is rather remote island of Japan.

Their area varies to large extent. Hokkaido prefecture is the largest prefecture and its area is 2 times larger than even sum of the 7 prefectures of Kyushu island (Geospatial Information Authority of Japan 2010). Moreover, the smallest prefecture, Kagawa, has just one-fortieth area of Hokkaido prefecture (Ibid). Tokyo, the most famous prefecture in Japan, is actually almost as small as Kagawa (Ibid). Economic activities of prefectures meanwhile are concentrated in just some prefectures with famous cities. Population varies from maximum of 13 million of Tokyo to minimum of 0.6 million of Tottori in 2009 (Statistics Bureau and the Director-General for Policy Planning of Japan 2011a). Variance of regional Gross Domestic Product extends from 90 trillion of Tokyo to 2 trillion of Tottori (Cabinet Office of Japan 2011). Although Tokyo is one of the smallest prefectures in Japan, they have the biggest regional economy. Over 45 times difference of economic size exists among prefectures of Japan.

A crucial point that should be discussed here is whether they hold the same developmental factors or not so that they will have more or less the same degree of importance of the developmental factors. As this study considered the point, it decided to exclude Okinawa from the population because of its remoteness and lack of overland connections with the other islands. Moreover, one more characteristic of Okinawa makes the region very different: existence of base of subsidiary of armed forces of U.S. Those differences may make development factors of the Okinawa prefecture totally dissimilar. Okinawa in fact depicts extraordinary value of change of the number of business places from 2001 to 2006 than the other regions, which can be expression of the peculiarity of Okinawa. The other regions in turn are connected with transportations, so that development of one prefecture should influence other prefectures to some extent. Thus, this study excludes just Okinawa prefecture in the subjects.

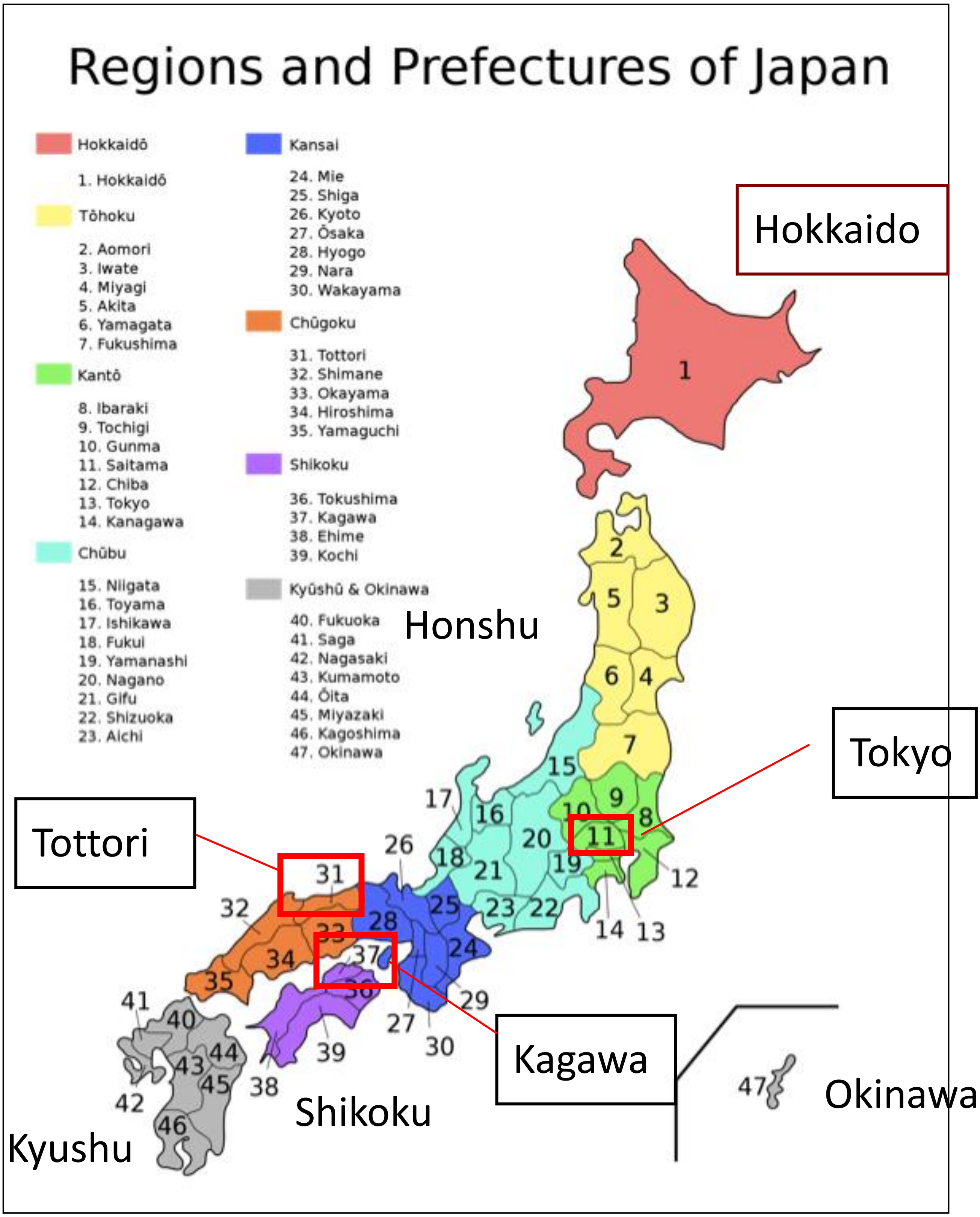

Figure 3.1. Geography of Japanese prefectures (adapted from Wikipedia: http://en.wikipedia.org/wiki/Prefectures_of_Japan)

3.2 Dependent variables

Now, this study moves on to selection of variables. With regard to dependent variables, data of manufacturing employment are registered on governmental records for over 20 manufacturing industries of all the Japanese 47 prefectures (Ministry of Economy, Trade and Industry of Japan 2003, 2009). The data were collected based on reports from companies, complemented with estimates for small companies with 1 to 3 employees for some years. The storage of the data extends over considerably long period, from early 1900s. The data contain information of all manufacturing companies including start-ups and even self-employed companies, separating data of business places with more than 30 workers, data of those with 4 to 30 workers and data of those with 1 to 3 workers. In the data, employees hired for less than one month are not included in the definition of workers, though it seems not to encompass problems for this study. Business places are defined as places where manufacturing or processing is implemented. Business places that do not manufacture or process seem to be excluded from the data. Thus, the business places must be equivalent to factories. From now on, when this study refers to employment related to dependent variables, this study means it as employment of the business places discussed here.

As dependent variables, this study calculates three variables: rates of change of regional manufacturing employment from 2001 to 2006 of: whole business places, business places with over 30 workers, and business places with under 30 workers. Investigation of all the categories would be important because small companies would behave differently from medium and large companies-- particularly more vulnerable-- and effects of the agglomeration inducing policies should be different based on size of companies. In turn, the period, 2001 to 2006, is set up due to two reasons: accordance with periods of the agglomeration inducing policies and harmony with business cycle of Japanese economy. As to the former, the first stage of Industrial cluster initiatives spanned from 2001 to 2005 (Sangyou kurasuta kenkyukai 2005). Most of the projects of the Knowledge cluster initiatives began in 2002 with duration of five years. The period, from 2001 to 2006, would be a suitable period for the policies to come into effect. With respect to the latter reason for adoption of the period, this study uses period equal to one business cycle in order to produce more generally applicable results. The beginning year 2001 is corresponding to the peak of 13th business cycle while the year 2006 is identified as the peak of 14th business cycle in Japan (Cabinet Office of Japan 2010). Economy has prosperity and depression by turns, and importance of factors for growth of companies in booming economy may be more or less different from ones in economic recession. Taking economic indexes along with business cycle would enable production of results valid for both downturn and prosperity of economy.

3.3 Independent variables

Next, this study moves on to discussion of selection of independent variables. For the two cluster initiatives, this study simply counts the number of prefectures covered by each cluster project. More detailed data of the clusters are not available. The operation above connotes that this study does not take into account quality of the clusters as well as voluntary cluster initiatives, which may lead to bias of the results. The coverage of each cluster project is depicted in Sangyou kurasuta kenkyukai (2005) for the Industrial clusters, and in Ministry of Education, Culture, Sports, Science and Technology of Japan (2009a) for the Knowledge clusters. It should be noted that the regions with high score of those variables very likely had already held higher level of developmental potential than other regions because they successfully went through selection of the ministries. Therefore, coefficients of the variables indicate benefits caused by not only the clusters but also their originally high potential.

As to policy for prefectures to invite large companies with high subsidy, one article summarizes such policies by interviews and investigation of archives (Cabinet Office of Japan 2005). The document shows variety of amount of the subsidy and year of beginning of the policies. With reference to the document, this study prepares a dummy variable named Policiesgood that takes value 1 for regions that developed policies with maximum of over 5000 million yen. Just 6 prefectures fall under the regions with the value 1. This study assumes that the other regions with cheaper subsidy than 5000 million are impotent for inviting companies because their cheaper subsidy should not retain enticement to companies owing to existence of the more subsidized policies. For that reason, the other regions with cheaper subsidy take value of 0 for the policy variable.

With respect to other important factors for agglomeration of human capitals and technology as control variables, this study includes factors denoting technological human capitals, innovative environment and knowledge intensive industries as discussed in Section 2.8. It finally uses three variables: start-up rate of manufacturing companies, proportion of number of technician to productive population in the region and share of manufacturing employment of high tech industries.

Start-up rate is representative of innovative environment of the region. While some start-ups would emerge driven by necessity like lack of money, some should be motivated by new technology and quite innovative. Moreover, new entry likely leads to more fierce competition, spurring innovative activities of incumbents (Porter 1990). Start-up rate is considerably relevant to variables in the analysis. For the analysis, prefectural start-up rate of manufacturing companies from 1999 to 2000 is taken from a report of Small and Medium Enterprise Agency of Japan (2002). This study divides the start-up rate by 2 since it is suspected to be too high for start-up rate of single year. This operation does not affect statistical significance and the other coefficients of results of the cross sectional analysis.

Number of technicians in turn directly represents regional technological human capitals. This study includes not only technicians in the business places of the dependent variables but also ones in other places. While the latter technicians seemingly do not influence the manufacturing employment of this study, they would in fact affect the employment through for example instructing workers in the business places, starting up their factories or whatever. It seems reasonable to include all the technicians related to manufacturing in the variable. The number of technicians in a region in 2000 is available from population census (Statistics Bureau and the Director-General for Policy Planning of Japan 2000b). Human resources working on creative tasks: research and development, management of manufacturing, planning of products and so on, fall under this category. The category encompasses technicians in relation to agriculture, information technology and construction, which however may cause bias of the regression analysis. Finally, this study divides the number of the technicians by the number of productive population in the region, which is stored in the data of Statistics Bureau and the Director-General for Policy Planning of Japan (2011a), because otherwise the effect and meaning of regional population dominates the variable. The variable accordingly should indicate degree of how prefectures rest on or value technicians.

The last component of the independent variables, high tech industries, denotes knowledge intensive industries. They should be the most important industries for economy of more developed countries in this knowledge intensive society. The more a region is occupied by the industries, the more the region may retain employment. Control of the high tech industries must be necessary for revealing true value of the other variables. As to source of the data, this study further relies on the source of the dependent variables. The data encompasses industries of: food, beverage and tobacco, textile, cloth, wood product, furniture and accessory, pulp and paper, chemical, plastic, rubber, ceramic, steel, nonferrous, metal, machinery, electric machinery, publishing and printing, transport machinery, precision machinery, tanner, oil and coal, arms, others. The high tech industries of this study include, chemical, machinery, electric machinery, transport machinery and precision machinery, along with the "High-technology industries" and "Medium-high-technology industries" of OECD (2007, p.220). This study calculates the share of the high tech industries according to each dependent variable. That is to say, the high tech industries variable for the business places with under 30 workers is different from that for the business places with over 30 workers.

Simultaneously with the calculation of the share of manufacturing employment of high tech industries, this study identified crucial missing values of the data for Nara prefecture. It specially depicts lack of data of Machinery industry, which are included in the definition of high tech industries. Owing to the missing data of the important industry, this study excludes Nara from the subject.

Other possible candidates for the independent variables were: research institutions, especially universities; patent; and innovation supporting institutions such as venture capitals. However, data of the candidates are not easily available in prefecture level. This study assumes that effects of those factors discussed above are somewhat indicated in the remaining variables. The two cluster variables in particular may suggest existence of certain level of knowledge and of those innovation supporting institutions, since the regions must have had enough characteristics to survive through selection of the cluster projects.

3.4 Examination of experience of hazard of the prefectures

Before proceeding to cross sectional analysis of the variables, this study checks whether 47 Japanese prefectures experienced hazards or not in the period covered in this study. Hazards may have strong effect on survival or growth of firms and make the regions experience different growth path in the recovery. Seclusion of such regions would be better in order to avoid bias of results of the analysis.

For evaluation of seriousness of hazards, this study basically relies on the data of Fire and Disaster Management Agency of Japan (2001, 2002, 2003, 2004, 2005). This study paid attention to index of the number of houses destroyed in one year. Destruction of houses is a rare event, so when extraordinary value is identified in the index, that must mean occurrence of hazards. Yet, how soon the regions recovered from the events, which is not understood with the data, is also to be considered. When regions recovered from hazard soon enough not to change their development path, those regions can be included in analyses. For those reasons, this study additionally checked detailed information about hazard from articles of Ministry of Land, Infrastructure, Transport and Tourism of Japan, which draw process of recovery of infrastructure.

According to the index of the number of houses destroyed, prefectures that experienced more than 1000 partial destruction of houses from 2001 to 2006 are: Miyagi, Niigata, Hyogo, Tottori, Miyazaki and Kagoshima. The destruction of Miyagi, Niigata and Tottori seem to be caused by earthquakes while that of the others probably came from heavy rains. However, the events except Niigata are relatively small enough for infrastructure of the regions to recover almost completely within 4 days (Ministry of Land, Infrastructure, Transport and Tourism of Japan. 2000a, 2003, 2004, 2005, 2006a, 2006b). On the other hand, the earthquakes to Niigata were absolutely disastrous and it takes over three years for the perfect restoration (Cabinet Office of Japan 2008). It seems better to subtract just Niigata prefecture in the analysis.

3.5 Models for the cross sectional analysis

This study finally holds the Japanese prefectures except Nara, Niigata and Okinawa, which are excluded because of missing data, experience of hazard and possible different development mechanisms respectively. To the prefectures left, this study applies a model written as:

$$y_i = \alpha + \beta x_i + \varepsilon_i$$

, where i denotes a prefecture, y is a dependent variable, α means intercept, β represents a vector of coefficients of independent variables, x is a vector of independent variables and ε is error term. This study however calculates standardized partial regression coefficients for the vector β. The intercept α resultingly becomes 0. Meanwhile, x contains variables describing: the number of Industrial cluster, the number of Knowledge cluster, adoption of policy to invite companies with high subsidy, start-up rate, proportion of number of technician to manufacturing employment and share of manufacturing employment of high tech industries (Table 3.1). The independent variables are subject to cross sectional analysis of regional manufacturing employment of the Japanese 44 prefectures. This study assumes that there is no reverse causation between the dependent variables and independent variables since certain time lag exists between them. However, the model might encompass omitted variable bias because of exclusion of non-common factors for the three types of agglomeration of human capitals and technology.

Table 3.1. Content and name of the independent variables in the models

Name of the variable	Content	Period
Policiesgood	=1 when prefectures held Policies to invite factories with subsidy of maximum over 5000 million yen; otherwise =0	
Industrial cluster	Number of clusters of the Industrial cluster initiatives	
Knowledge cluster	Number of clusters of the Knowledge cluster initiatives	
Startuprate	Rate of startup of manufacturing companies	1999~2000
Technician	Proportion of number of technicians to number of productive population	2000

Hightech	Share of manufacturing employment of high tech industries (calculated with respect to each category of dependent variable)	2001

In the cross sectional analysis, this study confirmed high probability of nonexistence of heteroscedasticity with the Breusch-Pagan test. Also, multicollenearity problem very unlikely exists in the analysis. This study calculated Variance Inflation Factor (VIF) for each independent variable and VIFs are so small, below 1.2, that multicollenearity must not occur. Finally, this study applied RESET tests for the models. The results indicate misspecification of most of the models. Thus, this study tests the models where square of the technician and start-up rate variables are added to the models described above, guessing that too many technicians and start-ups are harmful to economy. While the addition of the square variables solved the misspecification problem, addition of either of the squares did not improve results of RESET tests very much. From now on, this study calls the models with squares of the technician and start-up rate variables 'second models' and those without them 'basic models'.

3.6 Results

Before moving to results of the cross sectional analyses, this study reports decrease of manufacturing employment in Japanese prefectures, from the data of the dependent variables (Table 3.2). The words, EM-all, EM-over30 and EM-under30, respectively mean change of employment of all the business places, of business places with over 30 workers and of those with under 30 workers from 2001 to 2006. The data show that decrease of manufacturing employment is particularly evident for EM-under30. All of the prefectures suffered over 10% decrease of manufacturing employment of small businesses. On the other hand, not all regions decreased manufacturing employment for large and medium sized companies. However, the standard deviation of EM-over30 is large, 4 times as large as that of EM-under30, and almost half of regional manufacturing employment of large and medium companies disappeared in the worst case, Tokyo. Finally, just six prefectures increased whole manufacturing employment, namely, Aichi, Mie, Shiga, Saga, Kumamoto and Oita. Manufacturing in Japanese prefectures generally faced severe situation.

Table 3.2. Descriptive statistics of dependent variables

Dependent variables	Min	Max	Mean	Std.dev (*)
EM-all	-28.86	3.12	-6.57	6.00
EM-over30	-46.06	9.55	-3.00	9.54
EM-under30	-26.21	-10.82	-15.39	2.85

*std.dev= standard deviation

Through the look at the dependent variables, Tokyo is suspected to be an outlier since Tokyo's values of the dependent variables are always the lowest and have difference of more than twice as large as the standard deviations from the other values. For that reason, this study will conduct additional analysis without Tokyo. Description of the results will follow exhibit of results of the analysis with Tokyo.

Then, this study moves on to depiction of results of the cross sectional analysis (Table 3.3, 3.4, 3.5, 3.6). The models explain around half of change of manufacturing employment of the Japanese 44 prefectures: coefficients of determination are around 5.0. F-statistics of all the models post statistical significance. The second models, models with squares of the start-up rate and technician variables, generally present higher coefficients of determinations than the basic models.

When it comes to the models for EM-under30, coefficients with statistical significance are those of: technician, highly subsidized policies to invite companies, Industrial cluster initiatives and high tech industries variables (Table 3.3. The latter two have positive values while the former two present negative sign. Yet, the technician variables post different results for the basic model and the second model: while the ordinary technician variable is statistically significant in the basic model, the second model just depicts statistical significance of the squared technician variable connoting inverse U-curve effect of the number of technicians to regional manufacturing employment.

Table 3.3. Results of the cross sectional analyses for manufacturing employment of business places with under 30 workers (N=44)

	(1)		(2)	
(Intercept)	0.000		0.215	
	(0.098)		(0.128)	
Startuprate	-0.003		0.114	
	(0.111)		(0.112)	
I(Startuprate^2)			-0.094	
			(0.072)	
Technician	-0.824		-0.347	
	(0.120)	***	(0.249)	
I(Technician^2)			-0.120	
			(0.054)	*
Policiesgood	-0.326		-0.281	
	(0.103)	**	(0.100)	**
Industrialcluster	0.285		0.295	
	(0.111)	*	(0.108)	**
Knowledgecluster	-0.047		-0.087	
	(0.101)		(0.108)	
Hightech	0.906		0.704	
	(0.128)	***	(0.159)	***

Residual standard error:	0.649		0.622	
Adjusted R-squared:	0.585		0.619	
F-statistic:	11.120		9.719	
p-value of F-statistic:	0.000		0.000	

Standard errors in parentheses
’.’: statistically significant at 10 percent; ’*’: statistically significant at 5 percent;
’: statistically significant at 1 percent; ‘*’: statistically significant at 0.1 percent

For large and medium sized companies, coefficients of the technician and high tech industries variables of the models describe the same tendency as the models of small businesses (Table 3.4). The other control variable, start-up rate, in the basic model of EM-over30 shows statistical significance with negative sign differently from that in the models for EM-under30. Coefficients of the other variables do not embrace statistical significance.

Table 3.4. Results of the cross sectional analyses for manufacturing employment of business places with over 30 workers (N=44)

	(1)		(2)	
(Intercept)	0.000		0.226	
	(0.106)		(0.135)	
Startuprate	-0.298		-0.177	
	(0.118)	*	(0.113)	
I(Startuprate^2)			-0.076	
			(0.073)	
Technician	-0.642		-0.118	
	(0.112)	***	(0.205)	
I(Technician^2)			-0.151	
			(0.051)	**
Policiesgood	-0.037		0.005	
	(0.108)		(0.099)	
Industrialcluster	0.117		0.160	
	(0.115)		(0.108)	
Knowledgecluster	0.072		0.023	
	(0.109)		(0.114)	
Hightech	0.578		0.381	
	(0.115)	***	(0.120)	**
Residual standard error:	0.702		0.649	
Adjusted R-squared:	0.519		0.589	
F-statistic:	8.720		8.686	
p-value of F-statistic:	0.000		0.000	

Standard errors in parentheses
’.’: statistically significant at 10 percent; ’*’: statistically significant at 5 percent;
’: statistically significant at 1 percent; ‘*’: statistically significant at 0.1 percent

The models of EM-all depict the same pattern as those of EM-over30, pertaining to the control variables (Table 3.5). As to the other variables, just Industrial cluster variable of the second model is statistically significant. The coefficient signals positive sign as well as that of EM-under30.

Table 3.5. Results of the cross sectional analyses for manufacturing employment of all the business places (N=44)

	(1)		(2)	
(Intercept)	0.000		0.222	
	(0.109)		(0.147)	
Startuprate	-0.263		-0.143	
	(0.121)	*	(0.123)	
I(Startuprate^2)			-0.112	
			(0.079)	
Technician	-0.591		-0.191	
	(0.118)	***	(0.239)	
I(Technician^2)			-0.110	
			(0.059)	.
Policiesgood	-0.118		-0.064	
	(0.112)		(0.107)	
Industrialcluster	0.210		0.239	
	(0.119)	.	(0.117)	*
Knowledgecluster	-0.004		-0.011	
	(0.112)		(0.124)	
Hightech	0.707		0.535	
	(0.121)	***	(0.142)	***
Residual standard error:	0.721		0.698	
Adjusted R-squared:	0.493		0.524	
F-statistic:	7.954		6.920	
p-value of F-statistic:	0.000		0.000	

Standard errors in parentheses

’.’: statistically significant at 10 percent; ’*’: statistically significant at 5 percent; **’: statistically significant at 1 percent; ‘***’: statistically significant at 0.1 percent

Finally, this study discusses results of the analysis without Tokyo (Table 3.6). Since the RESET test indicates nonexistence of misspecification, just the results pertaining to the basic models are present. In addition, coefficients of the results of the basic model for EM-all are ones after using the White method because heteroscedasticity of the model is detected through the Breusch-Pagan test. As to the results, the explanation powers of the models without Tokyo decrease dramatically compared with the models with Tokyo. In particular, the model of EM-above30 does not explain the change of the employment very much. When it comes to signs and statistical significance of the variables, almost all of the variables show the same tendency as those in the models with Tokyo. The three variables regarding policies especially depict the completely identical tendency to those in the models with Tokyo. On the other hand, big difference exists in the technician variables: the variables lose statistical significance in all the models without Tokyo while they hold the significance in all the models with Tokyo. This study discusses what the difference of the technician models connotes in the next section, together with discussion on the results of the models with Tokyo.

Table 3.6. Results of the cross sectional analyses without Tokyo (N=43)

	EM-all (1)	EM-above30	EM-below30
(Intercept)	0.000	0.000	0.000
	(0.153)	(0.140)	(0.116)
Startuprate	-0.286	-0.359	0.066
	(0.215)	(0.155) *	(0.133)
Technician	-0.271	-0.222	-0.282
	(0.301)	(0.174)	(0.185)
Policiesgood	-0.138	-0.056	-0.368
	(0.200)	(0.142)	(0.123) **
Industrialcluster	0.264	0.196	0.334
	(0.147) .	(0.151)	(0.130) *
Knowledgecluster	-0.065	-0.013	-0.143
	(0.186)	(0.152)	(0.126)
Hightech	0.741	0.606	0.852
	(0.250) **	(0.175) **	(0.196) ***
Residual standard error:	0.866 (2)	0.918	0.759
Adjusted R-squared:	0.268 (2)	0.177	0.438
F-statistic:	3.562 (2)	2.509	6.450
p-value of F-statistic:	0.007 (2)	0.039	0.000

Standard errors in parentheses

’.’: statistically significant at 10 percent; ’*’: statistically significant at 5 percent; **’: statistically significant at 1 percent; ‘***’: statistically significant at 0.1 percent

(1): The coefficients are ones AFTER using the White method

(2): They are values BEFORE using the White method

3.7 Discussion

Now that this study revealed the results of the cross sectional analyses, it interprets the results. The results of pertaining to the technician and high tech industries variables of the models with Tokyo are more or less within expectation. High tech industries would be beneficial for regional manufacturing employment of all sizes of companies. Meanwhile, the number of technician seems to have inverse U-curve effect on the employment according to the coefficients of its squares of all the second models. Moderate number of technician might lead to retention of the employment. However, considering that the technician variables loss the statistical significance in the models without Tokyo, the number of technicians probably does not have influence to the other regions generally. It seems that the variables chiefly measure peculiarity of Tokyo as an outlier. Next, unexpected results were derived from the start-up variables. While this study expects positive coefficient of the variable owing to its function as stimulus of innovation, the variable just presents negative sign with statistical significance for the models of large and medium sized corporations. Fierce competition caused by start-up may have led to plight of large and medium sized companies.

Although results of the control variables remain to be explained to some extent, those are just control variables: focus of this study is on the other variables related to the agglomeration inducing policies. For the policy variables, the models without Tokyo present consistent results with the results of those with Tokyo. To begin with, the Knowledge cluster initiatives seem not to have performed well in terms of retention of manufacturing employment. Two reasonable explanations can be formulated for this result: the cluster initiatives are not effective because of their content and/or the period was too short for clusters to come into effect. Indeed, many projects of the Knowledge clusters initiatives were warned that they focused too much on researches without picking up regional need and meeting the need through business creation (Ministry of Education, Culture, Sports, Science and Technology of Japan 2008b, 2009b). It was also claimed that they lacked in regional integrative visions (Ministry of Education, Culture, Sports, Science and Technology of Japan 2008a, 2009c). The assessment gives reasons behind the inefficiency of the Knowledge cluster initiatives for retention of regional manufacturing.

Next, the other agglomeration inducing policies, highly subsidized policy to invite companies and Industrial cluster initiatives, seem to have effect to employment small manufacturing companies. The results indicate that small manufacturing companies gained benefit from Industrial cluster initiatives while the companies are negatively influenced by the policies to invite companies with high subsidy. With regard to the positive influence of Industrial cluster initiatives, networks established through the initiatives very likely strengthened capabilities of small manufacturing companies. Meanwhile, probable explanation to the negative impact of the other policies is that companies invited by the policy, especially large companies, drove existing small manufacturing companies away by competing with them.

On the other hand, the two policies likely did not affect manufacturing employment of large and medium companies. As to the policies to invite companies, the higher subsidy than that of other prefectures might not be attractive to large and medium companies very much. Other factors may be much more important for them. Or invited large and medium companies just competed with existing large and medium companies, depriving employment from them. In that case, the invited companies do not contribute to increase of regional manufacturing employment. In terms of the insignificance of the

Industrial cluster initiatives to employment change of large and medium manufacturing companies, the companies may not be involved in the initiatives. Executors of the initiatives may have prioritized small manufacturing companies and excluded large and medium manufacturing companies. Another possibility is that large and medium manufacturing companies avoid participating in network composed chiefly of small businesses. Or, even if they are involved in the network, it may not supply factors for growth of large and medium manufacturing companies very much because of difference of technology level that they possess. Nonparticipation of large companies or general trading companies is actually reported in Sangyou kurasuta kenkyukai (2005).

As another possibility regarding a reason why the agglomeration inducing policies do not work for some companies, this study argues that some prefectures are not equipped with factors necessary for the policies to function. Effect of the policies might become manifest only if regions are endowed with some factors. If so, variables describing the policies do not have consistent effect for all regions and tend not to express statistical significance in regression analysis. Analysis other than regression analysis is required. Therefore, this study additionally looks into success factors of those agglomeration inducing policies by comparing successful regions and unsuccessful regions with respect to the policies.

4 Exploratory research on success factors of the agglomeration inducing policies

In this section, this study conducts exploratory study of success factors of the agglomeration inducing policies. Assumption behind this analysis is that regions benefit from the agglomeration inducing policies only if they are equipped with some regional economic characteristics. For detection of such regional economic traits, this study compares economic indicators of high-performance regions and/or low-performance ones with respect to the two cluster initiatives, using additional indicators to those used in the regression analysis. This study does not analyze success factors of the policies to invite companies with high subsidy because the sample is too small, just 6. In the analysis, high performance prefectures are defined as ones that accomplish above-average value of regional manufacturing employment within prefectures selected for each cluster initiative. In other words, prefectures that do not contain cluster initiatives are excluded in the calculation of the average.

4.1 Absorptive capacity hypothesis and additional variables

In order to devise hypotheses for the analysis, the findings of the factors for exploiting the precursors in Section 2.7 are useful. The findings suggest that factors able to exploit world-class technology are of importance for the Knowledge cluster initiatives, which seek to raise research ability of regions. Examples of the factors are companies with similar technology, technicians and personnel clever in teaching technology like technological consultants. In turn, factors strengthening increase of transport productivity of production factors such as training centers, research group and secondhand market are critical for networking activities of the Industrial cluster initiatives. However, most of them, in particular the factors beneficial to the Industrial cluster initiatives, are difficult to operationalize into variables. This study focuses the second analysis on, again, factors about human capitals engaged with technological activities, the commonly identified important factor in the factors for exploiting the precursors discussed in Section 2.8. In the focus on human capitals engaged with technological activities, this study uses the concept "absorptive capacity" (Cohen and Levintbal 1990) as the hypothesis of the analysis. Sophisticated researches supplied through the two, especially Knowledge, cluster initiatives must require the receivers to be equipped with ability to transform the knowledge into business activities. Tacit knowledge acquired through networking strengthened by the Industrial cluster initiatives may also call for such ability. Without certain degree of absorptive capacity, regions would have difficulty to make the two cluster initiatives beneficial to them. The extent of the ability very likely depends on production factors, especially human capitals. Specially, level of their education should be crucial for high level of absorptive capacity. This study therefore looks mainly at variables about high tech industries and able human resources. However, it should be paid attention to that the high tech industries variable may obscure success factors of the two cluster initiatives since they generally increase the variables of regional employment, making prefectures high performance ones without contribution of the other absorptive capacity variables. Effect of high tech industries should be carefully subtracted in head or by some operations, in order to assess whether absorptive capacity is important for the two cluster initiatives or not.

In order to test the absorptive capacity hypothesis, this study adds three variables regarding human capitals to those analyzed in the regression analysis. The additional variables are derived from: the number of technician inside manufacturing companies, graduate of a university and the number of technical college students. While the last two pertain to sources of human capitals for manufacturing companies, the first deals with human capitals present in them.

As this study explains rationality of the choice of the additional variables, technicians inside regional manufacturing companies are key players to assimilate knowledge without doubt. They would be familiar with advanced technology and very likely contribute the most to transformation of technical knowledge into business activities. Source of the number of the technician according to Japanese prefectures is Statistics Bureau and the Director-General for Policy Planning of Japan (2000a), where categories of technicians are identical to that of the technician variable in the regression analysis. From the data, this study extracts the values of 2000. The values are then divided by number of all the manufacturing employment of the year 2000 of the same data, which in turn includes office workers, factory workers and so on differently from the data of dependent variables. The variable consequently denotes how much regional manufacturing companies focus on technological activities. Because of existence of two technician related variables, this study calls the added technician variable ‘manufacturing technician variable’ and the technician variable in the regression analysis ‘regional technicians’ from now on.

In turn, graduates of universities would be key players to digest knowledge as well. Some have acquired knowledge about state-of-the-art advanced technology. Even if they have not undergone education of advanced technology in the universities, they likely have improved their communication skills or apprehensive power to any kind of knowledge through study in universities. They seem to reinforce absorptive capacity of regions; therefore, this study includes ratio of graduate of universities to productive population in a prefecture, which likely indicates accessibility of talented people. Source of the number of graduate of universities is Statistics Bureau and the Director-General for Policy Planning of Japan (2011b). Data of regional productive population are the same as those used for the regional technician variable (Statistics Bureau and the Director-General for Policy Planning of Japan 2011a).

Students of technical colleges in a region are also important potential human capitals for manufacturing companies in the region. In particular, they can be considered as a major source of competent human capitals for regional small and medium sized manufacturing companies because graduates of universities in Japan tend to be employed by large companies apart from the original regions. Students of technician colleges probably contribute to absorptive capacity of regional manufacturing as they should be familiar with advanced technology especially of applied aspects. This study picks up the number of students of technical colleges in 2003, owing to data availability, from Ministry of Education, Culture, Sports, Science and Technology of Japan (2003). Then, it divides them by the number of manufacturing employees in the regions, which is taken from Statistics Bureau and the Director-General for Policy Planning of Japan (2000a), the same data for the manufacturing technician variable. The variable describes availability of persons conversant with advanced technology. This study names the variable 'Technical college'.

In summary, this study discusses success factors of the two cluster initiatives with variables related to the number of technicians inside manufacturing companies, that of graduate of universities and that of students in technical colleges, in addition to the regional technician and high tech industries variables. The discussion is made from perspective of absorptive capacity. Although correlation between some of them is high, especially one between the manufacturing technician variable and university graduate variable, and between the manufacturing technician variable and regional technician variable (Table 4.1), this study keeps separating them because above-average values of each variable are seen in different prefectures as shown in the following analysis.

Table 4.1. Correlation matrix between the three additional variables and the other variables investigated in the following analysis

	Technical college	University graduate	Manufacturing technician
Technical college	1.000	-0.408	-0.538
University graduate	-0.408	1.000	0.874
Manufacturing technician	-0.538	0.874	1.000

EM-under30	-0.322	-0.145	-0.010
EM-over30	-0.119	-0.437	-0.398
Policiesgood	-0.240	0.379	0.287
Industrial cluster	-0.162	0.386	0.323
Knowledge cluster	-0.068	0.263	0.163
Startuprate	-0.428	0.491	0.533
Regional technician	-0.326	0.661	0.756
Hightech of EM-under30	-0.611	0.469	0.640
Hightech of EM-over30	-0.540	0.170	0.400

4.2 Inquiry into the success factors

Now that this study described all the variables investigated, it begins the explorative study of success factors of the two cluster initiatives with the Knowledge cluster initiative for EM-under30. The variables investigated are described in the Table 4.2, with their average and standard deviation. When focus is put on the absorptive capacity variables in total, it seems that, the higher prefectures perform in the data, the more the variables overall become over average. For example, the top three prefectures, Nagano, Shizuoka and Aichi, show above-average values of at least three of the high tech industries, regional technicians, manufacturing technician and university graduate variables. Yet, even unsuccessful prefectures attain the same condition, indicating that the hypothesis of absorptive capacity is inadequate for this case. Moreover, because of positive influence of the Industrial cluster and the high tech industries detected in the regression analysis, it is difficult to distinguish sheer source of their above-average performance. For instance, the superior performance of the top three prefectures may be not due to absorptive capacity but because of their large share of high tech industries or large number of Industrial cluster projects. Any conclusion is not drawn in this case. Knowledge cluster may not have given benefits to small manufacturing companies fundamentally and/or general characteristics of small manufacturing companies undescribed in the variables like small financial capitals may have inhibited them from receiving benefits of the Knowledge cluster initiatives.

Table 4.2. Employment change of small manufacturing companies in prefectures selected by the Knowledge cluster initiatives and profile of the prefectures

Prefectures	EM under30	Policies good	Industrial cluster	Knowledge cluster	Startup rate
Nagano	-11.27	0	2	1	2.4
Shizuoka	-12.50	0	1	1	3.85
Aichi	-13.49	0	3	1	3.75
Kyoto	-14.01	0	3	2	5.2
Hyogo	-14.12	1	3	1	3.5
Toyama	-14.12	0	1	1	2.4
Kagawa	-14.31	0	1	1	3.5
Yamaguchi	-15.08	0	2	1	2.95
Osaka	-16.05	0	3	2	5.6
Fukuoka	-16.76	0	3	2	3.55
Ishikawa	-18.07	0	1	1	2.65
Tokushima	-18.39	0	1	1	3.4
Gifu	-19.50	1	2	1	2.3
Average	-15.21	0.154	2.000	1.231	3.465
Standard deviation	2.32	0.361	0.877	0.421	0.975

Table 4.2. (Continued)

Prefectures	EM under30	Hightech	Regional technicians	Manufacturing technician	University graduate	Technical college
Nagano	-11.27	0.42	0.0318	0.0579	0.137	0.0035
Shizuoka	-12.50	0.316	0.0293	0.0591	0.141	0.0019
Aichi	-13.49	0.292	0.0329	0.0636	0.172	0.0011
Kyoto	-14.01	0.194	0.0228	0.0665	0.188	0.0033
Hyogo	-14.12	0.247	0.0232	0.0684	0.197	0.0042
Toyama	-14.12	0.24	0.0298	0.0509	0.148	0.0106
Kagawa	-14.31	0.155	0.0227	0.0375	0.165	0.0174
Yamaguchi	-15.08	0.214	0.0212	0.0487	0.138	0.0180
Osaka	-16.05	0.27	0.0317	0.0667	0.173	0.0011
Fukuoka	-16.76	0.169	0.0232	0.0457	0.157	0.0104
Ishikawa	-18.07	0.202	0.0280	0.0436	0.146	0.0132
Tokushima	-18.39	0.143	0.0202	0.0459	0.141	0.0124
Gifu	-19.50	0.184	0.0214	0.0340	0.136	0.0039
Average	-15.21	0.234	0.0260	0.0529	0.157	0.0078

Standard deviation	2.32	0.074	0.0045	0.0111	0.020	0.0059

*The colored values are above-average (colored just for the variables related to absorptive capacity)

Next, this study investigates success and failure factors of Knowledge cluster initiatives for large and medium manufacturing corporations (Table 4.3). In this case, negative influence of start-up rate variable should be cared about as well as positive influence of high tech industries variable. The high performance prefectures are somewhat disparate from those of the case discussed above, but they also do not have commonly superior factors to those of the low performance prefectures. When it comes to absorptive capacity, almost all of the successful regions display above-average values of more than two of the human capital variables. However, above-average values of them are also seen in the low performance prefectures. Again, the absorptive capacity hypothesis seems inadequate to explain difference between successful regions and the others.

Table 4.3. Employment change of large and medium manufacturing companies in prefectures selected by the Knowledge cluster initiatives and profile of the prefectures

Prefectures	EM over30	Policies good	Industrial cluster	Knowledge cluster	Startup rate
Aichi	9.551	0	3	1	3.75
Gifu	7.798	1	2	1	2.3
Ishikawa	4.175	0	1	1	2.65
Shizuoka	2.692	0	1	1	3.85
Toyama	0.529	0	1	1	2.4
Kyoto	-1.366	0	3	2	5.2
Tokushima	-2.381	0	1	1	3.4
Nagano	-2.869	0	2	1	2.4
Hyogo	-3.808	1	3	1	3.5
Kagawa	-4.41	0	1	1	3.5
Fukuoka	-6.548	0	3	2	3.55
Yamaguchi	-9.251	0	2	1	2.95
Osaka	-15.966	0	3	2	5.6
Average	-1.681	0.154	2.000	1.231	3.465
Standard deviation	6.641	0.361	0.877	0.421	0.975

Table 4.3. (Continued)

Prefectures	EM over30	Hightech	Regional technicians	Manufacturing technician	University graduate	Technical college
Aichi	9.551	0.614	0.0329	0.0636	0.172	0.0011
Gifu	7.798	0.457	0.0214	0.0340	0.136	0.0039
Ishikawa	4.175	0.521	0.0280	0.0436	0.146	0.0132

Shizuoka	2.692	0.584	0.0293	0.0591	0.141	0.0019
Toyama	0.529	0.409	0.0298	0.0509	0.148	0.0106
Kyoto	-1.366	0.524	0.0228	0.0665	0.188	0.0033
Tokushima	-2.381	0.44	0.0202	0.0459	0.141	0.0124
Nagano	-2.869	0.701	0.0318	0.0579	0.137	0.0035
Hyogo	-3.808	0.519	0.0232	0.0684	0.197	0.0042
Kagawa	-4.41	0.319	0.0227	0.0375	0.165	0.0174
Fukuoka	-6.548	0.366	0.0232	0.0457	0.157	0.0104
Yamaguchi	-9.251	0.496	0.0212	0.0487	0.138	0.0180
Osaka	-15.966	0.466	0.0317	0.0667	0.173	0.0011
Average	-1.681	0.494	0.0260	0.0529	0.157	0.0078
Standard deviation	6.641	0.099	0.0045	0.0111	0.020	0.0059

*The colored values are above-average (colored just for the variables related to absorptive capacity)

In terms of Industrial cluster initiatives, positive correlation of the initiatives has been already identified for employment of small manufacturing firms. Therefore, this study targets just success factors of the initiatives for growth of regional employment of large and medium manufacturing companies. This study additionally limits its target to prefectures with the high tech industries variable ranging from 0.427 to 0.527, which are corresponding to its average plus and minus half of its standard deviation respectively. The manipulation has purpose to relatively equalize effect of the high tech industries variable and to make other success factors more highlighted. Table 4.4 shows the variables finally looked into in the analysis. Here, this study does not discuss the high tech industries variables, assuming their influence is equalized for each region. Yet, above-average human capital variables are seen in both the low performance prefectures and the high performance prefectures with almost the same frequency. In addition, the top prefecture, Gifu, does not have any above-average variables about human capital. The absorptive capacity hypothesis does not explain the difference of the prefectural performance. There might be other factors or theories elucidating the difference. Or the Industrial cluster initiatives fundamentally may not have held force to contribute to manufacturing employment of large and medium sized companies.

Table 4.4. Employment change of large and medium manufacturing companies in prefectures selected by the Industrial cluster initiatives and profile of the prefectures

Prefectures	EM over30	Policies good	Industrial cluster	Knowledge cluster	Startup rate
Gifu	7.798	1	2	1	2.3
Kumamoto	7.126	0	3	0	3

Oita	6.964	0	3	0	3.7
Ishikawa	4.175	0	1	1	2.65
Hiroshima	4.036	0	2	0	3.7
Tottori	2.358	0	2	0	2.95
Ibaraki	1.757	0	2	0	3.85
Kyoto	-1.366	0	3	2	5.2
Okayama	-1.732	1	2	0	3.25
Tokushima	-2.381	0	1	1	3.4
Saitama	-3.732	0	3	0	5.5
Hyogo	-3.808	1	3	1	3.5
Fukui	-4.722	0	1	0	1.8
Shimane	-6.087	0	2	0	2.7
Yamaguchi	-9.251	0	2	1	2.95
Nagasaki	10.759	0	3	0	3.6
Osaka	15.966	0	3	2	5.6
Tokyo	46.057	0	3	0	4.4
Average	-3.980	0.167	2.278	0.500	3.558
Standard Deviation	12.003	0.373	0.731	0.687	1.024

Table 4.4. (Continued)

Prefectures	EM over30	Hightech	Regional technicians	Manufacturing technician	University graduate	Technical college
Gifu	7.798	0.513	0.0214	0.0340	0.136	0.0039
Kumamoto	7.126	0.5	0.0189	0.0397	0.123	0.0148
Oita	6.964	0.524	0.0212	0.0394	0.128	0.0099
Ishikawa	4.175	0.501	0.0280	0.0436	0.146	0.0132
Hiroshima	4.036	0.519	0.0283	0.0571	0.177	0.0052
Tottori	2.358	0.471	0.0252	0.0367	0.134	0.0179
Ibaraki	1.757	0.466	0.0279	0.0653	0.135	0.0032
Kyoto	-1.366	0.431	0.0228	0.0665	0.188	0.0033
Okayama	-1.732	0.457	0.0231	0.0386	0.153	0.0042
Tokushima	-2.381	0.511	0.0202	0.0459	0.141	0.0124
Saitama	-3.732	0.485	0.0167	0.0517	0.182	0.0000
Hyogo	-3.808	0.474	0.0232	0.0684	0.197	0.0042
Fukui	-4.722	0.478	0.0285	0.0341	0.138	0.0096
Shimane	-6.087	0.431	0.0248	0.0259	0.123	0.0166
Yamaguchi	-9.251	0.496	0.0212	0.0487	0.138	0.0180
Nagasaki	10.759	0.521	0.0195	0.0447	0.109	0.0106
Osaka	15.966	0.44	0.0317	0.0667	0.173	0.0011
Tokyo	46.057	0.466	0.0645	0.1214	0.268	0.0030
Average	-3.980	0.482	0.0260	0.0516	0.155	0.0084

Standard Deviation	12.003	0.029	0.0101	0.0210	0.037	0.0058

*The colored values are above-average (colored just for the variables related to absorptive capacity) (The high tech industries variable is not colored because of the assumption of this analysis described in the body)

To sum up, this study does not specify success factors of the two cluster initiatives for manufacturing employment. Absorptive capacity hypothesis does not serve as explanation of difference between successful regions and unsuccessful regions pertaining to the two cluster initiatives. The two cluster initiatives seem simply inefficient as discussed in Section 3.7. This study finally derives some suggestions to all the three agglomeration inducing policies from the results of this analysis. Discussion of the theoretical framework of this study in light of the results will follow the suggestions.

5 Discussion of the overall results

5.1 Policy implications

This study starts the discussion of policy suggestions with the policies to invite companies with high subsidies. The results of the cross sectional analysis suggest that the policies do not contribute to employment growth; rather, the policies may lead to decrease of employment of small manufacturing companies. It can be thought that competition from companies invited by the policies drove small companies away. A suggestion drawn from those guess is that policies to invite companies should be deliberately composed with consideration of its effect to incumbents. In particular, the factors for exploiting organizations with big demand and/or those with world-class technology could be considered. Regions would be able to attain agglomeration of human capitals and technology by doing so.

Second, the Knowledge cluster initiatives seem not to have influenced manufacturing employment. This study follows the opinions in the reports described in Section 3.7 and reckons that the failure happened because some of the initiatives were implemented with neglect of regional need or business creation by using the augmented R&D ability of the region. Importance of business creation for the Knowledge cluster initiatives is actually suggested by the theoretical framework of this study. The problem of inconsideration of regional need is comparatively similar to that of the policies to invite companies, so this study devised almost the same suggestion to this policy: elaboration of the initiatives with consideration of the factors for exploiting the precursors. The elaboration must consequently include prioritization of business creation.

Third, the Industrial cluster initiatives seem to have succeeded in retention of manufacturing employment. Strengthened network through the initiatives very likely improved their capability to survive or grow. This improvement may be caused by learning effect through the network or increase of trade from newly found partners. In turn, the results of the cross sectional analysis indicate that the initiatives probably did not render employment of large and medium manufacturing companies. This would be because of lack of involvement of large manufacturing companies in the initiatives, as reported in Sangyou kurasuta kenkyukai (2005). The Industrial cluster initiatives could involve large and medium manufacturing companies more, considering the importance of large companies, which are likely the precursors of organizations with big demand and/or those with world-class technology. Yet, effect of the inclusion of large and medium companies to small firms should be cared in order to accomplish their synergy. Furthermore, large and medium companies might not be tempted into networks with small companies due to difference of their technological level. Regions may need to put forward concrete benefit of cooperation with small companies in order to engage the large and medium companies.

5.2 Implications for the theoretical framework and contribution of this study

Next, this study discusses the theoretical framework based on implications of the results. At first, it can be pointed out that the precursor of 'network among similar companies' can easily lead to agglomeration more than the other two precursors. The Industrial cluster initiatives probably led to increase of whole regional manufacturing employment, as indicated from the results of the cross sectional analysis of employment of whole regional manufacturing companies (Table 3.5). While the results would underline significance of the precursor for increase or agglomeration of human capitals, they indicate possibility of relative easiness to exploit agglomeration factors of the precursor. The exploitation might not require the factors theorized in this study, such as training centers, for causing agglomeration. On the other hand, it seems difficult to exploit agglomeration factors of the other precursors of agglomeration, organizations with big demand and those with world-class technology. The Knowledge cluster initiatives must have enabled emergence of world-class research facilities and also the highly subsidized policies to invite companies maybe attracted organizations with big demand or world-class technology. However, the two policies did not realize agglomeration of human capitals. This study guesses, from the discussion in the previous section, that the failure of the two policies in realizing agglomeration is owing to lack of the factors for exploiting the precursors. In particular, the failure of the Knowledge cluster initiatives exemplifies significance of business creation for agglomeration by organizations with world-class technology.

In summary, this study validates the roles of network of similar companies as a precursor of agglomeration from the results of the analysis. It also confirms importance of business creation for exploiting agglomeration factors of organizations with world-class technology. A difference of the theoretical framework from the results of the analysis could be easiness of exploitation of agglomeration factors of network of similar companies. The precursor might not require the factors for exploiting the precursor advocated in this study. Detailed investigation will be needed so as to confirm it.

Overall, contribution of this study would converge with two points: evaluation of Japanese cluster policies in rather macro level and theorizing precursors of cluster formation and factors for exploiting emergence of the precursors. For the first point, while some assessments of the Japanese cluster policies in 2000s are seen in micro level or according to each cluster, researches investigating general and macro effect of the cluster initiatives seem few. Additionally to the existing studies, this study finds that the Industrial cluster initiatives likely increased employment of small manufacturing companies. That would provide grounds to keep implementing the cluster initiatives.

As to the second point, this study integrated existing theories and detected three precursors of cluster formation and agglomeration. This study additionally identified agglomeration factors induced by the precursors as well as factors to exploit the agglomeration factors. The three precursors were derived from rather empirical literatures with focus on case studies while identification of the key agglomeration factors rested on relatively theoretical literatures. Moreover, the precursors and the agglomeration factors seem very coherent, so it can be said that this study bridges over theoretical works and empirical studies in terms of cluster formation. The theoretical corroboration of cluster formation would be significantly valuable. Moreover, this study confirmed validity of the theoretical framework to some degree by analysis of Japanese agglomeration inducing policies. The results of the cross sectional analysis indicate benefit of the precursor of network of similar companies. In addition, inquiry into the Knowledge cluster initiatives suggests need of business creation for exploiting agglomeration factors of world-class technology, which the theoretical framework also argues. Furthermore, the factors for exploiting the precursors can be used for checklist of policies for cluster formation, as somewhat done in the previous section. Considering growing importance of clusters for regional economic development, the theorization of the precursors and the factors for exploiting the precursors would be of big worthwhile.

5.3 Limitations and further researches

With respect to limitation of this study, this study identifies four limitations in it. As one limitation, it firstly mentions the small number of the population, 44. The small population may have inhibited some variables from developing statistical significance. As a further research coping this limitation, extension of time scale and analyzing panel data will be recommendable. In addition, analyses in smaller scale will be another further research against the limitation. Range of spillover of benefits of the clusters may be within just one city or around, so analyses in those scales will emphasis influence of the cluster initiatives. Analyses in smaller scale seem favorable for the next research.

In the second place, segmentation of industries for the dependent variables may be inappropriate to some degree for assessing the cluster initiatives. While this study includes employment of all the manufacturing industries in the dependent variables, the two cluster initiatives both targeted chiefly high tech industries. Just high tech industries could be included in the dependent variables for minute evaluation of the cluster initiatives. Such researches are other further researches.

In the third place, there are some problems associated with the choice of the independent variables. First, as described, the regional technician variable contains not only technicians related to manufacturing but also ones irrelevant to manufacturing. Second, the variable describing policies to invite companies with high subsidy is devised arbitrarily. Although the criterion for the variable seems reasonable to some degree, this study could additionally use and compare other criteria. Finally, even the cluster variables are somewhat arbitrary. More objective criteria such as subsidies injected into each cluster are preferable for composing the variables if data are available. Those potential criteria could be tried in the next research.

Last but not least, not all of the prefectures investigated in this study may be suitable for investigation of the agglomeration inducing policies. While this study inquired into factors and policies inducing agglomeration, some prefectures may have already been in post agglomeration phase. Classifying the prefectures according to the stages of ecosystem development of Nishizawa et al. (2010) and targeting just the prefectures in the first stage would have been more relevant. That is what the next study could adopt.

In addition to the limitation-related further researches above, qualitative studies into each cluster would be valuable for testing the theoretical framework of this study. The studies could look into whether and why the cluster initiatives render to agglomeration of human capitals or not, and compare the results with the theoretical framework. The qualitative studies would complement the further quantitative studies described above and give opportunities to elaborate the theoretical framework and policy implications of this study.

6 Conclusion

Driven by motivation to prevent ongoing severe hollowing out of Japanese manufacturing, this study looks into factors required for agglomeration of human capitals and technology, a necessary condition for development of high tech industries theorized by Nishizawa et al. (2010). Through literature review of cluster formation and types of clusters, this study identified three precursors of cluster formation and agglomeration: network of similar companies, organizations with world-class technology and organizations with big demand. In addition, this study clarified agglomeration factors induced by the precursors with literature review of factors producing agglomeration. The finding of agglomeration factors of the precursors enabled this study to theorize factors required for realizing agglomeration of human capitals and technology.

After having detected important factors for agglomeration of human capitals and technology, this study conducted cross sectional analysis of Japanese prefectures in order to evaluate effect of three policies that can induce emergence of the precursors to retention of regional manufacturing employment. The policies selected in this study are: policies to invite companies with high subsidy; Knowledge cluster initiatives of Ministry of Education, Culture, Sports, Science and Technology of Japan; and Industrial cluster initiatives of Ministry of Economy, Trade and Industry of Japan. They can contribute to agglomeration of human capitals and technology through activating the precursors of agglomeration. In addition, this study set up three control variables related to the number of technicians, manufacturing start-up rate and employment share of high tech industries, deriving them from the factors for exploiting agglomeration factors of the precursors. The independent variables were subject to the regression analysis of dependent variables of change of manufacturing employment from 2001 to 2006.

The models composed in this study explained approximately half of regional difference of change of manufacturing employment. The results of the cross sectional analysis hint that the policies to invite companies negatively influenced employment of small companies while the Industrial cluster initiatives contributed to retention of their employment. On the other hand, no effects is suggested with respect to the Knowledge cluster initiatives. Discussion of the results highlights effectiveness of the precursor of network of similar companies for agglomeration and significance of business creation for exploiting the precursor of organizations with world-class technology.

As policy suggestions based on the results, this study would make two recommendations; involving large companies in the networking promoted by the Industrial cluster initiatives and caring about the factors for exploiting agglomeration forces of the precursors in policy making. Neglect of the latter likely spoiled the knowledge cluster initiatives or even festered small manufacturing companies by the policies to invite companies with high subsidy. On the other hand, the former may lead to cluster formation or agglomeration because the large companies may be a precursor of cluster formation enduring big demand and/or world-class technology. Involvement of large companies and consideration of the factors for exploiting the precursors would be critical for attaining agglomeration of human capitals and technology plus consequent regional economic development.

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