System competency of SMEs in Japan from the viewpoint of Information Technology (IT) and Knowledge-Intensive Services (KIS)

YumiKo KINOSHITA
Graduate School of Interdisciplinary Informatics, The University of Tokyo

Abstract Japan Small Business Research Institute (JSBRI) schedules to perform two surveys in 2010 covering all Small and Medium-sized Enterprises (SMEs) in Japan. The first survey is on the capacity for adopting information technology (IT) to clarify current implementation, internal operation system, and market conditions regarding IT. The second survey is on human resources specifically designed to clarify SME’s role on the system competence and external sources for innovation. In line with these surveys, this paper discusses Bayesian methodology to analyze latent variables for verifying system competency from the viewpoint of Knowledge-intensive Services (KIS) in the context of service economy.

Keywords: Service economy, Small and Medium-sized Enterprises (SMEs), Bayesian econometrics, System competency, Knowledge-Intensive Services (KIS)

1. The role of Small and Medium-sized Enterprises (SMEs) in service economy
(1) Structural changes surrounding SMEs
In the context of service economy, the turnover per employee is higher for SMEs in service sectors than large firms, and statistically smaller firms are more dominant in number in service sectors1. SMEs are facing structural changes in their relationships with large firms (Figure 1) according to OECD 2, 3. Their role in the global market is said to be changing as services become more knowledge- and technology-intensive, in which not only large firms but also SMEs need to develop expertise on their own for providing high-quality knowledge services and/or technical services.

Service sectors traditionally rely on external sources for expertise knowledge, and SMEs are usually less capable of engaging in R&D than large enterprises2, 3, 5. In addition, only a small fraction of SMEs have reported turnover from trade6, and real globalization is yet to be achieved. It is not easy for SMEs to be competitive in developing expertise to compete in the global market. To cope with this situation, OECD2 proposes measures to promote innovation and growth of SMEs: strengthen competitiveness in global value chains, accumulate knowledge stock, provide better financing, upgrade technologies, protect intellectual property rights, facilitate compliance procedure, develop skills, attract Foreign Direct Investment (FDI), promote industrial clusters, and promote service networks in industries.

The optimal growth path for SMEs in the service sector should be clarified as they consist of a large part of the service sector. The ‘optimal’ growth of the service sector relates to the fact that the introduction of IT and expertise knowledge, by either internally, externally, or with public support, that aims to improve productivity and benefits from scale merit, does not always achieve the maximum output of the service sector. It is necessary to focus on maintaining geographical locality for some locally-traded services while it is important to invest into R&D in services to increase knowledge expertise and gain competitive edge in a global market.

(2) The role of Information Technology (IT) and knowledge
As for knowledge expertise and geographical networks, Krugman7, Ghironi and Melitz8, and Chaney9 argued that the issue of substitution is important to understand the effect of locality, elasticity of substitution of products, and expertise of knowledge. These aspects are normally correlated with the impacts of IT stock and worker’s skill compositions. It is assumed that one factor for the growth of the service sector is the intensity of technology as well as knowledge and their networks, which allow for endogenous development of knowledge, achieving a shift in productivity distributions.
among firms. To transform the service sector based on potential innovativeness of knowledge generated through service, it is suggested furthermore that increasing connection and adoption of service-related technologies in other research fields, such as IT, genomics, neurosciences, and environmental technologies, should be pursued\(^1\). This leads us to a new dimension of structuring the mechanism of service innovation.

(3) e-Services for the innovation in service

To provide businesses with expertise knowledge through IT infrastructure to achieve service innovation and the enhancement of the service sector, SMEs may face challenges in building cooperation and partnerships with private firms because of knowledge and technological intensity inherited in such services. Network-based services are offered to both small and large companies. In the recent few years, cloud computing is rapidly emerging. Cloud computing is considered to be beneficial for SMEs because of its low-cost, and maintenance free environment for small-scale businesses.

The core of the service is to create a market, which used to be segmented due to the geographical locality of services, by allowing for small firms to be connected into the bigger system through employment services for higher labor mobility, promotion of investment i.e. foreign direct investment for SMEs, and facilitation of administrative procedures required for doing business in domestic and foreign markets. These new trends can be effective for generating more innovation in service sector, whose impacts should be assessed more clearly.

With these various situations behind, the following sections will describe two nation-wide surveys for SMEs in Japan, which are going to be performed by Japan Small Business Research Institute (JSBRI) in 2010 for the investigation of system competency and human resources.

2. Nation-wide Surveys for SMEs

(1) Background of the surveys

The above-mentioned problems regarding SMEs can be analyzed by using official statistics and financial data. However, there are other types of data, which will be important in finding the system competence, the role of external expertise services that are purchased or obtained, and the level of IT system competency. These data are important to clarify the situations surrounding SMEs; however, they are not readily available in official statistics or industry statistics. In particular, data on SMEs are not sufficiently collected in general.

In line with these situations, Japan Small Business Research Institute (JSBRI)\(^2\) schedules to perform two large-scale surveys in 2010 covering all SMEs in Japan to investigate IT competency and innovation from human resource perspectives\(^3\). JSBRI is an organization, which performs regular statistical analyses and researches regarding SMEs, and works as a special think tank to support SMEs activities inside and outside Japan.

The first survey is on the capacity for adopting IT, which is to clarify the current implementation, human resources, internal operation system, and market conditions regarding IT infrastructure, and firm’s relationships with other firms, region, public institutions, specialized service providers and vendors. The second survey is about human resources for the innovation of SMEs. The latter survey is specifically designed to clarify the role of human resources on the system competence and the use of external sources for innovation in relation to regional (official and unofficial) networking and business conditions. Both surveys cover firms with less than ten employees. In total, these surveys consist of approximately 100 questions.

(2) Components of the surveys

In the first survey, the impact of IT infrastructure is analyzed from the perspectives of service innovation (i.e. the impact on expertise knowledge of associates, improvement of marketing methodology, increase in the amount of information available for customers, improvement of customizability of services according to the preferences of customers), the effectiveness of public IT infrastructure and IT services (i.e. provision of public business portal), and demand for networked IT services (i.e. coordinated systems within and across industries as well as public and private partnerships).

In the second survey, the role of human resources in service innovation is investigated from the viewpoint of regional market and business conditions (i.e. communication and exchange beyond industrial sectors, richness in human resources for legal, accounting, auditing, R&D services, effectiveness of environmental preservation initiatives, availability of higher education and life-long learning), public support (i.e. public services for expertise knowledge, availability of social welfare, childcare, and healthcare), and recruiting of highly skilled and knowledgeable mangers, engineers, and innovators (including efforts to build up intellectual property within firms and across regions).

(3) Diagram for analysis

This paper proposes to analyze each of these items according to the following path diagram (see Figure 2). Rectangles represent observed variables, and ovals are latent variables. Error terms are ovals with an ‘e’-label. Each single-headed arrow represents a regression weight and constraint is imposed on coefficient to be equal to one (1) for all error terms in order to make the model identified. Double-headed

---

\(^1\) See http://www.jsbri.or.jp/new-hp-e/

arrows are drawn for establishing covariance\textsuperscript{iii}. Where there are no double-headed arrows connecting any two variables, it is assumed that a correlation or covariance is zero (0). If the path diagram is too complicated with many variables, the diagram is decomposed into three parts (service enhancement and system integration, productivity, and technical knowledge differentiation).

Figure 2 Analysis of the mechanism for enhanced value-added service (Source: Modified based on Tassey\textsuperscript{10}.)

(4) Impact category
For each service sector group, this diagram can be applied to clarify the relationships of IT infrastructure, differentiation of technical knowledge and expertise, and productivity in particular. The relationships of these three latent variables can be analyzed by using Bayesian statistics. The results, particularly parameters regarding productivity, can be fed into panel data analysis on service economy to produce results in further detail.

Table 1 Impact Category

<table>
<thead>
<tr>
<th>Impact Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strategic planning</td>
</tr>
<tr>
<td>2. Entrepreneurial activity</td>
</tr>
<tr>
<td>3. Service enhancement and system integration</td>
</tr>
<tr>
<td>4. Market development</td>
</tr>
<tr>
<td>5. Enhanced value-added service</td>
</tr>
<tr>
<td>6. Risk reduction</td>
</tr>
<tr>
<td>7. Human resource development</td>
</tr>
<tr>
<td>8. Productivity improvement</td>
</tr>
<tr>
<td>9. Service (technical knowledge) differentiation</td>
</tr>
<tr>
<td>10. Market condition for doing business</td>
</tr>
<tr>
<td>11. Science base</td>
</tr>
<tr>
<td>12. Purchased technical services</td>
</tr>
<tr>
<td>13. Purchased technical services</td>
</tr>
<tr>
<td>14. Knowledge spillover</td>
</tr>
<tr>
<td>15. Infrastructure technologies</td>
</tr>
</tbody>
</table>

\textsuperscript{iii} The weight of each arrow is computed from the data obtained from surveys although market condition data i.e. World Bank Doing Business data for Japan is also used as supplement. Please refer to the World Bank for Japan’s country profile.

The description of each impact category in Figure 2 and Table 1 is presented as follows.

‘Strategic planning’ refers to political, economic, social, and technological analysis, which will influence firm’s decision making\textsuperscript{11}. Strategic planning also refers to ‘the first stage of the planning model, aligns information system (IS)’\textsuperscript{12} strategic planning with overall organizational planning by assessing organizational objectives and strategies, setting the IS mission, assessing the environment, and setting policies, objectives, and strategies for IS\textsuperscript{13}. The strategic direction works with market conditions to generate an entrepreneurial response within a firm\textsuperscript{13}.

As for ‘Entrepreneur’ and ‘Entrepreneurial activity,’ Schumpeter\textsuperscript{14} proposes that the entrepreneur is an innovator who introduces new technologies into the workplace or market, increasing efficiency, productivity or generating new products or services\textsuperscript{15}. Furthermore, the entrepreneur is also defined by the ability to move technology forward into innovation, and the entrepreneur is able to recognize the commercial potential of the invention and organize the capital, talent, and other resources that turn an invention into a commercially viable innovation\textsuperscript{13}.

‘Market conditions’ are defined based on Ayyagari, Beck, and Demirguc-Kunt\textsuperscript{16} and the World Bank\textsuperscript{17} to consider indicators on business environment i.e. entry costs\textsuperscript{v}, contract enforcement costs\textsuperscript{v}, exit costs, property costs\textsuperscript{vi}, credit information index\textsuperscript{vii}, rigidity of employment index\textsuperscript{viii}, legal origin\textsuperscript{ix}, culture\textsuperscript{x} and geography.

‘Market development’ is defined in Ansoff Matrix\textsuperscript{19} in Table 2. Market is developed when services are provided for new market, either geographically or different groups and types of customers. In relation to the ‘diversification of technological knowledge,’ firms strategically move into new markets with new services as a result of the diversification.

As for ‘Risk reduction,’ risks, if specifically related to

\textsuperscript{11} Ayyagari et al. define based on World Bank that ‘the legal costs of each procedure involved in formal registration of a company, relative to income per capita, that a start-up must bear before it becomes legally operational.’

\textsuperscript{12} Contract enforcement costs are defined as ‘official cost of going through court procedures.’

\textsuperscript{13} It is defined as ‘all legal court costs and other fees that are incurred when closing a limited liability company, expressed as a percentage of the total value of the estate.’

\textsuperscript{14} The index refers to ‘the rules affecting the scope, access and quality of credit information available through public or private bureaus.’

\textsuperscript{15} Employment index consist three components: difficulty of hiring, rigidity of hours, and difficulty of firing.

\textsuperscript{16} In the context of Japan, the entire Japan is in the same legal system. If there is any regional regulation imposed by local governments, it takes the value of 1, 2… correspondingly.

\textsuperscript{17} Culture index includes people’s mind and openness, cultural and natural environmental fitness to business, social environment, etc.
R&D, are defined by Tassy\textsuperscript{16}, which are caused by (1) technical complexity, (2) timing of investment with a combination of technical and market risks (time required and percentage of success), (3) economies of scale and scope, and (4) spillovers of technical knowledge. These are related to uncertainties.

As for ‘Service enhancement and system integration,’ system integration process is defined according to ISO 15504 as ‘to integrate the system elements (including software items, hardware items, manual operations, and other systems, as necessary) to produce a complete system that will satisfy the system design and the customers’ expectations expressed in the system requirements.’

‘Science base’ is related to firm’s appropriability, and is comprised of ‘purchased technologies,’ ‘purchased services’ and ‘networked services’ in this model. According to Audretsch et al.\textsuperscript{13}, science base is a concept of ‘the stock of knowledge generated from basic research, and resides in the public domain’ i.e. scientific journals, and university. ‘Purchased technologies’ are all purchased technologies other than KIS as intermediate, and ‘purchased services’ refer to KIS in the context of this analysis. ‘Networked services’ are obtained as un-purchased knowledge in the industry and regions, which relates to the role of external information or incoming spillovers. ‘Infrastructure technologies’ mainly refers to IT system in the firm and infrastructure in the region.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
& Existing products & New products \\
\hline
Existing markets & Market penetration & New product development \\
\hline
New markets & Market development & Diversification \\
\hline
\end{tabular}
\caption{Ansoff Matrix\textsuperscript{19}}
\end{table}

3. Summary
The research topic, service, is proliferated and a widely accepted one in today’s academia. This paper summarizes the recent trend surrounding SMEs in the global market. Then, this paper addresses one possible research methodology for clarifying system competency and the impacts of human resources on innovation from the viewpoint of SMEs in the service sector. This methodology must be further refined so that it will be able to yield useful outcome from the surveys for policy-making perspectives for SMEs.

Acknowledgement:
The author is fully appreciated for the support of Associate Professor Junichi Sakata, Tokyo Institute of Technology, and Visiting Researcher Katsuhiko Suzuki, Global Information and Telecommunication Institute, Waseda University, for the information on the surveys. With their support, the author has been given an opportunity to formulate the analysis methodology for the surveys. It is noted that the author is not involved in planning, designing, or execution of these surveys. This paper is submitted in the sole discretion of the author, and the author is responsible for any mistake in the analysis methodologies of possible outcome and results from these surveys, which are discussed in this paper.

Reference:
5) Woffl, A. (2005): The Service Economy in OECD Countries; OECD.

\textsuperscript{19} See http://www.actano.de/20911_EN-What%40s_new-Glossary.htm