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ABSTRACT

In this paper, we examine whether the NSM (the natural selection mechanism) works properly in Japanese information service industries.

Many start-up companies in information service industries enjoyed a bubble until 2000, when the bubble burst in IT and information service industries. Productive firms, as opposed to unproductive firms, are on the average driven out of the market in severe recessions, which was most noticeable in the burst of 2000. The breakdown of the NSM may indicate capital markets' inability to sort out good firms of high productivity that will eventually recover, from bad firms that should be driven out of the market anyway.

The breakdown is not found in custom software firms, which are the mainstream of information service firms. Instead, we see a breakdown of the NSM in prepackaged and business software and Internet data service firms. They are relatively new (though rapidly increasing) services in Japanese information services industries. This may imply that suppliers of capital did not have sufficient expertise to choose good firms from bad ones in the panic of the IT bubble burst of 2000.

Analysis of clusters in the information service industry shows that new firms with high productivity have been emerging in several areas in Japan, and an analysis of clusters shows how we can find the business networks in such clusters.

Key Words: information service industry, natural selection mechanism, productivity, entry effect, cluster, Total Factor Productivity

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1. Introduction

Information service industries including the software industry are an integral part of the so-called "IT (information technology) Revolution" alongside with the hardware industry, which has attracted much attention in recent discussions of economic growth. Both governments and business communities around the world consider information service industries as "strategic" industries. For example, the Japanese government launched an initiative called "e-Japan Strategy II" in 2003, and clearly targeted information service industries. Some firms in electronic industries are shifting their business emphasis from computer hardware to software and information services. Because of the prominent role of IT on recent economic development, in-depth analysis of software and other information service industries is urgently needed, especially from the perspective of promoting innovations and thus enhancing international competitiveness.

The necessity of Industry-dynamics analysis of software and information service industries is all the more apparent when we look at these industries from a productivity perspective. There is ample evidence that Japanese software and information service industries have problems preventing productivity enhancement (see Nishimura and Minetaki (2004) and references therein)). [1]

It has also been argued that a sharp difference in new business starts might also be an important cause of productivity differences in software and other information service industries between Japan and the United States. Proponents of this view, which might be the Japanese government's position, stress that a hallmark of US software and other information service industries is a very high rate of start-up companies. Through the NSM, high-productivity firms survive and low-productivity ones exit the market. Thus, as the argument goes, if entry is rather random, then there are a greater number of entrants, and if more high-productivity firms survive, then the industry's average productivity improvement is greater. At the same time, the less-competitiveness of software and other information service industries might arise from a malfunctioning of the NSM. Nishimura et al. (2005) investigated the natural selection mechanism in Japanese industries and suggested that there was a malfunctioning of the NSM in the banking-crisis period of 1996-1997. If there is a malfunctioning of the NSM, this causes a low-performance of Japanese information service industries.

Unfortunately however, there have been very few empirical studies investigating entry and exit in software and information service industries at the firm level, even in the United States where data

[1] In particular, Nishimura and Kurokawa (2004) have shown that seemingly productivity-enhancing outsourcing has actually negative effects on productivity in Japanese information service industries. They suggest that a particular industrial structure of these industries, namely, a remnant of the old competition-reducing main-supplier-subcontractor relationship, is a culprit of this dismal productivity performance. This is a stark contrast with US software and information service industries, in which outsourcing has been considered one of the major drivers of productivity improvement.

about IT industries are relatively available. [2] To the best of our knowledge, there is no empirical work done in Japan. This research fills this vacuum of empirical studies. Therefore, our main purposes are as follows: (1) To estimate total-factor productivity (TFP) in the information service sector using large-scale firm-level data, (2) To investigate entry and exit behavior to examine whether the information service industries are stagnant, and (3) To investigate whether the NSM works: Are surviving firms more productive than exiting firms?

The research reported here is based on large-scale Census-like survey data on all firms and establishments engaged in software and other information services, called the *Survey on Selected Service Industries*, *Volume of Information Services*. This is the most comprehensive data of information service industries in Japan. All firms at least partly engaging in software and information services are covered by this survey. This “census-like” characteristic is particularly important since we are concerned with entry and exit in these industries. Moreover, this survey is sufficiently detailed to enable us to examine not only country-level characteristics of entry and exit, but also their regional differences. This property is particularly important to assess regional policies regarding information and communication technology.

The results of this study show a rather lively picture of Japanese information service industries, and thus suggest that the “too low rates of business starts” argument is not convincing. Entries are numerous and exits are also not uncommon. Survival ratios are rather low, but the probability of survival increases significantly after several years. These characteristics are not unique in information service industries: they are qualitatively and quantitatively similar to those of other industries in Japan as shown in Nishimura et al. (2005).

There are, however, several striking results. Nishimura et al. (2005) have shown that efficient firms in terms of TFP went out of business while inefficient ones survived in the period from 1996-1997 of the banking crisis. That is, the Natural Selection Mechanism, which is supposedly inherent in a market economy, was apparently malfunctioning. This paper finds a similar breakdown of the Natural Selection Mechanism in information service industries in the period from 2000 to 2001, in which the so-called “IT bubble” burst.

This paper is organized as follows. The next section presents a brief survey of previous empirical entry/exit studies. Section 3 provides a brief explanation of the data we use. In section 4, we explore entry/exit behavior patterns of software and other information service firms nationwide and show basic TFP calculation results and analyze the relationship between a firm’s entry/exit and the aggregated levelTFP. The final section concludes the paper.

[2] A notable exception is Cusmano (2004, chapter 6) who examines ten start-up companies in software and information service industries.

2. Literature survey

The standard model of the NSM, since Javanovic (1982), depicts a firm's decision for entry, surviving, and exiting as a result of the maximization of the expected discounted future net cash flows. Empirical analysis based on firm models is necessary for investigating whether the NSM is working properly. However, the complexity of a rich theoretical model makes it difficult to accomplish a direct statistical test of structural equations. Thus, empirical studies try to examine the feasibility of a firm's model by testing the consistency between the model's implication and its reality with entry/exit behavior. Jovanovic and MacLonald (1994) demonstrate that firms' failure to capture innovative technology causes productivity slowdown and leads finally to a "shake-out". These studies show one of several choices, for a firm to decide entry and exit behavior. Klepper and Simons (2000) empirically confirm that the theoretical model, which explains why less productive firms are shaken out from the market, is consistent with firms' surviving/exit behavior in the U.S. tire industry.

If a panel dataset that depicts firms' entry, surviving, and exit behavior is available, we can calculate productivity measures and test whether they really conform to the theory. Haltiwanger (1997) found that a plant-level entry/exit pattern has significant effects on the overall TFP growth of U.S. manufacturing by using the Longitudinal Research Database. Hahn (2000) showed that a firm's turnover made a considerable contribution to industry-level TFP growth in the Korean manufacturing sector, based on establishment-level panel data. Aw et al. (2001) also showed that a firm's turnover contributes considerably to industry-level TFP growth using the Taiwanese Census of Manufacturers. Bellone et al. (2005) found that exiting firms, as a whole, display below-average performance levels, and are significantly smaller than their surviving counterparts using a French firms' dataset covering 14 manufacturing industries over the period from 1990-2002.

Although these studies give support to the function of the NSM, their data coverage is restricted to the manufacturing sector. Because of data constraints, there are few studies using datasets including the service sector. Nishimura et al. (2005), however, investigated the relationship between a firm's entry/exit behavior and TFP, based on a comprehensive firm-level panel dataset including manufacturing and service sectors for Japan from 1994 to 1998. They show that efficient firms in terms of TFP exited while inefficient ones survived in the banking-crisis period of 1996-1997 and suggest a malfunctioning of the NSM in severe recessions.

To the best of our knowledge, our paper is the first empirical analysis of this issue in the Japanese information service sector.

3. Data

3.1 Data source

The *Survey of Selected Service Industries, Volume of Information Service Industries*, has the most comprehensive statistics about Japanese information service industries. This survey, conducted by the Ministry of Economy, Trade, and Industry (METI), is a Census-like one, in which all firms and establishments engaged in information service industries are surveyed. Moreover, the coverage of the survey is far wider in its scope of information service industries than even the Establishment and Enterprise Census. The survey collects information about establishments and firms that have some business activities in information service, while the Census gathers information about establishments and firms whose major business activities are in information service. This is particularly important since information service industries are rapidly expanding ones with many entries from and exits to other industries.

The purpose of our study is to examine entry and exit behavior and investigate their effect on industry productivity. The *Survey of Selected Service Industries, Volume of Information Service Industries* is particularly suited for this purpose in several respects. First, the Survey meticulously distinguishes revenues, costs, labor inputs, and capital stocks in firms' information service activities from their other activities. This is important since some firms in our samples engage only partially in information service activities. In our empirical analysis, we use these revenues, costs, labor inputs, and capital stocks solely in their information service activities to construct value-added and other data necessary for TFP calculation. That is, our value-added, labor input, and capital stock data are solely of the firms' information service activities, and thus are not "contaminated" by other activities.

A notable characteristic of capital investment data in this data set is the many zeros and blanks found in the category of "acquisition of structure and buildings" and "acquisition of machines and equipment", on the one hand, and relatively large payments of computer-time lease and other rental payments that are supposedly equipment and building rents. This implies that in some cases a traditional perpetual inventory (PI) method may not be appropriate, especially in the case of capital service inputs of computers, where capitalization is more appropriate. Thus, in the following analysis, we use the PI method as much as possible, but when it is not appropriate, we resort to other procedures to get capital service inputs.

Finally, there is no intangible asset data in the Survey. In particular, there is no data of software assets that firms have. It is inconceivable that firms engaging information service activities have no software assets. Consequently, in the following empirical analysis, we should take this fact in mind.

3.2 “Active firms”

As in other surveys, it is not always possible to get sufficient information to compute TFP for all firms. For this reason, we restrict our attention to firms that are “actively involved” in software and information service activities. We set the following two criteria, and firms satisfying all these criteria are put in the following empirical analysis.

In the first step, if firms whose information service activities yield negative value-added and/or hire no worker in a particular year, we exclude these firms from our sample of the particular year. If these firms show positive value-added after that year, they are included in our sample thereafter. Actual occurrence of negative value-added is rather rare, accounting for less than 1% of our total firm-years. As shown in Table 1, this procedure results in, for example, 4,430 firms in the year of 1997.

In the second step, if firms do not have enough data points (a minimum of two years) to construct the average annual rate of investment, we excluded them from our sample. This procedure is needed to construct a benchmark-year capital stock to start from in the PI method.[3] Through this procedure, we get 3,551 “active firms” from 4,430 total firms in the first step. As shown in Table 1, our sample period is from1997-2002, and our sample is an unbalanced panel.[4]

To discern the characteristics of our set of “active firms”, we compare the whole samples and our truncated samples in the following tables.

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[3] In Kurokawa and Nishimura (2005), we have used more restrictive criterion in that, if firms do not have five consecutive years of information service- related equipment investment, we excluded them from our sample. This is necessary for accurate calculation of TFP: Kurokawa and Nishimura (2005) use the five-year average investment growth rate to estimate benchmark-year capital stocks. Here we use a looser criterion since we are concerned with mostly entry and exit and their effects on industry productivity level, rather than determinants of productivity growth.

[4] Alongside the survey itself, we use other industry information to correct errors and confusion in the survey in identifying enterprises and establishments. This meticulous procedure is extremely time-consuming, so that we are obliged to confine our analysis to the period between 1997 and 2002 due to time constraint.

Moreover, the Ministry changed the data collection method substantially from an essentially enterprise-based one to an establishment-based one in 2000, without proper adjustment to maintain quality of data. This causes a serious discontinuity in many data series found in the survey, especially in investment and capital lease. We make necessary adjustment by assuming per-worker capital stocks are the same between 1999 and 2000.

Table 1: Basic statistics of firms

	variables	All Firms					"Active Firms"				
		The number of firms	mean	S.D.	Min.	Max.	The number of firms	mean	S.D.	Min.	Max.
1997	value added	4430	83374.1	431313.7	41.5	23200000	3551	92380.4	281421.6	5.0	5799742
	the number of workers	4430	101.3	452.7	1.0	23668	3551	118.1	500.3	1.0	23668
	sales of information searvice	4430	149944.9	654264.6	60.0	25600000	3551	171838.4	587880.6	80.0	13400000
	labor compensation	4430	48001.5	155726.8	1.0	3922312	3551	56170.9	169067.7	1.0	3922312
1998	value added	5880	83172.8	478643.1	2.4	29600000	4553	94316.8	317652.6	5.0	6887120
	the number of workers	5880	91.7	281.5	1.0	6861	4553	107.8	310.6	1.0	6861
	sales of information searvice	5880	156100.8	842027.3	10.0	32100000	4553	184114.7	826055.0	80.0	30400000
	labor compensation	5880	46612.3	164254.5	5.0	4265426	4553	55810.0	182399.7	1.0	4265426
1999	value added	5744	89356.8	600223.0	1.0	33600000	4319	102780.0	461777.0	34.8	17900000
	the number of workers	5744	97.5	326.2	1.0	10682	4319	116.5	361.0	1.0	10682
	sales of information searvice	5744	181584.2	1357610.0	1.0	74100000	4319	215411.1	1444320.0	80.0	74100000
	labor compensation	5742	39714.0	140199.7	1.0	4943100	4319	46475.9	147431.9	1.0	4943100
2000	value added	6048	74791.2	368059.6	6.0	16700000	4369	92764.1	410941.2	10.0	16700000
	the number of workers	6048	103.3	386.5	1.0	15733	4369	126.1	433.8	1.0	15733
	sales of information searvice	6048	175989.9	1352099.0	46.0	71600000	4369	215009.1	1470189.0	250.0	71600000
	labor compensation	6045	48649.9	229275.2	1.0	11300000	4369	60296.9	257763.2	60.0	11300000
2001	value added	6339	84399.6	468071.1	3.0	22600000	4513	106946.1	536712.2	23.0	22600000
	the number of workers	6339	104.4	414.9	1.0	16698	4513	125.4	446.4	1.0	16698
	sales of information searvice	6339	215447.4	2052291.0	3.0	10300000	4513	266641.8	2286691.0	45.0	10300000
	labor compensation	6335	50047.0	235864.1	5.0	8775808	4513	63391.0	272152.0	63.0	8775808
2002	value added	6077	89442.7	435544.6	3.0	14500000	4360	110851.2	440185.7	58.0	14500000
	the number of workers	6077	108.8	393.9	1.0	11250	4360	131.5	412.5	1.0	9650
	sales of information searvice	6077	213942.7	1563759.0	3.0	76800000	4360	253191.1	1253698.0	6.0	40800000
	labor compensation	6073	53416.6	228656.4	3.0	7868448	4360	65761.7	224476.8	1.0	6677023

Source: *Survey of Selected Service Industries, Volume of Information Service Industries.*

Notes: Firms having negative value-added and/or zero worker are excluded.
Firms for which succicient information is available to estimate their TFP are called "Active firms".

Table 1 reports summary statistics of the whole sample after excluding firms with negative information service value-added and/or no information-service workers and those of our samples, “active firms”. In table 1, we find quite a similar picture between the total samples (excluding abnormal ones) and our “active firms” samples, except for the firm scale. Thus our target is slanted to larger firms. To interpret our results, these characteristics of our target of investigation should be kept in mind.

Next, Table 2 shows the evolution of the industry with respect to the number of firms. Here, we show breakdowns of a firm into several categories. First, Non-specialized firms are those in which none of their individual product-line sales is more than 50% of their total sales. Specialized firms are those in which their product-line sales exceeds 50% of their total sales. Categories of “Business Software”, “Game Software”, “OS” and “Internet Data Service” appear only after 2000.

We find that specialized firms make about 70-80% of all “active firms” and that software firms consisting of custom software and prepackaged software account for 65-75% of specialized firms.

Table 2: The number of firms

	1997	1998	1999	2000	2001	2002
All Firms	3551	4553	4319	4369	4513	4360
Non-specialized Firms	754	945	947	1255	1319	1288
Specialized Firms	2797	3608	3372	3114	3194	3072
Custom Software	1632	2071	1943	2191	2235	2151
Prepackaged Software	199	292	266	263	291	287
Business Software				199	197	192
Game Software				38	61	60
OS				18	26	26
System Administration and Management	65	117	113	130	148	159
Internet Data Service				11	17	21
Research	81	106	101	199	194	188
Others	820	1022	949	320	309	266
Software Firms	81	106	101	199	194	188
Non-software Firms	820	1022	949	320	309	266

The survey includes firms that are only partly involved in information service industries. They are the non-specialized firms in Table 2. These firms' performance duly affects profitability and productivity of information service businesses, and thus the analysis of profitability and productivity should take account of them. However, the entry and exit decisions of these firms are not likely to be much affected by their partial information service activities. Consequently, we should focus our attention on specialized firms when we consider the effects of entry and exit.

4. Entry, exit and productivity

4.1 Entry/exit behavior of Japanese information service industries

Here, we capture the entry/exit behavior of Japanese information service industries. Before we actually learn the results of entry/exit, it should be noted that the entry/exit behavior observed in our sample illustrates the dynamics of "active firms". In popular terminology, "exit" means a complete closure of business. However, according to this definition, "dormant" firms with no significant business that are still not closed are classified as continuing firms. In the economic analysis of productivity, we are concerned not with dormant firms, but with "active" firms. As depicted earlier, firms in our sample are "active firms", so that this problem may not occur.

Table 3 depicts how firms originated in a certain year have survived since then. While the "unconditional" rate is a ratio of the number of surviving firms to the number of firms in their entry year, "conditional" represents a comparison with the previous year.

Table 3: Entry and exit patterns in the **TFP estimated firms**

	Cohorts					
	Entry befor 1997	in 1998	in 1999	in 2000	in 2001	in 2002
Number of firms						
1997	3551					
1998	3361	1380				
1999	3203	1254	473			
2000	2806	1095	275	798		
2001	2600	998	187	584	490	
2002	2337	862	129	450	260	322
Number of exit firms						
1997						
1998	190					
1999	158	126				
2000	397	159	198			
2001	206	97	88	214		
2002	263	136	58	134	230	
Entry and Exit rate (%)						
	Entry	38.9	10.0	16.2	9.9	6.6
	Exit	5.4	6.0	15.3	12.2	16.9
Unconditional survival rate (%)						
1997	100.0					
1998	94.6	100.0				
1999	90.2	90.9	100.0			
2000	79.0	79.3	58.1	100.0		
2001	73.2	72.3	39.5	73.2	100.0	
2002	65.8	62.5	27.3	56.4	53.1	100.0
Conditional survival rate (%)						
1997	100.0					
1998	94.6	100.0				
1999	95.3	90.9	100.0			
2000	87.6	87.3	58.1	100.0		
2001	92.7	91.1	68.0	73.2	100.0	
2002	89.9	86.4	69.0	77.1	53.1	100.0

Notes:

1) An unconditional survival rate is for the ratio of the number of surviving firms to that in the original entry year.

2) A conditional survival rate is for the ratio of the number of surviving firms to that in the previous year.

3) Values in 1997 show the number of firms born exactly in 1997 and before then.

In this table, we find high rates of entry/exit. The entry/exit rate in this table is similar quantitatively and qualitatively to those of manufacturing and non-manufacturing industries in

Nishimura et al. (2005).. Although these are different industries, we compare the entry/exit rates with those of other countries' studies. The entry rates of 6.6-38.9% in Table 3 are much higher than in the Canadian case (2-7%), and close to the French case (7-12%), but less than in the U.S. case (30-50%). [5] The same relationship holds for the exit rates of the four countries so that firms' turnover rate in Japanese information service industries is very active compared with other Japanese industries and with manufacturing in other countries.

Furthermore, from the Table we observe (1) the unconditional survival rate is about 90% in the first year after entry in 1998, and 80% in the second year, (2) after 1999, 20%- plus to 40%- plus firms exit in the first year, (3) the probability of survival increases significantly after several years. Survival rates are primarily the same for the manufacturing sectors in Canada, the U.S., and all industries in Japan.[6] These results clearly imply that the picture depicting Japanese information service industries as stagnant is wrong. A large number of businesses, or more precisely, 'activity starts' are observed and a large number of business failures are also common. Also the survival ratio of new businesses is quite low, but it improves as firms survive longer. Business starts, however, decline sharply afterward. This decline may be influenced by the burst of the IT bubble, which affected Japanese information service industries strongly.

4.2 The Natural Selection Mechanism

Although we checked the similarities and differences in entry/exit patterns, those alone are not enough to evaluate the NSM in Japanese information service industries. Let us now consider the total factor productivity of firms. Thus, we examine whether firms with relatively a higher performance survive and whether those with a lower performance exit.

The macro- (industry) level TFP is calculated from the firm-level TFP as follows:

$$\ln TFP = \sum_i v_t^i \ln TFP_t^i \ , \qquad (1)$$

where v_t^i is a value-added share for firm i at time t. According to Olley and Pakes (1996), Eq. (1) can be rewritten as

[5] Dunne et al. (1988) covers all plants and their subsidiary firms except the smallest firms in the U.S. manufacturing industry from 1963 to1982. Baldwin and Gorecki (1991) also constructed a dataset on manufacturing plants and firms in Canada for 1970 to1982.

[6] The 5-year survival rate of the entry cohort is 40-60% for the U.S., 40% for Canada, and 53% for Japan.

$$\ln TFP = \ln \overline{TFP} + \sum_i \Delta v_t^i \Delta \ln TFP_t^i \ ,$$

$$\Delta v_t^i = v_t^i - \bar{v}_t \, , \quad \Delta \ln TFP_t^i = \ln TFP_t^i - \ln \overline{TFP}_t \, , \tag{2}$$

where $\bar{v}_t$ is an arithmetic mean of a firm's value-added share at time t. The first term is the non-weighted mean of firms' TFP and the second term is the covariance of firms' TFP and value-added share. The value of the second term will be positive (negative) if there is a positive (negative) correlation between a firm size and TFP.

Table 4 shows the results based on Eq. (2). The value of the covariance term is positive for all industries throughout the observation period, which implies that the firm-level economies- of- scale are observed in Japanese information service industries.

Table 4: TFP and its decomposition

	Industry level lnTFP	Non-weighted mean lnTFP	Covariance		Industry level lnTFP	Non-weighted mean lnTFP	Covariance
All Firms				Prepackaged Software			
1997	0.171	-0.098	0.269	1997	0.977	0.131	0.846
1998	0.172	-0.128	0.300	1998	0.612	0.102	0.510
1999	0.010	-0.198	0.208	1999	0.450	-0.022	0.472
2000	0.031	-0.239	0.270	2000	0.380	-0.040	0.420
2001	0.173	-0.226	0.399	2001	0.908	-0.151	1.059
2002	0.162	-0.232	0.393	2002	0.612	-0.029	0.641
Non-specialized Firms				Business Software			
1997	0.067	-0.082	0.149	1997			
1998	0.180	-0.122	0.303	1998			
1999	-0.051	-0.225	0.174	1999			
2000	-0.104	-0.341	0.238	2000	0.309	-0.013	0.322
2001	0.101	-0.348	0.448	2001	0.714	0.023	0.691
2002	0.101	-0.335	0.436	2002	0.592	0.020	0.572
Specialized Firms				Game Software			
1997	0.270	-0.103	0.373	1997			
1998	0.164	-0.129	0.293	1998			
1999	0.073	-0.191	0.264	1999			
2000	0.091	-0.198	0.289	2000	0.406	-0.119	0.526
2001	0.219	-0.176	0.396	2001	0.887	-0.221	1.108
2002	0.199	-0.188	0.387	2002	0.440	-0.118	0.558
Custom Software				OS			
1997	0.306	-0.036	0.342	1997			
1998	0.172	-0.066	0.238	1998			
1999	0.107	-0.115	0.221	1999			
2000	0.114	-0.154	0.268	2000	0.185	-0.188	0.373
2001	0.196	-0.123	0.319	2001	1.191	0.228	0.963
2002	0.196	-0.142	0.338	2002	0.828	-0.075	0.902
System Management and Administration				Others			
1997	-0.144	-0.282	0.138	1997	-0.057	-0.292	0.235
1998	-0.159	-0.229	0.070	1998	0.029	-0.327	0.356
1999	-0.115	-0.314	0.199	1999	-0.152	-0.399	0.248
2000	-0.358	-0.542	0.184	2000	-0.108	-0.479	0.372
2001	-0.345	-0.556	0.211	2001	-0.129	-0.500	0.372
2002	0.064	-0.450	0.513	2002	-0.283	-0.524	0.241
Internet Data Service				**Software Firms**			
1997				1997	0.413	-0.017	0.431
1998				1998	0.279	-0.044	0.323
1999				1999	0.215	-0.103	0.318
2000	-0.719	-1.086	0.367	2000	0.133	-0.144	0.277
2001	0.042	-0.887	0.929	2001	0.300	-0.117	0.416
2002	-0.272	-0.604	0.331	2002	0.266	-0.133	0.399
Research				**Non-software Firms**			
1997	0.291	0.036	0.255	1997	0.005	-0.195	0.200
1998	0.443	0.011	0.432	1998	0.110	-0.230	0.340
1999	0.165	-0.012	0.176	1999	-0.138	-0.309	0.170
2000	0.253	-0.157	0.410	2000	-0.153	-0.380	0.228
2001	0.170	-0.158	0.328	2001	-0.011	-0.390	0.379
2002	0.045	-0.221	0.266	2002	0.018	-0.378	0.396

Notes: Business Software, Game Software, OS and Internet Data Service emerge in *Survey of Selected Service Industries, Volume of Information Service Industries* since 2000. The firms are categorized by the sales share, which is more than 50% of sales.

Next, we examine whether the NSM has worked in the Japanese information service industries. If there exists an efficiency of a competitive market economy based on the NSM, firms with high productivity would survive while those with low productivity would exit.

Table 5 shows a simple comparison of TFP levels between surviving and exiting firms. The results are striking. When we look at the results for all firms, TFP levels of exiting firms are higher than those of surviving firms in the period from 1998-1999. When we pay attention to the results for specialized firms, exiting firms' TFP levels are higher than those of surviving firms in the period from 2000-2001. This exiting of relatively productive firms suggests a breakdown of the NSM.

Table 5: TFP of surviving & exiting firms

	1997-1998		1998-1999		1999-2000		2000-2001		2001-2002	
	Survive	Exit	Survive	Exit	Survive	Exit	Survive	Exit	Survive	Exit
All Firms	1.189	1.110	1.180	1.474	1.013	0.984	1.030	1.044	1.222	0.947
Non-specialized Firms	1.073	0.943	1.182	2.313	0.954	0.919	0.912	0.799	1.141	0.741
Specialized Firms	1.312	1.259	1.178	1.176	1.078	1.054	1.089	1.156	1.281	1.032
Software Firms	1.515	1.443	1.317	1.444	1.247	1.172	1.146	1.103	1.395	1.063

There is a difference between the two periods. In the 1998-1999 period, non-specialized firms show such a break down. As explained before, entry and exit of these non-specialized firms may not be related to the productivity of their information service activities, since the latter are not their main business activities. Thus, we should not put too much emphasis on the breakdown of the 1998-1999 period.

In contrast, however, the breakdown of the 2000-2001 period is a serious one, and is found in specialized firms. It should be noted here that more than 50% of specialized firms' sales are from information services. Thus, this clearly shows a breakdown of the natural selection mechanism in information service industries in this period.

It should be noted that the 2000-2001 period is the collapse of so-called IT bubble in the stock markets in Japan and the U.S.

Many start-up companies in information service industries enjoyed a bubble until 2000, but turned sour in subsequent years. As Nishimura et al. (2005) suggests, these results suggest that there exists a malfunctioning of the NSM in severe recessions. Productive firms, rather than unproductive firms, are on the average driven out of the market in severe recessions. And this dropping out is most noticeable in the burst of the IT bubble of 2000 in software and other information service industries. The breakdown of the NSM may indicate capital markets' inability to sort out good firms of high productivity that will eventually recover, from bad firms that should be driven out of market anyway. In other words, market malfunctioning may be interpreted in connection with serious non-performing loan problems within the Japanese banking system.

In fact, more information is found in Table 6. The breakdown is not found in custom software firms, which are the mainstream of information service firms. Instead, we see a breakdown of the NSM in prepackaged and business software and Internet data service firms. They are relatively new (though rapidly increasing) services in Japanese information services industries. This may imply that suppliers of capital do not have sufficient expertise to choose good firms from bad ones in a panic situation such as in the IT bubble burst of 2000.

Table 6: TFP of surviving & exiting firms for detailed Specialized Firms

	1997-1998		1998-1999		1999-2000		2000-2001		2001-2002	
	Survive	Exit	Survive	Exit	Survive	Exit	Survive	Exit	Survive	Exit
Specialized Firms	1.312	1.259	1.178	1.176	1.078	1.054	1.089	1.156	1.281	1.032
Custom Software	1.358	1.384	1.182	1.311	1.114	1.101	1.121	1.116	1.248	1.050
Prepackaged Software ***	2.734	1.252	1.825	2.216	1.579	1.513	1.406	2.201	2.555	1.479
Business Software							1.367	2.672	2.315	1.290
Game Software							1.508	1.416	2.473	1.337
OS							1.484	0.819	3.510	1.931
System Management and	0.866	0.625	0.852	0.879	0.917	0.758	0.700	0.693	0.720	0.607
Internet Data Service							0.458	0.893	1.068	0.600
Research	1.339	1.310	1.591	0.812	1.239	0.917	1.284	1.300	1.191	1.124
Others	1.051	0.670	1.077	1.130	0.953	0.814	0.888	1.326	0.921	0.846

5. Analysis of Information service cluster in Japan

In this section, we focus on several areas where information service companies seem to accumulate, collaborate, and where spin-off trees exist. We define such areas as information service industry cluster.

Sapporo valley is most famous cluster from the 1960's. In the early stage, some software companies collaborated with Professor Aoki's laboratory of Hokkaido University. There is spin-off tree in Sapporo valley. Hudson and BUG started up in 1970's. Computer-land Hokkaido and DATTJAPAN started up in 1980's. Famous companies such as Soft Front and OPENLOOP, emerged in the Sapporo valley. The reason why Sapporo valley is a cluster is that there are core companies in the network, and lots of spin offs. After the Net bubble collapsed in 2000-2002, Sapporo valley has not shown a very good performance. We point out several problems where the long stagnating Hokkaido economy has been wrongly influenced, where competitors located in other areas emerged, and where the competitiveness of Sapporo valley's venture companies has been weakened.

Shibuya Bit valley is famous as an Internet cluster. Unfortunately, the dataset we use cannot cover the entire Internet industry, but we try to analyze Shibuya in Tokyo. In addition to Internet companies, many software companies also accumulated in Shibuya. The characteristics of companies within this area is the tendency of independence from large and existing ICT companies, and little dependence on the public sector on the demand side.

In this chapter, we decompose TFP growth by using equation(3) as follows:

$$\Delta TFP_t = \sum_{i\in s}\theta_{it-\tau}\Delta\ln TFP_{it} + \sum_{i\in s}\Delta\theta_{it}(\ln TFP_{it-\tau} - \overline{\ln TFP_{t-\tau}}) + \sum_{i\in s}\Delta\theta_{it}\Delta\ln TFP_{it}$$
$$+\sum_{i\in N}\Delta\theta_{it}(\ln TFP_{it} - \overline{\ln TFP_{t-\tau}}) + \sum_{i\in X}\theta_{it-\tau}(\overline{\ln TFP_{t-\tau}} - \ln TFP_{it-\tau}) \qquad (3)$$

θ : Share of value added of each firm to total

$t-\tau$: Starting year of observation

t : Ending year of observation

s : Existing group of firms

N : Entry group of firms

X : Exit group of firms

The first term on the right- hand of equation(3) is within effect, the second is between effect, the third is the covariance effect, the forth is the entry effect, and the fifth is the exit effect.

Table7 shows the decomposition of TFP growth at the prefectural level in Japan, and additionally shows the decomposition of TFP growth at Shibuya in Tokyo. The particularity of Shibuya is that almost all parts of TFP growth (except for the exit effect) are positive and push up TFP growth totally. Within effect, between effect, and covariance effect represent the effect of existing firms. Entry effect represents the effect of new emerging firms. In Shibuya, both existing firms and new emerging firms have positive effect on TFP growth. According to table 8, the share of sales within the same industry is comparatively high, and this share suggests information service firms including Internet service collaborate together.

Table7 also shows that the entry effect in Kyoto is very high. In other words, new firms have been emerging and have pulled up TFP growth in Kyoto.

Table8 shows the characteristics of each area where information service firms accumulate.

Table7 Decomposition of TFP Growth in Prefecture from 2000 to 2002

	within effect	share effect	covariance effect	entry effect	exit effect	TFP growth rate
Hokkaido	-0.136	-0.019	-0.022	0.002	-0.028	-0.203
Aomori	-0.239	-0.062	0.003	-0.001	0.002	-0.296
Iwate	0.186	-0.039	-0.015	0.098	-0.003	0.226
Miyagi	-0.022	-0.059	0.001	0.059	-0.062	-0.083
Akita	0.205	-0.025	-0.028	0.216	-0.030	0.338
Yamagata	0.050	-0.093	-0.008	0.132	-0.007	0.074
Fukushima	0.144	-0.020	-0.006	0.001	0.000	0.120
Ibaragi	-0.090	-0.056	0.002	-0.008	-0.006	-0.158
Tochigi	0.305	-0.446	0.073	0.003	0.001	-0.064
Gunma	0.136	-0.036	-0.006	0.017	-0.012	0.098
Saitama	0.065	0.055	0.012	0.022	-0.064	0.091
Chiba	-0.082	-0.024	-0.027	0.005	-0.143	-0.271
Tokyo	0.067	-0.047	-0.004	0.026	-0.010	0.033
Tokyo (Shibuya)	0.129	0.032	0.013	0.019	-0.017	0.175
Kanagawa	0.206	-0.108	-0.012	0.056	-0.025	0.117
Nigata	0.073	-0.049	0.000	0.004	-0.010	0.018
Toyama	0.265	0.016	-0.063	-0.015	0.000	0.202
Ishikawa	0.129	-0.110	-0.033	0.116	-0.008	0.094
Fukui	0.083	-0.164	-0.027	0.034	-0.004	-0.079
Yamanashi	0.167	-0.194	-0.081	0.126	-0.013	0.004
Nagano	-0.024	-0.027	-0.002	0.027	-0.067	-0.093
Gifu	0.117	-0.031	-0.030	0.063	-0.018	0.100
Shizuoka	0.142	-0.056	-0.005	0.163	-0.044	0.201
Aichi	0.114	-0.056	-0.006	0.055	-0.025	0.082
Mie	0.067	-0.035	-0.019	-0.005	0.019	0.028
Shiga	-0.020	-0.358	0.004	0.010	0.000	-0.364
Kyoto	0.460	-0.160	-0.275	0.452	-0.013	0.463
Osaka	0.016	-0.124	-0.001	0.021	-0.019	-0.108
Hyogo	-0.037	-0.078	-0.002	0.080	-0.037	-0.074
Wakayawa	-0.140	-0.133	0.025	-0.006	-0.058	-0.311
Tottori	0.131	-0.012	-0.001	-0.002	0.000	0.116
Simane	-0.125	-0.048	0.006	0.005	0.016	-0.145
Okayama	0.016	-0.007	0.000	0.010	-0.012	0.007
Hirosima	0.026	-0.050	0.002	0.020	-0.035	-0.038
Yamaguchi	0.125	-0.078	-0.024	0.084	-0.001	0.105
Tokushima	0.563	-0.463	0.001	0.019	-0.010	0.110
Kagawa	0.094	-0.021	-0.004	0.032	0.108	0.209
Ehime	-0.047	-0.053	-0.014	0.012	-0.012	-0.114
Kochi	-0.010	-0.028	-0.001	0.006	-0.038	-0.071
Fukuoka	0.049	-0.099	-0.005	0.019	-0.008	-0.044
Saga	-0.091	-0.079	0.007	0.054	-0.005	-0.114
Nagasaki	-0.082	-0.067	0.027	0.019	-0.010	-0.113
Kumamoto	0.491	0.154	-0.192	0.113	-0.006	0.559
Ohita	0.086	-0.062	-0.002	0.068	-0.048	0.042
Miyazaki	0.091	0.015	-0.006	0.003	-0.002	0.101
Kagoshima	0.148	-0.048	-0.026	0.335	-0.142	0.267
Okinawa	-0.083	-0.198	0.008	0.042	0.008	-0.223

Table8　Characteristics of each area

	custom software	package software	to pubic sector	within industry
Hokkaido	45.8%	9.5%	12.8%	25.3%
Tokyo Shibuya	45.2%	9.8%	3.5%	29.8%
Gifu	39.9%	10.9%	14.0%	15.8%
Shizuoka	55.0%	7.4%	5.4%	21.7%
Kyoto	44.8%	11.9%	11.8%	21.2%
Fukuoka	53.7%	8.4%	9.7%	31.1%

Charts 1-4 show the business networks in some areas where clusters of the information service industry are located. Chart 1 shows the business network in Hokkaido, with two types of centrality: 1) firms belonging to major ICT vendors, and 2) firms belonging to Sapporo valley that we mentioned previously. Chart 2 shows the business network in Gifu, and in Softpia Japan, a core base for IT-related enterprises.

Chart 3 shows the business network in Shizuoka, which, from the user side, is a centrality for famous companies. Chart 4 shows the business network in Fukuoka.

Chart 1　Network in Hokkaido

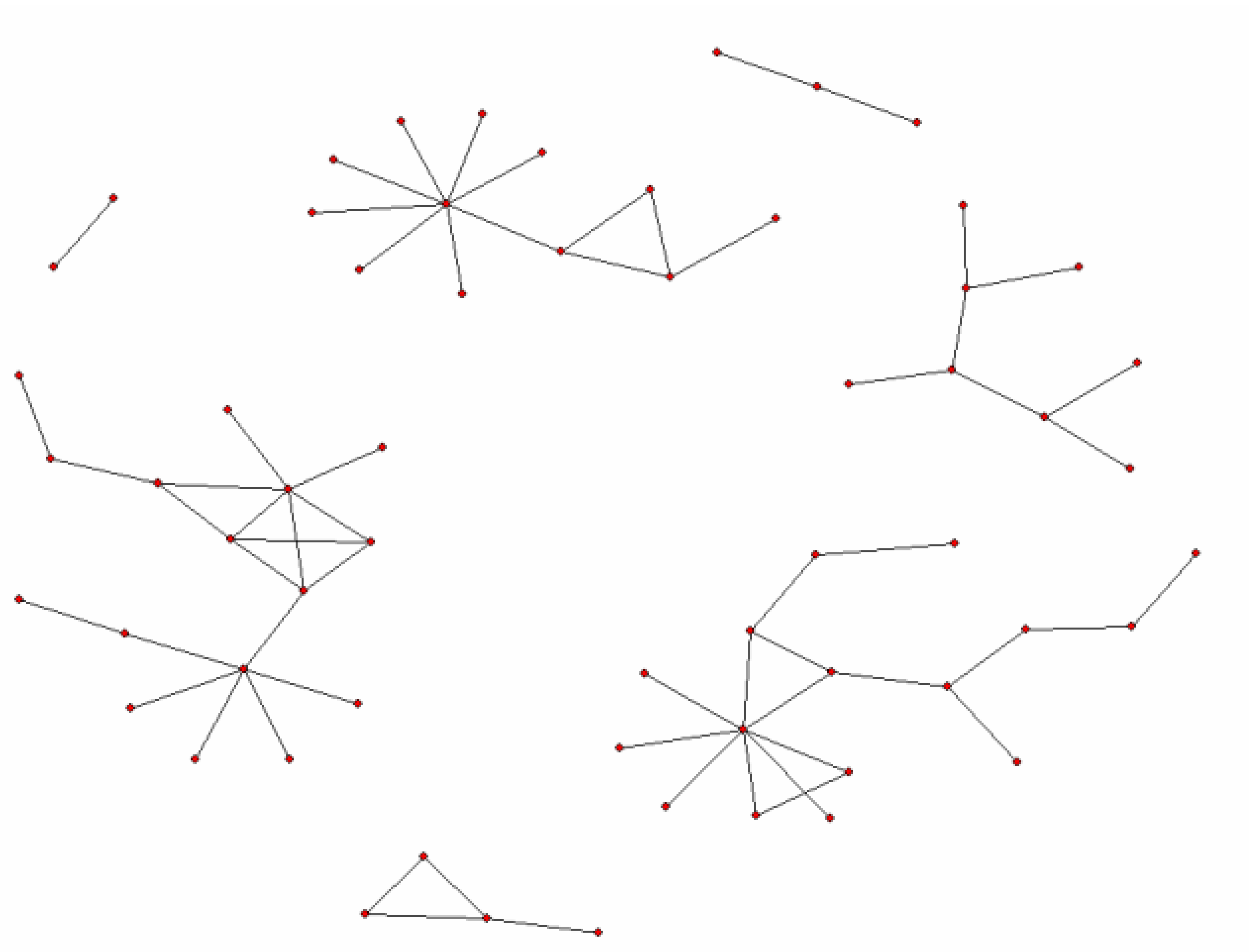


Chart 2　Network in Gifu

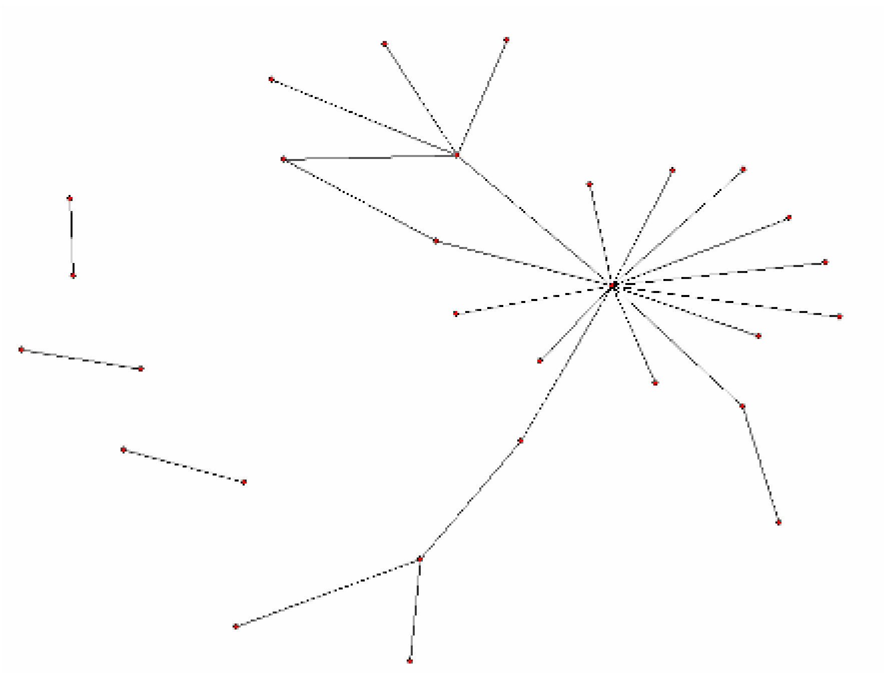


Chart 3　Network in Shizuoka

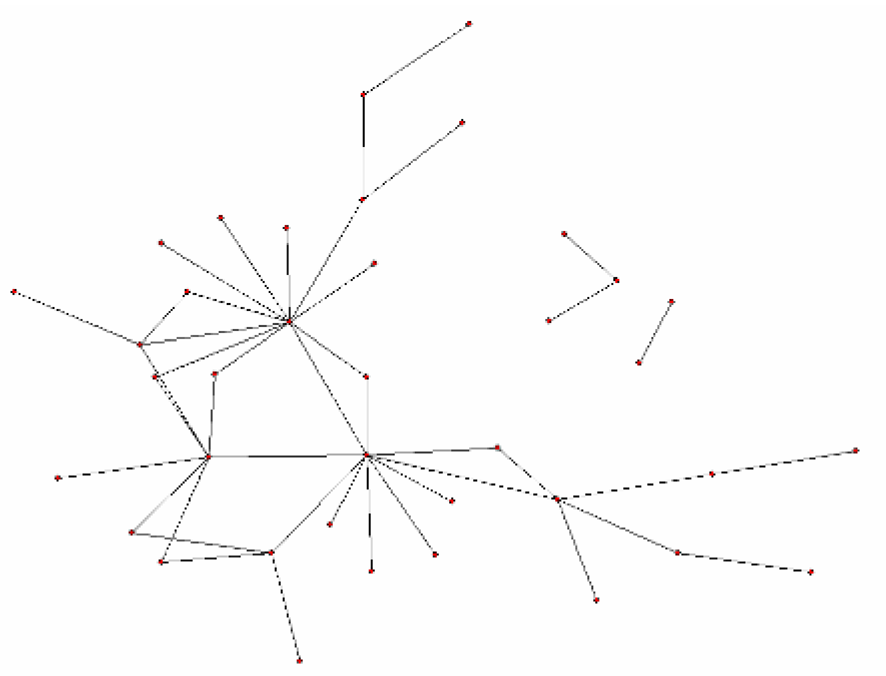
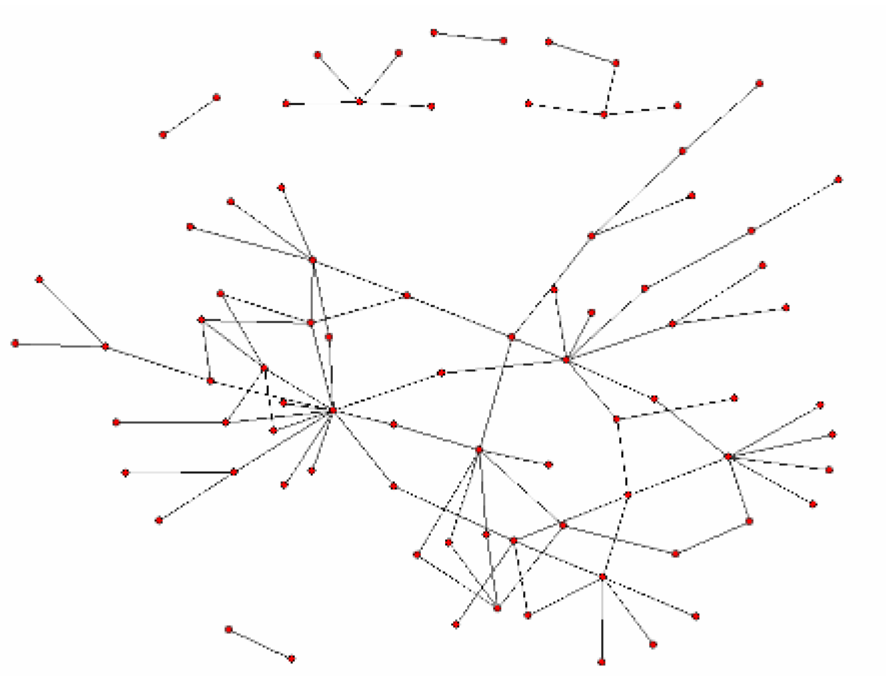


Chart 4　Network in Fukuoka



6. Conclusion

Using large-scale census-like data, we have examined the industry-dynamics of Japanese information service industries. Recent development of firm models provides theoretical background to the NSM in terms of productivity growth, showing that firms' rational decisions on entry, surviving, and exit lead to macroeconomic TFP growth. We have attempted to examine whether NSM works properly in Japanese information service industries. We have found very active industries: a large number of business starts are observed, and at the same time a large number of business failures are also common. The survival ratio of new businesses is quite low, but it improves as firms survive longer. These characteristics are also found in other industries in Japan and in other countries. Thus, all in all, Japanese industries are not stagnant, as some researchers tend to picture them, but are rather a quite competitive environment of struggle for survival.

However, in contrast with previous studies, the results of this study and Nishimura et al. (2005) suggest that there exist serious problems in the working of the market mechanism, especially in periods of severe recession. We have found that productive firms, rather than unproductive firms, are on the average driven out of the market in severe recessions. This anomaly appears in the spell of banking crises of 1997 in manufacturing and non-manufacturing industries, and in the burst of the IT bubble of 2000 in software and other information service industries. This clearly implies problems of the markets' selection mechanism, in particular, in banking and stock market systems that should play a crucial role in any such selection mechanisms

Analysis of clusters in the information service industry shows that new firms with high productivity have been emerging in several areas in Japan. This analysis also shows that we can find the business networks in such clusters.

References

[1]Aw, B., Chen, X. and Roberts, M. (2001) “Firm-level evidence on productivity differentials and turnover in Taiwanese manufacturing,” *Journal of Development Economics*, 66, pp. 51-86.

[2]Baldwin, J., Gorecki, P. (1991) “Firm entry and exit in the Canadian manufacturing sector 1970-1982,” *The Canadian Journal of Economics*, 24, p. 300-323.

[3]Bellone, F., Musso, P., Nesta, L. and Quere, M. (2005) “Productivity and market selection of French manufacturing firms in the nineties,” mimeo, International Workshop on Competition, Innovation and Productivity: Empirical Evidence from Firm-level Data, December.

[4]Cusumano, M. (2004) The Business of Software: What Every Manager, Programmer, and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad, Free Press, NewYork.

[5]Dunne, T., Roberts, M., Samuelson, L. (1988) “Patterns of firm entry and exit in U.S. manufacturing industries,” *The RAND Journal of Economics*, 19, pp. 495-515.

[6]Hahn, C. H. (2000) “Entry, exit and aggregate productivity growth: micro evidence on Korean manufacturing,” *Technical Report 45, OECD Economics Department*, December.

[7]Haltiwanger, J. (1997) “Measuring and analyzing aggregate fluctuations: the importance of building from microeconomic evidence,” *Review of the Federal Reserve Bank of St. Louis*, 79, pp. 55-77.

[8]Jovanovic, B. and MacDonald, G. (1994) “The life cycle of a competitive industry,” *Journal of Political Economy*, 102, pp. 322-347.

[9]Klepper, S. and Simons, K. (2000) “The making of an oligopoly: firm survival and technological change in the evolution of the U.S. tire industry,” *The Journal of Political Economy*, 108, pp. 728-760.

[10]Nishimura, K. and Kurokawa, F. (2004) “Total factor productivity in Japanese information service industries: firm-level analysis,” MMRC-F-11, *MMRC Discussion paper series*.

[11]Nishimura, K., Nakajima, T. and Keota, K. (2005) “Does the natural selection mechanism still work in severe recessions? Examination of the Japanese economy in the 1990s,” *Journal of Economic Behavior & Organization*, 58, pp. 53-78.

[12]Olley, G., Pakes, A. (1996) “The dynamics of productivity in the telecommunications equipment industry,” *Econometrica* , 64, pp. 1263-1297.