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Economies of Density and Productivity in Service Industries: An Analysis of Personal-Service Industries Based on Establishment-Level Data

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Economies of Density and Productivity in Service Industries: An Analysis of Personal-Service Industries Based on Establishment-Level Data[1]

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Abstract

The purpose of this paper is to investigate the basic facts of service industry productivity, such as economies of scale, economies of scope, and economies of density in Japan. Specifically, by using establishment-level data on personal-service industries in which the simultaneity of production and consumption is especially prominent, the paper estimates production functions both for value-added and physical output measures.

Key findings from the analysis are as follows:

1. In almost all the examined service industries, economies of scale in terms of establishment size and firm size, and economies of scope are found.
2. In almost all the examined service industries, significant economies of population density are observed, with productivity increases of 10%-20% when municipality population density doubles. The sizes of these coefficients are substantially larger than those observed in manufacturing industries for which sales destinations are far less restricted geographically; demonstrating demand density’s importance to the productivity of service industries.
3. The above findings are confirmed by estimation using measures of physical output instead of the amount of value added.

These findings suggest the possibility that consolidation and expansion at an establishment level, as well as multi-store and chain store operations at a firm level, may help improve the productivity of personal-service industries. Formation of population-dense areas is also suggested, as this would have a positive effect on productivity.

Keywords: Service Industry, Productivity, Economies of Scale, Demand Density
JEL Classification: D24, L84, R12

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1. Introduction

The purpose of this paper is to investigate empirically the basic facts of service industry productivity, such as economies of scale, economies of scope, and economies of population density in Japan. Specifically, by using establishment-level data on personal-service industries in which the simultaneity of production and consumption is especially prominent, the paper estimates production functions for ten narrowly defined industries. I compare the results of the analyses for the service industries with those of the results for the manufacturing and retail industries in order to highlight the differences between industries.[2]

Recent studies stress the importance of service industries on a country's economic growth performance. For example, van Ark et al. (2008) analyses the industry-level productivity growth of Europe and the United States and concludes that the major factor behind the divergence of aggregate-level productivity is the difference in service sector productivity. In Japan, productivity of the service sector has becoming an important policy agenda and the Service Productivity and Innovation for Growth (SPRING) organization and Service Engineering Research Center were established to enhance service sector innovation and productivity.

For the manufacturing sector, numerous estimations of production and cost functions have been conducted and are utilized in planning industrial policy.[3] However, in service industries, because of the lack of appropriate firm- or establishment-level data, empirical studies on fundamental production structure such as scale economies have been quite limited. Therefore, planning of policy to enhance service sector productivity depends heavily on aggregate-level international comparisons and some case studies.

Simultaneous production and consumption is often pointed out as a characteristic of services. This means most service industries cannot have inventories to smooth production and service industry productivity is affected by demand conditions, which include time-series fluctuations of demand and spatial difference in demand density.

For the time-series aspect, Basu et al. (2006), by using industry-level, time-series data and correcting for unobserved input utilization, shows larger discrepancy between the

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2 Analysis of the retail industry uses micro data from the Census of Commerce (2004). Analysis of manufacturing uses micro data from the Census of Manufacturers (2004). Specifications of the production functions are essentially the same as the personal-service industries, but because of the differences in the original data, some differences exist. In the estimation of retail, the dependent variable is sales (not value-added) and independent variables include a dummy for self-service and dummies for a two-digit industry. In manufacturing, explanatory variables do not include a measure of diversification.

3 Nakajima et al. (1998) is a good example of this type of analysis.

observed total factor productivity (TFP; standard Solow residual) and the "purified" technology change in the non-manufacturing sector compared with the durable manufacturing sector. In Japan, Kawamoto (2005) conducts a similar analysis by using 1973-1988 data from the Japan Industrial Productivity (JIP) Database and shows that the influence of the input utilization rate on output in the non-manufacturing industry is three times larger than the durable manufacturing industry. Miyagawa et al. (2005) indicates the correlation coefficient between observed TFP and the index of business cycle (diffusion index or composite index) is higher for non-manufacturing industries than manufacturing industries.

Concerning the spatial aspect, much research on agglomeration economies is related to the subjects covered in this paper. Rosenthal and Strange (2004), a representative survey in this area, concludes that the productivity is 3% to 8% higher if the population density of a city doubles. However, most of the empirical research in this area uses municipal-level data[4] or manufacturing industry plant-level data.[5] For example Nakamura (1985), a representative research study on Japan's agglomeration economies on productivities, estimates the translog production function of two-digit manufacturing industries by using city-level, aggregated data from 1979 and shows that the elasticity of labor productivity with respect to the population of cities is on average 3.4%, but the results vary considerably among industries. Tabuchi (1986) also uses a cross-section of city-level manufacturing data from 1980 and conducts regression to explain labor productivity. The result shows the elasticity of labor productivity with respect to population density of a city ranges from 4% to 8% depending on the specification. Analysis focusing on non-manufacturing industries is rare and analysis using service industry establishment-level data is almost nonexistent.[6]

Although its data used is for a specific manufacturing industry, Syverson (2004) investigates the effect of spatial substitutability on the productivity of plants. The hypotheses are that consumers can easily switch between suppliers in a densely clustered market and that inefficient producers have difficulty surviving. As a result, in markets with high density, average productivities are higher and the dispersion of productivities among plants should be lower. Syverson (2004) tests these hypotheses by using ready-mixed concrete plants in the U.S. and shows results consistent with the hypotheses. Syverson (2007), also using data for ready-mixed concrete plants, shows that price dispersion falls with increase in spatial competition. It also suggests that the same mechanism is likely to play a larger role in the

4 In the U.S., Ciccone and Hall (1996) is a good example. In Japan, Kanemoto et al. (1996) and Davis and Weinstein (2001) are examples using municipal-level data.
5 In the U.S., Henderson et al. (1995) and Henderson (2003) are examples using data on manufacturing plants.
6 There are several papers analyzing productivity of non-manufacturing sectors by using geographically aggregated data. Mera (1973) and Dekle (2002) are examples. Both of the papers suggest the strong relationship between productivity and spatial density in non-manufacturing industries in Japan.

service, retail, or wholesale industries. The idea of these analyses, though the data used are not for the service sector, is the most relevant for my analyses.

Based on the above discussion, this paper, by using unique establishment-level data for ten personal-service industries in Japan, investigates factors influencing service industries' TFP. The focus is the effects of spatial demand density. Major results can be summarized as follows.

1) In almost every service industry, economies of scale in terms of establishment size and firm size, and economies of scope are found.

2) Almost all of the service industries show significant economies of population density. The productivity of a plant is on average 10% to 20% higher when the population density of the city doubles. The effects of the demand density in these industries are far larger than in the manufacturing industry.

3) These results hold even if we use physical output measures, which are not affected by price differences among cities.

The rest of this paper is organized as follows. Section 2 explains the data used and method of analyses. Section 3 shows and interprets the estimation results of the production functions. Section 4 presents conclusions including policy implications.

2. Data and Methods

(1) Data

This paper uses data on personal-service industries covered by the Survey of Selected Service Industries conducted by the Ministry of Economy, Trade and Industry (METI). This survey, started in 1973, is conducted to clarify the actual conditions of service industries and obtain basic data for policies concerning them. The sample covers all establishments operating in Japan. At the beginning, the survey covered only five service industries, but the coverage has been expanded gradually. The survey now covers more than twenty industries. It is conducted every year, but most industries are surveyed every three to four years, except for goods-leasing and information services, which are surveyed annually. The survey collects information for establishments or firms depending on industry characteristics. Its items are widespread and some difference can be found by industry.

In this paper, I use recent (from 2001 to 2005) establishment-level data on ten personal-service industries: movie theaters, golf courses, tennis courts, bowling alleys, fitness clubs, golf driving ranges, culture centers, theaters (including rental halls), wedding ceremony halls, and esthetic salons. These industries are not minor in Japan. Table 1 shows the market sizes and numbers of employees of these industries.

(2) Methodology

This paper estimates simple Cobb-Douglas production functions. The dependent variables are 1) value-added and 2) measures of physical output. Independent variables include labor (number of employees), proxy for tangible capital, degree of diversification (share of main business sales), dummy for multiple establishments, population density of the location city, number of the same industry's establishments in the same city.

$$\ln Y = ß_0 + ß_1 \ln L + ß_2 \ln K + ß_3 \text{ Diversification} + ß_4 \text{ Dummy for Multiple Establishment}$$
$$+ ß_5 \text{ Population Density} + ß_6 \text{ Number of Local Establishments}$$

In order to estimate production function correctly, information on fixed capital stock is essential. Unfortunately, however, the Survey of Selected Service Industries does not collect this information. Although the survey collects information on equipment investment flow, it is impossible to estimate capital stock by using the perpetual inventory method, because the survey is not conducted every year for each industry. On the other hand, the survey contains data on good proxies of fixed capital for the personal-service industries. For example, the number of courts for tennis courts, number of lanes for bowling alleys, number of boxes for golf driving ranges, number of seats for theaters, and so on. Although these proxies for capital stock do not cover buildings or machines, they capture the most important aspects of each service. In addition, because these variables are physical measures of capital, it is not necessary to use price deflators. Moreover, they reflect the amount of an important capital stock – land.

Value-added (*va*) is calculated as va = sales - costs + wages + rents. Total rents are the sum of rents for land and buildings and rents for equipments. It is desirable to add user cost of capital (interest payment) explicitly (the data on interest payment is not available and it is also impossible to estimate) because the value of tangible capital stock is not surveyed.[7] However, because imputed rents for possessed fixed capital are included in the value-added, the treatment is neutral for possession or leasing. As for the physical measures of outputs, for example, the total number of yearly users for movie theaters is available and the total number of yearly games is available for bowling alleys. Although these physical output measures are not perfect, they have an advantage in that they are not affected by price differences among establishments. I use these measures to check the robustness of the results using revenue-based

7 Since the Survey of Selected Service Industries does not have information on capital depreciation, the value-added used here is the "net" value-added.

output measure.[8]

Among the explanatory variables, the number of employees (*emp*) includes part-time workers and temporary workers. Unfortunately, the number of hours is unavailable. Measures of capital stocks are, as I have already explained, different by industry. Specific variables are listed in Table 2.

As is obvious, the sum of the coefficients for L and K are the measure of scale elasticity. If the figure is larger than unity, there is an economy of scale at the establishment level. This measure is not a pure technological economy of scale and this includes both supply-side and demand-side factors. The share of the main business sales (*mshare*) is calculated as the sales of main services divided by the total sales of establishments. The coefficient measures the degree of the economies of scope. The service establishments investigated here often operate restaurants or shops as side businesses. These activities may share common inputs or may have synergy by collecting customers. If there is an economy of scope, the coefficient of this variable will be negative.[9] The dummy for multiple establishments (*multidum*) is an important variable. The dummy equals one if the establishment is a part of a firm which has more than two establishments in the same industry, and the dummy equals zero otherwise. The coefficient of this variable indicates the existence of firm-level economies of scale, which is different from establishment-level economies of scale. For example, if a firm operates many establishments around Japan, the productivity of the establishments may be higher by efficient management of common tasks, common procurement, or share of know-how among establishments. The population density of the located city comes from the 2005 Population Census.[10] In the estimations, log of this variable (*lnpopdens*) is used in order to compare the results with preceding studies. For personal-service industries, population density can be interpreted as demand density. The coefficients of this variable indicate the output elasticity with respect to demand density. In addition to the abovementioned variables, the number of establishments of the same industry in the city (*num*) is included in a supplementary estimation. This variable proxies the market factors affecting productivity, which include degree of competition, knowledge spillover, sharing of locally common inputs, and so on. Although the coefficient of this variable itself is important, the effect of the inclusion of this variable on the coefficient of population density is also of interest.

8 Foster et al. (2008), compare physical TFP measures and revenue-based TFP measures for several narrowly defined manufacturing industries in the U.S. This paper indicates that measured productivity dynamics differ significantly by the TFP measures used.

9 Since the capital stock measures do not cover all of the fixed capital stocks, the coefficients of *mshare* may be upward-biased. In this sense, this variable can be interpreted as control variable to correct the possible bias.

10 In some cases, because of recent active mergers among municipalities in Japan, population density for some establishments is missing.

Estimations are made by using the latest cross-sectional data for each industry. The latest years are different industry by industry. In addition to these cross-section regressions, I estimate by pooling two years of observations to check for robustness. For example, golf course, tennis court, bowling alleys, and golf driving range data for 2001 and 2004 are pooled. For fitness club and wedding ceremony halls, data for 2002 and 2005 are pooled. In these estimations, I add a year dummy (*yeardum*) for the observations of the latest year.[11]

3. Results

(1) Economies of Scale and Economies of Scope

All estimation results are presented in the appendix. The estimated scale elasticity for each industry is indicated in Table 3. Surprisingly, the figures for all industries except culture centers exceed unity, which suggests the existence of establishment-level economies of scale. The simple average is around 1.2. Most of the service industries' economies of scale are larger than average manufacturing plants.[12]

As Basu et al. (2006) and Kawamoto (2005) pointed out, the measured Solow-residuals are affected by mismeasurements of the capacity utilization rate. This means estimated scale elasticity is also affected by demand conditions. For example, the capacity utilization rate of a service establishment located in a shrinking city is expected to be lower than an establishment located in an expanding city. In this situation, scale elasticity might be overestimated. Therefore the figures estimated here should not be interpreted as pure technological economy of scale. The purpose of this paper is not to estimate the pure technological factor, but the effects of both supply-side factors and demand-side factors. In the service industries, because it is impossible to have inventory, capacity utilization is the most important factor determining their productivity. To omit this factor and to focus only on the pure technological factor ignores the essential aspect of the service sector.

The coefficients of the dummy for multiple establishments (*multidum*) indicate the existence of firm-level economies of scale after controlling for establishment-level economies of scale. Table 4 summarizes the results by industry. For fitness clubs, culture centers, and esthetic salons, the coefficients exceed 0.3 and are statistically significant. This means the productivity of a single establishment of multiple-establishment firm is, ceteris paribus, more than 30% higher than a firm with a single establishment. For golf courses, tennis courts,

11 For esthetic salons, which were surveyed only once in 2002, only cross-section regression is conducted. Unfortunately, the original data for different years are difficult to connect to make a longitudinal data set.

12 The corresponding figure for manufacturing plants is around 1.16 (estimated using Census of Manufacturers in 2004).

bowling alleys, and wedding ceremony halls, the coefficients are around 0.10 to 0.15, which also indicates significant firm-level economies of scale. These results reflect the fact that large firms are efficient in managing common tasks or sharing know-how among establishments, which suggests superior firms' expansion to many areas or chain-type operations may contribute to the productivity growth of service industries.[13]

Concerning the economies of scope, the coefficients of *mshare* are generally negative and significant. This indicates a diversification advantage at the establishment level. In order to understand the magnitude, I calculate the standard deviations of *mshare* multiplied by 1 minus the coefficients of *mshare* (Table 5). With the exception of culture centers, for which the figure is extremely large, the figures are around 10% to 30%, indicating sizable economies of scope. The only exception is wedding ceremony halls, for which the coefficient of *mshare* is negative and significant. Overall, in most personal-service industries, providing various types of services in an establishment is useful to enhance the productivity by a synergy effect − collecting customers, efficient utilization of the facilities, etc.

(2) Economies of Demand Density

The coefficients of population density (*lnpopdens*) are the focus of this study. Table 6 is the summary of the results. In most industries, the elasticity of output with respect to population density is around 0.1 to 0.2 and the differences among industries are small. This means that doubling the population density of a city increases productivity from 10% to 20%. To compare with the coefficients for manufacturing and retail, the coefficients for the personal-service industries are far larger.[14] According to a representative survey by Rosenthal and Strange (2004), doubling city size increases productivity of the city roughly from 3% to 8%. The figures for the service industries estimated here are larger than the "consensus" when using aggregate-level data or manufacturing industry data.

Densely populated cities, because the average size of establishments may be large, also benefit from the abovementioned economies of scale. In fact, the denser the population is, the larger the average size of establishments in all ten industries. In order to see the magnitude of this "indirect effects" of population density, I calculate the elasticity of the average size of establishments with respect to population density multiplied by the scale elasticity. Table 7

13 For multiple establishments, measured productivity may be upward-biased simply because common management and administration costs are borne by the headquarters. To answer this argument, I conduct an analysis by splitting the multiple establishments dummy into headquarter dummy and branch dummy. According to the result, even though the statistical significance is lower for the headquarters, it generally is still positive and significant.

14 The result for the manufacturing industry (0.03) is close to Nakamura (1985) and smaller than Tabuchi (1986).

shows the total effects of population density as the sum of the direct productivity effect and the indirect effect through the scale economy. Although the indirect effects are smaller than the direct effects, these increase the effect of population density on productivity by 2% to 9%. As a result, the difference between service industries and manufacturing becomes larger by considering this indirect effect.[15]

Syverson (2004) argues that in a denser market higher substitutability among producers truncates productivity distribution from below, resulting in higher minimum and average productivity levels as well as less productivity dispersion. To see this, I calculate the index of productivity dispersion (P90/P10, P75/P25, and log variance) for high population density cities and low population density cities separately (Table 8). The results differ by industry. For golf courses, fitness clubs, and esthetic salons, the dispersion is larger in low population density cities, consistent with the Syverson's (2004) result for the ready-mixed concrete industry in the U.S., but for theaters and wedding ceremony halls the productivity dispersion is larger in dense cities. It seems to me that Syverson's (2004) argument cannot be generalized. To observe without prejudgment, productivity distributions are not necessarily truncated, but the overall distributions are higher in densely populated cities.

Next, the number of establishments of the same industry (*num*) is added as a right-hand-side variable. The coefficients of this variable and those of population density with this additional variable are indicated in Table 9. The coefficients of the number of establishments are (though often insignificant) mostly positive, which suggests that the number of competing establishments has a positive effect on productivity.[16] However, even after controlling for this variable (localization economies from knowledge spillover, efficiency from intense competition, etc.) the sizes of the coefficients of population density are not significantly affected.

Overall, these results suggest that the agglomeration economies of the service industries come mainly from demand density.[17]

Up to now, I have used cities as units of calculating population density. However, appropriate areas for analysis may differ by industry. For some industries, consumers may visit a faraway establishment to purchase the service. To check this, I use the population density of the city and prefecture simultaneously as an explanatory variable. The results for population

15 In manufacturing, there is no significant relationship between the population density of the location and the average size of plants.

16 For movie theaters, wedding ceremony halls, and esthetic salons, coefficients of the number of establishments in the city are positive and significant.

17 The same regression was made by pooling two years of observations (excluding esthetic salons). All coefficients for the variables of interest (scale elasticity, economies of scope, and economies of demand density) are similar in size.

density are indicated in Table 10. For six industries (movie theaters, tennis courts, bowling alleys, theaters, wedding ceremony halls, and esthetic salons) coefficients for population density of the city are significant, but those of the prefecture are insignificant. For four industries (golf courses, fitness clubs, golf driving ranges, and culture centers) both city population density and prefecture population density are positive and significant, but the size of the coefficients of the city population are larger for golf driving ranges and culture centers. These results show, with some exceptions, that most of the personal-service industries' markets are geographically localized.

(3) Estimations Using Physical Output Measures

I have to this point used value-added as an explanatory variable for the production function estimation. As I mentioned earlier, the Survey of Selected Service Industries has information on physical output measures for most of the personal-service industries. Because the estimations of production function in this paper are a narrowly defined industry basis, these physical output measures can be used as dependent variables. In the analyses based on value-added, price differences among cities may overstate the effect of population density. Generally, the larger the size of the city, the higher the price level is. Foster et al. (2008), for example, compare physical TFP and revenue-based TFP for several U.S. manufacturing plants producing homogeneous products. They find that revenue-based TFP has positive correlations with the product prices at the plant level. In order to avoid this bias and to check the robustness of the above results, I conduct the analyses by using physical output measures.

The output measures used in the analyses are the total number of users（*lnuser*）for movie theaters, tennis courts, golf driving ranges, fitness clubs, and esthetic salons; total number of wedding parties (*lnuser*) for wedding ceremony halls; total number of games played (*lngame*) for bowling alleys; and total number of participants multiplied by the term of the classes (*lnuserterm*) for culture centers. All these measures are on an annual basis and expressed in logarithmic form.[18]

Here I conduct only a simple form of regression – the number of establishments in a city is not added as an explanatory variable. Table 11 is a summary of the major results. The estimated scale elasticity exceeds unity for seven industries, excluding golf courses and wedding ceremony halls. Most of the service industries still exhibit scale economies at the establishment level. The coefficients of the dummy of multiple establishments (*multidum*) are also positive and significant for eight industries, excluding culture centers. This also confirms

18 The appropriate physical output measure is not available only for theaters.

the results using revenue-based value-added as dependent variables. The reason for higher productivity of larger establishments or larger firms is not their higher service prices but that their physical output quantities per inputs are larger. The coefficients for population density are positive and significant for eight industries, excluding fitness clubs. To carefully see the output elasticity with respect to population density, in four industries (movie theaters, golf courses, tennis courts, and esthetic salons) the results are similar in magnitude for value-added basis and physical-output basis. On the other hand, in three industries (bowling alleys, golf driving ranges, and culture centers) the elasticity almost halves in estimations using physical output measures. For these three industries, higher service prices in densely populated large cities somewhat overstate the effects of population density on productivities in which value-added is used as an output measure. However, even accounting for this bias, these industries still show economically significant economies of demand density.[19]

To summarize, almost all of the results obtained by using physical output measures confirm the results using value-added measures. Although in some service industries, the effects of higher service prices in large cities can be observed, the price effects are not a dominant factor behind the economies of density.

4. Conclusions

This paper, by using unique Japanese micro data for personal-service industries, empirically investigates the basic facts of service industry productivity, such as economies of scale, economies of scope, and economies of density in Japan. Specifically, by using establishment-level data from the Survey of Selected Service Industries, I estimate cross-sectional and pooled OLS production functions for ten industries.

Major findings from the analysis can be summarized as follows:

1) In almost all the examined service industries, economies of scale in terms of establishment size and firm size, and economies of scope are found. The sizes of these effects are economically significant.

2) In almost all the examined service industries, significant economies of population density are observed, with productivity increases from 10% to 20% when municipality population density doubles. The sizes of these coefficients are substantially larger than those observed in manufacturing industries for which sales destinations are far less restricted geographically; demonstrating demand density’s importance toward the productivity of service industries.

19 The size of the estimated coefficient is larger by using a physical output measure only for wedding ceremony halls.

3) The above findings are confirmed by estimation using measures of physical output instead of the amount of value-added.

These findings suggest the possibility that consolidation and expansion at the establishment level, as well as multi-store and chain store operations at the firm level, may help improve the productivity of personal-service industries. Formation of population-dense areas is also suggested, as this would have a positive effect on productivity. This, however, may involve the trade-off between productivity improvement and other social and/or economic policy goals.

In Japan, population has begun to decline. The long-term population projection (National Institute of Population and Social Security Research) estimates a 13.4% decrease over the next 30 years and 29.6% over the next 50 years. This may work as a factor to pull down the productivity of the service sector.[20] It is important for urban planning to consider the impact of population distribution on service sector productivity. In order to enhance the productivity of the service sector, some trade-offs with other values such as regionally balanced growth or the survival of existing firms and establishments are inevitable.

This paper is an attempt to analyze personal-service industries' establishment-level productivity, which to date has not been studied. However, there are various data limitations: the data quality issue on capital stock measure, lack of information for labor quality and working hours, difficulty in constructing panel data, etc. This paper analyzes only a small number of personal-service industries. There is urgent need for the government statistical agency to enrich establishment-level service statistics.

20 If the Japanese population decreases uniformly, the density effect will negatively contribute to the service sector productivity at around 0.1% annually.

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Table 1 Size of the Selected Personal-service Industries

Industry	year	Number of establishments	Annual sales (billion yen)	Number of employee
Movie theaters	2004	2,464	228.6	16,292
Golf courses	2004	2,026	975.8	132,570
Tennis courts	2004	1,531	55.2	14,516
Bowling alleys	2004	948	130.3	16,348
Fitness clubs	2005	1,881	385.8	67,874
Golf driving ranges	2004	2,707	167.5	27,670
Culture centers	2005	698	57.3	55,271
Theaters	2004	698	197.3	12,262
Wedding ceremony halls	2005	2,826	891.1	98,668
Esthetic salons	2002	5,877	234.3	23,944

(source) Survey of Selected Service Industries (METI)

Table 2 Measures of Fixed Capital Stock

Industry	Measures of capital stock
Movie theaters	Area of floor
Golf courses	Number of holes
Tennis courts	Number of courts
Bowling alleys	Number of lanes
Fitness clubs	Area of floor
Golf driving ranges	Number of boxes
Culture centers	Area of floor
Theaters	Number of seats
Wedding ceremony halls	Area of floor
Esthetic salons	Number of beds

(source) Survey of Selected Service Industries (METI)

Table 3 Scale Elasticity at Establishment Level

Industry	Scale elasticity	
	single year	pooled
Movie theaters	1.125	1.094
Golf courses	1.278	1.280
Tennis courts	1.287	1.315
Bowling alleys	1.154	1.164
Fitness clubs	1.102	1.115
Golf driving ranges	1.412	1.379
Culture centers	0.953	0.981
Theaters	1.149	1.162
Wedding ceremony halls	1.076	1.089
Esthetic salons	1.499	-
(simple average)	1.204	1.175
Retail	1.324	-
Manufacturing	1.163	-

(notes) Scale elasticity indicates figures from latest year and pooled regressions. Area of floor is used as measure of capital stock for retail and value of tangible capital is used for manufacturing.

Table 4 Coefficient of Multiple Establishments Dummy (*Multidum*)

Industry	single year		pooled	
Movie theaters	0.260	***	0.294	***
Golf courses	0.115	***	0.144	***
Tennis courts	0.147	**	0.130	***
Bowling alleys	0.112	***	0.109	***
Fitness clubs	0.358	***	0.361	***
Golf driving ranges	0.083	**	0.086	***
Culture centers	0.360	***	0.362	***
Theaters	-0.083		-0.027	
Wedding ceremony halls	0.141	***	0.115	***
Esthetic salons	0.578	***	-	
(simple average)	0.239		0.200	
Retail	0.384	***	-	
Manufacturing	0.112	***	-	

(notes) *significant at 10%; ** significant at 5%; *** significant at 1%. Simple average excludes theaters.

Table 5 Economy of Scope (Coefficients of *Mshare*)

	single year			pooled		
	mshare		-mshare*sd	mshare		-mshare*sd
Movie theaters	-1.643	***	20.1%	-1.305	***	16.0%
Golf courses	-0.356	**	4.0%	-0.375	***	4.2%
Tennis courts	-0.645	***	19.0%	-0.719	***	21.2%
Bowling alleys	-0.581	***	12.9%	-0.696	***	15.5%
Fitness clubs	-1.108	***	21.3%	-1.093	***	21.1%
Golf driving ranges	-1.136	***	19.4%	-1.168	***	20.0%
Culture centers	-1.989	***	70.3%	-2.102	***	74.3%
Theaters	-1.186	***	29.7%	-0.756	***	18.9%
Wedding ceremony halls	-0.151	***	5.1%	-0.242	***	8.1%
Esthetic salons	-0.653	***	13.6%	-		-
(simple average)			21.6%			22.1%
Retail	-0.003	***	7.6%	-		-

(notes) *significant at 10%; ** significant at 5%; *** significant at 1%

Table 6 Economy of Population Density (Coefficients of *lnpopdens*)

	single year		pooled	
Movie theaters	0.132	***	0.124	***
Golf courses	0.141	***	0.149	***
Tennis courts	0.191	***	0.190	***
Bowling alleys	0.096	***	0.090	***
Fitness clubs	0.103	***	0.101	***
Golf driving ranges	0.200	***	0.196	***
Culture centers	0.166	***	0.173	***
Theaters	0.433	***	0.432	***
Wedding ceremony halls	0.081	***	0.082	***
Esthetic salons	0.088	***	-	
(simple average)	0.163		0.171	
Retail	0.048	***	-	
Manufacturing	0.027	***	-	

(notes) *significant at 10%; ** significant at 5%; *** significant at 1%

Table 7 Effect of Population Density Including Indirect Effect

	Direct Effect	Indirect Effect	Total Effect
Movie theaters	0.132	0.018	0.150
Golf courses	0.141	0.032	0.174
Tennis courts	0.191	0.048	0.239
Bowling alleys	0.096	0.034	0.130
Fitness clubs	0.103	0.023	0.126
Golf driving ranges	0.200	0.095	0.295
Culture centers	0.166	-0.006	0.160
Theaters	0.433	0.015	0.448
Wedding ceremony halls	0.081	0.009	0.091
Esthetic salons	0.088	0.047	0.135
(simple average)	0.133	0.033	0.167
Retail	0.048	0.014	0.063
Manufacturing	0.027	0.000	0.027

(notes) Total effect are the sum of direct effect of population density and indirect effect through scale effect. Simple average is calculated by excluding theater where the direct effect is extremely large.

Table 8 Distribution of TFP by Population Density

	P75-P25		p90-p10		Log Variance	
	Low	High	Low	High	Low	High
Movie theaters	0.960	0.868	1.849	1.879	0.675	1.003
Golf courses	0.651	0.571	1.383	1.286	0.419	0.333
Tennis courts	1.027	1.101	2.231	2.131	1.220	0.956
Bowling alleys	0.624	0.600	1.238	1.297	0.339	0.297
Fitness clubs	0.783	0.769	1.571	1.475	0.526	0.432
Golf driving ranges	0.855	0.904	1.734	1.695	0.596	0.503
Culture centers	1.337	1.228	2.242	2.566	0.952	1.155
Theaters	1.401	1.613	3.282	3.585	2.048	2.646
Wedding ceremony halls	0.676	0.743	1.471	1.593	0.434	0.500
Esthetic salons	1.037	0.974	2.131	1.984	0.859	0.754
Retail	1.204	1.198	2.495	2.486	1.571	1.756
Manufacturing	0.728	0.721	1.509	1.515	0.456	0.485

(notes) Low population density cities and high population density cities are classified by the average population density.

Table 9 Effect of Including the Number of Establishments in the City

	coefficients	
	num	*lnpopdens*
Movie theaters	0.030 ***	0.087 ***
Golf courses	0.005	0.141 ***
Tennis courts	0.004	0.188 ***
Bowling alleys	-0.025 *	0.102 ***
Fitness clubs	0.006	0.098 ***
Golf driving ranges	0.004	0.197 ***
Culture centers	-0.021	0.175 ***
Wedding ceremony halls	0.007 ***	0.066 ***
Esthetic salons	0.003 ***	0.075 ***
Retail	0.000 ***	0.038 ***
Manufacturing	0.000 ***	0.025 ***

(notes) Theaters, where most of the establishments do not have competiting establishments in the same city, is excluded.

Table 10 Coefficients of City and Prefecture Population Density

	Coefficients			
	City Population Density		Prefecture Population	
Movie theaters	0.0865	***	0.0617	
Golf courses	0.0715	***	0.2007	***
Tennis courts	0.2094	***	-0.0312	
Bowling alleys	0.0928	***	0.0170	
Fitness clubs	0.0587	***	0.0634	***
Golf driving ranges	0.2022	***	0.0516	***
Culture centers	0.1106	***	0.0867	**
Theaters	0.3172	***	0.1169	
Wedding ceremony halls	0.0716	***	0.0180	
Esthetic salons	0.0837	***	0.0061	
Retail	0.0467	***	0.0038	***

(notes) Results from a regression in which both city and prefecture population densities are included as dependent variables. *significant at 10%; ** significant at 5%; *** significant at 1%

Table11 Results Using Physical Output Measures

Industry	Scale Elasticities		Multidum		lnpopdens	
	Revenue-based	Physical	Revenue-based	Physical	Revenue-based	Physical
Movie theaters	1.125	1.094	0.336	0.494	0.132	0.122
Golf courses	1.278	0.913	0.102	0.055	0.141	0.119
Tennis courts	1.287	1.032	0.143	0.506	0.191	0.222
Bowling alleys	1.154	1.251	0.130	0.153	0.096	0.049
Fitness clubs	1.102	1.201	0.363	0.421	0.103	-
Golf driving ranges	1.412	1.493	0.058	0.124	0.200	0.116
Culture centers	0.953	1.025	0.347	-	0.166	0.080
Wedding ceremony halls	1.076	0.955	0.151	0.007	0.081	0.181
Esthetic salons	1.499	1.251	0.579	0.320	0.088	0.066

(notes) "-" means insignificant at 10% level

Appendix Table 1: Movie Theaters

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.7899	15.83	0.000	0.8078	16.20	0.000
lnfloor	0.3355	7.20	0.000	0.3345	7.23	0.000
mshare	-1.6429	-5.12	0.000	-1.6576	-5.21	0.000
multidum	0.2601	3.16	0.002	0.2249	2.73	0.007
lnpopdens	0.1321	5.25	0.000	0.0871	3.03	0.003
num				0.0296	3.18	0.002
_cons	4.3478	10.39	0.000	4.5578	10.83	0.000
Number of obs	641			641		
Adj R-squared	0.6845			0.6889		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.7895	22.96	0.000	0.8087	23.53	0.000
lnfloor	0.3042	9.77	0.000	0.2986	9.66	0.000
mshare	-1.3049	-5.85	0.000	-1.3006	-5.87	0.000
multidum	0.2943	5.32	0.000	0.2678	4.86	0.000
lnpopdens	0.1245	7.19	0.000	0.0816	4.17	0.000
num				0.0225	4.55	0.000
yeardum	-0.1584	-3.26	0.001	-0.1231	-2.52	0.012
_cons	4.4341	15.35	0.000	4.6286	15.97	0.000
Number of obs	1199			1199		
Adj R-squared	0.6882			0.6932		

(note) Pooled 2001 and 2004

Appendix Table 2: Golf Courses

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.8210	31.10	0.000	0.8197	31.03	0.000
lnhole	0.4565	7.30	0.000	0.4546	7.27	0.000
mshare	-0.3560	-2.52	0.012	-0.3591	-2.55	0.011
multidum	0.1151	3.56	0.000	0.1088	3.33	0.001
lnpopdens	0.1413	10.90	0.000	0.1410	10.88	0.000
num				0.0045	1.32	0.188
_cons	4.6317	22.04	0.000	4.6304	22.04	0.000
Number of obs	1389			1389		
Adj R-squared	0.6254			0.6256		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.8078	39.85	0.000	0.8064	39.77	0.000
lnhole	0.4722	10.02	0.000	0.4703	9.98	0.000
mshare	-0.3750	-3.36	0.001	-0.3775	-3.38	0.001
multidum	0.1437	5.97	0.000	0.1378	5.67	0.000
lnpopdens	0.1493	15.37	0.000	0.1486	15.29	0.000
num				0.0044	1.72	0.085
yeardum	-0.0949	-3.96	0.000	-0.0960	-4.01	0.000
_cons	4.6899	29.30	0.000	4.6922	29.33	0.000
Number of obs	2532			2532		
Adj R-squared	0.6210			0.6213		

(note) Pooled 2001 and 2004

Appendix Table 3: Tennis Courts

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	1.0013	37.90	0.000	1.0023	37.85	0.000
lncourt	0.2857	7.11	0.000	0.2849	7.09	0.000
mshare	-0.6451	-6.14	0.000	-0.6444	-6.13	0.000
multidum	0.1465	2.34	0.020	0.1466	2.34	0.020
lnpopdens	0.1911	8.82	0.000	0.1877	8.31	0.000
num				0.0035	0.54	0.590
_cons	4.0330	22.17	0.000	4.0395	22.15	0.000
Number of obs	1314			1314		
Adj R-squared	0.6569			0.6568		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	1.0082	50.73	0.000	1.0090	50.69	0.000
lncourt	0.3071	10.49	0.000	0.3061	10.45	0.000
mshare	-0.7193	-8.04	0.000	-0.7182	-8.02	0.000
multidum	0.1303	2.84	0.005	0.1314	2.86	0.004
lnpopdens	0.1899	11.96	0.000	0.1866	11.26	0.000
num				0.0032	0.70	0.481
yeardum	-0.0251	-0.60	0.547	-0.0254	-0.61	0.541
_cons	4.0921	28.24	0.000	4.0996	28.22	0.000
Number of obs	2226			2226		
Adj R-squared	0.6756			0.6756		

(note) Pooled 2001 and 2004

Appendix Table 4: Bowling Alleys

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.7731	21.64	0.000	0.7771	21.73	0.000
lnlane	0.3805	7.12	0.000	0.3809	7.14	0.000
mshare	-0.5811	-5.57	0.000	-0.5754	-5.52	0.000
multidum	0.1117	2.85	0.004	0.1129	2.88	0.004
lnpopdens	0.0962	6.64	0.000	0.1016	6.86	0.000
num				-0.0252	-1.72	0.085
_cons	5.1502	30.21	0.000	5.1494	30.24	0.000
Number of obs	861			861		
Adj R-squared	0.7037			0.7044		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.7069	27.93	0.000	0.7108	28.10	0.000
lnlane	0.4573	11.77	0.000	0.4602	11.87	0.000
mshare	-0.6957	-8.70	0.000	-0.6943	-8.70	0.000
multidum	0.1089	3.73	0.000	0.1100	3.78	0.000
lnpopdens	0.0902	8.34	0.000	0.0966	8.76	0.000
num				-0.0304	-2.85	0.004
yeardum	-0.0830	-2.92	0.004	-0.0857	-3.02	0.003
_cons	5.3106	40.48	0.000	5.3127	40.59	0.000
Number of obs	1596			1596		
Adj R-squared	0.6741			0.6755		

(note) Pooled 2001 and 2004

Appendix Table 5: Fitness Clubs

	(1) 2005 Cross-Section			(2) 2005 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.6813	31.32	0.000	0.6818	31.35	0.000
lnfloor	0.4211	19.14	0.000	0.4216	19.17	0.000
mshare	-1.1076	-12.29	0.000	-1.1007	-12.20	0.000
multidum	0.3575	9.30	0.000	0.3579	9.32	0.000
lnpopdens	0.1034	8.78	0.000	0.0978	7.94	0.000
num				0.0062	1.53	0.126
_cons	3.7211	24.34	0.000	3.7181	24.33	0.000
Number of obs	1832			1832		
Adj R-squared	0.8038			0.804		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.6881	39.59	0.000	0.6888	39.67	0.000
lnfloor	0.4271	24.30	0.000	0.4273	24.34	0.000
mshare	-1.0926	-15.22	0.000	-1.0853	-15.13	0.000
multidum	0.3612	11.96	0.000	0.3625	12.02	0.000
lnpopdens	0.1007	10.59	0.000	0.0921	9.20	0.000
num				0.0093	2.73	0.006
yeardum	0.0452	1.74	0.082	0.0410	1.58	0.114
_cons	3.6156	28.93	0.000	3.6226	29.01	0.000
Number of obs	3081			3081		
Adj R-squared	0.7921			0.7925		

(note) Pooled 2002 and 2005

Appendix Table 6: Golf Driving Ranges

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.6209	24.38	0.000	0.6210	24.38	0.000
lnbox	0.7915	26.15	0.000	0.7916	26.16	0.000
mshare	-1.1364	-12.48	0.000	-1.1363	-12.48	0.000
multidum	0.0829	2.38	0.018	0.0828	2.37	0.018
lnpopdens	0.1998	18.45	0.000	0.1974	17.80	0.000
num				0.0037	1.01	0.315
_cons	3.1764	24.91	0.000	3.1747	24.89	0.000
Number of obs	2299			2299		
Adj R-squared	0.7253			0.7253		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.5649	30.60	0.000	0.5649	30.60	0.000
lnbox	0.8139	36.35	0.000	0.8142	36.36	0.000
mshare	-1.1683	-16.82	0.000	-1.1696	-16.84	0.000
multidum	0.0862	3.38	0.001	0.0863	3.38	0.001
lnpopdens	0.1960	24.71	0.000	0.1934	23.74	0.000
num				0.0039	1.44	0.151
yeardum	-0.1008	-4.63	0.000	-0.0997	-4.58	0.000
_cons	3.3685	34.62	0.000	3.3674	34.61	0.000
Number of obs	4204			4204		
Adj R-squared	0.7116			0.7116		

(note) Pooled 2001 and 2004

Appendix Table 7: Culture Centers

	(1) 2005 Cross-Section			(2) 2005 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.5982	17.85	0.000	0.5975	17.83	0.000
lnfloor	0.3548	9.62	0.000	0.3579	9.68	0.000
mshare	-1.9895	-17.34	0.000	-1.9934	-17.37	0.000
multidum	0.3597	4.14	0.000	0.3610	4.16	0.000
lnpopdens	0.1664	5.68	0.000	0.1747	5.80	0.000
num				-0.0210	-1.17	0.241
_cons	3.9476	12.68	0.000	3.9411	12.67	0.000
Number of obs	665			665		
Adj R-squared	0.6346			0.6348		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.6477	24.50	0.000	0.6473	24.48	0.000
lnfloor	0.3328	11.83	0.000	0.3349	11.84	0.000
mshare	-2.1024	-24.36	0.000	-2.1038	-24.37	0.000
multidum	0.3622	5.68	0.000	0.3616	5.67	0.000
lnpopdens	0.1729	8.09	0.000	0.1763	8.06	0.000
num				-0.0090	-0.74	0.462
yeardum	-0.0501	-0.86	0.392	-0.0508	-0.87	0.387
_cons	3.9782	17.31	0.000	3.9736	17.28	0.000
Number of obs	1158			1158		
Adj R-squared	0.6584			0.6583		

(note) Pooled 2002 and 2005

Appendix Table 8: Theaters (including Rental Halls)

	(1) 2004 Cross-Section			(2) 2004 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.5898	6.09	0.000	0.5449	5.83	0.000
lnseat	0.5592	5.02	0.000	0.6091	5.67	0.000
mshare	-1.1860	-3.69	0.000	-1.2815	-4.15	0.000
multidum	-0.0827	-0.39	0.696	-0.1099	-0.54	0.589
lnpopdens	0.4333	6.06	0.000	0.2690	3.51	0.001
num				0.0972	4.78	0.000
_cons	0.3298	0.32	0.748	0.9879	0.99	0.321
Number of obs	266			266		
Adj R-squared	0.4352			0.479		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.6086	8.78	0.000	0.5558	8.25	0.000
lnseat	0.5531	6.71	0.000	0.5889	7.40	0.000
mshare	-0.7556	-3.33	0.001	-0.8991	-4.09	0.000
multidum	-0.0271	-0.18	0.857	-0.0254	-0.18	0.861
lnpopdens	0.4317	8.13	0.000	0.2828	4.96	0.000
num				0.0884	5.89	0.000
yeardum	-0.3376	-2.41	0.016	-0.3578	-2.65	0.008
_cons	0.3180	0.41	0.678	1.0585	1.41	0.158
Number of obs	435			435		
Adj R-squared	0.4532			0.4931		

(note) Pooled 2001 and 2004

Appendix Table 9: Wedding Ceremony Halls

	(1) 2005 Cross-Section			(2) 2005 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.8763	58.54	0.000	0.8711	58.21	0.000
lnfloor	0.1996	10.35	0.000	0.2014	10.48	0.000
mshare	-0.1513	-3.42	0.001	-0.1527	-3.46	0.001
multidum	0.1405	5.07	0.000	0.1409	5.10	0.000
lnpopdens	0.0814	9.42	0.000	0.0659	7.10	0.000
num				0.0065	4.45	0.000
_cons	4.7188	41.35	0.000	4.7751	41.74	0.000
Number of obs	2693			2693		
Adj R-squared	0.7332			0.7350		

	(3) Pooled OLS			(4) Pooled OLS		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.8729	72.83	0.000	0.8670	72.30	0.000
lnfloor	0.2166	13.89	0.000	0.2176	14.00	0.000
mshare	-0.2423	-6.83	0.000	-0.2421	-6.84	0.000
multidum	0.1151	5.31	0.000	0.1162	5.38	0.000
lnpopdens	0.0819	11.95	0.000	0.0669	9.12	0.000
num				0.0068	5.54	0.000
hi						
yeardum	-0.0250	-1.19	0.234	-0.0306	-1.46	0.145
_cons	4.6880	50.37	0.000	4.7504	50.84	0.000
Number of obs	4503			4503		
Adj R-squared	0.7296			0.7314		

(note) Pooled 2002 and 2005

Appendix Table 10: Esthetic Salons

	(1) 2002 Cross-Section			(2) 2002 Cross Section		
lnva	Coef.	t	P>t	Coef.	t	P>t
lnemp	0.8148	41.44	0.000	0.8111	41.29	0.000
lnbed	0.6845	28.57	0.000	0.6794	28.38	0.000
mshare	-0.6531	-10.93	0.000	-0.6509	-10.91	0.000
multidum	0.5775	18.54	0.000	0.5721	18.39	0.000
lnpopdens	0.0878	9.87	0.000	0.0752	8.08	0.000
num				0.0030	4.55	0.000
_cons	4.6111	54.12	0.000	4.6511	54.40	0.000
Number of obs	5348			5348		
Adj R-squared	0.6764			0.6776		