



## **Application of an alternative method for compiling business demography statistics of establishments**

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### **Abstract**

Business demography statistics can be compiled by a business register that is usually a major data source for the statistics. Business registers, however, sometimes have tender points in compiling business demography statistics; there may be a certain amount of time lag between births (openings) or deaths (closings) of businesses and their registrations. Moreover it often happens that closed businesses are not registered for a long time, even forever. These situations cause some trouble in the accuracy of the business demography statistics. To overcome the tender points, an alternative method for compiling business demography statistics was worked out using the data of the Economic Censuses. In this method, the rates of births, deaths, survivals, etc. of establishments by major categories such as industry can be calculated using the data of transition between the two Censuses. This paper presents the results of the application of this method to the data of the Economic Censuses conducted in 2009 and 2012 in order to derive business demography statistics, which were more accurate and could be comparable with the statistics based on the business register.

**Keywords:** business register; economic census; births; deaths.

### **1. Introduction**

Business demography statistics are the statistics aiming to clarify the situation of economy in terms of its growth and productivity as well as to obtain the information for tackling social economic issues. The elements of the statistics consist of data on births, deaths, survivals, etc. of businesses, and they can be compiled by various methods including the utilization of a business register that is usually a major data source for the statistics. However, business registers sometimes have tender points in compiling business demography statistics; there might be a certain amount of time lag between births or deaths of businesses and their registrations. Moreover it often happens that closed businesses are not registered for a long time, even forever. These situations cause some trouble in the accuracy of the business demography statistics. The situation in the Japanese business register is no exception, though the business demography statistics based on the business register is not yet compiled.

One way to overcome this issue is to use data of economic censuses. According to the Manual of Eurostat & OECD (2007), data from censuses are less frequent than business registers and they may raise major comparability issues. In addition, it would be literally impossible to identify deaths of businesses by means of surveys, as there would be no units to be surveyed. As economic censuses are not conducted in many countries, little study has been done concerning the methods and their application in compiling business register statistics based on the data of economic censuses.

This paper presents an alternative method and its application in calculating the indicators of business demography statistics such as annual rates of births, deaths, and survivals of establishments by major category using the transition data of two consecutive Economic Censuses in Japan. In this method unique natures of Japanese Economic Census were utilized; the Economic Censuses have been relatively frequently conducted in Japan – twice every five years – and the list of businesses produced by the last census has been used at the present census, which allowed identifying closed businesses as well as survived businesses. Then the method is applied to calculate the business demography



statistics by using the data of the Economic Censuses conducted in 2009 and 2012, in order to clarify the actual situation of businesses in those days.

## **2. Methodology**

The method for compiling business demography statistics used in this paper is based on that given in Takahashi (2005). In the method, the data source for calculating business demography statistics is the data of the Economic Censuses, and the statistical unit for the calculation is an establishment, which is the basic enumeration unit in conducting the Economic Census in Japan.

In calculating business demography statistics, five unknown variables are selected in regard to births, deaths, survivals, and transfers among categories which are related to the analyses concerned. Then five simultaneous equations are set up using known quantities obtained from two consecutive Economic Censuses. By solving the equations, the values of the five unknown variables are derived.

This method has an advantage that closed businesses can be certainly understood by the results of the Economic Census in which the list of businesses in the last Census is utilized in the present Census allowing for the detection of closed businesses. However, as pointed out in Ahmad (2006), it is difficult to get information on short-lived births – businesses that opened after the last Census and closed before the present Census. This weakness can be minimized by relatively frequent implementation of the Economic Census in Japan where the Census has been conducted twice every five years.

As the description of the method in Takahashi (2005) is written only in Japanese and rather summarized, details of the method are given below for the sake of convenience.

### **2.1. Data source**

In general, it is considered that the most potent data source for the business demography statistics is a statistical or administrative business register. Business registers, however, usually have some gap in terms of timeliness and/or coverage between the registrations of businesses and actual situations. This is also true for the Japanese business register called “Establishment Frame Database (EFD)”, where data updates for the register are mainly based on the Labor Insurance Data and the Commercial and Corporate Registration Data, while the data of the Economic Census being the original data source.

The Labor Insurance Data and the Commercial and Corporate Registration Data cover a large part of the population of the EFD; however, some individual proprietorship businesses such as those with no employees are covered by neither source of the Data. This would cause a problem that those individual proprietorship businesses, which are very small businesses, would not be included in the business demography statistics, if the statistics were compiled based on the business register EFD.

Contrarily, if the business demography statistics are compiled based on the Economic Censuses using an alternative method, all categories of the businesses in the business register EFD can be covered, whose population includes all the businesses except for some specific businesses such as individual proprietorship businesses in Agriculture, Forestry and Fishery. In Japan, the Economic Census and its predecessor Establishment and Enterprise Census have been conducted twice every five years since 1996. This frequency is also beneficial for compiling business demography statistics. So in the study here, the data of the Economic Census is used for calculating indicators of business demography statistics.

### **2.2. Statistical Unit**

There are several kinds of statistical units that can be considered for businesses: local kind of activity unit, kind of activity unit, local unit, enterprise, enterprise group, etc. In the Japanese Economic Census, there are three kinds of statistical units: establishment, enterprise and enterprise group. It

should be noted that an establishment in the Japanese Economic Census is a local unit, which is defined as follows.

*An Establishment refers to a unit of place where economic activities are performed and fulfill the following conditions in principle:*

- A. *An establishment is a unit of place which occupies a certain space (1 plot) and in which economic activities are performed under a single management agency.*
- B. *An establishment has persons engaged as well as equipment and manufactures, and sells objects and provides services on a continual basis.*

The fundamental unit in the Economic Census is an establishment, because this is the unit for the enumeration in the Census. The other units, enterprise and enterprise group, can be formed by using the information of establishments obtained at the Economic Census. Therefore, the establishment is used here as a statistical unit for compiling business demography statistics because it is simple and straightforward.

### 2.3. Derivation of calculating formulae

As the indicator variables for business demography statistics of establishments, five unknown variables are defined, all of which are annual rates by a category concerned such as industry.

$$\begin{array}{l}
 R_b : \text{birth rate} \\
 R_d : \text{death rate} \\
 R_s : \text{survival rate (in the same category)} \\
 R_{ti} : \text{transfer-in rate (of survivals)} \\
 R_{to} : \text{transfer-out rate (of survivals)}
 \end{array}
 \left. \vphantom{\begin{array}{l} R_b \\ R_d \\ R_s \\ R_{ti} \\ R_{to} \end{array}} \right\} (1)$$

Here,  $R_{ti}$  and  $R_{to}$  denote the rate of transfer-in to a category concerned and the rate of transfer-out from a category concerned, respectively.

In order to obtain the value of the above five unknown variables (1), five simultaneous equations are set up using the following six known quantities derived from the results of the Economic Censuses. Note that the following values are considered by each category such as an industry.

$$\begin{array}{l}
 N_p : \text{number of establishments in the previous Economic Census} \\
 N_l : \text{number of establishments in the last Economic Census} \\
 N_d : \text{number of dead (closed) establishments between the previous and} \\
 \quad \text{the last Economic Census} \\
 N_{ts} : \text{number of survived establishments at the last Economic Census} \\
 \quad \text{including the transferred-in establishments to the category} \\
 N_s : \text{number of survived establishments in the same category} \\
 n : \text{number of years between the previous and the last Economic Census}
 \end{array}
 \left. \vphantom{\begin{array}{l} N_p \\ N_l \\ N_d \\ N_{ts} \\ N_s \\ n \end{array}} \right\} (2)$$

Five simultaneous equations are obtained based on the various relationships among the five unknown variables (1) and the six known quantities (2), which are presented as follows.

The relation of the number of establishments between the previous and the last Economic Census resulted in the first equation,

$$N_p \cdot (R_s + R_{ti} + R_b)^n = N_l. \quad (3)$$

The second equation relates to the survivals of establishments between two Economic Censuses,

$$N_p \cdot R_s^n = N_s. \quad (4)$$

If the number of survived establishments transferred into the category concerned is temporarily defined as  $N_{ti}$ , the following equation holds in regard to survived establishments including transferred-in:

$$N_s + N_{ti} = N_{ts}, \quad (5)$$

where  $N_{ti}$  can be calculated as follows.

$$\begin{aligned} N_{ti} &= N_p \cdot R_{ti} + N_p \cdot (R_s + R_{ti} + R_b) \cdot R_{ti} + N_p \cdot (R_s + R_{ti} + R_b)^2 \cdot R_{ti} + \dots \\ &\quad + N_p \cdot (R_s + R_{ti} + R_b)^{n-1} \cdot R_{ti} \\ &= N_p \cdot \left\{ \frac{1 - (R_s + R_{ti} + R_b)^n}{1 - (R_s + R_{ti} + R_b)} \right\} \cdot R_{ti} \end{aligned} \quad (6)$$

So the third equation (5) is written as

$$N_s + N_p \cdot \left\{ \frac{1 - (R_s + R_{ti} + R_b)^n}{1 - (R_s + R_{ti} + R_b)} \right\} \cdot R_{ti} = N_{ts}. \quad (7)$$

The next equation, obtained from the relations concerning to the number of dead establishments, is

$$N_p \cdot R_d + N_p \cdot R_s \cdot R_d + N_p \cdot R_s^2 \cdot R_d + \dots + N_p \cdot R_s^{n-1} \cdot R_d = N_d, \quad (8)$$

which leads to the fourth equation,

$$N_p \cdot \left( \frac{1 - R_s^n}{1 - R_s} \right) \cdot R_d = N_d. \quad (9)$$

The last equation is based on the “conservation of the number of establishments” that is expressed as follows.

$$N_p \cdot R_s + N_p \cdot R_d + N_p \cdot R_{to} = N_p \quad (10)$$

Dividing both sides of the above equation by  $N_p$ , the equation (10) can be simplified to,

$$R_s + R_d + R_{to} = 1. \quad (11)$$

By solving the system of five equations (3), (4), (7), (9) and (11), the following calculating formulae are obtained for the five unknown variables.

$$\left. \begin{aligned} R_s &= (N_s/N_p)^{1/n} \\ R_{ti} &= \left( \frac{N_{ts} - N_s}{N_p} \right) \cdot \left\{ \frac{1 - (N_l/N_p)^{1/n}}{1 - N_l/N_p} \right\} \\ R_b &= (N_l/N_p)^{1/n} - R_s - R_{ti} \\ R_d &= \frac{N_d}{N_p} \cdot \frac{1 - R_s}{1 - R_s^n} \\ R_{to} &= 1 - R_s - R_d \end{aligned} \right\} \quad (12)$$

In performing the above calculations to compile business demography statistics, the results of the consecutive two Economic Censuses were used, of which the format is shown in Table 1.

Table 1 Relation table for compiling business demography statistics

Last Census		Survived Establishments						Dead Establishments	Total
		A-category	B	C	D	...	R		
Survived Establishments	A-category	$N_s$						$N_d$	$N_p$
	B								
	C								
	D								
	⋮								
	R								
	Sub-total	$N_{ts}$							
Born Establishments									
Total		$N_I$							

In Table 1, five of the known quantities  $N_p$ ,  $N_b$ ,  $N_d$ ,  $N_{ts}$ , and  $N_s$  for the category A are shown. The remaining quantity  $n$  can be derived from the census dates of the two consecutive Economic Censuses.

### 3. Results

Business demography statistics based on business registers have sometimes difficulties in understanding births and deaths of businesses timely and accurately especially for those of closed businesses. In this study, the data of the Economic Censuses were used to calculate the indicators of business demography statistics as an alternative method for compiling the statistics. The indicators were obtained using the calculating formulae derived from various relationships among indicators (unknown variables) and data from the Economic Censuses. Table 2 shows the results obtained using the alternative method.

Table 2 Indicators of Business Demography Statistics by Industry (Major Category) – Average annual rates between July 1, 2009 and February 1, 2012

Indicators of Business Demography Statistics	Birth Rate (%)	Death Rate (%)	Survival Rate (%) (in the same industry)	Transfer-in Rate (%) (of survivals)	Transfer-out Rate (%) (of survivals)
	$R_b$	$R_d$	$R_s$	$R_{ti}$	$R_{to}$
Industry (Major Category)					
Total	3.0	7.2	91.6	1.2	1.2
A Agriculture and Forestry	3.3	6.2	92.2	1.8	1.6
B Fisheries	1.7	6.8	92.1	1.5	1.2
C Mining and Quarrying of Stone and	2.3	7.7	80.6	6.7	11.7
D Construction	1.4	6.6	92.6	1.0	0.8
E Manufacturing	1.4	6.6	91.0	2.7	2.4
F Electricity, Gas, Heat Supply and	2.7	4.9	91.9	0.9	3.2
G Information and Communications	3.6	11.2	85.8	2.6	3.0
H Transport and Postal Activities	2.0	7.0	92.1	1.1	0.9
I Wholesale and Retail Trade	3.1	7.5	90.8	0.8	1.7
J Finance and Insurance	3.9	8.3	91.1	1.6	0.6
K Real Estate and Goods Rental and	1.4	6.0	93.2	1.5	0.8
L Scientific Research, Professional and Technical Services	2.9	8.0	90.3	1.4	1.7
M Accommodations, Eating and Drinking Services	5.2	9.4	90.2	0.5	0.3
N Living-Related and Personal Services and Amusement Services	2.9	6.3	93.1	0.6	0.6
O Education, Learning Support	3.7	7.4	92.0	0.6	0.6
P Medical, Health Care and Welfare	5.1	4.7	95.1	0.2	0.2
Q Compound Services	0.6	2.4	92.7	0.6	4.9
R Services, n.e.c.	2.8	6.7	91.6	3.2	1.7

As can be read, the average annual birth rate of establishments between July 1, 2009 and February 1, 2012 was 3.0 %, while the average annual death rate was 7.2 %. This resulted in the decrease (- 4.2 %) of the number of establishments during the period. Looking at the annual average rates by major industry, the average annual birth rate of establishments was the highest in “M – Accommodations, Eating and Drinking Services” (5.2 %), followed by “P – Medical, Health Care and Welfare” (5.1 %) and “J – Finance and Insurance” (3.9 %). On the other hand, the average annual death rate of establishments was the highest in “G – Information and Communications” (11.2 %), followed by “M – Accommodations, Eating and Drinking Services” (9.4 %) and “J – Finance and Insurance” (8.3 %).

It can be observed that the industry which had relatively high birth rate showed relatively high death rate. This was backed by the correlation coefficient of the birth rate (Rb) and the death rate (Rd), which was 0.455, indicating the distinction between a relatively “active” industry and a relatively non “active” industry.

#### **4. Conclusions**

In this paper, an alternative method for calculating business demography statistics, which is based not only on the business register but on the data of the Economic Censuses, was presented and it was applied to the calculation of indicators of the business demography statistics using the data of the Economic Censuses in Japan conducted in 2009 and 2012. The results of the calculation showed that the average annual death rate of establishments exceeded average annual birth rate during the period. And those industries that have relatively high birth rate showed relatively high death rate, resulting in a relatively high correlation coefficient between the birth rates and the death rates.

It would be interesting to know other indicators of business demography statistics such as birth rates and death rates of establishments by their size classes as well as the number of employees created by newly opened establishments. Finally, it should be noted that these accurate indicators based on the alternative method could be compared with those based on the business register EFD, if they could be compiled in the future. This would contribute to the improvement of the business demography statistics based on the business register.

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