Measurement of Depreciation Rates using Microdata from Disposal Survey of Japan

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Paper prepared for the 35th IARIW General Conference

Copenhagen, Denmark, August 20-25, 2018

Session 7E-2: Measuring Capital and Wealth I

FRIDAY, AUGUST 24, 14:00-17:30

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July 28, 2018

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Abstract

This paper estimates the asset service lives (ASL), the rates of depreciation, and the declining balance rates (DBR) based on a finely-defined classification of assets, which distinguishes 369 asset types, using data on ASL and aged-prices of disposed assets collected in the *Survey on Capital Expenditures and Disposals* from 2006 to 2014 in Japan. This survey collected 1,111,913 data of disposed assets from business accounts of private corporations, of which 936,861 are defined as retired assets acquired new and are used to estimate the survival profiles, and of which 84,291 are defined as sold assets for continued uses with positive prices are used to estimate the age-price profiles.

The Japan's rates of geometric depreciation estimated in this study are broadly similar to the estimates at Statistics Canada (Baldwin, Liu, and Tanguay, 2015), but considerably higher than those used in the U.S. BEA (2013), e.g. 7.5%, 7.3%, and 3.2%, respectively, for industrial building construction, 7.6%, 6.7%, and 2.5% for office buildings, 29.1%, 27.9%, and 19.3% for automobiles, 24.4%, 24.9%, and 11.2% for telecommunication equipment, and 17.9%, 17.2%, and 11.0% for industrial machinery. The sources in these gaps are due to the shorter ASL and the higher DBR in Japan and Canada, compared to the U.S. The exceptional asset is computers. Japan's rate of depreciation for computers is estimated as 29.6%, compared to 43.1% in Canada and 33.9% in the U.S. The gap is originated from much longer ASL observed in Japan (8.0 years on average), compared to Canada (4.9 years).

Keywords: capital, asset service life, depreciation rates, declining balance rates
JEL classification: C81, D24, E22

Any errors that remain are our sole responsibility. The views expressed in this paper are those of the authors and do not necessarily reflect the official views of the Economic and Social Research Institute (ESRI), Cabinet Office, Government of Japan. (Contact us: https://form.cao.go.jp/esri/en_opinion-0008.html)

1 Introduction

Estimating aging effects on asset retirement and price is problematic, since the required data are collected only partly and infrequently, if not unavailable. Consequently they have often appeared arbitrary without appropriate statistical basis in the national accounts. This was recognized as one of the areas required to be improved in the revision of the stock account in the Japan's system of national accounts (JSNA), which has been relied on ad hoc parameters assumed in the early 1970s. The Economic and Social Research Institute (ESRI), Cabinet Office, Government of Japan, has managed to make it through the data shortage within the project for a comprehensive revision on the JSNA capital stock launched in 2005.[1]

In order to collect the data for aged assets based on the detailed classification systematically, the ESRI started to conduct the *Survey on Capital Expenditures and Disposals* (CED) in 2006. The disposal survey in CED is designed to provide information required for estimating the aging profiles on asset retirement and price covering a wide range of assets owned by private corporations. In comparison with similar surveys conducted in Canada and the Netherlands[2], our survey has some unique characteristics. First, the CED is designed to have a very detailed classification of assets, with more than 600 asset classes at the most disaggregated level, in order to improve homogeneity within each type of asset. Second, it provides more comprehensive information on the characteristics of disposed assets both at their acquisition and at their disposal. In each observation of disposal data, it is identified at its acquisition if it was a new asset, a second-hand asset, or repair and improvement on assets acquired in the past; and at its disposal if a second-hand asset was sold for continued use or scrapped. Third, the periods of acquisition and disposal are reported monthly in the CED. It enables us to properly capture the profiles of assets with relatively short services lives as ICT equipment.[3]

This paper is an update of our previous study (Nomura and Suga, 2013), in order to provide the estimates on the rates of depreciation in the 2011 JSNA benchmark revision published as of the end of 2016. Compared to our previous study, there are several improvements in this paper. First, the raw data collected from the 2006–2012 CED, which was used in Nomura and Suga (2013), was inspected, in particular from the point of the views of identifying outliers and improving classification of assets. Due to our further data screening in this study, ad hoc assumptions used in our previous paper to ease some noises by misreporting could be removed. Secondly, the sample number of disposed assets was increased from 838,000 to 1,112,000, by adding the newly collected data from the 2013 and 2014 CED. Third, the assets disposed by the Great East Japan Earthquake in March 11, 2011 are newly identified in the questionnaires in the 2012–2014 CED and the impacts as a result of exceptional events could be removed in this study. Finally, in order to make observed asset prices with different ages to be more comparable, the noises of consumption tax on the prices as of both periods of acquisition and disposal

[1] See Nomura and Futakami (2005).

[2] See the studies based on micro database in Canada: Gellatly, Tanguay and Yan (2002), Statistics Canada (2007), and Baldwin, Liu and Tanguay (2015), and the studies in Netherlands: Meinen, Verbiest and Wolf (1998), Bergen, Haan, Hij and Horsten (2005), and Erumban (2008).

[3] The questionnaire of *Capital and Repair Expenditures Survey* by Statistics Canada directly investigates age of a disposed asset, rather than periods of disposal and acquisition. Gellatly, Tanguay and Yan (2002) adopted the correction for digit preference in the respondents, since they found a concentration of asset durations on rounding values like 5, 10, 15, and 20 years. The CED does not have such biases.

were newly considered.

In Section 2, we describe some properties of the CED disposal data and discuss our definitions the types of disposed assets, especially focusing on the remained values of retired assets. The methodological framework to estimate the survival profile based on the Weibull function and the age-price profile is described in Section 3. Section 4 reports the estimated results of the Weibull survival profiles for 369 assets and the age-price profiles for 265 assets. The estimates in this study are compared with those in our previous (Nomura and Momose, 2008 and Nomura and Suga, 2013), Canada (Statistics Canada, 2007 and Baldwin, Liu, and Tanguay, 2015), and in the U.S. (BEA, 2013). Section 5 concludes. Data screening process is reported in Appendix 1 and some detailed tables on our estimates are shown in Appendix 2.

2 Data

2.1 Asset Classification

The first disposal survey in *Survey on Capital Expenditures and Disposals* (CED) was conducted by ESRI as of the end of 2006, collecting data of disposed assets in Japan's fiscal year 2005 (April 2004–March 2005).[4] The CED consists of three questionnaires on capital and repair expenditures, financial leases, and disposals. In the disposal survey of CED, assets are classified into four broad asset groups; they are buildings and accompanying equipment, machinery and equipment, transportation equipment, and other equipment. In each group of assets, fifteen observations of disposed assets that are expected to be randomly selected by corporations are reported, yielding a total of sixty observations of disposed assets covering all four asset groups if a firm fully responds. The collected data are carefully examined at ESRI to correct for the misreported units and periods, and the misclassification of assets and categories. Appendix 1 provides the questionnaires of the disposal survey (in Table 9) and a description on the screening processes of the disposal data collected by CED.

The CED has a detailed classification for more than 600 types of assets. Better defining assets is expected to improve the stability of the estimates in rate of depreciation over periods. In order to define assets, we have considered three points of view. First view is a difference in materials or technologies used in assets. The buildings with different structure (e.g. wooden, steel-framed reinforced concrete, reinforced concrete, steel-framed, and others) are separately treated in our asset classification. Second, some assets are classified by the type of use. A physically unique motor vehicle is used in different production processes, e.g. for own use in corporations, passenger services, freight transportation, rental, demonstration, and so on. These differences in type of use may have a considerable impact in the economic behavior of disposal. Third, the large-scale repair and improvement as investment is separately identified from the acquisition of the asset itself.[5]

[4] The questionnaire and the system of asset classification for CED were designed by Koji Nomura, Yuji Onuki, and Shinichi Shimakita at the National Wealth Division, ESRI. In the 2006 CED, the survey subjects are about 133,000 firms that have a capital of 30 million yen or more, of which the numbers of survey objects and the effective responses are 30,000 (the sampling rate is 22.6 percent) and 12,173 (the response rate is 40.6 percent), respectively.

[5] Investment of building consists of new constructions as well as the large-scale repair and improvement of buildings purchased in the past. The latter expected to be depreciated faster than the building structure itself and tends to increase

The minimum number of available observations required to estimate the aging profiles on asset retirement and price is set as 20 in each type of asset. The defined classification has 369 types of asset at the most detailed 6-digit classification and 95 types as sub-aggregates at the 3-digit classification, while its broad groups of asset type are consistent with the 2008 SNA classification of assets.[6]

2.2 Definition of Retirement

Table 1 presents our definition on types of disposed assets and classifies them into five groups from (a) to (e). First, the group (a) is defined for the assets sold to other domestic producers for continued use in a similar production process. The assets in this group are recognized as surviving assets ([1] in Table 1) and are excluded from the sample used in estimating the survival profile by definition.

Table 1: Types of Disposed Assets

<table>
<tr><th colspan="4" rowspan="2">types of disposed assets</th><th rowspan="2">definition of retirement</th><th colspan="2">definition of remained value in assets</th></tr>
<tr><th>sold or scrapped</th><th>to whom</th><th>for what</th><th>(def-1)</th><th>(def-2)</th></tr>
<tr><td>(a)</td><td rowspan="4">sold (with positive prices)</td><td rowspan="2">to domestic producers</td><td>continuous use in the similar production process</td><td>[1] surviving assets</td><td colspan="2">market value</td></tr>
<tr><td>(b)</td><td>continuous use in the different production process or household</td><td rowspan="4">[2] retired assets</td><td rowspan="2">market value</td><td rowspan="4">0</td></tr>
<tr><td>(c)</td><td rowspan="2">to foreign purchasers</td><td>continuous use</td></tr>
<tr><td>(d)</td><td rowspan="2">scrapped</td><td rowspan="2">scrap value</td></tr>
<tr><td></td><td>anyone</td></tr>
<tr><td>(e)</td><td>scrapped</td><td>anyone</td><td></td><td></td><td></td><td></td></tr>
</table>

The second group (b) also consists of the assets sold to domestic producers, but for a use in different production processes or households. For example, based on the actual disposal data in CED, a considerable number of motor vehicles are deployed as fixed assets for a demonstration use in retailer's showroom and they have by nature a very short service life (just over 1 year on average, as measured later). Figure 1 provides the histogram of the number of collected samples on asset service lives of ordinary passenger cars. It describes how the cars with different uses can be mixed in a single type of asset. There are a considerable number of the assets owned and disposed within twelve months by car retailers.[7] This paper try to treat the same assets with different uses separately and classifies them into different types of asset.[8] In estimating the survival profile, the assets in group (b) are treated

the share in investment in developed economies. It may tend to overestimate the capital stock level if they were not identified in measuring capita stock by the perpetual inventory method.

[6] See Annex 1 in the 2008 SNA (United Nations, 2009).

[7] The vehicles disposed by car retailers consists of cars for their demonstration use and own business use, which are not necessarily identified in the CED questionnaire (some can be identified based on the asset explanations reported). Most of demonstrator cars identified in the CED were disposed within four ages. In this paper, we define the demonstrator cars, which are belong to the second group (b) in Table 1, as the cars disposed from car retailers within four ages.

[8] In the recent market of motor vehicle in Japan, when new cars are not sold to the Japanese customers, car retailers once register them by themselves and sell the new cars for sale as used at the second-hand market (and most are exported). Based on the Nikkei article ("Sri Lanka- A paradise of new cars for sale as used" in Japanese; February 19, 2016), the cars with 100–200 thousand km mileages are sold to the countries Kenya and Myanmar, but the cars with less one thousand km mileages, most of which are HV (hybrid vehicle) or EV (electric vehicle), are sold to Sri Lanka.

as retired ([2] in Table 1) since they are interpreted to be retired from the use in original production process.

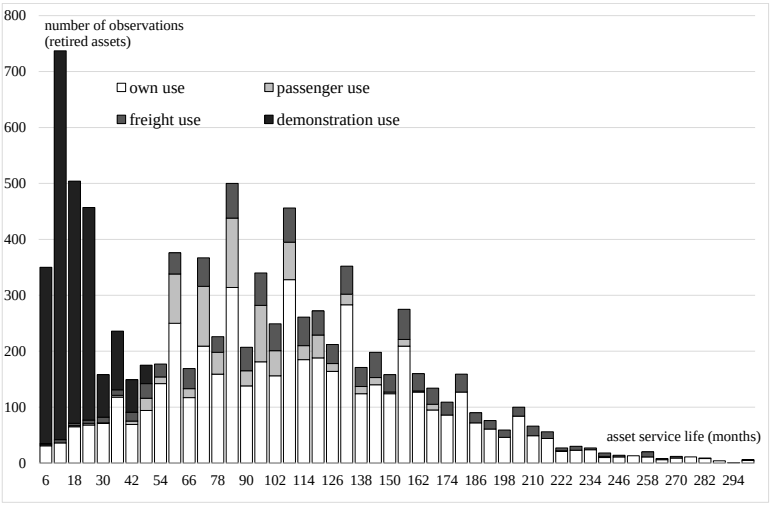

Figure 1: Histogram of ASL in Ordinary Passenger Cars

The third group (c) of disposed assets is to be exported (for scraps or uses in production process in foreign countries) and hence recognized as assets retired from domestic production.[9] The fourth group (d) consists of assets to be scrapped with positive prices and the fifth group (e) are assets simply abandoned. This paper defines the assets from (b) to (e) as retired assets ([2] in Table 1), to be used in estimating the survival profiles.

Table 2 lays out the sample size of each asset type collected by the disposal survey in CED during 2006–2014 based on the 1-digit classification of asset. The number of observations in Table 2 are counted after the following processes for redefining asset types. First, the asset that is reported as sold with zero or no information on its selling prices is redefined to an unidentified asset in [3]. Second, even if sold assets have positive selling prices, it sometimes seems to be better to recognize as the scrap values rather than the remained values of second-hand assets for continuous use. Thus we redefine the sold assets, of which the selling prices are less than 1% of its acquisition costs at constant price, as retired assets in [2]. Finally, the assets disposed by the Great East Japan Earthquake in 2011 are treated separately in [4], in order to prevent them from affecting the estimated aging profiles of assets.[10]

Out of the full sample of disposed assets (1,111,913 observations in all), 8.7% (97,038 observations) are recognized as [1]surviving assets defined in Table 1, 88.2% (980,731 observations) are recognized as [2]retired assets defined in Table 1, 2.7% (29,584) are not identified if it was sold or

Figure 1 may illuminate this kind of behavior. In our purpose of measuring ASL and depreciation rates, it is important to treat them separately.

[9] In the case of airplanes, all disposed assets collected in the survey are sold to domestic or foreign producers. Airplanes can have a very long service life as long as they are appropriately maintained, but they can also be retired prematurely for economic reasons. We treat all disposed airplanes as retired assets in the third group (c).

[10] These redefinitions are not considered in Nomura and Suga (2013). This redefinition in this paper may tend to increase the estimates of asset service lives and decrease the estimated rates of depreciation, as shown in Sections 0 and 4.2, respectively.

retired as of the period of disposal (classified to [3] in Table 2), and 0.4% (4,560) are disposed by the effect of the Great East Japan Earthquake in 2011 (classified to [4] in Table 2).

Table 2: Number of Observations in 2006–2014 CED

1st-digit classification of asset	SNA 2008 code	[1] surviving assets, sold with positive prices: (a)	of which, new assets as of acquisition period	[2] retired assets: (b)-(e)	of which, new assets as of acquisition period	[3] disposed assets, unkown if they were sold or retired	[4] disposed assets by the Great East Japan Earthquake	Total
1.Dwellings	AN111	2,752	1,949	5,290	4,640	268	22	8,332
2.Buildings other than dwellings	AN1121	5,027	4,168	52,998	49,995	1,574	636	60,235
3.Other structures	AN1122	2,293	2,127	52,824	50,748	1,598	325	57,040
4.Installation of equipment	-	4,967	4,612	114,720	111,742	2,974	680	123,341
5.Transport equipment	AN1131	40,360	33,202	91,589	78,810	5,231	412	137,592
6.ICT equipment	AN1132	4,210	4,083	157,317	154,134	4,003	337	165,867
7.Other machinery and equipment	AN1133	37,361	34,096	505,050	485,891	13,909	2,145	558,465
8.Costs of ownership transfer	AN116	53	42	738	703	17	2	810
9.Software	AN11731	15	12	205	198	10	1	231
Total		97,038	84,291	980,731	936,861	29,584	4,560	1,111,913

Unit: number of samples. Source: Survey on Capital Expenditures and Disposals, 2006–2014, (ESRI). Note: The asset group [2] includes the sold assets, of which the selling prices are less than 1% of the acquisition costs. The group [3] includes the sold assets with zero selling prices.

Within the assets of retired assets in [2], 936,861 observations were acquired as new and 43,870 were second-hand.[11] In estimating the survival profiles, we restrict our sample to the former of 936,861 observations to define appropriately the asset service lives. In estimating the age-price profiles (APP), 84,291 observations of the surviving assets acquired as new and sold with positive prices are used.

2.3 Definition of Asset Valuation

For the purpose of estimating APP, it may be more controversial how the remained asset values of retired assets should be defined and measured. As shown in Table 1, it is possible to estimate the APP based on two different definitions of the remained values of retired assets. In definition-1 (def-1 in Table 1), the values of retired assets are assumed to be the same as the scrap values or the values sold at the second-hand markets regardless of the differences in the subsequent use of the assets. Some of retired assets still have market values in a different production process (group (b) in Table 1), in foreign countries (group (c)), or as scrap (groups (d) and (e)). It seems economically reasonable to assume that assets are retired when the net present value stemming from the future capital income flows drops below the value received from the market.

In definition-2 (def-2 in Table 1), on the other hand, the remained values of retired assets are assumed to be zero. It seems reasonable to consider that a demonstrator car in retailer's showroom was retired not because it could be sold with a good price at the second-hand markets, but because it has lost its value of capital services as the purpose of a demonstrator car after it has aged for a few years as shown in Figure 1. The similar things happen in case of scraps. For the cases that the assets are sold as scraps with considerably positive prices, it is obvious that the scrap values do not lie in the

[11] The ages of these second-hand assets as of those acquisitions are not identified in the CED questionnaire. Thus they are not used in estimating the survival profiles and the age-price profiles in this study.

future capital services of the assets. Assets can generate capital values as a factor of production, only when they are kept intact as a functioning unit.

The choice on the definition of asset valuation depends on the methodological framework and practical assumptions used in capital stock measurement in the national accounts. If all exports of second-hand assets (and all sales to other institutional units) can be captured and explicitly treated in stock measurement, the asset valuation based on definition-1 may be consistent. In this case, however, the complicated framework to measure capital stocks, in which the assets are treated by vintage and the APP are defined only for surviving assets (not for a cohort of assets), are required. In the stock account of the current JSNA, the geometric approach as the APP for a cohort of assets is assumed, thus in which the disposals of second-hand assets are not explicitly treated, although the purchases of second-hand assets are included in investment. Thus the definition-2 may be preferred in the current JSNA.[12] In this paper, the depreciation rates are estimated based on the two asset valuations and the definition-2 estimates are treated as our default.

3 Methodology

We follow the models on vintage prices in Jorgenson (1973, 1989), Hulten and Wykoff (1981a, 1981b, and 1981c), and Diewert and Wykoff (2007). Let us start with measuring the survival profile and the average years of asset service lives. A number of empirical studies on the survival function of produced assets have assumed the Weibull family of distributions to approximate retirement patterns.[13] The Weibull survival profile with age τ is formulated as:

(1) $\quad s_\tau = \mathrm{EXP}[-(\tau/\lambda)^\alpha]$,

where λ and α are the scale and shape parameters, respectively (both are greater than 0).[14]

We approximate the actual survival probability using the asset service ages of the retired assets (defined in Section 2.2), weighted by the acquisition costs at constant prices as proxies for the quantities of the retired assets. In CED data, some observations have exceptionally large values as acquisition costs.[15] In each type of asset, we assume the upper limit of acquisition costs of the observations to provide the maximum value as the weights in estimating the Weibull survival profile, as shown in Figure 2. In our measurement, the observations of the top 1%, 5%, 15%, and 25% acquisition costs are adjusted in each type of asset.[16]

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[12] The asset valuation based on the definition-2 may be preferred especially for measuring productive aspect of capital and for productivity analysis.

[13] See Meinen, et al (1998), Nomura (2005), Erumban (2008), and Statistics Canada (2008).

[14] The Weibull distribution is more flexible than the exponential distribution, since it is the exponential distribution of the power transformed age: λ^α. In the special case of α=1, the Weibull distribution is identical with the exponential distribution, which has the constant rate of retirement.

[15] The distribution of acquisition costs reported in CED has a long tail in some assets. This may reflect not only the difference in the value of a single unit of asset, but also the difference in units (e.g. the total of sold assets is recorded when they are not separated) and in misreports of the units (the reporting unit was 10,000 yen in 2006 CED, but revised to 1,000 yen after 2007 in CED).

[16] In Nomura and Suga (2013), the observations of the top 25% acquisition costs were adjusted as their conservative assumption. However, this a prior assumption might underestimate the impacts of the large-scale observations. Due to our further data examination on data, some misreporting units are fixed in the disposal data used in this study. This paper examines four assumptions on the maximum values in Section 0 and finally accepts the top 5% adjustment rule as default estimates of this paper.

The survival function estimated using the observations collected during a short period by disposal surveys can be biased since the actual investment patterns are not steady. The use of pooled data of the disposed assets collected in a longer period during 2006–2014 is expected to reduce these biases, in compared to our previous studies. For the assets which have long service lives, however, we adjust the acquisition costs by multiplying the inverse of the volume index of investment to ease such biases.[17]

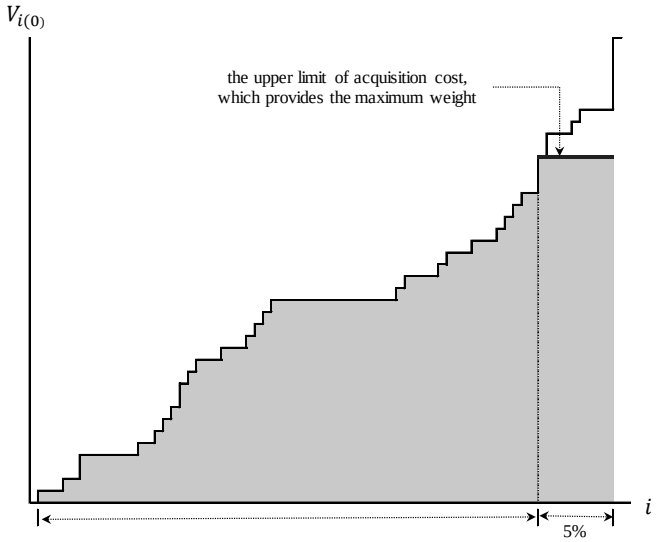


Figure 2: Maximum Acquisition Cost as the Weight

Taking logarithm of the Weibull cumulative hazard function (H_τ), we can obtain a log-linear relationship with age as follows:

(2) $\ln H_\tau = \beta + \alpha \ln \tau,$

where $\beta = -\alpha \ln \lambda$. The two parameters α and β are estimated for 369 types of asset in this paper. The 1st moment of the Weibull probability density function gives the average asset service life (T):

(3) $T = \lambda \Gamma(1 + 1/\alpha),$

where $\Gamma(\ )$ is the gamma function.

For estimating the price profile by aging, we begin with the definitions of two types of prices observed in CED. When i observations (i=1,2,…,N) are available in each type of asset to be sold, we express the value received by seller of the asset with age (τ) as of the period of disposal (t) as $D_{i(t,\tau)}$. The corresponding acquisition cost (gross book value) paid by the purchaser of the new asset (age 0) as of the past period of ($t-\tau$) as $A_{i(t-\tau,0)}$. Both are evaluated at historical costs.

[17] The volume index of investment (normalized as 1.0 in 2010) is defined by the investment at constant prices in each type of asset. The lower bound in the volume index is set as 0.5 for all assets, thus the acquisition costs as the sample weights are adjusted to be doubled at most.

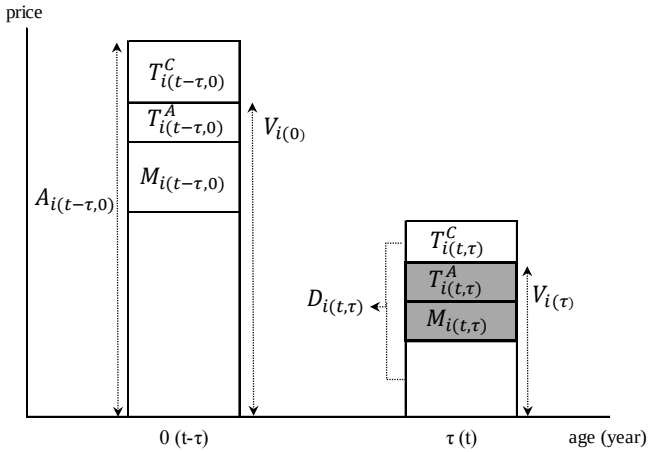


Figure 3: Adjustment on Observed Prices in Each Observation

For these two prices to be comparable in each observation of *i*, the differences in cost coverages and price definitions should be adjusted. Figure 3 compares the cost coverages of the two prices. The acquisition cost ($A_{i(t-\tau,0)}$) recorded in business accounts may include the wholesale margin and transportation costs ($M_{i(t-\tau,0)}$), acquisition tax of assets ($T^A_{i(t-\tau,0)}$), and the consumption tax ($T^C_{i(t-\tau,0)}$), which is deductible. The value received by seller ($D_{i(t,\tau)}$) may include the consumption tax ($T^C_{i(t,\tau)}$) and exclude other costs required for the purchaser; acquisition tax of assets ($T^A_{i(t,\tau)}$) and the wholesale margin and transportation costs ($M_{i(t,\tau)}$). For the purchaser of this second-hand asset, $T^C_{i(t,\tau)}$ is deductible.

To make these two comparable, $A_{i(t-\tau,0)}$ is converted to the acquisition value at constant price excluding deductible consumption;

(4) $$V_{i(0)} = \left(A_{i(t-\tau,0)} - T^C_{i(t-\tau,0)}\right)/P_{t-\tau},$$

where P_t stands for the price index for acquisition of a new asset. The deductible consumption is measured as

(5) $$T^C_{i(t-\tau,0)} = A_{i(t-\tau,0)}\pi^C_{t-\tau}/(1+\pi^C_{t-\tau}),$$

where π^C_t stands for the consumption tax rate at *t*. The value received by the seller $D_{i(t,\tau)}$ is converted to the hypothetical asset price paid by the purchaser,

(6) $$V_{i(\tau)} = \left(D_{i(t,\tau)} - T^C_{i(t,\tau)} + M_{i(t,\tau)} + T^A_{i(t,\tau)}\right)/P_t,$$

by excluding the consumption tax which is deductible for the purchaser of the asset[18],

(7) $$T^C_{i(t,\tau)} = D_{i(t,\tau)}\pi^C_t/(1+\pi^C_t),$$

and including the estimates of the wholesale margin and transportation costs[19] and acquisition tax of assets paid by the purchaser;

(8) $$M_{i(t,\tau)} = \left(D_{i(t,\tau)} - T^C_{i(t,\tau)}\right)m^C_t,$$

and

[18] In our previous study (Nomura and Suga, 2013), the consumption tax to be deductible for purchaser of the asset was not considered in equation (6).

[19] The rate of margin and transportation in each type of asset is based on the 2011 Benchmark Input-Output Table, published in June 2015 by Ministry of Internal Affairs and Communications. The average rates for machinery and equipment are 14.8% for the trade margin and 1.6% for the transportation cost.

(9) $T^{A}_{i(t,\tau)} = \left(D_{i(t,\tau)} - T^{C}_{i(t,\tau)} + M_{i(t,\tau)}\right)\pi^{A}_{t}$.

Based on these two adjusted prices, the age-price ratio of a surviving asset with age τ is defined as:

(10) $\rho'_{i(\tau)} = V_{i(\tau)}/V_{i(0)}$.

Next we formulate the age-price ratio for the cohort of assets, as a weighted average of that of surviving assets in equation (10) and that of retired assets. A number of studies have assumed the values of retired assets are zero, mainly due to the lack of information on net scrap value (gross scrap value less demolition costs) even though Hulten and Wykoff (1981b) recommended to include it in measuring APP. In defining APP, definition-1 in Table 1 assumes that the values of retired assets are identical with the market values of second-hand assets (for the assets of (b) and (c) in Table 1)[20] or scrap values (for the assets of (d) and (e)). In this approach, the age-price ratio for the cohort of assets $\rho^{*}_{\tau,i}$ is assumed as:

(11) $\rho^{*}_{i(\tau)} = s_{\tau}\rho'_{i(\tau)} + (1 - s_{\tau})\theta_{i(\tau)}$,

where $\theta_{i(\tau)}$ represents the average market values of the retired assets:

(12) $\theta_{i(\tau)} = \begin{cases} V_{i(\tau)}/V_{i(0)} & \text{, for assets in (b) and (c)} \\ \sum_{i'} V_{i'(\tau)}/\sum_{i'} V_{i'(0)} & \text{, for assets in (d) and (e)} \end{cases}$.

where i' is defined as the observations in the sample of retired assets aged over the average asset service lives (T) in equation (3) in each type of asset.[21]

Definition-2 in Table 1 assumes zero values for retired asset. In this approach, the age-price ratio of the cohort of assets $\rho^{**}_{i(\tau)}$ is assumed as:

(13) $\rho^{**}_{i(\tau)} = s_{\tau}\rho'_{i(\tau)}$.

Using three measures of age-price ratios, namely $\rho'_{i(\tau)}$ (for surviving assets), $\rho^{*}_{i(\tau)}$ (for the cohort of assets in definition-1), and $\rho^{**}_{i(\tau)}$ (for the cohort of assets in definition-2), three types of APP (APP'_{τ}, APP^{*}_{τ}, and APP^{**}_{τ}, respectively) are estimated in each of 263 types of assets. We assume APP follows the time-invariant geometric function. For example, in the case of definition-2, the parameter γ is estimated by taking logarithm of APP:

(14) $\ln APP^{**}_{\tau} = \gamma\tau$,

based on the weighted least squares method using the adjusted acquisition values at constant prices in equation (4), $V_{i(0)}$, as the weights.[22] A constant rate of depreciation δ is obtained as

(15) $\delta = 1 - \mathrm{EXP}(\gamma)$.

[20] The group (b) consists of demonstrator motor vehicles, which are recognized as retired from the original production process. And the group (c) consists of airplanes, in which all sold assets are assumed to be exported and are recognized as retired from the domestic economy by our definition.

[21] We assumed that the scrap value to the acquisition cost at constant prices does not exceed 10% in each asset.

[22] Although the CED data enables us to identify sold assets with positive selling prices, it would be hard to identify if they are the remained value of the surviving assets for continued use or the scrap value. For estimating APP, we use the observations, of which age-price rations range from 0.1 to 1.0.

4 Results

4.1 Asset Service Life

Table 3 shows the average asset service lives (ASL as T) estimated in the Weibull survival profile, based on different assumptions on the maximum acquisition costs as the weights used in the estimation, i.e. 1%, 5%, 15%, and 25% cases, shown in Figure 2. The estimates are based on 96 asset classifications, aggregated from the 6-digit estimates by 369 types of asset using the capital stock weights.[23]

Table 3: Estimated ASL by Different Assumptions

	this study				NS		this study				NS
	1%	5%	15%	25%	(2013)		1%	5%	15%	25%	(2013)
Total Assets owned by corporations	**21.7**	**21.0**	**20.2**	**19.6**	**18.8**	48.Other motor vehicles	14.9	14.5	14.2	14.0	13.5
1.Dwellings	**34.7**	**34.5**	**34.6**	**34.2**	**32.6**	49.Motorcycles	4.6	4.6	4.7	5.7	5.4
1.Houses owned by corpoations	34.6	34.0	33.9	33.5	32.9	50.Industrial trailers	15.9	15.8	15.6	15.5	15.1
2.Complex housing owned by corpoations	34.7	35.0	35.3	35.0	32.4	51.Other transport equipment	16.1	15.7	15.2	15.2	14.8
2.Buildings other than dwellings	**30.1**	**28.6**	**26.9**	**25.4**	**23.7**	**6.ICT equipment**	**9.3**	**9.5**	**9.7**	**9.8**	**9.8**
3.Plants	33.6	32.4	30.5	28.9	27.2	52.Computer equipment	7.2	7.4	7.7	7.8	7.7
4.Warehouses	30.5	30.3	29.1	28.1	26.6	53.Computer attachments	8.5	8.6	8.8	8.9	8.7
5.Offices	36.0	33.1	30.8	28.7	26.1	54.Wired telecommunication equipment	9.6	9.4	9.3	9.2	9.0
6.Stores	23.5	22.8	20.9	19.1	18.5	55.Wireless telecommunication equipment	12.0	12.8	13.1	13.2	14.0
7.Hotels	22.6	23.6	22.2	20.9	19.5	56.Office machines	10.0	10.1	10.3	10.4	10.2
8.Restaurants	15.7	14.9	14.1	13.5	12.3	**7.Other machinery and equipment**	**15.9**	**15.7**	**15.5**	**15.4**	**15.1**
9.Laboratories	28.1	25.6	23.3	22.3	20.0	57.Boilers and turbines	23.7	21.6	21.1	20.5	20.4
10.Model home	6.9	6.9	6.7	6.6	6.4	58.Engines	19.7	19.4	19.0	18.6	17.8
11.Recreation and training facilities	29.6	31.0	30.1	29.7	28.8	59.Carrying equipment	21.8	21.0	20.3	20.0	19.5
12.Other buildings	24.0	22.4	21.3	20.6	19.6	60.Refrigerators	17.5	17.1	16.8	16.5	16.2
3.Other structures	**23.4**	**22.4**	**21.5**	**21.1**	**20.4**	61.Pomps and compressors	19.6	19.1	18.7	18.4	17.9
13.Power plants	26.2	25.1	24.1	23.6	23.2	62.Industrial robots	12.9	13.0	13.2	13.5	13.2
14.Industrial water supply facilities	26.1	25.7	24.8	24.2	23.8	63.Other general industrial M&E	17.5	17.1	16.7	16.4	16.1
15.Sewage facilities	24.0	23.0	22.3	21.8	21.4	64.M&E for agriculture	18.5	17.3	17.0	16.9	16.8
16.Telecommunications and broadcasting facilities	15.7	15.2	15.2	15.2	13.9	65.M&E for construction and minig	13.9	14.0	14.1	14.2	13.5
17.Oil and Gas storage facilities and pipelines	34.7	32.7	29.9	28.7	28.2	66.M&E for food industry	20.1	19.6	18.8	18.2	18.0
18.Waste disposal facilities	16.6	16.9	16.4	16.3	15.8	67.M&E for textile and apparel industries	23.3	22.6	21.8	21.3	20.7
19.Advertising facilities	14.7	14.5	14.1	13.9	13.4	68.M&E for lumber and wood industries	17.1	17.3	17.1	17.0	16.5
20.Greening facilities	19.2	19.2	19.0	19.0	18.7	69.M&E for pulp and paper industries	17.2	17.0	16.5	16.2	15.8
21.Paved roadways	22.7	22.0	21.3	21.0	20.5	70.M&E for chemical industry	19.3	18.8	18.4	18.2	17.8
22.Automobile parking	16.6	16.5	16.0	15.8	14.9	71.Plastic working machinery	18.1	17.6	17.1	16.8	15.9
23.Other structures	23.5	22.2	21.4	21.0	20.5	72.Metal machines	20.6	20.5	20.3	20.2	19.6
4.Building equipment	**16.4**	**15.7**	**14.9**	**14.5**	**14.1**	73.Metal working machines	21.9	21.1	20.3	19.9	19.2
24.Power wiring equipment	18.6	18.3	17.6	17.0	16.4	74.Semiconductor manufacturing equipment	11.4	11.6	11.7	11.9	11.8
25.Power outlet wiring equipment	15.9	14.8	13.8	13.1	12.7	75.M&E for other industries in special purpose	21.3	20.3	19.0	18.3	18.1
26.Telecommunications wiring equipment	10.4	9.8	9.4	9.2	8.9	76.Machinists' precision tools	11.8	12.4	12.7	12.9	12.6
27.Anti-theft alarm equipment	13.0	12.4	11.8	11.7	11.6	77.Molds	11.3	11.5	11.6	11.6	11.3
28.Other electric equipment	17.2	16.6	15.4	14.7	14.5	78.Other general M&E	19.6	18.8	18.0	17.4	16.8
29.Water supply equipment	23.0	22.2	20.9	20.0	19.7	79.Equipment for servise industries	4.6	4.6	4.4	4.3	4.1
30.Hot water equipment	19.5	18.7	17.8	17.2	17.1	80.Electric audio and visual equipment	9.2	9.5	9.8	10.0	9.8
31.Water removal equipment	22.0	21.2	20.2	19.6	18.8	81.Household electric appliances	13.5	13.4	13.5	13.6	13.4
32.Sanitary equipment	21.1	20.5	19.2	18.6	18.1	82.Electronic appliances	12.7	13.0	13.2	13.4	13.4
33.Septic tanks	18.9	19.1	19.1	19.4	18.0	83.Electric measuring instruments	14.3	14.4	14.8	15.1	15.1
34.Gas fitting	21.2	20.3	19.4	18.9	18.6	84.Generators and electric motors	17.8	17.2	17.0	16.9	16.4
35.Ventilation equipment	19.2	18.3	17.1	16.6	16.2	85.Other industrial electric M&E	18.1	17.7	16.9	16.3	16.5
36.Smoke control equipment	19.6	17.9	16.2	15.3	15.2	86.Electric lighting fixtures	12.4	12.3	12.2	12.1	12.1
37.Disaster alarm equipment	19.8	19.6	19.1	18.4	18.1	87.Optical machinery	16.2	15.8	15.1	14.7	14.2
38.Escape equipment	17.6	17.9	17.2	16.7	16.2	88.Other precision instrument	13.6	14.0	14.4	14.5	14.2
39.Air curtains and automatic door equipment	15.7	15.4	15.1	15.0	14.4	89.Textile products	11.7	11.7	11.5	11.5	11.3
40.Arcades and sunshade equipment	15.8	16.0	15.7	15.3	14.9	90.Wood products	12.9	13.0	13.2	13.3	12.8
41.Interior decorating, partition and furniture	10.2	9.9	9.7	9.7	9.2	91.Metal products	14.7	14.5	14.7	14.9	14.3
42.Other buildings and accompanying facilities	13.5	12.7	12.2	12.0	11.7	92.Musical instruments	19.7	19.7	18.7	18.7	18.1
5.Transport equipment	**12.4**	**12.2**	**12.1**	**11.8**	**11.4**	93.Information recording mediums	8.8	9.2	10.1	10.4	9.5
43.Ships	19.8	19.0	17.2	16.7	15.9	94.Other manufacturing products	11.5	11.7	12.6	12.7	12.7
44.Airplanes	14.5	13.4	13.0	10.9	10.1	**8.Cost of ownership transfer**	**11.4**	**11.0**	**10.9**	**10.8**	**9.8**
45.Railcar	23.5	23.6	24.2	24.3	24.2	95.Cost of ownership transfer	11.4	11.0	10.9	10.8	9.8
46.Motor cars	9.1	9.1	9.1	9.2	9.0	**9.Software**	**10.3**	**10.3**	**10.2**	**10.4**	**10.8**
47.Bus and truck	12.5	12.5	12.6	12.6	12.1	96.Software	10.3	10.3	10.2	10.4	10.8

Unit: years. Note: The average asset service lives are aggregated from the 6-digit estimates, using the estimated stock weights as of the end of 2013.

[23] In aggregation, the weights are based on the estimated capital stocks owned by corporations as of the end of 2013 in JSNA. For the details which are not available in JSNA stock estimates, the total acquisition costs collected from CED was used to divide the stock estimates to correspond to our asset classification.

The 25% case estimates in Table 3 are comparable with our previous estimates in Nomura and Suga (2013). The estimates of T are somewhat upwardly revised, especially in buildings. This is mainly due to our further screening on the data in 2006–2012 CED. Some of building equipment that was involved in building itself (asset classes 1 or 2 in Table 3) in our previous studies is reclassified to building equipment (asset class 3) in this study, based on the reported explanations on the assets. In addition, the assets disposed by the East Japan Great Earthquake in 2011 were excluded from the retired asset observations in this study, in order to estimate the usual profile of surviving asset.

These further data screening enables us to relax the assumptions on maximum acquisition costs as the weights. The difference in these assumptions has a considerable impact on the estimates of T. In non-residential buildings (asset class 2), the changes on the assumptions from 25% to 15%, 5%, and 1% makes the estimated T to increase 1.5 years (7% increase of 23.7 years in the 25% case), 3.2 years (13%), and 4.7 years (21%), respectively. These results imply that the large-scale assets tend to have longer service lives. An exception is the ICT equipment (asset class 6), in which the large-scale asset tends to have a shorter service life. In this study, we adopt the 5% case estimates, by considering that CED may tend to collect large-scale assets compared to the population of assets.

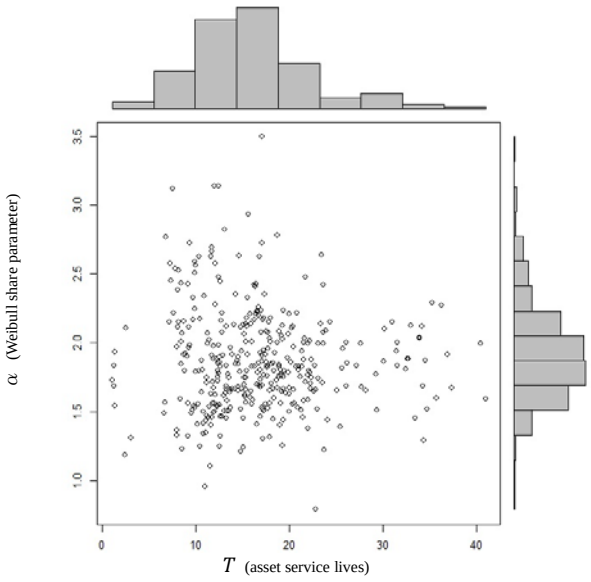
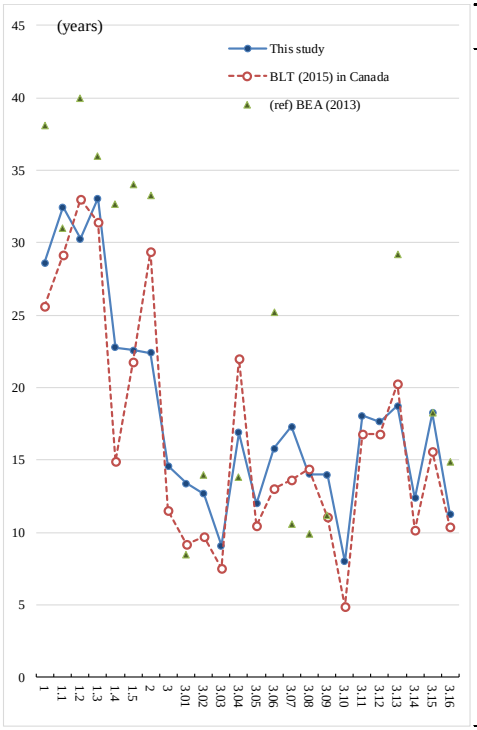


Figure 4: Estimated Parameters of Retirement Profiles

Figure 4 shows the estimated results of the average asset service lives (T) and the Weibull shape parameter (α), for 369 types of assets. The estimated service lives of the retired assets owned by corporations range from 1.0 year (88.light passenger cars for demonstration use) to 41.0 year (27.offices-reinfordced concrete); 61% out of the 369 assets has an average service life between 10 to 20 years, 25% over 20 years and 14% has below 10 years. The details in the estimated Weibull retirement profiles are presented in Table 10 in Appendix 2.

The shape parameter (α) determines the hazard rates of assets. In the special case of $\alpha = 1$, the Weibull distribution is identical with the exponential distribution that has a constant hazard rate (and

a constant rate of retirement). In the case of $\alpha = 2$, the hazard rate increases linearly. Meinen, Verbiest, and Wolf (1998) indicates that the hazard rates estimated in the Netherlands tend to be regressively increasing ($1 < \alpha < 2$) in many assets, except in computers, which have a progressively increasing hazard rate ($2 < \alpha$). Our results show the assets have progressively increasing hazard rates ($2 < \alpha$) are not exceptional (30% of the 369 assets). In particular, motor vehicles for passenger use, e.g. 99.motor coaches (3.5) and 93.ordinary passenger cars, and computers, e.g. 153.word processors (2.6), 124.personal computers (2.6), and 150.copy machines (2.5), tend to have α that is greater than 2. An institutional factor like the automobile inspection or speed of technological changes may be reflected in the shape parameters and affect the retirement behavior.[24] Based on our results in Figure 4, only in the assets with longer service lives (over 25 years) like building and construction, the estimated hazard rates tend to be regressively increasing ($1<\alpha<2$).



		This study	BLT (2015) in Canada	(ref) BEA (2013)
1	**Buildings(non-dwellings)**	**28.6**	**25.6**	**38.1**
1.1	Plants for manufacturing (13-18)	32.4	29.2	31.0
1.2	Warehouses (19-24)	30.3	33.0	40.0
1.3	Office buildings (25-30)	33.1	31.4	36.0
1.4	Shopping centres, plazas, malls, stores (31-36)	22.8	14.9	32.7
1.5	Other industrial and commercial buildings (37-42,45-48)	22.6	21.8	34.0
2	**Engineering construction**	**22.4**	**29.4**	**33.3**
3	**Machinery and equipment**	**14.6**	**11.5**	
3.01	Office furniture, furnishing (344,348)	13.4	9.2	8.5
3.02	Non-office furniture, furnishings and fixtures (342,343,345,347,349,350)	12.7	9.7	14.0
3.03	Automobiles and major replacement parts (86-95)	9.1	7.5	
3.04	Buses (all types) and major replacement parts (96-99)	16.9	22.0	13.8
3.05	Trucks, vans, truck tractors, truck trailers and major replacement parts (100-108)	12.0	10.5	
3.06	Other transportation equipment (79-85,109-123)	15.8	13.0	25.2
3.07	Tractors of all types and other field equipment (185-188)	17.3	13.6	10.6
3.08	Heavy construction equipment (189-199)	14.0	14.4	9.9
3.09	Scientific, professional and medical devices (339-341)	14.0	11.1	11.2
3.10	Computers, associated hardware and word processors (124-137)	8.0	4.9	
3.11	Heating, electrical, plumbing, air conditioning and refrigeration equipment (60-70,164-168)	18.1	16.8	
3.12	Pollution abatement and control equipment (227)	17.6	16.8	
3.13	Motors, generators, transformers, turbines, compressors and pumps of all types (155-157,169-174,317-328)	18.7	20.3	29.2
3.14	Capitalized tooling and other tools (hand, power, industrial) (264-269)	12.4	10.2	
3.15	Computer-assisted processing machinery and equipment (177,178,188,189,200-217)	18.3	15.6	18.3
3.16	Communication and related equipment (138-149)	11.3	10.4	14.9

Unit: years. Note: The ex post estimates on average service lives of assets owned by corporations are compared. Our estimates are aggregated from the 6-digit estimates (Table 10) based on 369 asset classification, using the stock weights as of the end of 2013. The corresponding codes of our asset classification are presented in parentheses.

Figure 5: International Comparison of Estimated ASL

Figure 5 compares our estimates with the estimates in Baldwin, Liu and Tanguay (2015) at Statistics Canada.[25] Although international comparison of asset service lives is never precise due to

[24] Nomura (2005) found that almost half of the assets have a shape parameter greater than 2, based on 66 types of asset classifications and the single-year disposal data. Nomura and Momose (2008) also indicates that 41% of the assets (80 assets) have progressively increasing hazard rates, based on 195 assets. The disaggregation in asset classification and the use of nine-year pooled data might improve the estimates of the parameters and the asset service lives in this paper.

[25] For better comparison, we follow the asset classification used at Statistics Canada: Table 8 (buildings), Table 9 (engineering construction), and Table 10 (machinery and equipment) in Baldwin, Liu and Tanguay (2015), and we aggregate our 6-digit estimates in Japan (Table 10) to correspond to this classification, using the stock weights as of the

the differences in asset classification and coverage, the ex post estimates of average service lives are broadly similar between Canada and Japan, in both of buildings and machinery and equipment. The comparison with the estimates in BEA (2013) is also presented for some selected assets in Figure 5. The U.S. estimates on building are quite longer than the estimates in Canada and Japan. The gaps between Canada-Japan and the U.S. will emerge more sharply in comparison of depreciation rates in section 4.2, due to the lower declining balance rates (DBR) assumed in the U.S.

In Japan, computers have a relatively longer service life of 8.0 years on average (3.10 in Figure 5), although the differences in the observation periods should be kept in mind (e.g. the timing of a new operating system may cluster the replacement of old computes). Based on the observations of the computers retired from 2006 to 2014, computer peripheral equipment has longer service lives, computers itself have about 8 years of service lives: 7.2 years for 124.personal computer, 8.1 years for 125.workstations, 7.4 years for 126.Midrange computers, and 7.6 years for 127.Mainframe computers, as presented in Table 10. Figure 4 shows the histograms of the number of observations in each asset service life of retired computers. Across all types of computers, the mode is 7 years (72–84 months) while a considerable number of computers were used beyond 10 years, especially in manufacturing sectors.

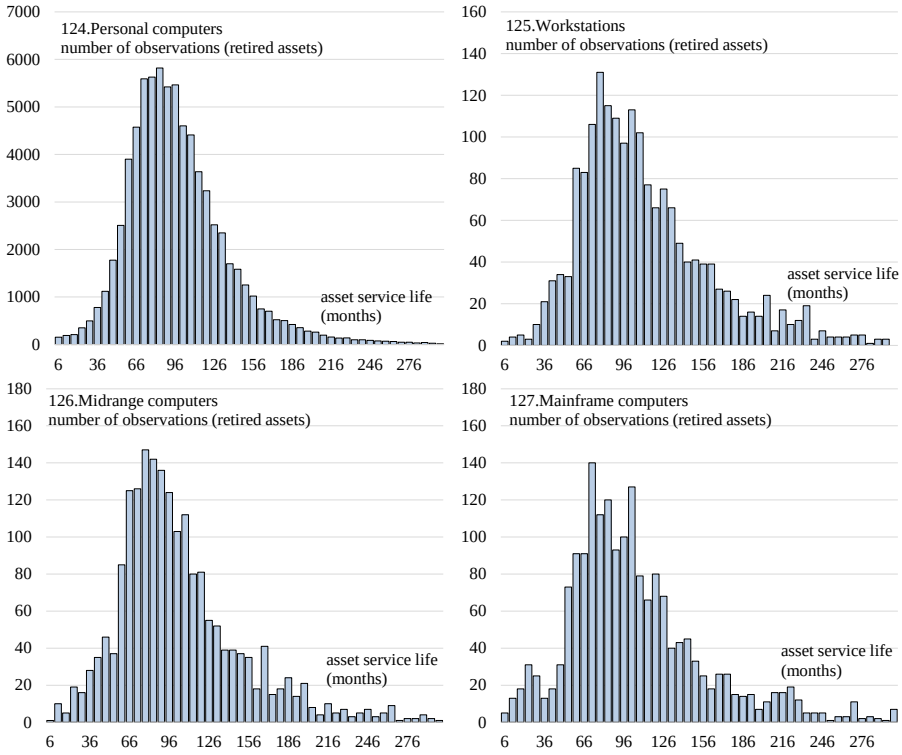


Figure 6: Histograms of ASL in Computers

end of 2013. The BEA (2013) estimates presented as reference in Figure 5 are also aggregated from the estimates based on the U.S. asset classifications, using the stock weights (Detailed Data for Fixed Assets and Consumer Durable Goods, BEA website: http://www.bea.gov/National/FAweb/Index2002.htm) as of the end of 2012 in the U.S.

4.2 Depreciation Rate

Using the data on sold assets for continuous use in the domestic production process (84,291 data in Table 2), the geometric rates of depreciation (δ) are estimated for 265 types of assets at the 6-digit asset classification, based on the estimated APP using the age-price ratios including scrap values of retired assets $\rho^{*}_{i(\tau)}$ (definition-1) in equation (11) and the age-price ratios assuming no values for retired assets $\rho^{**}_{i(\tau)}$ (definition-2) in equation (13). For the assets where the sample size is less than 20, δ is determined by the ratio of DBR/T using the estimated average asset service lives (T) and the assumed declining balance rates (DBR), that are approximated by the estimates at the aggregated level of 3-digit classification of assets.

A summary of our estimates on the ASL, the geometric rate of depreciation, and the DBR are presented in Table 5, based on 96 asset classification aggregated from the 6-digit estimates in Table 10. Table 4 compares our estimates revised in this paper to our previous study (Nomura, and Suga, 2013), based on 96 asset classification aggregated from the 6-digit estimates. The estimated depreciation rates are revised downwardly especially in buildings and construction, reflecting the upward revisions on the estimates of T in this paper, as discussed in section 4.1. There are no considerable revisions in transport equipment and ICT equipment. In software our estimates are upwardly revised from 21.2% to 21.9% in the case of definition-2. The aggregate rate of depreciation for corporations as a whole economy, reflecting the stock structures as of the end of 2013, is revised from 14.9% to 13.8% in definition-2. Comparing the results of the two assumptions on asset valuations of retired assets, the rate of depreciation using definition-2 is 1.3 percentage points higher than the estimates based on definition-1.

Table 4: Comparison of Estimated Depreciation Rates with Our Previous Study

	this study		NS (2013)			this study		NS (2013)	
	def-1	def-2	def-1	def-2		def-1	def-2	def-1	def-2
Total Assets owned by corporations	**.125**	**.137**	**.136**	**.149**	48.Other motor vehicles	.169	.178	.176	.191
1.Dwellings	**.071**	**.074**	**.078**	**.080**	49.Motorcycles	.334	.427	.387	.415
1.Houses owned by corpoations	.076	.078	.082	.085	50.Industrial trailers	.168	.179	.182	.190
2.Complex housing owned by corpoations	.065	.070	.072	.076	51.Other transport equipment	.152	.162	.158	.173
2.Buildings other than dwellings	**.078**	**.085**	**.089**	**.096**	**6.ICT equipment**	**.243**	**.275**	**.251**	**.277**
3.Plants	.072	.075	.080	.084	52.Computer equipment	.257	.306	.262	.298
4.Warehouses	.072	.078	.084	.088	53.Computer attachments	.245	.285	.230	.277
5.Offices	.069	.076	.083	.088	54.Wired telecommunication equipment	.239	.257	.263	.281
6.Stores	.082	.092	.093	.108	55.Wireless telecommunication equipment	.211	.233	.248	.253
7.Hotels	.111	.118	.113	.120	56.Office machines	.260	.280	.252	.274
8.Restaurants	.110	.122	.128	.146	**7.Other machinery and equipment**	**.172**	**.188**	**.181**	**.193**
9.Laboratories	.070	.078	.088	.101	57.Boilers and turbines	.120	.124	.114	.124
10.Model home	.199	.263	.229	.256	58.Engines	.171	.174	.177	.181
11.Recreation and training facilities	.077	.084	.075	.086	59.Carrying equipment	.150	.155	.152	.157
12.Other buildings	.084	.094	.094	.104	60.Refrigerators	.159	.171	.172	.182
3.Other structures	**.103**	**.111**	**.115**	**.128**	61.Pomps and compressors	.165	.170	.146	.153
13.Power plants	.080	.084	.088	.093	62.Industrial robots	.163	.188	.201	.208
14.Industrial water supply facilities	.087	.091	.076	.081	63.Other general industrial M&E	.175	.181	.177	.185
15.Sewage facilities	.111	.116	.117	.123	64.M&E for agriculture	.154	.163	.124	.131
16.Telecommunications and broadcasting facilities	.106	.126	.107	.148	65.M&E for construction and minig	.157	.165	.157	.166
17.Oil and Gas storage facilities and pipelines	.103	.104	.150	.151	66.M&E for food industry	.179	.187	.186	.194
18.Waste disposal facilities	.110	.116	.152	.168	67.M&E for textile and apparel industries	.148	.153	.129	.135
19.Advertising facilities	.138	.158	.150	.169	68.M&E for lumber and wood industries	.148	.163	.129	.151
20.Greening facilities	.119	.125	.105	.115	69.M&E for pulp and paper industries	.167	.173	.168	.174
21.Paved roadways	.118	.123	.126	.132	70.M&E for chemical industry	.154	.161	.158	.167
22.Automobile parking	.118	.135	.113	.135	71.Plastic working machinery	.173	.180	.164	.176
23.Other structures	.104	.111	.116	.123	72.Metal machines	.137	.148	.150	.157
4.Building equipment	**.130**	**.148**	**.149**	**.164**	73.Metal working machines	.133	.138	.141	.146
24.Power wiring equipment	.122	.133	.119	.137	74.Semiconductor manufacturing equipment	.221	.232	.250	.259
25.Power outlet wiring equipment	.138	.158	.152	.174	75.M&E for other industries in special purpose	.157	.165	.160	.167
26.Telecommunications wiring equipment	.133	.196	.145	.203	76.Machinists' precision tools	.175	.197	.184	.200
27.Anti-theft alarm equipment	.136	.170	.143	.154	77.Molds	.219	.240	.227	.245
28.Other electric equipment	.131	.140	.149	.159	78.Other general M&E	.124	.136	.158	.165
29.Water supply equipment	.110	.117	.122	.128	79.Equipment for servise industries	.357	.484	.603	.634
30.Hot water equipment	.125	.133	.130	.143	80.Electric audio and visual equipment	.202	.241	.211	.250
31.Water removal equipment	.136	.139	.134	.139	81.Household electric appliances	.185	.211	.204	.224
32.Sanitary equipment	.118	.123	.122	.128	82.Electronic appliances	.183	.207	.197	.206
33.Septic tanks	.114	.123	.133	.140	83.Electric measuring instruments	.212	.219	.198	.203
34.Gas fitting	.140	.144	.147	.151	84.Generators and electric motors	.138	.144	.128	.146
35.Ventilation equipment	.128	.134	.151	.159	85.Other industrial electric M&E	.138	.152	.128	.146
36.Smoke control equipment	.156	.167	.164	.170	86.Electric lighting fixtures	.197	.217	.174	.198
37.Disaster alarm equipment	.102	.115	.190	.193	87.Optical machinery	.136	.156	.149	.164
38.Escape equipment	.111	.126	.212	.215	88.Other precision instrument	.232	.242	.232	.239
39.Air curtains and automatic door equipment	.122	.140	.163	.169	89.Textile products	.141	.167	.173	.184
40.Arcades and sunshade equipment	.103	.133	.158	.164	90.Wood products	.189	.211	.187	.198
41.Interior decorating, partition and furniture	.160	.192	.178	.205	91.Metal products	.142	.161	.141	.161
42.Other buildings and accompanying facilities	.132	.156	.147	.168	92.Musical instruments	.137	.141	.111	.118
5.Transport equipment	**.204**	**.226**	**.209**	**.239**	93.Information recording mediums	.180	.214	.205	.217
43.Ships	.136	.142	.127	.137	94.Other manufacturing products	.142	.168	.159	.169
44.Airplanes	.104	.151	.109	.224	**8.Cost of ownership transfer**	**.153**	**.182**	**.199**	**.211**
45.Railcar	.111	.115	.081	.088	95.Cost of ownership transfer	.153	.182	.199	.211
46.Motor cars	.273	.291	.278	.292	**9.Software**	**.183**	**.219**	**.187**	**.212**
47.Bus and truck	.187	.206	.196	.213	96.Software	.183	.219	.187	.212

Unit: rates. Note: The depreciation rates are aggregated from the 6-digit estimates (Table 10) based on 369 asset classification, using the stock weights as of the end of 2013.

Table 5: Summary of Estimated Results

asset classification	code	weight (‰)	T (years)	def-1 δ (%)	def-1 DBR	def-2 δ (%)	def-2 DBR
Total Assets owned by corporations		1000	21.0	.125	2.61	.137	2.88
1.Dwellings		41.0	34.5	.071	2.43	.074	2.56
1.Houses owned by corpoations	101	21.0	34.0	.076	2.58	.078	2.66
2.Complex housing owned by corpoations	102	20.1	35.0	.065	2.27	.070	2.45
2.Buildings other than dwellings		232.6	28.6	.078	2.23	.085	2.44
3.Plants	201	67.8	32.4	.072	2.32	.075	2.43
4.Warehouses	202	12.5	30.3	.072	2.19	.078	2.36
5.Offices	203	63.6	33.1	.069	2.28	.076	2.51
6.Stores	204	26.1	22.8	.082	1.87	.092	2.10
7.Hotels	205	11.2	23.6	.111	2.62	.118	2.77
8.Restaurants	206	4.2	14.9	.110	1.63	.122	1.81
9.Laboratories	207	2.5	25.6	.070	1.79	.078	1.99
10.Model home	208	2.0	6.9	.199	1.37	.263	1.80
11.Recreation and training facilities	209	2.6	31.0	.077	2.39	.084	2.62
12.Other buildings	210	40.3	22.4	.084	1.88	.094	2.11
3.Other structures		308.4	22.4	.103	2.30	.111	2.49
13.Power plants	301	50.7	25.1	.080	2.02	.084	2.11
14.Industrial water supply facilities	302	12.0	25.7	.087	2.23	.091	2.33
15.Sewage facilities	303	6.0	23.0	.111	2.56	.116	2.66
16.Telecommunications and broadcasting facilities	304	56.2	15.2	.106	1.60	.126	1.91
17.Oil and Gas storage facilities and pipelines	305	41.5	32.7	.103	3.37	.104	3.41
18.Waste disposal facilities	306	4.7	16.9	.110	1.85	.116	1.96
19.Advertising facilities	307	9.7	14.5	.138	1.99	.158	2.29
20.Greening facilities	308	4.9	19.2	.119	2.28	.125	2.40
21.Paved roadways	309	23.9	22.0	.118	2.58	.123	2.71
22.Automobile parking	310	10.0	16.5	.118	1.95	.135	2.22
23.Other structures	311	88.7	22.2	.104	2.32	.111	2.46
4.Building equipment		79.8	15.7	.130	2.04	.148	2.32
24.Power wiring equipment	401	4.1	18.3	.122	2.24	.133	2.44
25.Power outlet wiring equipment	402	4.8	14.8	.138	2.04	.158	2.34
26.Telecommunications wiring equipment	403	1.2	9.8	.133	1.31	.196	1.92
27.Anti-theft alarm equipment	404	0.4	12.4	.136	1.69	.170	2.10
28.Other electric equipment	405	9.0	16.6	.131	2.17	.140	2.31
29.Water supply equipment	406	7.5	22.2	.110	2.44	.117	2.61
30.Hot water equipment	407	1.2	18.7	.125	2.33	.133	2.47
31.Water removal equipment	408	2.7	21.2	.136	2.87	.139	2.94
32.Sanitary equipment	409	1.4	20.5	.118	2.42	.123	2.52
33.Septic tanks	410	0.8	19.1	.114	2.18	.123	2.35
34.Gas fitting	411	1.0	20.3	.140	2.85	.144	2.93
35.Ventilation equipment	412	5.6	18.3	.128	2.34	.134	2.45
36.Smoke control equipment	413	1.2	17.9	.156	2.79	.167	2.99
37.Disaster alarm equipment	414	4.5	19.6	.102	1.99	.115	2.25
38.Escape equipment	415	0.1	17.9	.111	1.99	.126	2.25
39.Air curtains and automatic door equipment	416	0.7	15.4	.122	1.88	.140	2.16
40.Arcades and sunshade equipment	417	0.4	16.0	.103	1.65	.133	2.13
41.Interior decorating, partition and furniture	418	7.9	9.9	.160	1.59	.192	1.91
42.Other buildings and accompanying facilities	419	25.3	12.7	.132	1.67	.156	1.98
5.Transport equipment		48.5	12.2	.204	2.49	.226	2.75
43.Ships	501	2.3	19.0	.136	2.57	.142	2.69
44.Airplanes	502	7.3	13.4	.104	1.39	.151	2.02
45.Railcar	503	2.0	23.6	.111	2.61	.115	2.71
46.Motor cars	504	20.8	9.1	.273	2.47	.291	2.64
47.Bus and truck	505	10.4	12.5	.187	2.34	.206	2.58
48.Other motor vehicles	506	0.7	14.5	.169	2.46	.178	2.59
49.Motorcycles	507	0.4	4.6	.334	1.55	.427	1.98

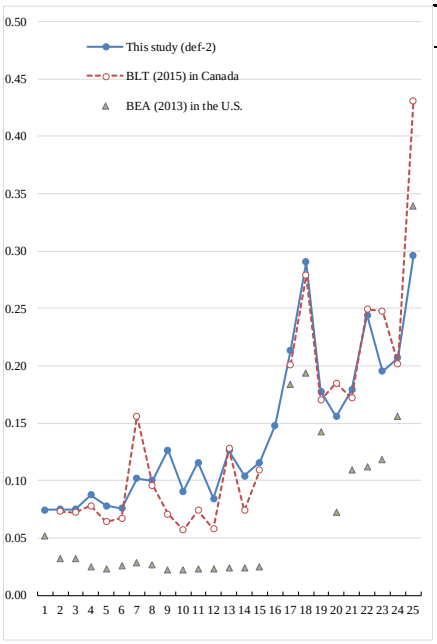
Unit: rates. Note: The asset service lives (T) and depreciation rates (δ) are aggregated from the 6-digit estimates (Table 10) based on 369 asset classification, using the stock weights as of the end of 2013. The DBR (declining balance rates) for aggregated assets are defined based on the aggregated T and δ.

Table 5: Summary of Estimated Results (continued)

asset classification	code	weight (‰)	T (years)	def-1 δ (%)	def-1 DBR	def-2 δ (%)	def-2 DBR
50.Industrial trailers	508	2.8	15.8	.168	2.65	.179	2.83
51.Other transport equipment	509	1.7	15.7	.152	2.39	.162	2.54
6.ICT equipment		23.5	9.5	.243	2.32	.275	2.62
52.Computer equipment	601	5.5	7.4	.257	1.90	.306	2.26
53.Computer attachments	602	5.3	8.6	.245	2.12	.285	2.46
54.Wired telecommunication equipment	603	3.8	9.4	.239	2.26	.257	2.43
55.Wireless telecommunication equipment	604	4.4	12.8	.211	2.71	.233	2.99
56.Office machines	605	4.5	10.1	.260	2.63	.280	2.84
7.Other machinery and equipment		214.4	15.7	.172	2.70	.188	2.95
57.Boilers and turbines	701	5.7	21.6	.120	2.58	.124	2.66
58.Engines	702	4.8	19.4	.171	3.31	.174	3.37
59.Carrying equipment	703	7.5	21.0	.150	3.16	.155	3.25
60.Refrigerators	704	6.0	17.1	.159	2.72	.171	2.92
61.Pomps and compressors	705	12.4	19.1	.165	3.15	.170	3.25
62.Industrial robots	706	1.8	13.0	.163	2.11	.188	2.43
63.Other general industrial M&E	707	5.4	17.1	.175	3.00	.181	3.11
64.M&E for agriculture	708	1.2	17.3	.154	2.66	.163	2.83
65.M&E for construction and minig	709	12.8	14.0	.157	2.21	.165	2.32
66.M&E for food industry	710	2.3	19.6	.179	3.51	.187	3.66
67.M&E for textile and apparel industries	711	1.2	22.6	.148	3.34	.153	3.45
68.M&E for lumber and wood industries	712	0.2	17.3	.148	2.56	.163	2.82
69.M&E for pulp and paper industries	713	2.5	17.0	.167	2.84	.173	2.94
70.M&E for chemical industry	714	6.8	18.8	.154	2.89	.161	3.02
71.Plastic working machinery	715	1.9	17.6	.173	3.04	.180	3.16
72.Metal machines	716	10.3	20.5	.137	2.80	.148	3.03
73.Metal working machines	717	5.2	21.1	.133	2.80	.138	2.93
74.Semiconductor manufacturing equipment	718	5.8	11.6	.221	2.56	.232	2.68
75.M&E for other industries in special purpose	719	5.2	20.3	.157	3.19	.165	3.35
76.Machinists' precision tools	720	14.2	12.4	.175	2.16	.197	2.44
77.Molds	721	10.8	11.5	.219	2.52	.240	2.75
78.Other general M&E	722	5.2	18.8	.124	2.34	.136	2.56
79.Equipment for servise industries	723	5.9	4.6	.357	1.64	.484	2.22
80.Electric audio and visual equipment	724	1.4	9.5	.202	1.92	.241	2.29
81.Household electric appliances	725	2.5	13.4	.185	2.47	.211	2.83
82.Electronic appliances	726	5.9	13.0	.183	2.37	.207	2.68
83.Electric measuring instruments	727	3.5	14.4	.212	3.06	.219	3.17
84.Generators and electric motors	728	2.6	17.2	.138	2.37	.144	2.48
85.Other industrial electric M&E	729	20.1	17.7	.138	2.44	.152	2.69
86.Electric lighting fixtures	730	8.3	12.3	.197	2.43	.217	2.68
87.Optical machinery	731	0.7	15.8	.136	2.15	.156	2.46
88.Other precision instrument	732	12.2	14.0	.232	3.25	.242	3.39
89.Textile products	733	2.0	11.7	.141	1.65	.167	1.96
90.Wood products	734	3.9	13.0	.189	2.46	.211	2.75
91.Metal products	735	4.5	14.5	.142	2.06	.161	2.32
92.Musical instruments	736	0.4	19.7	.137	2.71	.141	2.79
93.Information recording mediums	737	0.0	9.2	.180	1.65	.214	1.96
94.Other manufacturing products	738	11.5	11.7	.142	1.66	.168	1.97
8.Cost of ownership transfer		13.0	11.0	.153	1.68	.182	1.99
95.Cost of ownership transfer	801	13.0	11.0	.153	1.68	.182	1.99
9.Software		38.7	10.3	.183	1.90	.219	2.26
96.Software	901	38.7	10.3	.183	1.90	.219	2.26
A. Building and construction (1-3)		582.1	25.7	.091	2.33	.098	2.53
B. Machinery and Equipment (4-9)		417.9	14.3	.172	2.46	.192	2.75

Unit: rates. Note: The asset service lives (T) and depreciation rates (δ) are aggregated from the 6-digit estimates (Table 10) based on 369 asset classification, using the stock weights as of the end of 2013. The DBR (declining balance rates) for aggregated assets are defined based on the aggregated T and δ.

Figure 7 compares our estimates on the rate of depreciation with Baldwin, Liu and Tanguay (2015) at Statistics Canada and BEA (2013) in the U.S. Japan's average rates of depreciation (definition-2) are similar to those in Canada, with some exceptions as engineering construction (9-12 in Figure 7), in which Japan's rates are higher by 3-4 percentage points. A possible explanation is that our estimates are on the assets owned by private corporations. In computers, reflecting a large gap in the estimated average ASL of 8.0 years in Japan and 4.9 years in Canada (as presented in Figure 5), the rate of depreciation for computers in Canada (43.1%) is much higher than the U.S. (33.9%) and Japan (29.6%).



		This study		BLT (2015)	BEA (2013)
		def-1	def-2	in Canada	in the U.S.
1	Dwellings owned by firms (1-6)	.071	.074		.051
2	Industry building construciton	.072	.075	.073	.032
3	Plants for manufacturing (13-18)	.072	.075	.072	.032
4	Commercial building construction	.079	.087	.078	.025
5	Warehouses (19-24)	.072	.078	.064	.023
6	Office buildings (25-30)	.069	.076	.067	.025
7	Hotels, stores and restaurants (31-40)	.093	.102	.156	.028
8	Other buildings (41-48)	.088	.100	.096	.027
9	Transportation Engineering Construction (57-58)	.118	.127	.071	.023
10	Waterworks Engineering Construction (50)	.087	.091	.057	.022
11	Sewage Engineering Construction (51)	.111	.116	.074	.023
12	Electric Power Engineering Construction (49)	.080	.084	.058	.023
13	Communication Engineering Construction (52)	.106	.126	.128	.023
14	Oil and Gas Engineering Construction (53)	.103	.104	.074	.024
15	Other Engineering Construction (54-56,59)	.108	.116	.109	.024
16	Buildings accompanying facilities (60-78)	.130	.148		
17	Trucks, trucks chassis, vans, sport utility vehicles and major replacement parts (100-108)	.192	.214	.201	.184
18	Automobiles, vans, and sport utility vehicles and major replacement parts (86-95)	.273	.291	.279	.193
19	Tractors of all types and other field equipment (185-188)	.167	.178	.170	.143
20	Transportation Equipment (79-85,96-99,109-114,121-123)	.128	.156	.185	.072
21	Industrial Machinery (115-120,156-275,323,324,326,339,340)	.168	.179	.172	.110
22	Telecommunication Equipment (138-149)	.224	.244	.249	.112
23	Furnitures (344,348)	.184	.195	.248	.118
24	Other Machinery and Equipment (150-155,276-322,325,327-338,341-343,345-347,349-364)	.182	.207	.202	.156
25	Computers (124-137)	.251	.296	.431	.339

Unit: rates. Note: Our estimates are aggregated from the 6-digit estimates (Table 10) based on 369 asset classification, using the stock weights as of the end of 2013, for comparison. The corresponding codes of our asset classification are presented in parentheses.

Figure 7: Comparison of Estimated Depreciation Rates

The U.S. rates of depreciation (BEA, 2013) are much lower than those in Canada and Japan. Although this is consistent with our observation that the ASL is longer in the U.S. national accounts in Figure 5, the gap in depreciation rates expands due to lower DBR used in the U.S. estimates. The results measured in Canada and Japan show that the DBR for these long-lived assets (2.43 for plants, 2.36 for warehouses, and 2.51 for offices as presented in Table 5) are much higher than those derived from the historical U.S. studies, in which BEA assumes 0.97 for private nonresidential structures. These gaps in the parameters involved in the national accounts have to be in mind in international comparison.[26]

[26] Jorgenson, Nomura and Samuels (2016) compares relative volumes of capital input in Japan and the U.S. The volume level index of capital input per capita is 0.637 (36.3% smaller in Japan to the U.S.), which is a product of the volume index of capital stock per capita (0.909) and the index of capital quality (0.701). Lower index of capital quality indicates the larger shares of compensation for land as a capital in Japan, however the relative levels of capital stock may largely depend on the gap in the depreciation rates used in Japan and the U.S.

Figure 8 presents the estimates for depreciation rates and DBR (definition-2) by 265 types of assets. In our estimates, 60% of the estimated DBR ranges from 2 to 3 (36.1% and 24.0% are in regions of 2.0–2.5 and 2.5–3.0, respectively). Only a small number of assets with specific purposes (such as motor vehicles for demonstration use) has around 1.0 DBR with high depreciation rates. On building and construction, the assets with DBR that is smaller than 2.0 account only 10 out of 52 types of assets. The weighted average of DBR is estimated as 2.44 for non-residential building, 2.49 for other structures, 2.75 for transport equipment, 2.62 for ICT equipment, and 2.95 for other machinery and equipment, as presented in Table 5. This result justifies accelerating depreciation in the early ages of the asset, even in building and construction.

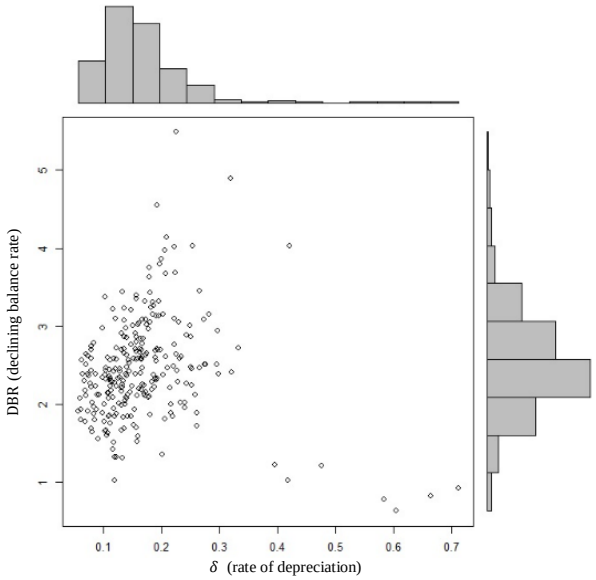


Figure 8: Estimated Rate of Depreciation and DBR

Table 6 presents the estimates of the average service lives (T), rates of depreciation (δ), and the DBR for the six types of buildings by types of building structure: wooden, SRC (steel-framed reinforced concrete), RC (reinforced concrete), S (steel-framed), and other structure. Although data uncertainty should be noted,[27] we could not find a clear relationship between the physical robustness and the asset service life. In all types of buildings except offices, wooden buildings have longer service lives than SRC buildings, which tend to be at locations commanding higher land prices.[28] It therefore seems reasonable that the retirement pattern depends more on economic decisions, and that shorter service lives and higher depreciations in B&C are observed in countries confronted by higher land prices.

[27] In many samples it is difficult to check the validity of reported building structures and the comparison by type of structure is subject to more data uncertainty.
[28] Reflecting the market prices of second-hand buildings, on the other hand, the wooden buildings have higher rates of depreciation rate, thus higher DBRs, relative to more durable buildings, as in houses owned by corporations.

Table 6: Depreciation Rates by Building Structure

	Wooden			SRC			RC			S			Others		
	T	δ	DBR	T	δ	DBR	T	δ	DBR	T	δ	DBR	T	δ	DBR
1.Houses owned by corpoations	34.2	.081	2.76	33.9	.059	2.00	36.3	.076	2.75	33.0	.080	2.63	31.0	.082	2.55
2.Complex housing owned by corporations	35.3	.066	2.33	34.3	.073	2.52	36.9	.068	2.52	32.6	.075	2.45	31.6	.067	2.11
3.Plants	40.5	na	na	37.4	.072	2.70	34.7	.082	2.83	31.5	.073	2.28	29.3	.082	2.39
4.Warehouses	34.6	na	na	28.2	.083	2.36	35.7	.074	2.64	30.1	.076	2.27	22.8	.101	2.30
5.Offices	33.5	.085	2.84	34.3	.074	2.54	41.0	.066	2.71	26.2	.083	2.16	21.3	.094	2.01
6.Stores	23.8	.094	2.23	20.5	.096	1.97	29.2	.069	2.02	22.1	.097	2.14	12.2	.134	1.64

Note: SRC: steel-framed reinforced concrete, RC: reinforced concrete, S: steel-framed.
Unit: years for T and % for δ.

Our estimates based on disposal data can be compared with the estimates using market rent data in Japan. Saita and Higo (2010) found the depreciation rates of the office building for Japan ranged from 4.6–5.6% based on their estimates of hedonic functions using rent data[29] and that it was twice larger than the estimate of 2.47% by the Hulten-Wykoff study (1981). Conceptually the estimates by Saita-Higo are comparable with our estimate (definition-2) of 7.6% in Table 5. The gap of 2-3 percentage points may be originated from the differences in their assumption on service lives. They assume 39–44 years by referring to a study investigating the service lives of office buildings in the central Tokyo (four Wards of Chiyoda, Chuou, Minato, and Shinjuku). However, this is much longer than our observations of 17.3–41.0 years as the average service lives of offices (Table 10).

In addition, other differences should be kept in mind. First, our disposal data covers the office buildings not only in the central Tokyo, but the whole of Japan. The share of small and medium size offices is larger in our samples, and this may bring out smaller ASL and higher depreciation rates. Second, offices that are not fully maintained are included in our samples. The data of the offices owned by J-REIT may have a sample bias from the point of the view of the quality in office building. Increasing the observations of less-quality and less-maintained offices may bring out higher depreciation rates. Although further examination will be required to bridge these observations, a gap of 2-3 percentage points in office buildings seems to be reasonable by taking into account of the potential biases.

Another important source in explaining the difference in the depreciation rates of buildings between Japan and other countries may stem from the consideration of renovation-type assets. Table 7 presents comparisons of the estimates between new acquisition and renovation of buildings. Compared with new construction of buildings, renovation activity has 39.1% shorter service lives and 37.4% higher rates of depreciation. In particular, there is a large gap in the depreciation rates in plants (11.4% for renovation versus 7.3% for new construction) and recreation and training facilities (13.4% for renovation versus 8.2% for new construction). It is a significant factor that will considerably raise the rate of depreciation in the time-series of building and construction for a whole economy. Given the distinctive nature of investment, a proper separation of renovation from other building investment may

[29] This data covers office building in the central Tokyo (five central Wards of Chiyoda, Chuou, Minato, Shibuya, and Shinjuku), owned by the J-REIT (Japan Real Estate Investment Trust) as of the period of 2007. Saita and Higo (2010) controlled the effects by the differences in locations, rents of land, equipment attached to building, sample bias that retired buildings are not observed, and replacement investment.

be a key to improving the measurement of capital stock.[30]

Table 7: Depreciation Rates for Renovation of Buildings

	new assets			ranovation			renovation/new	
	T	δ	DBR	T	δ	DBR	T	δ
1.Houses owned by corpoations	34.4	.078	2.68	23.5	.087	2.05	0.685	1.118
2.Complex housing owned by corporations	35.5	.069	2.46	21.6	.087	1.88	0.608	1.251
3.Plants	33.0	.073	2.41	20.0	.114	2.29	0.607	1.569
4.Warehouses	30.9	.076	2.35	19.1	.114	2.18	0.618	1.508
5.Offices	33.8	.075	2.52	17.3	.106	1.82	0.511	1.417
6.Stores	23.5	.090	2.11	15.9	.113	1.79	0.677	1.253
7.Hotels	24.1	.114	2.76	19.3	.142	2.76	0.802	1.246
8.Restaurants	15.2	.119	1.81	12.3	.147	1.81	0.813	1.230
9.Laboratories	26.1	.076	1.98	17.6	.112	1.98	0.677	1.477
10.Model home	6.7	.266	1.79	10.1	.177	1.79	1.507	0.664
11.Recreation and training facilities	31.5	.082	2.59	19.3	.134	2.59	0.612	1.635
12.Other buildings	22.6	.094	2.12	17.4	.109	1.90	0.770	1.166
Total	30.1	.082	2.47	18.3	.113	2.07	0.609	1.374

Unit: years for T and % for δ.

Table 8 presents the estimates of the average asset service lives and the depreciation rates for motor vehicles by type of use. Our asset classification allows us to compare the differences of depreciation rates by four types of use: firm-own use, passenger use, freight use, and demonstration-use. Although demonstrator cars have much shorter lives of 1.0–1.3 years and high depreciation rates of over 80%, it marks a clear difference from own use and freight use. For passenger use, ordinary cars including taxis have faster rates of depreciation than that for other uses.

Table 8: Depreciation Rates by Use Types of Vehicles

	own use			passenger use			freight use			demonstration use		
	T	δ	DBR	T	δ	DBR	T	δ	DBR	T	δ	DBR
1.Light passenger car	9.7	.262	2.56				10.0	.250	2.50	1.0	.889	0.93
2.Small passenger car	9.1	.286	2.61				9.3	.297	2.76	1.3	.829	1.08
3.Ordinary passenger car	9.1	.285	2.59	7.5	.331	2.48	9.8	.266	2.62	1.2	.844	1.05
4.Minibus	15.6	.169	2.64	17.1	.158	2.70						
5.Motor coaches	12.4	.230	2.84	12.4	.180	2.23						
6.Mini-sized pickup truck	11.7	.213	2.50				12.1	.205	2.48			
7.Pickup truck	11.7	.197	2.31				12.1	.206	2.48			
8.Truck	12.8	.200	2.55				1.3	.822	1.10			

Unit: years for T and % for δ.

5 Conclusion

This study is an update of Nomura and Suga (2013) to provide the comprehensive estimates on the rates of depreciation for private corporations used in the 2011 JSNA benchmark revision. By our further examination on the CED 2006–2012 and the addition of the CED 2013–2014, the ASL are somewhat revised upwardly, thus the depreciation rates are downwardly revised, in building and construction. However, the overall propensity on asset profiles do not change.

The rates of geometric depreciation estimated in this study are broadly similar to the estimates at

[30] The current fixed capital formation matrices in JSNA still does not separately treat the renovation at the most detailed level of assets. This is a next challenge for the stock account in JSNA.

Statistics Canada (Baldwin, Liu, and Tanguay, 2015), but considerably higher than those used in the U.S. BEA (2013). For example, the depreciation rates in Japan, Canada, and the U.S. are 7.5%, 7.3%, and 3.2%, respectively, for industrial building construction, 7.6%, 6.7%, and 2.5% for office buildings, 29.1%, 27.9%, and 19.3% for automobiles, 24.4%, 24.9%, and 11.2% for telecommunication equipment, and 17.9%, 17.2%, and 11.0% for industrial machinery. The sources in these gaps are due to the shorter ASL and the higher DBR in Japan and Canada, compared to the U.S.

The estimates in this paper covers the assets owned by private corporations. In the 2011 JSNA benchmark revision that was published as of the end of 2016, the depreciation rates for the assets owned by government and public corporations were also developed mainly using the observed ASL data and our assumptions on DBR measured in this study.

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Appendix.1 Data Screening

Each observation in the disposal survey in CED provides the information presented in Table 9. The answers are carefully examined at ESRI to address any possible incomplete response and misreports. First, observations with missing years of acquisition and disposal or the reported time of acquisition being after the reported time of disposal are removed (Q3 and Q6 in Table 9). When the months of acquisition and disposal are missed (only the year is reported), June is assumed as approximation. Only in the case that the year of acquisition and disposal are the same, January is assumed for acquisition and December for disposal. Second, when the asset described to be acquired “second-hand” (e.g. old buildings in Q1) but the classification of acquisition reported “new” in Q4, the classification of acquisition is corrected to “second-hand”, and vice versa.

Third, some respondents misreported the purchase values of the assets thousand times over in Q5. Every asset with an unusual acquisition value is extracted. An experimental range of acquisition value for a single asset is assumed and the outliers from this range are carefully examined, so as not to provide inappropriate weights in estimating survival profiles and age-price profiles.

Table 9: Questionnaires in Disposal Survey

Q1	description on disposed asset (maker brands, model type, and any explanation on properties of this asset)	
Q2	6-digit classification of asset (based on the search system)	
Q3	period of acquisition	a.year
		b.month
Q4	asset type as of the period of asset acquisition	a.new product
		b.second-hand product
		c.repair and improvement on assets (acquired in the past)
Q5	nominal acquisition cost as of the period of purchase of asset	
Q6	period of disposal	a.year
		b.month
Q7	disposal type	a.sold
		b.scrapped
Q8	value received at the period of disposal (If the asset is sold (a in Q6), this value is the sales price that was actually obtained from selling (not the residue value in account ledgers). If the asset is scrapped (b in Q6), this value is the sales price as scrap.)	
Q9	any additional notes on this asset (e.g. “The sales price of this building includes land price.” “The sales price is the scrap value of several assets, (it cannot be recorded for each asset .)")	

Fourth, despite our effort in developing a system to facilitate respondents’ search for the proper code of the asset reported, we found a lot of misclassification of assets in Q2, which is incompatible with the descriptions of assets in Q1. Thus we selected frequently-appearing words from the descriptions of assets and made a “corpus” specific to each particular asset-category. The asset-code screening rules are made by the positive or negative lists of keywords (e.g. maker brands, model name, etc.) referring to the high-frequency phrases mechanically extracted from the corpus which contains records of all descriptions of assets in the CED accumulated over nine years. The rules also consider some features of Japanese language (e.g. word-order, special-meaning kanji characters, etc.). All asset-categories reported are compared to this corpus and are adjusted to be appropriate. From the information of the classification of acquisition in Q4, renovation for buildings are classified as a separate category from the building itself. Parts/module only for transport equipment are classified as a separate category from the completed product into which they are assembled and those for other equipment are contained in the same categories as the completed product.

In examining the reported descriptions of assets in Q1, it was unexpectedly found that quite a few records of payments for ownership transfer costs (OTCs) on fixed assets and for acquisition of the custom-made and pre-packaged software were reported. Consequently five new separated categories are prepared for them, and their service lives and the rate of depreciation are calculated on trial in the same way as the other fixed assets are. After this screening process, the asset classification is redefined to 369 types at the most detailed level.

Appendix.2 Supplementary Tables

Table 10: Estimated ASL and Rate of Depreciation

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	(t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	(t-value)	adj R^2	δ (%)	DBR
1.Houses owned by corpoations (wooden)	101021	14.4	2.12	163.6	-7.7	-176.4	38.6	.970	815	34.2	194	-.069	-24.7	.758	.066	a	-.082	-32.9	.848	.079	2.70	-.084	-33.5	.852	.081	2.76
2.Houses owned by corpoations (steel-framed reinforced concrete: SRC)	101022	2.0	2.03	58.6	-7.4	-66.1	38.3	.934	242	33.9	151	-.042	-15.1	.600	.041	a	-.058	-24.2	.795	.056	1.91	-.061	-24.9	.803	.059	2.00
3.Houses owned by corpoations (reinforced concrete: RC)	101023	2.9	2.27	63.5	-8.4	-72.1	41.0	.936	275	36.3	156	-.064	-28.9	.842	.062	a	-.075	-37.6	.901	.072	2.62	-.079	-39.4	.909	.076	2.75
4.Houses owned by corpoations (steel-framed: S)	101024	0.3	2.12	65.0	-7.7	-75.4	37.2	.975	111	33.0	29	-.065	-10.4	.786	.063	a	-.082	-14.0	.871	.078	2.58	-.083	-14.2	.874	.080	2.63
5.Houses owned by corpoations (other structure)	101025	0.4	2.15	45.1	-7.6	-49.9	35.0	.935	143	31.0	23	-.070	-9.3	.788	.068	a	-.082	-11.7	.855	.079	2.44	-.086	-12.0	.860	.082	2.55
6.Houses owned by corpoations (renovation)	101029	0.8	1.71	94.7	-5.6	-111.0	26.4	.951	463	23.5	34	-.063	-11.7	.799	.061	a	-.087	-17.3	.897	.084	1.97	-.091	-17.2	.897	.087	2.05
7.Complex housing owned by corporations (wooden)	102021	4.0	2.29	84.1	-8.4	-90.8	39.8	.969	229	35.3	27	-.038	-7.2	.656	.037	a	-.061	-14.6	.887	.059	2.08	-.068	-16.2	.906	.066	2.33
8.Complex housing owned by corporations (steel-framed reinforced concrete: SRC)	102022	5.3	1.68	58.9	-6.1	-67.2	38.4	.874	502	34.3	335	-.057	-37.2	.805	.055	a	-.069	-50.9	.886	.067	2.30	-.076	-53.9	.896	.073	2.52
9.Complex housing owned by corporations (reinforced concrete: RC)	102023	8.5	1.91	89.2	-7.1	-99.9	41.6	.917	719	36.9	400	-.055	-38.3	.786	.054	a	-.067	-51.5	.869	.065	2.39	-.071	-53.9	.879	.068	2.52
10.Complex housing owned by corporations (steel-framed: S)	102024	1.0	1.88	47.7	-6.8	-53.6	36.7	.923	191	32.6	38	-.062	-10.5	.741	.060	a	-.076	-13.6	.830	.073	2.39	-.078	-13.8	.832	.075	2.45
11.Complex housing owned by corporations (other structure)	102025	0.6	2.00	38.4	-7.2	-42.6	35.6	.893	178	31.6	38	-.047	-14.5	.846	.045	a	-.063	-19.9	.912	.061	1.94	-.069	-19.7	.911	.067	2.11
12.Complex housing owned by corporations (renovation)	102029	0.7	2.00	288.0	-6.4	-344.5	24.3	.991	734	21.6	50	-.045	-16.3	.841	.044	a	-.082	-29.1	.944	.078	1.69	-.091	-25.4	.928	.087	1.88
13.Plants (wooden)	201001	2.1	1.99	142.2	-7.6	-160.6	45.7	.980	411	40.5						b				.057	2.30				.059	2.40
14.Plants (steel-framed reinforced concrete: SRC)	201002	10.6	1.67	196.5	-6.2	-245.9	41.8	.963	1,498	37.4	98	-.058	-28.5	.892	.056	a	-.073	-39.7	.941	.071	2.64	-.075	-39.9	.942	.072	2.70
15.Plants (reinforced concrete: RC)	201003	6.1	1.52	113.9	-5.5	-137.5	38.5	.921	1,115	34.7	39	-.067	-20.9	.918	.065	a	-.082	-26.6	.948	.079	2.74	-.085	-26.2	.946	.082	2.83
16.Plants (steel-framed: S)	201004	45.5	1.94	453.3	-6.9	-533.6	35.5	.984	3,302	31.5	136	-.054	-22.2	.784	.052	a	-.072	-34.5	.897	.069	2.17	-.075	-35.0	.900	.073	2.28
17.Plants (other structure)	201005	0.4	1.51	257.7	-5.3	-304.8	32.5	.967	2,288	29.3	80	-.059	-17.5	.793	.057	a	-.080	-25.7	.892	.077	2.27	-.085	-26.6	.898	.082	2.39
18.Plants (renovation)	201009	3.1	1.63	999.5	-5.1	-1147.0	22.4	.997	3,312	20.0	103	-.083	-20.9	.809	.080	a	-.113	-30.6	.901	.107	2.15	-.122	-32.0	.909	.114	2.29
19.Warehouses (wooden)	202001	0.9	1.87	201.5	-6.8	-230.9	38.9	.983	696	34.6						b				.063	2.17				.067	2.33
20.Warehouses (steel-framed reinforced concrete: SRC)	202002	1.3	1.66	228.9	-5.7	-261.2	31.6	.987	667	28.2	46	-.063	-19.4	.890	.062	a	-.082	-26.1	.937	.079	2.22	-.087	-25.5	.934	.083	2.36
21.Warehouses (reinforced concrete: RC)	202003	1.7	1.60	99.6	-5.9	-120.2	39.9	.936	684	35.7	37	-.056	-19.8	.913	.054	a	-.073	-29.8	.960	.070	2.51	-.077	-30.8	.962	.074	2.64
22.Warehouses (steel-framed: S)	202004	7.8	1.87	281.8	-6.6	-324.9	33.9	.976	1,956	30.1	119	-.053	-19.9	.768	.051	a	-.073	-33.2	.903	.070	2.11	-.079	-35.6	.914	.076	2.27
23.Warehouses (other structure)	202005	0.1	1.66	1209.3	-5.4	-1356.0	25.5	.998	3,044	22.8	98	-.072	-16.7	.739	.069	a	-.098	-24.9	.863	.093	2.12	-.106	-27.6	.886	.101	2.30
24.Warehouses (renovation)	202009	0.7	1.56	519.1	-4.8	-582.3	21.2	.995	1,427	19.1	56	-.073	-21.7	.893	.071	a	-.104	-32.7	.950	.099	1.88	-.121	-37.6	.962	.114	2.18
25.Offices (wooden)	203001	1.4	1.45	153.4	-5.2	-176.8	36.9	.970	728	33.5	33	-.067	-12.6	.828	.065	a	-.087	-16.8	.895	.083	2.79	-.088	-17.0	.897	.085	2.84
26.Offices (steel-framed reinforced concrete: SRC)	203002	26.6	1.29	194.2	-4.7	-261.6	37.1	.952	1,889	34.3	225	-.053	-26.0	.751	.051	a	-.069	-37.3	.861	.067	2.30	-.077	-38.5	.868	.074	2.54
27.Offices (reinforced concrete: RC)	203003	16.1	1.59	163.6	-6.1	-210.3	45.7	.944	1,602	41.0	236	-.052	-29.2	.783	.050	a	-.065	-39.9	.871	.063	2.56	-.068	-40.9	.876	.066	2.71
28.Offices (steel-framed: S)	203004	16.5	1.85	450.2	-6.3	-525.8	29.4	.991	1,842	26.2	166	-.054	-27.0	.815	.053	a	-.076	-42.7	.916	.073	1.91	-.086	-45.3	.925	.083	2.16
29.Offices (other structure)	203005	0.3	1.51	509.2	-4.8	-602.9	23.6	.991	2,366	21.3	116	-.057	-20.3	.780	.056	a	-.088	-35.0	.913	.085	1.80	-.099	-36.0	.918	.094	2.01
30.Offices (renovation)	203009	2.7	1.51	820.8	-4.4	-949.3	19.1	.994	3,728	17.3	135	-.056	-18.8	.723	.054	a	-.095	-33.8	.894	.090	1.56	-.112	-41.9	.928	.106	1.82
31.Stores (wooden)	204001	1.1	1.22	99.2	-3.9	-129.0	25.4	.972	288	23.8	27	-.062	-8.4	.720	.060	a	-.094	-13.7	.874	.089	2.12	-.099	-14.4	.884	.094	2.23
32.Stores (steel-framed reinforced concrete: SRC)	204002	5.9	1.56	216.5	-4.9	-292.7	22.8	.974	1,268	20.5	62	-.050	-16.4	.812	.049	a	-.083	-32.6	.945	.080	1.64	-.101	-35.6	.953	.096	1.97
33.Stores (reinforced concrete: RC)	204003	5.8	1.77	137.4	-6.2	-186.0	32.9	.958	838	29.2	59	-.040	-14.0	.768	.040	a	-.064	-27.4	.927	.062	1.80	-.071	-30.1	.939	.069	2.02
34.Stores (steel-framed: S)	204004	10.8	1.80	174.2	-5.8	-216.3	24.8	.960	1,260	22.1	104	-.068	-23.8	.845	.066	a	-.092	-36.2	.927	.088	1.94	-.102	-37.6	.932	.097	2.14
35.Stores (other structure)	204005	0.1	1.53	273.2	-4.0	-326.1	13.6	.982	1,402	12.2	89	-.066	-14.2	.694	.063	a	-.124	-31.8	.919	.117	1.42	-.144	-36.4	.937	.134	1.64
36.Stores (renovation)	204009	2.4	1.65	552.0	-4.7	-676.7	17.8	.994	1,751	15.9	60	-.063	-18.0	.843	.061	a	-.111	-33.1	.948	.105	1.67	-.120	-31.7	.944	.113	1.79
37.Hotels	205000	9.9	1.43	57.6	-4.7	-69.8	26.5	.900	370	24.1	58	-.086	-14.1	.773	.082	a	-.114	-19.8	.871	.108	2.60	-.121	-21.1	.884	.114	2.76
38.Hotels (renovation)	205009	1.3	1.75	147.4	-5.4	-176.6	21.7	.979	457	19.3						b				.135	2.60				.142	2.76
39.Restaurants	206000	3.8	1.70	151.2	-4.8	-182.8	17.0	.967	778	15.2	38	-.064	-14.6	.848	.062	a	-.114	-29.2	.957	.107	1.63	-.127	-26.1	.947	.119	1.81
40.Restaurants (renovation)	206009	0.4	1.54	120.7	-4.0	-140.4	13.7	.981	284	12.3						b				.132	1.63				.147	1.81
41.Laboratories	207000	2.3	1.68	200.5	-5.7	-242.5	29.2	.989	433	26.1	33	-.051	-9.8	.740	.050	a	-.071	-13.7	.850	.068	1.77	-.079	-14.3	.861	.076	1.98
42.Laboratories (renovation)	207009	0.1	1.82	60.6	-5.4	-68.3	19.9	.963	141	17.6						b				.101	1.77				.112	1.98
43.Model home	208000	1.9	1.56	76.3	-3.1	-89.9	7.5	.900	647	6.7	55	-.135	-11.3	.698	.126	a	-.226	-20.8	.887	.202	1.36	-.310	-28.8	.938	.266	1.79
44.Model home (renovation)	208009	0.1	1.41	40.4	-3.4	-50.3	11.1	.932	120	10.1						b				.134	1.36				.177	1.79
45.Recreation and training facilities	209000	2.5	1.83	62.1	-6.5	-70.9	35.5	.881	524	31.5	158	-.063	-27.4	.826	.061	a	-.078	-39.1	.906	.075	2.37	-.086	-45.8	.930	.082	2.59

Table 10: Estimated ASL and Rate of Depreciation (continued, 1)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	α (t-value)	β	β (t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	γ (t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	γ (t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	γ (t-value)	adj R^2	δ (%)	DBR
46.Recreation and training facilities (renovation)	209009	0.1	1.25	47.8	-3.8	-54.0	20.7	.924	188	19.3						b				.123	2.37				.134	2.59
47.Other buildings	210000	38.3	1.64	724.6	-5.3	-829.5	25.3	.990	5,040	22.6	323	-.058	-31.0	.749	.057	a	-.087	-49.8	.885	.083	1.88	-.098	-54.5	.902	.094	2.12
48.Other buildings (renovation)	210009	2.0	1.56	325.8	-4.6	-376.5	19.4	.989	1,195	17.4	39	-.074	-8.8	.665	.071	a	-.108	-13.9	.831	.102	1.78	-.115	-13.9	.832	.109	1.90
49.Power plants	301000	50.7	1.66	429.4	-5.5	-490.0	28.1	.986	2,684	25.1	87	-.056	-13.8	.685	.055	a	-.084	-22.4	.851	.080	2.02	-.088	-23.3	.862	.084	2.11
50.Industrial water supply facilities	302000	12.0	1.81	837.9	-6.1	-951.8	28.9	.997	2,344	25.7	40	-.066	-10.2	.719	.064	a	-.091	-16.8	.876	.087	2.23	-.095	-17.7	.886	.091	2.33
51.Sewage facilities	303000	6.0	1.52	212.1	-4.9	-239.1	25.5	.961	1,816	23.0	44	-.090	-15.5	.844	.086	a	-.118	-22.1	.917	.111	2.56	-.123	-23.0	.923	.116	2.66
52.Telecommunications and broadcasting facilities	304000	56.2	2.06	441.6	-5.9	-510.0	17.1	.979	4,117	15.2	75	-.055	-10.7	.603	.054	a	-.112	-25.8	.899	.106	1.60	-.135	-23.9	.884	.126	1.91
53.Oil and Gas storage facilities and pipelines	305000	41.5	1.88	309.7	-6.8	-362.0	36.9	.968	3,221	32.7	93	-.093	-16.9	.754	.089	a	-.109	-21.3	.829	.103	3.37	-.110	-21.7	.835	.104	3.41
54.Waste disposal facilities	306000	4.7	1.73	312.4	-5.1	-346.1	18.9	.987	1,281	16.9	32	-.072	-13.8	.856	.070	a	-.116	-25.2	.952	.110	1.85	-.123	-26.5	.956	.116	1.96
55.Advertising facilities	307000	9.7	1.68	1489.2	-4.7	-1704.4	16.2	.997	7,347	14.5	127	-.112	-30.4	.879	.106	a	-.148	-45.4	.942	.138	1.99	-.172	-51.9	.955	.158	2.29
56.Greening facilities	308000	4.9	1.65	522.9	-5.0	-571.7	21.4	.993	2,059	19.2	58	-.090	-10.0	.630	.086	a	-.127	-15.8	.811	.119	2.28	-.134	-16.8	.829	.125	2.40
57.Paved roadways	309000	23.9	1.58	958.8	-5.1	-1089.3	24.5	.992	7,272	22.0	155	-.096	-22.5	.765	.092	a	-.125	-32.3	.871	.118	2.58	-.131	-34.2	.883	.123	2.71
58.Automobile parking	310000	10.0	1.40	547.3	-4.1	-616.4	18.1	.987	3,857	16.5	138	-.087	-17.4	.686	.083	a	-.126	-27.2	.843	.118	1.95	-.145	-32.3	.883	.135	2.22
59.Other structures	311000	88.7	1.67	1893.5	-5.4	-2140.9	24.9	.996	14,222	22.2	375	-.084	-31.4	.724	.080	a	-.110	-44.8	.843	.104	2.32	-.117	-46.9	.854	.111	2.46
60.Power wiring equipment installation	401000	4.1	1.66	1042.9	-5.0	-1204.9	20.4	.995	5,412	18.3	184	-.098	-24.4	.764	.094	a	-.131	-37.8	.886	.122	2.24	-.143	-43.9	.913	.133	2.44
61.Power outlet wiring equipment installation	402000	4.8	1.52	1233.7	-4.3	-1487.0	16.4	.992	12,073	14.8	340	-.111	-39.1	.818	.105	a	-.148	-55.8	.901	.138	2.04	-.172	-76.8	.946	.158	2.34
62.Telecommunications wiring equipment installation	403000	1.2	1.54	522.7	-3.7	-601.8	10.9	.984	4,400	9.8	104	-.088	-13.0	.619	.084	a	-.143	-21.1	.810	.133	1.31	-.218	-47.8	.956	.196	1.92
63.Anti-theft alarm equipment installation	404000	0.4	1.75	445.5	-4.6	-500.6	13.9	.993	1,325	12.4	32	-.110	-7.2	.615	.104	a	-.147	-10.6	.777	.136	1.69	-.186	-13.6	.852	.170	2.10
64.Other electric equipment installation	405000	9.0	1.70	1774.2	-5.0	-2141.7	18.6	.998	7,305	16.6	193	-.104	-20.5	.685	.099	a	-.140	-30.3	.826	.131	2.17	-.150	-31.9	.840	.140	2.31
65.Water supply equipment installation	406000	7.5	1.70	1320.4	-5.5	-1553.0	24.9	.995	7,981	22.2	299	-.089	-28.1	.726	.085	a	-.116	-41.7	.853	.110	2.44	-.125	-46.6	.879	.117	2.61
66.Hot water equipment installation	407000	1.2	1.73	315.4	-5.2	-359.4	20.9	.982	1,841	18.7	69	-.100	-11.1	.637	.095	a	-.133	-16.4	.795	.125	2.33	-.142	-18.0	.825	.133	2.47
67.Water removal equipment installation	408000	2.7	1.75	871.0	-5.6	-1011.4	23.8	.995	3,434	21.2	110	-.120	-18.9	.764	.113	a	-.146	-24.8	.848	.136	2.87	-.150	-25.7	.857	.139	2.94
68.Sanitary equipment installation	409000	1.4	1.66	822.3	-5.2	-960.1	22.9	.996	2,546	20.5	97	-.094	-21.4	.825	.090	a	-.126	-32.5	.916	.118	2.42	-.132	-35.2	.927	.123	2.52
69.Septic tanks installation	410000	0.8	1.80	560.7	-5.5	-612.0	21.5	.997	1,006	19.1	23	-.088	-6.7	.655	.085	a	-.121	-10.2	.816	.114	2.18	-.131	-11.4	.848	.123	2.35
70.Gas fitting installation	411000	1.0	1.56	673.7	-4.9	-767.6	22.6	.995	2,103	20.3	198	-.124	-26.2	.776	.116	a	-.151	-34.2	.855	.140	2.85	-.155	-35.0	.861	.144	2.93
71.Ventilation equipment installation	412000	5.6	1.79	964.2	-5.4	-1125.3	20.6	.994	5,909	18.3	146	-.105	-20.0	.733	.100	a	-.137	-30.5	.865	.128	2.34	-.144	-32.2	.876	.134	2.45
72.Smoke control equipment installation	413000	1.2	1.56	248.5	-4.7	-299.3	19.9	.977	1,447	17.9	41	-.145	-16.9	.874	.135	a	-.170	-20.6	.912	.156	2.79	-.182	-21.1	.916	.167	2.99
73.Disaster alarm equipment installation	414000	4.5	1.63	1398.5	-5.0	-1638.5	21.9	.997	5,462	19.6	93	-.068	-14.1	.679	.065	a	-.107	-25.0	.870	.102	1.99	-.122	-30.5	.909	.115	2.25
74.Escape equipment installation	415000	0.1	1.31	181.1	-3.9	-211.2	19.4	.987	448	17.9						b				.111	1.99				.126	2.25
75.Air curtains and automatic door equipment installation	416000	0.7	1.75	1224.1	-5.0	-1366.9	17.2	.998	3,555	15.4	67	-.089	-13.6	.732	.085	a	-.130	-22.5	.883	.122	1.88	-.151	-28.8	.925	.140	2.16
76.Arcades and sunshade equipment installation	417000	0.4	1.59	720.4	-4.6	-818.1	17.9	.997	1,553	16.0	25	-.069	-6.9	.648	.067	a	-.109	-12.5	.862	.103	1.65	-.142	-23.1	.955	.133	2.13
77.Interior decorating, partition and furniture installation	418000	7.9	1.53	1386.4	-3.7	-1552.0	11.0	.987	24,521	9.9	486	-.116	-35.8	.725	.110	a	-.175	-57.9	.874	.160	1.59	-.214	-74.0	.918	.192	1.91
78.Other buildings and accompanying facilities installation	419000	25.3	1.46	1643.3	-3.8	-1880.8	14.0	.993	18,637	12.7	514	-.090	-32.1	.667	.086	a	-.141	-57.2	.864	.132	1.67	-.170	-71.5	.909	.156	1.98
79.Steel ships	501010	1.4	2.42	76.6	-7.9	-96.1	26.6	.957	266	23.6	173	-.084	-33.8	.868	.080	a	-.104	-47.1	.928	.099	2.34	-.110	-48.1	.930	.104	2.45
80.Other ships	501020	0.1	1.24	57.9	-3.4	-65.6	16.1	.910	332	15.1	87	-.096	-12.5	.640	.092	a	-.149	-20.6	.829	.139	2.09	-.156	-21.1	.836	.145	2.18
81.Ships (improvement)	501099	0.9	1.56	89.4	-4.0	-105.1	13.4	.985	124	12.0						b				.193	2.32				.202	2.43
82.Airplanes	502000	2.5	0.79	5.2	-2.3	-6.0	19.8	.468	30	22.8						c				.074	1.68				.096	2.19
83.Airplanes (improvement)	502009	4.8	1.23	140.6	-2.7	-166.0	9.1	.982	370	8.6	23	-.063	-5.0	.512	.061	a	-.127	-10.2	.817	.119	1.02	-.197	-18.0	.934	.179	1.53
84.Railcar	503000	1.8	2.64	134.3	-8.6	-141.2	26.4	.966	630	23.5						b				.099	2.32				.104	2.43
85.Railcar (improvement)	503009	0.2	2.15	460.7	-7.1	-532.2	27.5	.990	2,111	24.3	22	-.243	-7.0	.684	.216	a	-.256	-7.8	.730	.226	5.49	-.261	-8.1	.747	.230	5.58
86.Light passenger car (own use)	504011	0.7	2.17	201.3	-5.2	-217.3	11.0	.943	2,448	9.7	390	-.244	-39.3	.798	.216	a	-.291	-52.1	.875	.252	2.46	-.304	-56.2	.890	.262	2.56
87.Light passenger car (freight use)	504013	0.5	2.57	221.6	-6.2	-236.7	11.3	.966	1,731	10.0	171	-.210	-24.2	.773	.189	a	-.259	-34.2	.872	.228	2.29	-.287	-38.7	.898	.250	2.50
88.Light passenger car (demonstration)	504014	0.0	1.72	133.5	-0.3	-27.8	1.2	.955	838	1.0						c				.203	0.21				.889	0.93
89.Small passenger car (own use)	504021	6.3	2.43	605.1	-5.7	-648.6	10.3	.971	10,934	9.1	2,850	-.278	-130.1	.856	.243	a	-.321	-174.1	.914	.275	2.50	-.337	-194.5	.930	.286	2.61
90.Small passenger car (freight use)	504023	1.8	2.72	329.7	-6.4	-352.8	10.5	.961	4,443	9.3	519	-.264	-47.5	.813	.232	a	-.308	-66.6	.895	.265	2.47	-.352	-82.6	.929	.297	2.76

Table 10: Estimated ASL and Rate of Depreciation (continued, 2)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	(t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	(t-value)	adj R^2	δ (%)	DBR
91.Small passenger car (demonstration)	504024	0.1	1.93	304.4	-0.7	-171.8	1.5	.971	2,783	1.3						c				.237	0.31				.829	1.08
92.Ordinary passenger cars (own use)	504031	9.5	1.90	717.9	-4.4	-765.6	10.2	.991	4,926	9.1	3,125	-.268	-148.6	.876	.235	a	-.324	-200.9	.928	.276	2.51	-.335	-217.4	.938	.285	2.59
93.Ordinary passenger cars (passenger use)	504032	0.6	3.12	74.5	-6.6	-79.8	8.4	.873	805	7.5	39	-.328	-20.2	.913	.280	a	-.387	-28.4	.954	.321	2.40	-.402	-30.1	.959	.331	2.48
94.Ordinary passenger cars (freight use)	504033	1.2	2.25	278.2	-5.4	-297.6	11.1	.986	1,121	9.8	361	-.251	-44.3	.845	.222	a	-.289	-57.2	.901	.251	2.47	-.310	-65.9	.923	.266	2.62
95.Ordinary passenger cars (demonstration)	504034	0.1	1.83	323.7	-0.6	-158.7	1.4	.981	2,072	1.2						c				.246	0.30				.844	1.05
96.Minibus (own use)	505011	0.0	2.12	65.0	-5.7	-70.4	14.9	.963	162	13.2						c				.170	2.25				.184	2.43
97.Minibus (passenger use)	505012	0.0	2.33	23.5	-6.7	-26.0	17.5	.831	113	15.5	46	-.150	-18.9	.885	.139	a	-.181	-24.7	.930	.166	2.57	-.184	-25.0	.931	.168	2.61
98.Motor coaches (own use)	505021	0.1	2.93	51.9	-8.4	-57.5	17.5	.946	155	15.6	29	-.154	-14.3	.875	.143	a	-.182	-18.7	.923	.166	2.59	-.186	-19.3	.927	.169	2.64
99.Motor coaches (passenger use)	505022	1.0	3.50	200.9	-10.3	-215.3	19.0	.958	1,759	17.1	237	-.150	-38.1	.859	.140	a	-.170	-46.1	.900	.157	2.68	-.172	-46.7	.902	.158	2.70
100.Mini-sized pickup truck (own use)	505031	0.1	3.14	102.5	-8.2	-107.7	13.9	.963	410	12.4	26	-.229	-9.3	.766	.204	a	-.252	-11.1	.825	.223	2.76	-.261	-11.8	.841	.230	2.84
101.Mini-sized pickup truck (freight use)	505033	0.1	2.48	180.0	-6.5	-191.4	14.0	.981	631	12.4	38	-.148	-8.1	.629	.138	a	-.190	-11.9	.787	.173	2.15	-.198	-12.4	.800	.180	2.23
102.Pickup truck (own use)	505041	0.5	2.66	298.4	-6.9	-319.1	13.2	.992	758	11.7	224	-.183	-23.2	.706	.168	a	-.227	-33.5	.834	.203	2.38	-.240	-36.4	.856	.213	2.50
103.Pickup truck (freight use)	505043	1.0	2.57	193.8	-6.7	-205.4	13.6	.966	1,304	12.1	360	-.161	-37.5	.796	.149	a	-.211	-60.0	.909	.191	2.31	-.229	-68.1	.928	.205	2.48
104.Truck (own use)	505051	0.6	2.69	161.8	-7.0	-173.9	13.2	.981	501	11.7	183	-.141	-28.1	.811	.131	a	-.195	-48.3	.927	.177	2.08	-.220	-52.3	.937	.197	2.31
105.Truck (freight use)	505053	5.5	2.28	227.0	-5.9	-247.0	13.6	.967	1,755	12.1	1,138	-.164	-85.7	.866	.151	a	-.214	-137.6	.943	.193	2.33	-.230	-156.4	.956	.206	2.48
106.Tractor head	505060	1.4	2.21	81.9	-5.9	-88.3	14.4	.958	294	12.8	227	-.154	-35.9	.850	.143	a	-.206	-58.7	.938	.186	2.37	-.223	-70.0	.956	.200	2.55
107.Bus and Truck (demonstration)	505094	0.1	1.54	89.7	-0.6	-40.0	1.5	.964	302	1.3	71	-.372	-18.7	.831	.311	a	-.877	-71.3	.986	.149	0.20	-1.405	-58.5	.980	.822	1.10
108.Bus and Truck (improvement)	505099	0.1	1.91	170.4	-4.4	-193.8	9.8	.987	392	8.7	46	-.176	-14.1	.811	.162	a	-.244	-24.4	.928	.217	1.89	-.295	-32.0	.957	.256	2.23
109.Special-purpose motor vehicles and attaching to vehicles	506010	0.7	2.11	318.5	-5.9	-354.1	16.7	.979	2,199	14.8	505	-.138	-45.5	.804	.129	a	-.183	-70.7	.908	.167	2.47	-.193	-78.7	.925	.176	2.60
110.Other motor vehicles	506020	0.1	1.72	151.1	-4.5	-175.4	13.9	.978	515	12.4	76	-.148	-16.4	.779	.138	a	-.210	-27.7	.910	.189	2.34	-.224	-32.0	.931	.201	2.48
111.Motorized two-wheeled vehicle	507010	0.1	1.84	229.3	-4.1	-241.3	9.5	.979	1,141	8.4						c				.158	1.33				.197	1.65
112.Small motorcycles	507020	0.0	1.36	115.5	-2.9	-121.1	8.7	.981	258	8.0	28	-.269	-6.2	.570	.236	a	-.355	-8.6	.721	.299	2.39	-.361	-8.7	.728	.303	2.42
113.Large motorcycles	507030	0.3	1.30	19.8	-1.6	-15.0	3.3	.678	187	3.1	60	-.342	-7.8	.501	.290	a	-.505	-11.2	.674	.396	1.22	-.713	-19.5	.863	.510	1.57
114.Motorcycles (demonstration)	507094	0.0	1.69	45.9	-0.6	-20.1	1.4	.938	141	1.2	0	.000	0.0	.000	.000	a	.000	0.0	.000	.263	0.33	.000	0.0	.000	.843	1.05
115.Towing tractors	508010	0.2	1.91	827.9	-5.7	-895.7	19.6	.996	2,603	17.4						c				.155	2.71				.164	2.86
116.Platform trailers	508020	0.0	1.75	76.7	-5.4	-81.1	21.2	.946	334	18.9	63	-.096	-14.6	.772	.092	a	-.137	-24.5	.905	.128	2.42	-.145	-27.1	.921	.135	2.55
117.Fork lift trucks	508030	1.8	2.23	1282.1	-6.5	-1406.9	18.6	.990	16,079	16.5	1,035	-.135	-57.0	.758	.126	a	-.170	-81.8	.866	.156	2.57	-.180	-90.1	.887	.165	2.72
118.Other industrial trailers	508040	0.5	2.42	290.1	-7.0	-316.2	18.4	.984	1,371	16.3	68	-.142	-16.6	.801	.132	a	-.181	-27.2	.916	.166	2.70	-.194	-32.6	.940	.176	2.87
119.Industrial trailers (demonstration)	508094	0.0	2.11	59.8	-2.2	-62.2	2.9	.963	138	2.5	41	-.338	-13.3	.811	.286	a	-.648	-32.8	.963	.118	0.30	-.744	-27.6	.949	.595	1.52
120.Industrial trailers (improvement)	508099	0.3	1.64	267.9	-4.1	-299.5	11.9	.988	908	10.6						b				.245	2.60				.259	2.75
121.Bicycles and manual type wheelchairs	509010	0.1	1.45	60.9	-4.3	-71.6	20.2	.957	167	18.3						b				.131	2.39				.139	2.53
122.Rear cars, carts and rickshaws	509020	0.1	1.46	803.1	-4.3	-864.4	18.6	.994	3,650	16.9	68	-.112	-9.6	.575	.106	a	-.151	-13.8	.736	.140	2.37	-.172	-16.7	.804	.158	2.66
123.Other transport equipment	509030	1.5	1.79	1167.4	-5.1	-1260.3	17.4	.997	4,033	15.5	172	-.126	-15.6	.585	.118	a	-.168	-23.0	.754	.154	2.39	-.178	-25.0	.783	.163	2.53
124.Personal computers	601010	3.5	2.57	1245.2	-5.4	-1280.0	8.2	.954	74,924	7.2	1,038	-.237	-52.1	.723	.211	a	-.303	-81.4	.865	.261	1.89	-.377	-109.6	.920	.314	2.27
125.Workstations	601020	0.3	2.38	204.8	-5.3	-210.0	9.1	.959	1,814	8.1	26	-.223	-13.1	.868	.200	a	-.276	-18.8	.932	.241	1.95	-.309	-21.9	.948	.266	2.15
126.Midrange computers	601030	0.1	2.45	249.0	-5.2	-252.7	8.3	.970	1,951	7.4						b				.257	1.90				.307	2.26
127.Mainframe computers	601040	1.6	2.22	200.3	-4.8	-205.2	8.6	.956	1,827	7.6						b				.250	1.90				.298	2.26
128.Magnetic disc drives	602010	1.4	1.97	109.7	-4.3	-111.0	9.0	.931	890	8.0						b				.263	2.10				.306	2.45
129.Optical disk drives	602020	0.2	2.54	87.3	-5.5	-87.8	8.8	.940	492	7.8						b				.270	2.10				.314	2.45
130.Flexible magnetic disc cartridges	602030	0.0	2.77	39.1	-5.6	-39.6	7.6	.873	224	6.8						b				.310	2.10				.361	2.45
131.Other external memories	602040	0.2	2.15	109.7	-4.5	-106.8	8.1	.946	684	7.2						b				.293	2.10				.341	2.45
132.Printers	602050	1.2	2.44	527.8	-5.5	-549.2	9.5	.968	9,093	8.4	136	-.225	-22.1	.782	.202	a	-.274	-31.0	.876	.240	2.02	-.336	-46.2	.940	.285	2.41
133.Displays	602060	0.7	2.11	332.9	-5.0	-348.3	10.4	.980	2,249	9.2	28	-.180	-8.5	.718	.165	a	-.245	-14.3	.879	.217	2.00	-.301	-24.3	.955	.260	2.40
134.Other input-output devices	602070	0.3	1.96	148.5	-4.6	-156.3	10.5	.971	652	9.3						b				.227	2.10				.264	2.45
135.Banking terminals	602080	0.8	2.59	131.0	-6.2	-138.3	11.1	.939	1,118	9.9						b				.213	2.10				.248	2.45

Table 10: Estimated ASL and Rate of Depreciation (continued, 3)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	(t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	(t-value)	adj R^2	δ (%)	DBR
136.Other terminals	602090	0.3	2.07	409.4	-4.7	-424.6	9.6	.988	2,042	8.5	42	-.310	-22.5	.924	.267	a	-.350	-27.2	.946	.295	2.51	-.383	-31.1	.958	.318	2.71
137.Other computer attachments	602100	0.3	1.92	375.8	-4.4	-392.0	10.0	.979	2,966	8.9	71	-.231	-15.1	.762	.206	a	-.290	-21.9	.871	.252	2.24	-.318	-27.1	.912	.273	2.43
138.Telephone equipment	603010	0.3	1.71	1133.9	-4.3	-1217.6	12.5	.997	4,207	11.2	64	-.098	-8.2	.506	.094	a	-.127	-10.7	.639	.119	1.33	-.231	-26.8	.918	.206	2.30
139.Other telephone systems	603020	0.3	1.67	1360.9	-4.3	-1469.1	13.3	.998	4,383	11.9	63	-.164	-12.8	.722	.152	a	-.208	-17.8	.833	.187	2.22	-.223	-19.6	.859	.200	2.37
140.Facsimiles	603030	0.2	2.51	509.5	-6.1	-535.0	11.2	.981	4,970	9.9	29	-.339	-14.7	.881	.288	a	-.353	-15.5	.892	.298	2.95	-.358	-15.6	.893	.301	2.97
141.Automatic telephone switching equipment	603040	0.3	2.02	348.1	-5.2	-384.0	12.9	.982	2,210	11.4	50	-.267	-14.0	.796	.234	a	-.288	-15.6	.828	.250	2.86	-.296	-15.8	.832	.256	2.93
142.Digital transmission equipment	603050	1.5	2.15	733.7	-4.8	-811.4	9.3	.990	5,706	8.2	85	-.260	-26.6	.892	.229	a	-.299	-31.9	.923	.258	2.12	-.319	-32.7	.926	.273	2.24
143.Other carrier frequency device and attachments	603060	1.2	1.98	718.6	-4.7	-800.2	10.5	.995	2,741	9.3	42	-.229	-14.0	.824	.204	a	-.279	-19.0	.895	.244	2.26	-.298	-20.2	.906	.257	2.39
144.Mobile phones, PHS and car telephones	604010	0.3	1.79	130.4	-4.3	-137.1	11.2	.984	271	10.0						b				.269	2.68				.296	2.95
145.Radio and TV broadcasting equipment	604020	0.9	2.13	451.8	-5.9	-470.6	15.9	.992	1,675	14.1	25	-.188	-10.2	.803	.171	a	-.214	-13.9	.884	.193	2.71	-.238	-19.6	.939	.211	2.98
146.Other mobile-station communication equipment	604030	2.6	1.83	115.3	-5.0	-124.0	14.9	.971	394	13.3						b				.202	2.68				.223	2.95
147.Portable communication equipment	604040	0.0	1.21	67.6	-3.3	-73.0	15.8	.866	707	14.8						b				.181	2.68				.199	2.95
148.Associated radio equipment	604050	0.6	1.25	48.4	-3.0	-54.6	11.2	.906	244	10.4						b				.258	2.68				.284	2.95
149.Other radio communication equipment	604060	0.0	1.71	248.0	-4.4	-262.9	13.2	.984	1,016	11.8	21	-.166	-8.5	.772	.153	a	-.197	-10.3	.833	.179	2.10	-.238	-13.0	.889	.212	2.49
150.Copy machines	605010	1.5	2.53	500.5	-5.6	-525.5	9.2	.956	11,651	8.1	233	-.377	-36.4	.850	.314	a	-.406	-42.8	.887	.334	2.71	-.418	-45.2	.898	.342	2.78
151.Calculator	605020	0.2	2.17	132.6	-5.4	-130.5	11.8	.953	874	10.4						b				.245	2.56				.266	2.78
152.Cash registers	605030	0.1	2.15	444.3	-4.9	-460.1	9.8	.992	1,628	8.7	20	-.196	-5.6	.603	.178	a	-.265	-8.9	.795	.233	2.02	-.296	-10.8	.853	.256	2.23
153.Word processors	605040	0.0	2.63	232.0	-7.4	-236.1	16.5	.990	556	14.7						b				.174	2.56				.189	2.78
154.Other office machines	605050	2.7	2.07	938.9	-5.3	-950.7	12.7	.990	8,725	11.2	143	-.220	-16.8	.664	.197	a	-.250	-20.6	.748	.221	2.49	-.286	-26.2	.827	.248	2.79
155.Boilers	701010	2.8	1.82	458.6	-5.8	-529.5	23.6	.978	4,728	21.0	103	-.106	-19.7	.789	.101	a	-.131	-25.8	.866	.123	2.58	-.136	-26.7	.874	.127	2.66
156.Turbines	701020	2.9	1.78	120.9	-5.7	-137.4	24.9	.965	533	22.1						b				.116	2.58				.120	2.66
157.Engines	702000	4.8	1.44	257.7	-4.4	-290.2	21.3	.986	929	19.4	77	-.158	-16.1	.771	.146	a	-.188	-19.9	.837	.171	3.31	-.192	-20.2	.841	.174	3.37
158.Elevators and escalators	703010	1.7	1.68	352.8	-5.8	-422.1	31.0	.979	2,611	27.7	87	-.103	-15.3	.727	.098	a	-.123	-19.6	.815	.116	3.22	-.127	-20.3	.826	.119	3.30
159.Overhead cranes	703020	0.3	1.96	362.5	-6.6	-404.6	29.1	.986	1,875	25.8	57	-.109	-12.3	.726	.103	a	-.128	-16.1	.819	.120	3.10	-.136	-18.5	.856	.128	3.29
160.Other cranes	703030	0.8	1.99	374.5	-6.5	-418.8	26.7	.993	1,049	23.7	53	-.090	-18.4	.864	.086	a	-.110	-24.6	.920	.104	2.47	-.113	-24.8	.921	.107	2.53
161.Winches	703040	0.6	1.88	227.5	-6.1	-239.9	25.2	.987	708	22.4						b				.135	3.02				.139	3.11
162.Conveyers	703050	2.7	1.92	756.7	-5.7	-830.9	19.1	.992	4,562	16.9	98	-.196	-29.8	.901	.178	a	-.218	-35.0	.926	.196	3.32	-.224	-36.3	.931	.201	3.40
163.Other carrying equipment	703060	1.4	1.86	369.7	-5.5	-410.8	19.7	.974	3,719	17.5	173	-.124	-25.4	.788	.117	a	-.156	-35.0	.876	.145	2.53	-.162	-36.5	.885	.150	2.63
164.Refrigerators	704010	1.4	1.84	368.4	-5.6	-428.1	21.3	.979	2,935	18.9	63	-.153	-20.5	.869	.142	a	-.174	-25.4	.911	.160	3.02	-.181	-26.3	.916	.165	3.12
165.Refrigerated showcases, including refrigerated display shelf	704020	0.6	1.68	282.5	-4.5	-311.1	14.9	.985	1,216	13.3	50	-.238	-17.6	.860	.212	a	-.262	-20.0	.889	.230	3.06	-.284	-22.3	.908	.247	3.28
166.Air conditioners, package type	704030	3.2	2.20	762.5	-6.5	-819.4	18.9	.996	2,371	16.8	37	-.132	-10.1	.732	.124	a	-.156	-12.8	.814	.145	2.42	-.173	-14.9	.856	.159	2.66
167.Other applied refrigerators	704040	0.4	2.18	226.9	-6.6	-259.0	20.3	.990	525	18.0						b				.150	2.69				.161	2.89
168.Other refrigerators	704050	0.4	2.03	814.1	-6.1	-912.0	20.2	.997	2,109	17.9	45	-.171	-13.3	.796	.157	a	-.189	-15.2	.837	.173	3.09	-.199	-16.3	.854	.181	3.24
169.Pomps	705010	2.3	1.67	924.1	-5.1	-1016.7	20.9	.995	4,138	18.7	69	-.126	-10.1	.595	.118	a	-.152	-12.8	.701	.141	2.63	-.159	-13.5	.724	.147	2.75
170.Compressors	705020	1.6	2.21	511.7	-6.9	-564.0	22.6	.991	2,393	20.0	86	-.143	-24.3	.872	.133	a	-.163	-31.1	.918	.151	3.01	-.169	-34.0	.931	.156	3.12
171.Fans	705030	0.0	1.58	174.2	-5.0	-198.5	24.0	.983	528	21.6						b				.145	3.12				.150	3.23
172.Vacuum pumps and equipment	705040	1.4	1.68	393.0	-4.9	-438.3	18.9	.992	1,184	16.9	30	-.166	-10.0	.768	.153	a	-.199	-12.9	.846	.181	3.05	-.205	-13.5	.858	.186	3.13
173.Hydraulic equipment	705050	3.5	1.67	448.6	-5.2	-487.1	22.4	.993	1,469	20.0	44	-.118	-11.3	.743	.111	a	-.146	-15.8	.850	.136	2.71	-.156	-17.7	.876	.144	2.88
174.Pneumatic equipment	705060	1.1	1.83	504.4	-5.8	-568.7	23.6	.995	1,159	21.0	28	-.178	-20.6	.938	.163	a	-.197	-24.1	.954	.178	3.75	-.199	-24.3	.955	.180	3.78
175.Transmissions	705070	2.5	1.85	134.0	-5.6	-146.4	20.3	.959	775	18.1	28	-.229	-9.9	.777	.205	a	-.252	-11.6	.827	.222	4.02	-.255	-11.9	.833	.225	4.06
176.Other power transmissions	705080	0.0	1.83	155.7	-5.8	-174.5	24.0	.977	567	21.3						b				.147	3.12				.151	3.23
177.Numerical control robots	706010	0.4	2.35	336.4	-6.5	-357.2	16.0	.990	1,201	14.2	49	-.184	-15.1	.822	.168	a	-.210	-18.8	.878	.189	2.69	-.216	-19.6	.887	.195	2.77
178.Other industrial robots	706020	1.3	1.89	189.1	-5.0	-202.6	14.1	.985	527	12.5	45	-.131	-10.8	.719	.123	a	-.167	-15.2	.836	.154	1.93	-.205	-20.8	.905	.185	2.32
179.Industrial kiln	707010	0.7	1.67	463.3	-5.1	-534.6	21.7	.992	1,823	19.4	44	-.206	-12.3	.773	.186	a	-.230	-15.0	.836	.206	3.98	-.234	-15.8	.849	.209	4.05
180.Heavy oil and gas firing equipment, including light oil	707020	0.2	1.50	227.2	-4.6	-254.9	22.1	.982	967	20.0	120	-.079	-17.7	.722	.076	a	-.119	-31.2	.890	.112	2.23	-.125	-33.2	.902	.117	2.34

Table 10: Estimated ASL and Rate of Depreciation (continued, 4)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	α (t-value)	β	β (t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	γ (t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	γ (t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	γ (t-value)	adj R^2	δ (%)	DBR
181.Mechanical parking systems	707030	0.1	1.52	158.2	-4.5	-189.5	19.0	.972	729	17.2	76	-.122	-22.1	.865	.115	a	-.144	-32.7	.934	.134	2.30	-.171	-37.9	.950	.157	2.70
182.Item and inner packaging machine	707040	1.7	2.21	484.0	-6.5	-537.5	18.6	.992	1,982	16.5	75	-.190	-32.7	.934	.173	a	-.211	-39.1	.953	.190	3.14	-.216	-40.2	.956	.194	3.20
183.Packaging machines	707050	0.4	2.63	281.1	-7.7	-301.9	19.0	.986	1,138	16.8	32	-.161	-14.7	.870	.149	a	-.185	-17.9	.909	.169	2.84	-.190	-18.7	.916	.173	2.92
184.Other general industrial machinery and equipment	707060	2.1	1.85	4112.7	-5.4	-4520.3	18.8	.998	40,001	16.7	1,358	-.145	-58.1	.713	.135	a	-.177	-79.5	.823	.162	2.71	-.188	-89.3	.854	.171	2.86
185.Agricultural tractors and ground leveling equipment	708010	0.4	1.62	37.7	-4.6	-40.8	17.0	.905	150	15.2						b				.173	2.64				.184	2.81
186.Cultivation and manegement equipment	708020	0.7	2.00	160.0	-6.0	-176.3	20.3	.976	622	18.0	62	-.128	-17.2	.825	.120	a	-.154	-22.1	.887	.143	2.57	-.165	-24.1	.903	.152	2.73
187.Feed mill machines	708030	0.0	2.48	135.2	-7.9	-150.9	24.5	.970	571	21.7						b				.121	2.64				.129	2.81
188.Other agricultural machinery and equipment	708040	0.1	1.82	182.5	-5.6	-207.9	21.2	.988	406	18.9	23	-.154	-6.4	.633	.143	a	-.176	-7.6	.709	.161	3.04	-.187	-8.2	.742	.171	3.22
189.Graders	709010	0.2	1.66	72.1	-4.7	-74.5	16.7	.973	147	14.9	147	-.093	-27.3	.835	.089	a	-.150	-53.8	.952	.140	2.08	-.160	-57.4	.957	.148	2.20
190.Shovel excavators	709020	7.7	1.24	115.3	-3.2	-123.9	13.4	.947	748	12.5	1,181	-.122	-65.9	.786	.115	a	-.186	-106.7	.906	.170	2.13	-.196	-113.2	.916	.178	2.23
191.Excavators, except shovel machinery	709030	0.2	2.13	72.7	-6.0	-80.5	17.0	.975	138	15.1	69	-.108	-11.4	.651	.103	a	-.152	-19.2	.842	.141	2.13	-.167	-21.5	.870	.154	2.32
192.Construction cranes	709040	1.3	2.00	53.7	-5.7	-55.1	17.4	.922	246	15.4	194	-.078	-31.8	.839	.075	a	-.128	-58.8	.947	.120	1.85	-.134	-57.9	.945	.125	1.92
193.Construction tractors	709050	0.9	1.50	35.4	-4.1	-37.0	14.8	.929	97	13.3	220	-.114	-28.8	.790	.108	a	-.173	-49.5	.918	.158	2.11	-.184	-54.7	.932	.168	2.24
194.Asphalt paving machines	709060	0.2	2.78	43.3	-8.5	-45.8	21.1	.938	125	18.8	41	-.134	-16.9	.874	.126	a	-.159	-23.5	.931	.147	2.76	-.161	-23.9	.933	.148	2.78
195.Concrete machines	709070	0.4	2.08	132.0	-6.4	-147.1	21.3	.973	488	18.9	33	-.181	-8.8	.697	.166	a	-.200	-10.2	.756	.181	3.43	-.209	-10.7	.776	.188	3.56
196.Machines for foundation work	709080	0.2	1.69	51.6	-5.0	-56.0	19.1	.922	227	17.0	26	-.064	-8.0	.708	.062	a	-.114	-16.4	.911	.108	1.84	-.123	-17.1	.918	.116	1.97
197.Drills and rock drills	709090	0.3	1.75	37.3	-5.6	-42.3	25.1	.900	155	22.3	26	-.102	-7.9	.700	.097	a	-.130	-10.9	.819	.122	2.72	-.133	-11.1	.825	.125	2.79
198.Crushers, Mills, sorters and auxiliary machinery	709100	0.5	1.69	148.0	-5.0	-168.8	18.8	.976	545	16.8	68	-.111	-14.4	.751	.105	a	-.142	-19.6	.849	.132	2.22	-.163	-25.2	.903	.150	2.52
199.Other machinery and equipment for construction and mining	709110	0.9	1.86	247.7	-5.5	-268.8	19.3	.970	1,904	17.1	261	-.115	-31.1	.787	.109	a	-.150	-46.5	.892	.139	2.38	-.161	-52.6	.914	.149	2.55
200.Grain processing machines	710010	0.6	2.08	187.2	-6.8	-216.4	26.7	.977	839	23.6	65	-.204	-25.7	.910	.184	a	-.214	-29.4	.930	.193	4.55	-.217	-30.4	.934	.195	4.60
201.Bread-making and confectionery machines	710020	0.5	1.89	273.0	-5.9	-315.0	22.3	.966	2,641	19.8	63	-.220	-22.7	.891	.198	a	-.234	-24.5	.905	.209	4.14	-.235	-24.6	.905	.210	4.16
202.Milk processing and dairy products machinery	710030	0.2	1.76	207.2	-5.4	-240.0	21.3	.978	966	18.9						b				.187	3.54				.194	3.68
203.Charcuterie and fishery products manufacturing equipment	710040	0.2	2.43	531.5	-7.1	-591.1	18.5	.992	2,345	16.4	78	-.242	-23.3	.874	.215	a	-.254	-25.5	.893	.224	3.69	-.257	-26.1	.897	.227	3.73
204.Other food processing machinery	710050	0.8	1.83	830.7	-5.5	-945.3	19.9	.987	9,274	17.7	217	-.116	-16.7	.560	.109	a	-.151	-24.5	.735	.140	2.48	-.172	-31.0	.815	.158	2.79
205.Machines related to spinning	711010	0.3	1.39	164.4	-4.6	-194.8	27.9	.968	887	25.4						b				.129	3.28				.133	3.39
206.Looms and braiding machines	711020	0.4	2.09	149.6	-6.9	-168.7	27.0	.976	556	23.9	29	-.124	-9.0	.733	.116	a	-.145	-11.9	.828	.135	3.23	-.150	-12.6	.844	.139	3.32
207.Dyeing and finishing machines	711030	0.3	2.21	114.4	-7.0	-128.5	23.5	.947	728	20.8						b				.158	3.28				.163	3.39
208.Sewing machinery	711040	0.1	2.15	203.3	-6.4	-210.0	20.1	.988	491	17.8	31	-.186	-9.5	.741	.170	a	-.205	-11.5	.810	.186	3.31	-.217	-13.0	.845	.195	3.47
209.Other sewing machines	711050	0.0	2.07	149.2	-6.2	-161.2	20.0	.979	483	17.8	34	-.211	-13.5	.842	.190	a	-.232	-16.1	.884	.207	3.67	-.234	-16.5	.888	.209	3.71
210.Sawmill machines	712010	0.0	1.60	118.1	-4.8	-132.5	20.4	.977	333	18.3						b				.140	2.56				.154	2.82
211.Woodworking machines	712020	0.1	2.35	201.2	-7.0	-215.3	19.6	.986	586	17.3	29	-.172	-12.0	.831	.158	a	-.191	-15.4	.891	.174	3.02	-.199	-17.0	.909	.181	3.13
212.Plywood machines, including fiberboard machine	712030	0.1	2.23	126.8	-6.6	-141.4	19.2	.973	448	17.0	25	-.116	-8.2	.728	.109	a	-.143	-12.4	.859	.133	2.26	-.167	-17.7	.926	.154	2.60
213.Pulp and paper making machines	713010	0.2	1.94	363.9	-6.2	-414.2	24.1	.987	1,724	21.4	32	-.134	-17.2	.902	.125	a	-.150	-20.1	.926	.139	2.97	-.157	-21.6	.936	.146	3.11
214.Printing machinery	713020	1.3	2.41	554.9	-7.0	-640.5	18.4	.993	2,125	16.3	129	-.146	-29.3	.869	.136	a	-.178	-42.5	.933	.163	2.66	-.186	-46.7	.944	.170	2.77
215.Paper covering machinery	713030	0.4	2.00	387.8	-6.1	-445.3	21.1	.992	1,185	18.7	41	-.142	-17.0	.875	.133	a	-.169	-24.0	.934	.156	2.91	-.174	-25.6	.941	.160	2.98
216.Bookbinding machines	713040	0.3	2.73	161.2	-8.1	-172.8	19.2	.984	428	17.0	38	-.189	-12.3	.798	.172	a	-.204	-14.0	.837	.185	3.15	-.209	-14.6	.848	.189	3.22
217.Plate making machines	713050	0.2	2.82	149.2	-7.6	-160.8	14.7	.968	729	13.1						b				.214	2.81				.222	2.91
218.Filters	714010	0.6	1.70	215.5	-5.1	-237.7	20.2	.985	704	18.1	22	-.086	-3.2	.294	.083	a	-.123	-5.0	.521	.116	2.09	-.127	-5.1	.535	.119	2.15
219.Sorters	714020	0.5	1.95	338.3	-5.8	-366.4	19.9	.993	812	17.7						b				.162	2.87				.170	3.01
220.Heat exchangers, including partial condensers and heat converters	714030	0.6	1.79	293.8	-5.5	-331.2	22.4	.993	599	19.9						b				.144	2.87				.151	3.01
221.Mixers, agitators, kneaders, dissolvers, granulators, emulsifiers and crushers	714040	0.7	2.03	823.2	-6.2	-902.1	21.7	.997	1,995	19.3	42	-.105	-9.5	.681	.099	a	-.136	-14.9	.840	.128	2.46	-.151	-18.6	.891	.140	2.70
222.Reactors, generators, carbonizes and electrolytic cells	714050	0.7	1.77	311.1	-5.4	-349.9	21.6	.983	1,671	19.2						b				.149	2.87				.157	3.01
223.Evaporators, distillers, digesters and crystallizers	714060	0.1	1.76	138.3	-5.7	-158.8	24.7	.972	550	22.0						b				.130	2.87				.137	3.01
224.Dryers	714070	0.2	1.86	341.7	-5.8	-380.0	22.8	.991	1,090	20.2	50	-.088	-9.4	.636	.084	a	-.121	-14.6	.809	.114	2.30	-.143	-19.7	.886	.133	2.70
225.Dust collectors	714080	0.6	2.12	245.1	-6.5	-268.0	21.7	.985	942	19.3	20	-.205	-6.2	.650	.185	a	-.224	-7.3	.722	.200	3.86	-.228	-7.5	.735	.204	3.92

Table 10: Estimated ASL and Rate of Depreciation (continued, 5)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	α (t-value)	β	β (t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	γ (t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	γ (t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	γ (t-value)	adj R^2	δ (%)	DBR
226.Tanks for chemical equipment	714090	0.5	1.80	629.3	-5.7	-687.0	23.6	.996	1,754	21.0	23	-.084	-5.8	.583	.081	a	-.118	-9.3	.788	.111	2.33	-.125	-10.2	.818	.117	2.46
227.Chemically treated environment protecting equipment	714100	0.8	1.76	205.8	-5.2	-237.5	19.8	.982	793	17.6						b				.163	2.87				.171	3.01
228.Other equipment for culture and control chemical machinery	714110	1.5	1.65	1200.8	-4.9	-1319.1	20.0	.994	8,439	17.9	133	-.172	-21.1	.769	.158	a	-.200	-26.7	.843	.182	3.25	-.208	-28.4	.859	.188	3.36
229.Injection molding machines	715010	0.9	1.93	275.3	-5.8	-314.9	20.8	.979	1,647	18.4	201	-.157	-26.6	.779	.145	a	-.183	-33.8	.850	.167	3.08	-.187	-34.6	.856	.170	3.14
230.Extruders	715020	0.4	2.24	498.6	-6.9	-583.1	21.9	.995	1,181	19.4	40	-.205	-20.5	.913	.185	a	-.219	-23.2	.931	.196	3.80	-.222	-23.9	.934	.199	3.85
231.Other plastic working machinery and auxiliary equipment	715030	0.7	1.91	985.9	-5.5	-1093.4	17.6	.995	4,876	15.6	274	-.155	-26.7	.723	.144	a	-.183	-33.8	.806	.168	2.61	-.200	-39.2	.849	.181	2.82
232.Numerically controlled lathes	716010	1.0	2.03	156.5	-6.5	-173.7	24.4	.938	1,620	21.7	132	-.146	-18.0	.711	.136	a	-.171	-23.8	.810	.157	3.40	-.173	-24.7	.822	.159	3.45
233.Other lathes	716020	0.1	2.00	205.1	-6.9	-221.2	31.2	.978	946	27.7	33	-.058	-5.8	.498	.056	a	-.090	-10.7	.774	.086	2.39	-.094	-11.5	.798	.090	2.49
234.Drilling machines	716030	0.2	2.00	153.2	-6.8	-160.5	29.4	.965	840	26.1	35	-.123	-9.8	.730	.116	a	-.142	-12.5	.817	.132	3.44	-.145	-12.9	.826	.135	3.51
235.Boring machines	716040	0.1	2.04	51.5	-7.4	-59.3	38.3	.939	174	33.9						b				.082	2.78				.088	2.99
236.Milling machines	716050	0.1	2.10	87.9	-7.4	-96.3	34.1	.916	707	30.2	39	-.080	-6.5	.516	.077	a	-.104	-9.9	.712	.099	2.98	-.106	-10.2	.726	.101	3.04
237.Grinding machines	716060	1.2	2.01	439.8	-6.5	-474.0	25.0	.991	1,677	22.2	166	-.110	-16.9	.633	.104	a	-.140	-25.3	.794	.131	2.90	-.147	-27.7	.822	.136	3.03
238.Gear cutting machines and gear finishing machines	716070	0.3	1.83	69.1	-6.3	-75.6	30.6	.957	216	27.2						b				.102	2.78				.110	2.99
239.Special purpose machines for metal cutting	716080	2.1	2.26	195.0	-6.6	-211.8	18.9	.977	915	16.7	62	-.105	-12.3	.707	.100	a	-.141	-19.5	.860	.132	2.21	-.178	-32.6	.945	.163	2.73
240.Machining centers	716090	1.4	1.88	127.6	-6.0	-148.2	24.2	.938	1,081	21.5	145	-.146	-21.4	.760	.136	a	-.170	-27.0	.834	.156	3.36	-.172	-27.6	.840	.158	3.40
241.Other metal machine tools	716100	3.8	1.80	539.1	-5.5	-590.9	21.9	.984	4,708	19.4	298	-.112	-22.0	.618	.106	a	-.147	-32.2	.777	.136	2.65	-.157	-36.5	.817	.145	2.83
242.Rolling mill machines and attachments	717010	1.4	2.14	465.7	-7.0	-537.5	26.4	.993	1,557	23.4	33	-.081	-4.4	.352	.078	a	-.110	-6.4	.546	.104	2.43	-.114	-6.7	.569	.108	2.52
243.Finishing equipment	717020	0.6	1.82	267.7	-5.3	-297.0	18.3	.987	911	16.3	23	-.135	-7.5	.708	.126	a	-.173	-11.0	.839	.159	2.59	-.183	-12.1	.863	.167	2.72
244.Bending machines	717030	0.2	2.11	86.4	-6.6	-93.6	22.8	.955	353	20.2	31	-.180	-10.0	.763	.164	a	-.198	-12.0	.822	.179	3.63	-.199	-12.1	.824	.181	3.65
245.Hydraulic presses	717040	0.2	1.99	164.8	-6.5	-184.3	26.0	.981	516	23.1	39	-.081	-11.9	.782	.078	a	-.109	-18.7	.899	.103	2.37	-.120	-22.7	.929	.113	2.61
246.Mechanical presses	717050	1.3	1.83	820.0	-5.9	-919.7	25.6	.997	2,033	22.7	146	-.121	-23.7	.794	.114	a	-.145	-32.0	.875	.135	3.07	-.152	-35.9	.898	.141	3.20
247.Shearing machines	717060	0.1	2.12	137.1	-6.6	-149.2	23.0	.969	593	20.4	42	-.103	-10.8	.733	.098	a	-.129	-15.1	.843	.121	2.46	-.143	-18.0	.884	.133	2.71
248.Forging machines	717070	0.2	1.38	134.7	-4.4	-161.0	24.0	.979	395	22.0						b				.125	2.76				.131	2.88
249.Wire forming machines	717080	0.3	1.83	196.2	-5.8	-228.5	23.3	.989	442	20.7						b				.133	2.76				.139	2.88
250.Welding apparatus, gas-operated	717090	0.1	1.95	711.1	-5.8	-741.2	19.5	.995	2,766	17.3	100	-.152	-19.5	.791	.141	a	-.180	-26.6	.876	.164	2.84	-.186	-28.1	.887	.170	2.93
251.Other metal working machinery	717100	0.8	1.85	1080.6	-5.6	-1192.2	20.5	.993	7,865	18.2	369	-.140	-30.4	.715	.131	a	-.171	-42.5	.831	.157	2.87	-.180	-46.7	.855	.164	3.00
252.Wafer processing equipment	718010	3.2	1.80	173.0	-4.5	-186.4	12.1	.973	840	10.7	87	-.201	-15.4	.730	.182	a	-.258	-21.4	.840	.227	2.43	-.275	-24.3	.871	.240	2.58
253.Assembly equipment	718020	0.5	1.91	313.9	-4.9	-343.7	13.2	.992	829	11.7	98	-.218	-17.0	.746	.196	a	-.256	-21.8	.829	.226	2.64	-.278	-26.0	.873	.242	2.83
254.Flat panel and display manufacturing equipment	718030	0.4	1.47	120.7	-3.7	-133.0	12.3	.956	673	11.2	69	-.206	-22.6	.881	.187	a	-.263	-30.2	.930	.231	2.59	-.277	-32.5	.939	.242	2.70
255.Clean room equipment	718040	0.1	2.18	126.5	-6.2	-138.4	17.5	.981	310	15.5	22	-.211	-13.5	.892	.190	a	-.228	-15.8	.918	.204	3.15	-.234	-16.4	.924	.208	3.23
256.Pure and ultrapure water systems	718050	0.8	1.85	183.2	-5.2	-215.9	16.4	.968	1,112	14.5	55	-.144	-12.9	.752	.134	a	-.180	-17.2	.843	.165	2.40	-.184	-17.5	.848	.168	2.44
257.Other semiconductor manufacturing equipment	718060	0.9	1.88	1514.2	-4.9	-1610.9	13.4	.997	5,891	11.9	546	-.244	-49.1	.815	.217	a	-.279	-61.2	.873	.243	2.89	-.288	-64.3	.883	.251	2.98
258.Rubber industrial machinery and appliances	719010	0.8	1.71	211.4	-5.5	-242.7	24.3	.965	1,635	21.7	54	-.141	-10.7	.677	.132	a	-.160	-12.8	.752	.148	3.21	-.163	-13.1	.759	.151	3.27
259.Asphalt emulsion and other asphalt products manufacturing machinery	719020	0.1	1.97	121.0	-6.2	-136.3	23.0	.966	520	20.4	20	-.111	-8.8	.794	.105	a	-.142	-12.9	.892	.132	2.69	-.150	-14.4	.912	.140	2.85
260.Coke manufacturing machinery	719030	1.0	1.81	67.2	-6.5	-89.9	36.5	.982	85	32.4						b				.092	2.98				.097	3.13
261.Glass industrial special machinery	719040	0.2	1.56	129.7	-4.4	-146.4	17.1	.966	599	15.4						b				.194	2.98				.204	3.13
262.Special machines for chemicals and pharmaceutical preparations manufacturing	719050	0.3	1.75	472.0	-5.0	-507.5	17.0	.989	2,488	15.2	47	-.159	-10.9	.714	.147	a	-.192	-14.4	.815	.175	2.65	-.204	-15.5	.836	.184	2.80
263.Other equipment for culture and control special industrial machinery	719060	3.0	1.78	1754.2	-5.2	-1937.9	18.7	.993	21,722	16.7	615	-.167	-38.1	.702	.154	a	-.196	-48.6	.793	.178	2.97	-.209	-54.2	.827	.188	3.14
264.Special steel cutting tools	720010	0.4	1.34	104.1	-3.3	-110.4	11.8	.922	916	10.8						b				.201	2.18				.224	2.43
265.Cemented carbide and diamond tools	720020	1.0	1.10	122.6	-2.7	-132.2	11.9	.982	281	11.5						b				.189	2.18				.211	2.43
266.Pneumatic tools	720030	0.1	1.77	137.9	-5.2	-145.5	19.4	.984	311	17.2						b				.126	2.18				.141	2.43
267.Electric tools	720040	0.2	2.17	226.5	-6.4	-240.4	19.4	.989	589	17.1						b				.127	2.18				.142	2.43
268.Fixtures and accessories for metal machining	720050	5.8	1.50	724.9	-3.7	-773.0	12.0	.990	5,206	10.8	141	-.105	-7.6	.286	.100	a	-.170	-13.1	.547	.157	1.70	-.219	-18.4	.705	.197	2.13
269.Other machinists' precision tools	720060	6.7	1.53	1059.4	-4.2	-1107.4	15.2	.995	5,525	13.7	180	-.171	-12.9	.478	.157	a	-.209	-16.4	.598	.189	2.59	-.218	-16.9	.612	.196	2.69
270.Molds for presses	721010	3.7	1.49	1822.3	-3.8	-1964.2	13.2	.997	9,976	11.9	185	-.142	-13.6	.499	.133	a	-.203	-21.1	.706	.184	2.19	-.218	-23.2	.744	.196	2.33

Table 10: Estimated ASL and Rate of Depreciation (continued, 6)

6-digit classification of asset	code	weight (‰)	Weibull Distribution								Age-Price Profile for Surviving Assets					Estimated Depreciation Rates and Declining Balance Rates									
																(definition-1)					(definition-2)				
			α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	γ	(t-value)	adj R^2	δ (%)	DBR	γ	(t-value)	adj R^2	δ (%)	DBR
271.Molds for forging	721020	0.3	1.41	502.8	-3.5	-535.0	11.8	.986	3,566	10.8	51	-.054	-6.5	.446	.053	a	-.131	-17.5	.857	.123	1.32	-.166	-22.6	.909	.153	1.64
272.Molds for casting, including ones for die-casting	721030	0.8	1.49	273.7	-3.5	-282.7	10.6	.964	2,786	9.6	28	-.505	-8.1	.700	.396	a	-.546	-8.9	.738	.421	4.03	-.557	-9.1	.744	.427	4.09
273.Molds for plastics	721040	3.6	1.46	771.9	-3.7	-851.5	13.0	.992	4,851	11.7	154	-.195	-13.1	.526	.177	a	-.236	-16.2	.630	.210	2.47	-.274	-20.1	.723	.239	2.81
274.Molds for rubber and glass	721050	0.4	1.56	298.6	-4.0	-314.9	13.1	.987	1,198	11.8						b				.211	2.48				.231	2.72
275.Other molds and dies	721060	1.8	1.43	1061.0	-3.6	-1158.5	12.2	.995	5,403	11.1	133	-.218	-11.7	.503	.196	a	-.268	-14.7	.619	.235	2.61	-.300	-17.3	.691	.259	2.87
276.Fire extinguishing appliances, including appliances for fire engines	722010	0.1	1.74	70.9	-5.7	-75.5	25.9	.937	338	23.1						b				.099	2.28				.107	2.47
277.Valves and Cocks	722020	3.1	1.45	596.3	-4.6	-732.8	23.7	.990	3,449	21.4	94	-.083	-10.9	.558	.080	a	-.117	-16.3	.738	.110	2.36	-.121	-17.0	.754	.114	2.45
278.Other general machines and equipment	722030	2.0	1.79	1988.3	-5.0	-2157.0	16.5	.997	11,432	14.7	227	-.112	-16.4	.542	.106	a	-.158	-25.7	.744	.147	2.15	-.186	-33.8	.834	.170	2.50
279.Pinball machines and slots	723010	4.5	1.18	131.1	-1.1	-117.4	2.6	.937	1,150	2.4	44	-.337	-3.1	.168	.286	a	-.542	-4.8	.331	.419	1.02	-.857	-9.1	.649	.575	1.40
280.Amusement machines for amusement arcade	723020	0.1	1.49	158.1	-3.0	-172.1	7.3	.983	429	6.6	34	-.215	-6.6	.559	.193	a	-.303	-10.0	.744	.261	1.72	-.372	-13.5	.843	.311	2.05
281.Amusement park and other amusement equipment	723030	0.0	1.45	73.2	-3.9	-84.8	14.6	.946	308	13.3						b				.088	1.17				.115	1.53
282.Automats	723040	0.1	2.34	127.1	-5.9	-135.2	12.3	.940	1,025	10.9						b				.107	1.17				.140	1.53
283.Cigarette-vending machines	723050	0.0	2.11	95.2	-6.0	-100.4	17.4	.975	231	15.4						b				.076	1.17				.100	1.53
284.Ticket dispensers	723060	0.3	3.14	209.4	-8.2	-227.5	13.4	.980	880	12.0						b				.098	1.17				.128	1.53
285.Other vending machines	723070	0.1	2.63	185.4	-6.7	-204.6	13.1	.986	485	11.6						b				.101	1.17				.132	1.53
286.Industrial washing machines	723080	0.1	1.46	42.7	-3.9	-45.1	14.2	.895	214	12.8						b				.091	1.17				.119	1.53
287.Automobile maintenance and servicing equipment	723090	0.2	2.07	204.8	-6.1	-218.0	19.2	.962	1,650	17.0	37	-.111	-6.4	.519	.105	a	-.142	-8.9	.681	.133	2.25	-.156	-10.0	.729	.145	2.45
288.Other Machinery for retail and personal servise industries	723100	0.4	1.55	348.5	-3.8	-371.7	11.4	.979	2,638	10.3	84	-.190	-12.3	.640	.173	a	-.241	-17.6	.785	.215	2.20	-.266	-19.6	.820	.234	2.40
289.Electric audio equipment	724010	0.1	1.67	300.5	-4.5	-311.4	14.8	.977	2,138	13.3	51	-.157	-11.0	.701	.145	a	-.181	-12.8	.763	.165	2.19	-.225	-17.5	.857	.202	2.68
290.Television apparatus, except liquid crystal receivers	724020	0.1	1.90	681.3	-5.1	-661.4	14.5	.994	2,702	12.9	35	-.069	-5.5	.456	.067	a	-.125	-12.3	.812	.117	1.51	-.163	-18.1	.904	.151	1.94
291.Liquid crystal television receivers	724030	0.5	1.59	348.4	-3.6	-345.6	9.3	.989	1,391	8.4	34	-.201	-12.2	.812	.182	a	-.249	-15.7	.878	.220	1.85	-.305	-21.1	.929	.263	2.21
292.Video tape recorders	724040	0.0	1.98	258.1	-5.1	-245.9	13.4	.988	794	11.9						b				.157	1.87				.188	2.24
293.Video cameras, except those for broadcast	724050	0.1	1.80	611.4	-4.1	-604.6	9.9	.993	2,629	8.8	64	-.170	-15.7	.792	.156	a	-.230	-24.6	.904	.206	1.81	-.273	-32.0	.941	.239	2.10
294.Digital cameras	724060	0.2	2.01	90.0	-4.5	-90.0	9.5	.955	378	8.5						b				.222	1.87				.265	2.24
295.DVD videos	724070	0.1	2.11	64.9	-4.7	-61.7	9.1	.929	322	8.1						b				.232	1.87				.277	2.24
296.Other video equipment	724080	0.2	1.80	306.5	-4.4	-300.1	11.6	.987	1,203	10.3	27	-.148	-11.1	.819	.137	a	-.200	-17.4	.918	.181	1.87	-.236	-23.3	.952	.210	2.16
297.Consumer-use air conditioners	725010	0.6	1.94	1338.5	-5.5	-1421.3	16.8	.988	21,094	14.9	271	-.137	-20.9	.616	.128	a	-.162	-26.7	.724	.150	2.23	-.197	-36.2	.829	.178	2.66
298.Heating and moisture retaining electric heating appliances	725020	0.0	2.06	1080.4	-6.4	-1247.2	22.4	.982	21,335	19.9	424	-.093	-34.7	.740	.089	a	-.122	-53.4	.871	.115	2.29	-.135	-62.8	.903	.126	2.51
299.Electric rice cookers	725030	0.2	1.89	188.8	-5.3	-198.9	16.4	.993	246	14.6						b				.168	2.44				.192	2.80
300.Microwave ovens	725040	0.1	1.89	229.5	-5.0	-231.8	14.1	.991	458	12.5						b				.196	2.44				.224	2.80
301.Other electrothermal cocking appliances	725050	0.3	1.77	503.6	-4.7	-530.1	14.0	.991	2,196	12.5	53	-.179	-15.4	.818	.164	a	-.203	-17.6	.854	.184	2.29	-.241	-24.9	.921	.214	2.67
302.Electric fans	725060	0.0	1.66	59.4	-4.6	-59.9	16.3	.953	174	14.6						b				.168	2.44				.192	2.80
303.Fans	725070	0.0	1.85	152.7	-5.1	-157.7	16.1	.987	319	14.3						b				.171	2.44				.196	2.80
304.Electric washing machines	725080	0.3	1.96	137.5	-5.4	-148.0	15.4	.983	320	13.7						b				.179	2.44				.205	2.80
305.Electric refrigerators	725090	0.6	1.86	2300.1	-4.9	-2352.0	14.1	.999	5,814	12.5	149	-.209	-18.4	.693	.189	a	-.233	-21.2	.751	.208	2.61	-.267	-27.1	.831	.234	2.93
306.Vacuum cleaners	725100	0.2	2.16	235.0	-5.8	-238.7	14.4	.976	1,362	12.8						b				.192	2.44				.220	2.80
307.Other household electric appliances	725110	0.2	1.62	754.3	-4.2	-786.2	13.5	.991	5,010	12.1	120	-.258	-22.4	.807	.227	a	-.286	-26.1	.850	.249	3.01	-.303	-27.7	.865	.262	3.17
308.X-ray systems	726010	1.4	1.91	99.9	-5.3	-105.2	15.7	.974	264	13.9	29	-.222	-12.5	.843	.199	a	-.252	-15.2	.888	.223	3.09	-.265	-16.9	.908	.233	3.24
309.Industrial televisions and videos	726020	0.2	2.07	209.9	-5.5	-233.9	14.5	.989	487	12.8						b				.185	2.37				.209	2.68
310.Electronic microscopes	726030	0.4	2.21	127.5	-6.4	-136.0	17.8	.966	577	15.8						b				.150	2.37				.170	2.68
311.Other electronic appliances	726040	3.8	1.85	404.2	-4.9	-417.8	13.9	.994	924	12.3	45	-.161	-11.3	.739	.148	a	-.189	-13.9	.809	.172	2.12	-.225	-17.4	.870	.201	2.48
312.Electric meters	727010	0.2	1.83	279.3	-5.3	-283.2	18.0	.986	1,077	16.0						b				.190	3.05				.197	3.15
313.Electric measuring instruments	727020	0.6	2.14	433.6	-6.2	-454.4	17.9	.986	2,582	15.9	63	-.279	-17.1	.822	.243	a	-.293	-18.6	.845	.254	4.03	-.300	-19.3	.855	.259	4.12
314.Semiconductor and IC measuring instruments	727030	0.3	1.75	185.5	-4.4	-194.5	12.6	.978	776	11.2	103	-.296	-27.7	.881	.256	a	-.331	-33.0	.913	.282	3.16	-.344	-35.5	.925	.291	3.26
315.Industrial instruments	727040	0.4	2.17	217.5	-6.3	-225.9	18.4	.993	343	16.3						b				.187	3.05				.193	3.15

Table 10: Estimated ASL and Rate of Depreciation (continued, 7)

6-digit classification of asset	code	weight (‰)	Weibull Distribution α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	Age-Price Profile for Surviving Assets N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	Estimated Depreciation Rates and Declining Balance Rates (definition-1) γ	(t-value)	adj R^2	δ (%)	DBR	(definition-2) γ	(t-value)	adj R^2	δ (%)	DBR
316.Other electric measuring instruments	727050	1.8	1.67	198.7	-4.6	-205.0	15.5	.952	1,975	13.9	67	-.179	-9.8	.585	.164	a	-.216	-12.6	.702	.194	2.69	-.226	-13.4	.727	.202	2.80
317.General purpose engine generators	728010	0.3	1.40	33.3	-4.3	-38.0	20.9	.925	91	19.0	29	-.082	-11.4	.815	.079	a	-.116	-16.9	.908	.109	2.08	-.121	-17.2	.911	.114	2.18
318.Motor generators	728020	0.3	1.53	59.2	-4.5	-65.5	18.9	.953	176	17.0	20	-.130	-8.4	.775	.122	a	-.165	-11.3	.865	.152	2.59	-.173	-12.2	.880	.159	2.71
319.Other generater, except for turbine generators	728030	0.1	1.30	43.3	-3.8	-47.1	18.6	.953	94	17.2						b				.137	2.36				.144	2.47
320.Electric motors	728040	1.9	1.80	79.2	-5.3	-87.1	19.0	.984	100	16.9						b				.140	2.36				.146	2.47
321.Switchgears, controlling equipment and switchboards	729010	13.6	1.52	199.9	-4.5	-231.8	19.7	.981	765	17.7						b				.136	2.42				.150	2.66
322.Transformers	729020	1.7	1.99	108.4	-6.4	-120.4	24.8	.977	283	22.0						b				.110	2.42				.121	2.66
323.Arc welding equipment	729030	0.1	2.05	272.5	-6.3	-286.3	21.7	.979	1,584	19.2						b				.126	2.42				.139	2.66
324.Resistance welding equipment	729040	0.1	1.64	51.2	-4.4	-49.3	14.7	.962	105	13.1						b				.184	2.42				.203	2.66
325.Accumulator and power supply equipment	729050	0.5	1.87	47.5	-5.2	-54.5	16.3	.941	142	14.4						b				.168	2.42				.184	2.66
326.Electric furnaces and industrial electric heater	729060	0.9	1.64	530.2	-5.0	-622.6	21.9	.984	4,580	19.6	116	-.080	-17.3	.720	.077	a	-.116	-29.8	.884	.109	2.14	-.129	-34.3	.910	.121	2.36
327.Power conversion equipment	729070	2.1	1.66	39.7	-4.7	-43.0	17.2	.927	125	15.3						b				.158	2.42				.173	2.66
328.Other industrial electric machinery and equipment	729080	1.1	1.61	249.8	-4.6	-265.6	17.0	.987	821	15.2	32	-.161	-8.1	.669	.148	a	-.190	-9.8	.748	.173	2.63	-.211	-11.1	.792	.190	2.89
329.Incandescent lamp fixtures	730010	1.8	1.50	55.8	-4.1	-63.6	15.0	.945	182	13.6						b				.178	2.42				.196	2.66
330.Fluorescent luminaires	730020	1.5	1.55	101.8	-4.1	-114.1	14.0	.980	217	12.6						b				.192	2.42				.212	2.66
331.High-intensity discharge lamps	730030	0.1	1.91	40.6	-5.6	-46.6	19.2	.965	61	17.1						b				.142	2.42				.156	2.66
332.Other electric lighting fixtures	730040	4.9	1.63	143.1	-4.2	-158.0	13.0	.975	516	11.7						b				.207	2.42				.228	2.66
333.Cameras	731010	0.5	1.55	2052.0	-4.5	-2374.8	17.8	.998	9,333	16.0	221	-.103	-30.0	.803	.097	a	-.135	-40.8	.883	.126	2.01	-.158	-55.0	.932	.146	2.34
334.Photographic machines and related and instruments	731020	0.0	2.45	92.3	-6.5	-94.6	14.2	.975	217	12.6						b				.170	2.14				.194	2.45
335.Microscopes and magnifying glasses	731030	0.1	2.23	251.0	-6.5	-251.8	18.7	.980	1,257	16.6	49	-.155	-10.4	.687	.143	a	-.183	-13.5	.787	.167	2.78	-.196	-15.2	.825	.178	2.96
336.Motion picture equipment	731040	0.0	1.98	82.3	-5.2	-85.6	14.1	.942	417	12.5						b				.172	2.14				.196	2.45
337.Other optical machinery	731050	0.0	1.77	305.3	-4.8	-328.1	15.1	.986	1,322	13.4	55	-.150	-9.8	.635	.139	a	-.183	-13.6	.769	.168	2.25	-.215	-17.5	.848	.193	2.60
338.Watches and clocks	732010	0.0	2.18	54.3	-6.5	-55.1	19.5	.942	183	17.3						b				.183	3.16				.192	3.31
339.Physical and chemical instruments	732020	0.4	2.13	677.2	-6.1	-701.6	17.3	.996	1,688	15.3	41	-.374	-14.6	.838	.312	a	-.385	-15.3	.850	.320	4.90	-.387	-15.4	.852	.321	4.92
340.Instruments and appliances for analyzing, testing, measuring and scaling	732030	6.6	2.01	1437.1	-5.8	-1499.2	18.1	.985	31,753	16.0	517	-.193	-30.6	.645	.175	a	-.218	-36.9	.725	.196	3.13	-.235	-42.7	.779	.210	3.36
341.Medical and surgical equipment	732040	5.1	1.99	291.4	-5.1	-313.4	12.7	.979	1,794	11.3	123	-.286	-19.8	.760	.249	a	-.320	-23.3	.815	.274	3.08	-.326	-24.0	.824	.279	3.13
342.Carpets	733010	0.8	1.88	820.0	-4.9	-907.2	13.7	.997	2,329	12.2						b				.136	1.65				.161	1.96
343.Other textile products	733020	1.1	1.53	515.0	-3.9	-569.8	12.7	.995	1,387	11.4						b				.145	1.65				.172	1.96
344.Wooden furniture and fixtures	734010	3.0	1.58	1716.7	-4.3	-1825.5	14.8	.995	14,242	13.3	203	-.166	-16.2	.562	.153	a	-.213	-23.3	.727	.192	2.55	-.224	-24.8	.751	.200	2.67
345.Wooden doors and windows	734020	0.4	1.67	273.3	-4.6	-308.5	15.9	.992	580	14.2						b				.174	2.47				.191	2.72
346.Pallets	734030	0.4	2.33	59.7	-5.6	-60.0	10.9	.868	545	9.7	49	-.123	-9.3	.635	.115	a	-.171	-13.8	.794	.158	1.53	-.347	-20.4	.895	.293	2.84
347.Other wood products	734040	0.1	1.61	112.2	-4.3	-125.0	14.5	.964	465	13.0	21	-.279	-7.2	.705	.243	a	-.310	-8.4	.768	.266	3.45	-.314	-8.5	.774	.269	3.49
348.Metal furniture and furnishings, fixtures	735010	1.0	1.64	1784.4	-4.5	-1921.6	15.2	.995	15,951	13.6	424	-.131	-23.8	.571	.123	a	-.176	-35.6	.749	.162	2.20	-.199	-44.0	.820	.181	2.46
349.Fabricated structural and Prefabricated architectural metal products	735020	0.8	1.66	113.0	-4.5	-121.0	15.3	.962	507	13.6	28	-.083	-7.4	.660	.080	a	-.145	-17.0	.911	.135	1.84	-.160	-20.8	.939	.148	2.02
350.Gas and petrol equipment, heaters and cooking appliances	735030	0.5	1.75	478.8	-4.8	-516.1	15.2	.994	1,364	13.6	49	-.176	-8.2	.577	.161	a	-.222	-12.1	.749	.199	2.70	-.241	-14.2	.804	.214	2.91
351.Metallic containers	735040	0.0	1.80	58.4	-4.7	-59.5	13.9	.879	470	12.4	60	-.097	-13.3	.747	.092	a	-.161	-22.8	.896	.148	1.84	-.167	-22.5	.894	.154	1.91
352.Metallic tanks and reservoirs	735050	1.4	1.45	351.8	-4.1	-377.5	16.7	.993	875	15.1	24	-.098	-6.4	.625	.093	a	-.141	-9.9	.801	.131	1.99	-.159	-11.6	.847	.147	2.22
353.Other metal products	735060	0.8	1.60	755.2	-4.6	-785.5	17.6	.993	3,880	15.8	130	-.079	-11.0	.482	.076	a	-.118	-17.7	.706	.111	1.76	-.150	-26.6	.844	.139	2.20
354.Electronic musical instruments	736010	0.1	2.08	57.8	-6.2	-67.9	19.7	.972	98	17.5	22	-.189	-11.0	.844	.172	a	-.206	-12.5	.876	.187	3.26	-.216	-13.4	.891	.194	3.40
355.Other musical instruments	736020	0.3	1.53	44.2	-4.8	-46.8	23.2	.958	87	20.9	20	-.081	-4.6	.500	.077	a	-.117	-7.0	.704	.110	2.31	-.119	-7.1	.711	.112	2.35
356.Information recording mediums	737000	0.0	1.56	170.2	-3.6	-168.9	10.2	.952	1,450	9.2						b				.180	1.65				.214	1.96
357.Sporting equipment	738010	1.1	1.83	158.0	-4.8	-162.5	14.2	.987	321	12.6						b				.131	1.65				.155	1.96
358.Advertising and sign and display equipment	738020	1.2	1.46	853.5	-3.7	-958.3	12.5	.991	6,385	11.4	107	-.105	-8.8	.419	.100	a	-.166	-15.1	.680	.153	1.73	-.177	-15.8	.700	.162	1.84
359.Manequins and other models	738030	0.2	1.33	74.4	-2.9	-84.2	8.7	.944	331	8.0						b				.206	1.65				.245	1.96
360.Industrial models	738040	0.6	1.51	94.1	-3.6	-105.2	10.7	.950	463	9.6						b				.172	1.65				.204	1.96

Table 10: Estimated ASL and Rate of Depreciation (continued, 8)

6-digit classification of asset	code	weight (‰)	Weibull Distribution								Age-Price Profile for Surviving Assets					Estimated Depreciation Rates and Declining Balance Rates									
																	(definition-1)					(definition-2)				
			α	(t-value)	β	(t-value)	λ	adj R^2	N	T (years)	N	γ	(t-value)	adj R^2	δ (%)	met-hod*)	γ	(t-value)	adj R^2	δ (%)	DBR	γ	(t-value)	adj R^2	δ (%)	DBR
361.Safety protectors and lifesaving equipment	738050	1.9	0.96	14.3	-2.3	-12.2	10.8	.557	163	11.0						b				.150	1.65				.179	1.96
362.Unit housing	738060	2.0	1.35	58.6	-3.3	-64.7	12.0	.978	79	11.0	58	-.056	-8.6	.558	.055	a	-.128	-22.9	.900	.120	1.32	-.145	-25.6	.918	.135	1.49
363.Room units	738070	1.7	1.50	143.0	-3.9	-162.1	13.3	.983	359	12.0						b				.138	1.65				.163	1.96
364.Other manufacturing products	738080	2.9	1.51	1837.2	-4.0	-1985.9	14.5	.997	10,931	13.1	333	-.111	-19.1	.522	.105	a	-.153	-27.0	.686	.142	1.85	-.197	-42.1	.842	.179	2.34
365.OTCs (Planning)	801010	3.6	1.32	109.3	-3.5	-132.7	13.7	.985	179	12.6						b				.131	1.65				.156	1.96
366.OTCs (Administrating)	801020	2.5	1.87	47.2	-4.6	-56.6	12.0	.944	134	10.7						b				.155	1.65				.184	1.96
367.OTCs (Transaction fee)	801030	3.9	1.32	32.1	-3.0	-34.6	10.0	.915	97	9.2						b				.180	1.65				.214	1.96
368.OTCs (Transportation fee)	801040	2.9	1.40	93.7	-3.6	-107.4	12.7	.968	292	11.6						b				.142	1.65				.169	1.96
369.Software	901000	38.7	2.63	75.1	-6.4	-81.0	11.6	.966	198	10.3						b				.183	1.90				.219	2.26

Note: *) a: T and δ are estimated, b: δ is computed by using the estimated T and the assumed DBR, c: In definition-1, δ is assumed as the estimated δ in the APP of surviving assets and δ is computed by assuming 0.1= (1-δ)T in definition-2