Measurement of Depreciation Rates based on Disposal Asset Data in Japan

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Revision of Capital Stock Estimates in JSNA

Estimation of Aging-profiles of assets:

- Geometric for tangible assets and straight-line for software.
- Depreciation rates are based on the Tax-Lives.
- Some empirical evidence finds that $\delta$ (depreciation rates) assumed in the current JSNA may be inappropriate for some assets.

<table>
<thead>
<tr>
<th>Assets</th>
<th>$T$</th>
<th>$\delta$</th>
<th>NCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings</td>
<td>28.0</td>
<td>7.9</td>
<td>251163</td>
</tr>
<tr>
<td>Non-residential buildings</td>
<td>37.4</td>
<td>6.0</td>
<td>250712</td>
</tr>
<tr>
<td>Other structures</td>
<td>33.7</td>
<td>6.6</td>
<td>190913</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>7.6</td>
<td>26.2</td>
<td>26332</td>
</tr>
<tr>
<td>Agriculture machinery</td>
<td>9.2</td>
<td>22.2</td>
<td>2902</td>
</tr>
<tr>
<td>Other machinery</td>
<td>10.6</td>
<td>19.5</td>
<td>175055</td>
</tr>
<tr>
<td>Cultivated assets</td>
<td>5.4</td>
<td>12.1</td>
<td>1674</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>27.8</td>
<td>9.9</td>
<td>898749</td>
</tr>
</tbody>
</table>

Note: NCS is net capital stock at the end of 2000 (billion yen). The stocks depreciated by straight-line (infrastructure and software) are excluded in this table. (Nomura and Futakami, 2005)
## Approaches to Estimate Aging-profiles

<table>
<thead>
<tr>
<th>approach</th>
<th>good points</th>
<th>problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax-lives</td>
<td>* easy to collect</td>
<td>* uncertain sources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* hard to connect to asset (product) classification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* tends to be shorter than actual life</td>
</tr>
<tr>
<td>Registration data (administrative records)</td>
<td>* very good source to estimate service lives</td>
<td>* available assets are limited (dwellings, buildings, transportation equipment)</td>
</tr>
<tr>
<td></td>
<td>* covers all assets for particular type of assets</td>
<td></td>
</tr>
<tr>
<td>Market price data of aged assets (second-hand, rentals, or insurance)</td>
<td>* good source to estimate Age-Price Profiles (APP).</td>
<td>* needs an assumption of surviving rates to correct sample biases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* lemons bias</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* markets are limited (buildings, motor vehicles, ships)</td>
</tr>
<tr>
<td>Disposal data</td>
<td>* good source to estimates survival function and APP (no need to assume survival functions, a priori)</td>
<td>* sample biases in disposal data</td>
</tr>
<tr>
<td></td>
<td>* covers many types of asset</td>
<td>* immature second-hand market: representativeness</td>
</tr>
<tr>
<td></td>
<td>* larger samples</td>
<td>* lemons bias</td>
</tr>
</tbody>
</table>
Disposal Survey (1)
-Characteristics of Disposal data

Disposal and Discard

Disposal (withdrawal of assets from the owner)

Discard (withdrawal of assets from the economy)

Sold (as second-hand assets for continued use)
Disposal Survey (2)
- Characteristics of Disposal Data

- Disposal (from the owner)
  - Discard (from the economy)
  - Sold (for continued use)

- New assets
- Second-hand assets
- Renovation

period of disposal

period of acquisition
Disposal Survey (3) - Disaggregation of Asset

- More than 600 assets at the most detailed level for better homogeneity within each type of asset.
- Roughly, survival function can be estimated for 300-400 types of assets and Age-Price Profile for 200 types of assets.
- Disaggregation enables us
  - to evaluate technological changes embodied in capital (e.g. ICT-related, industrial robots, etc).
  - to estimate average depreciation rates for the past or other countries, reflecting the differences in asset compositions and industry structure over periods or across countries.

<table>
<thead>
<tr>
<th>Six broad groups of assets</th>
<th>Number of assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Buildings</td>
<td>66</td>
</tr>
<tr>
<td>2. Equipment attached to buildings</td>
<td>41</td>
</tr>
<tr>
<td>3. Structures</td>
<td>47</td>
</tr>
<tr>
<td>4. Machineries</td>
<td>172</td>
</tr>
<tr>
<td>5. Transportation equipment</td>
<td>56</td>
</tr>
<tr>
<td>6. Other machinery and equipment</td>
<td>257</td>
</tr>
<tr>
<td>sum</td>
<td>639</td>
</tr>
</tbody>
</table>
Methodology

Discard (survival function)

- The Weibull distribution: \( S(n) = \text{EXP}[-(n/\lambda)^\alpha] \)
  - \( n \): age, \( \lambda \): scale parameter, \( \alpha \): shape parameter
  - The results are comparable with the estimates in Netherlands (Meinen et al., 1998; Erumban, 2008), Canada (Statistics Canada, 2008), and Japan (Nomura, 2005b).
  - Number of asset samples: about 180,000 discard data (excluding sold assets)

Depreciation (age-price profiles)

- As a basic framework, we follow Hulten-Wykoff method.
  - To correct the sampling biases, we use the estimated Weibull survival probability.
  - Number of asset samples: about 26,000
Summary of Average Service Lives
- Comparison with Canadian Estimates

Comparison of Average Service Lives - Transport Equipment (motor vehicle)

Note: The estimates for Canada, the U.S., and the Netherlands are based on Table 9 in Erumban (2008).
Comparison of Average Service Lives -Computers

Note: The estimates for Canada, the U.S., and the Netherlands are based on Table 9 in Erumban (2008).
Comparison of Average Service Lives
-Machinery and Equipment

0 5 10 15 20 25 30 35 40

Canada (Baldwin et al) ex post
Canada (Baldwin et al) ex ante
U.S. (BLS)
U.S. (BEA)
Netherlands (Meinen)
Netherlands (Bergen et al)
Netherlands (Erumban)
Japan (old estimates: Nomura)
Japan (1: new assets: S(1,2,*))
Japan (2: second-hand: S(2,2,*))
Japan (3: renovation: S(3,2,*))
Japan (4: 1)+3): S(1 or 3,2,*))
Japan (5: all: S(*,2,*))

Note: The estimates for Canada, the U.S., and the Netherlands are based on Table 9 in Erumban (2008).
Geometric Depreciation Rates
- Histogram

(Building and Construction
Machinery and Equipment)

0.06 0.09 0.12 0.15 0.18 0.21 0.24 0.27 0.3 0.33 0.36 0.39 0.42 0.45 0.48 0.51

Geometric Depreciation Rates

(number of assets)
N=195

4. Warehouses
103. Flat panel and display manufacturing equipment
9. Model houses/rooms (for exhibition)
151. Servicing machines
Geometric Depreciation Rates for Machinery and Equipment - Comparison with Canada and the U.S.

Geometric Depreciation Rates for Building and Construction - Comparison with Canada and the U.S.

Thank you very much

Comments welcome
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