Time Series Data of Japanese Capital Stock by Sector: “Cascaded Leaky Buckets” in INFORUM approach

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Purpose of research

- In sufficiency of appropriate data of investment in capital goods by sector, “Cascaded Leaky Buckets” approach is useful to convert from the flow data of capital formation to the stock.

- In case of inefficiency of time series capital stock data, it is possible to trace out the hypothetical steady state path of capital stock by purchasing sector to fulfill the water into the bucket (to accumulate capital goods) to some extent.
Capital stock data in SNA based table in Japan has not the enough numbers of purchasing sectors for Input-Output analysis.

Stock data of capital goods are estimated from the flow data of investment and wearout rate by supplying sector using “Cascaded Leaky Buckets” approach in a “G” program developed by Clopper Almon (1994, The Craft of Economic Modeling).
• In order to get the value of capital formation in real term by purchasing sector, the capital matrix share in 1995 are introduced as an unchanged share for a whole estimated periods from 1973 to 1999.

• Data of fixed capital matrix is released attached with Input-Output tables in benchmark year (every five years) in Japan.
“Cascaded Leaky Buckets” in INFORUM approach

- Preparatory works;
- Adjustment of different sector classifications between Input-Output tables, and SNA National Accounts.
- Assumption of wearout or spillage rate by sector.
Numerical example and conceptual figure

\[ y_t = (1 - r) y_{t-1} + x_t \]

- \( t > 0, 1 > r > 0 \)
- where \( x \) : investment flow
- \( y \) : capital stock
- \( r \) : spill rate of capital goods
- \( y = \text{@cum}( y, x, r ) \),
Equilibrium level of capital

- $x = 100$ are invested, and a spill rate $r$ is assumed at $r = 0.08$ each period.
- Equilibrium of capital stock is calculated as the gross investment divided by spill rate; $100 / 0.08 = 1,250.00$. 
Estimated steady state of capital stock path

Numerical example of capital stock
Supplying and purchasing industries

- Precise classification of supplying industries and purchasing industries are re-classified to 208 sector by 104 sector.

- Among 208 supplying sectors, there are 62 sectors of capital goods sold to purchasers as the capital formation.

- Purchasers have the assets which consist of different service lives to be summed up.

- Fixed capital matrix in value is converted to the share table by calculating by the capital goods sold to purchasing sectors divided by total value of investment goods as a supplying sector. The service lives were assumed for various information.
Spillage rate assumed by supplying sector

- Necessary appropriate assumption of the wearout or spillage of capital goods.
- Spill-rate by supplying capital goods was assumed to falls into the ranges from 1 year to 30 years. ➔ Refer to ttl file
assumption of the spillage of capital goods

- # Calculate Capital stock
- add capstkf.add 3 3 "Other Edible"
- add capstkf.add 4 3 "Non-Edibles"
- add capstkc.add 5 10 "Fruits ???"
- add capstkf.add 7 3 "Stock Raise ???"
- add capstke.add 45 3 "Clothing"
- add capstke.add 46 5 "Other Textil"
- add capstkc.add 18 10 "Other Non-M ???"
- add capstkb.add 50 15 "Furniture ???"
- add capstkb.add 51 15 "Metal Furnit"
- add capstkb.add 104 15 "Other Steel Prod"
- add capstkb.add 111 15 "Other Non-ferr."
- add capstkb.add 112 15 "Metal for Const."
**Broadly classified tangible fixed assets**

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>All industries</td>
<td>362,150</td>
<td>498,725</td>
<td>692,004</td>
<td>891,454</td>
<td>1,028,675</td>
<td>1,093,764</td>
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<td>59,569</td>
<td>70,420</td>
<td>82,020</td>
<td>91,300</td>
<td>96,268</td>
<td>97,253</td>
</tr>
<tr>
<td>and fishing</td>
<td>742</td>
<td>902</td>
<td>2,603</td>
<td>7</td>
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<td>Mining</td>
<td>1,902</td>
<td>2,043</td>
<td>2,225</td>
<td>33</td>
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<td>Construction</td>
<td>14,239</td>
<td>18,843</td>
<td>25,635</td>
<td>36,951</td>
<td>40,722</td>
<td>39,707</td>
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<td>347,759</td>
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<td>56,233</td>
<td>78,171</td>
<td>97,822</td>
<td>109,457</td>
<td>115,158</td>
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<tr>
<td>trade</td>
<td>94</td>
<td>96</td>
<td>81</td>
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<tr>
<td>Finance and insurance</td>
<td>6,544</td>
<td>9,213</td>
<td>14,738</td>
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<td>14,797</td>
<td>25,661</td>
<td>34,625</td>
<td>39,315</td>
<td>40,773</td>
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<td>50,838</td>
<td>73,482</td>
<td>99,397</td>
<td>115,409</td>
<td>124,394</td>
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<td>communication</td>
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<td>3</td>
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<tr>
<td>Electricity, gas and</td>
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<td>43,943</td>
<td>58,325</td>
<td>77,745</td>
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<td>42</td>
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<td>Services</td>
<td>24,089</td>
<td>44,694</td>
<td>83,189</td>
<td>122,797</td>
<td>161,058</td>
<td>199,198</td>
</tr>
<tr>
<td>Primary industry</td>
<td>59,569</td>
<td>70,420</td>
<td>82,020</td>
<td>91,300</td>
<td>96,268</td>
<td>97,253</td>
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<td>Secondary industry</td>
<td>161,270</td>
<td>208,580</td>
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<td>141,310</td>
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<td>333,568</td>
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<td>606,326</td>
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<td>754</td>
<td>340</td>
<td>382</td>
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</table>

**Values of Tangible fixed assets by sectors**
Government statistics of capital stocks

Tangible Fixed Assets in 1993 SNA base

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (Million Yen in Real Term)</th>
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<tbody>
<tr>
<td>1980IV</td>
<td>1,000,000,000</td>
</tr>
<tr>
<td>1985IV</td>
<td>1,200,000,000</td>
</tr>
<tr>
<td>1990IV</td>
<td>1,400,000,000</td>
</tr>
<tr>
<td>1995IV</td>
<td>1,600,000,000</td>
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<td>2000IV</td>
<td>1,800,000,000</td>
</tr>
<tr>
<td>2004IV</td>
<td>2,000,000,000</td>
</tr>
</tbody>
</table>

Services
- Electricity, gas and water supply
- Transportation and communication
- Real estate
- Finance and insurance
- Wholesale and retail trade
- Manufacturing
- Construction
- Mining
- Agriculture, forestry and fishing
### Share of tangible fixed assets by sectors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All industries</td>
<td>0.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>16.43%</td>
<td>14.12%</td>
<td>11.85%</td>
<td>10.24%</td>
<td>9.36%</td>
<td>8.89%</td>
</tr>
<tr>
<td>Mining</td>
<td>0.53%</td>
<td>0.41%</td>
<td>0.32%</td>
<td>0.29%</td>
<td>0.27%</td>
<td>0.25%</td>
</tr>
<tr>
<td>Construction</td>
<td>3.93%</td>
<td>3.78%</td>
<td>3.70%</td>
<td>4.15%</td>
<td>3.96%</td>
<td>3.63%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>40.07%</td>
<td>37.63%</td>
<td>35.92%</td>
<td>34.65%</td>
<td>33.67%</td>
<td>31.79%</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>11.92%</td>
<td>11.28%</td>
<td>11.30%</td>
<td>10.97%</td>
<td>10.64%</td>
<td>10.53%</td>
</tr>
<tr>
<td>Finance and insurance</td>
<td>1.81%</td>
<td>1.85%</td>
<td>2.13%</td>
<td>2.17%</td>
<td>2.25%</td>
<td>2.43%</td>
</tr>
<tr>
<td>Real estate</td>
<td>2.85%</td>
<td>2.97%</td>
<td>3.71%</td>
<td>3.88%</td>
<td>3.82%</td>
<td>3.73%</td>
</tr>
<tr>
<td>Transportation and communication</td>
<td>6.01%</td>
<td>10.19%</td>
<td>10.62%</td>
<td>11.15%</td>
<td>11.22%</td>
<td>11.37%</td>
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<tr>
<td>Electricity, gas and water supply</td>
<td>9.78%</td>
<td>8.81%</td>
<td>8.43%</td>
<td>8.72%</td>
<td>9.15%</td>
<td>9.16%</td>
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<tr>
<td>Services</td>
<td>6.65%</td>
<td>8.96%</td>
<td>12.02%</td>
<td>13.78%</td>
<td>15.66%</td>
<td>18.21%</td>
</tr>
<tr>
<td>Primary industry</td>
<td>16.45%</td>
<td>14.12%</td>
<td>11.85%</td>
<td>10.24%</td>
<td>9.36%</td>
<td>8.89%</td>
</tr>
<tr>
<td>Secondary industry</td>
<td>44.53%</td>
<td>41.82%</td>
<td>39.94%</td>
<td>39.09%</td>
<td>37.89%</td>
<td>35.67%</td>
</tr>
<tr>
<td>Tertiary industry</td>
<td>39.02%</td>
<td>44.06%</td>
<td>48.20%</td>
<td>50.67%</td>
<td>52.75%</td>
<td>55.43%</td>
</tr>
</tbody>
</table>
Gov.'s statistics of capital stock share by sector

Share of Tangible Fixed Assets by sector in 1993 SNA base

- Services
- Electricity, gas and water supply
- Transportation and communication
- Real estate
- Finance and insurance
- Wholesale and retail trade
- Manufacturing
- Construction
- Mining
- Agriculture, forestry and fishing
Investment by Selling Industry

Piled Carpet in Investment by Selling Industry
Investment by purchasing sector

Investment in Composite Capital Goods by Purchasing Industry
Major Capital Goods in Investment by Selling Industry

Top 10 Selling Industries of Investment in Capital Goods

- 190 Information
- 136 Automobile
- 128 Communication
- 122 Other General
- 156 Oth. Construct
- 127 Computer
- 154 Dwell Construct
- 159 Other Civil
- 170 Wholesale
- 153 Dwell Construct
Estimation Results of Capital Stock

- Since estimated stock data of capital formation does not reach the steady state to some extent, hypothetical path of capital stock might be omitted for the time being if circumstances of data range permit.

- Although Investment by sector and in aggregate value have fluctuations, our estimated values of Capital Stock does not cause extreme fluctuation, but trace the moderate growth by sector and in aggregate value.

- Levels of estimated capital stock by major reports of institution and government fall into some narrow range.
Investment & Capital Stock in Sector 98

Graphs showing the trends of Investment (Inv) and Capital Stock for 98 Office supply from 1975 to 1995.
Investment & Capital Stock in Sector 89
Investment & Capital Stock in Sector 49

Inv; 49 Automobile

Capital Stock; 49 Automobile
Estimated Capital Stock in major purchasing sectors

**Capital Stock in Top 10 Purchasing Industries**

- 98 Office sup
- 89 Adv&Inform
- 70 House rent
- 62 ElectricPw
- 78 AirTranspS
- 84 Education
- 67 Retail sal
- 49 Automobile
- 66 Wholesales
- 92 ReprAuto&M
Comparison of estimated capital formation
ESRI: Economic and Social Research Institute

Total capital formation

200,000 400,000 600,000 800,000 1,000,000 1,200,000 1,400,000 1,600,000

JIP estimation  ESRI  JIDEAL estimation
• JIDEAL estimated the lower level of capital stock compared with ESRI-JIP project and the ESRI official statistics level.

• The level of capital stock estimated by JIDEAL is lower than ESRI stat by -15%. The level of JIP estimation is higher than ESRI by +40%.

• In 1975, Top 10 purchasing industries have 67% share in the total capital stocks. In 1999, the share of top 10 industries has decreased to the share of 55%.
Further perspective in research

• Appropriate adjustment of capital matrix share to be proceeded for the change over year.

• In order to adjust the level and growth rate, more reliable assumption of spill rate in capstk.ttl to be introduced.

• Latest benchmark table of Input-Output data for 2000 to be surcharged.