

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

*Toshiaki Hasegawa*  
*Faculty of Economics*  
*Chuo University, JAPAN*

Prepared for 14<sup>th</sup> International INFORUM Conference,  
September 11-15, 2006, Traunkirchen, Austria

## *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*

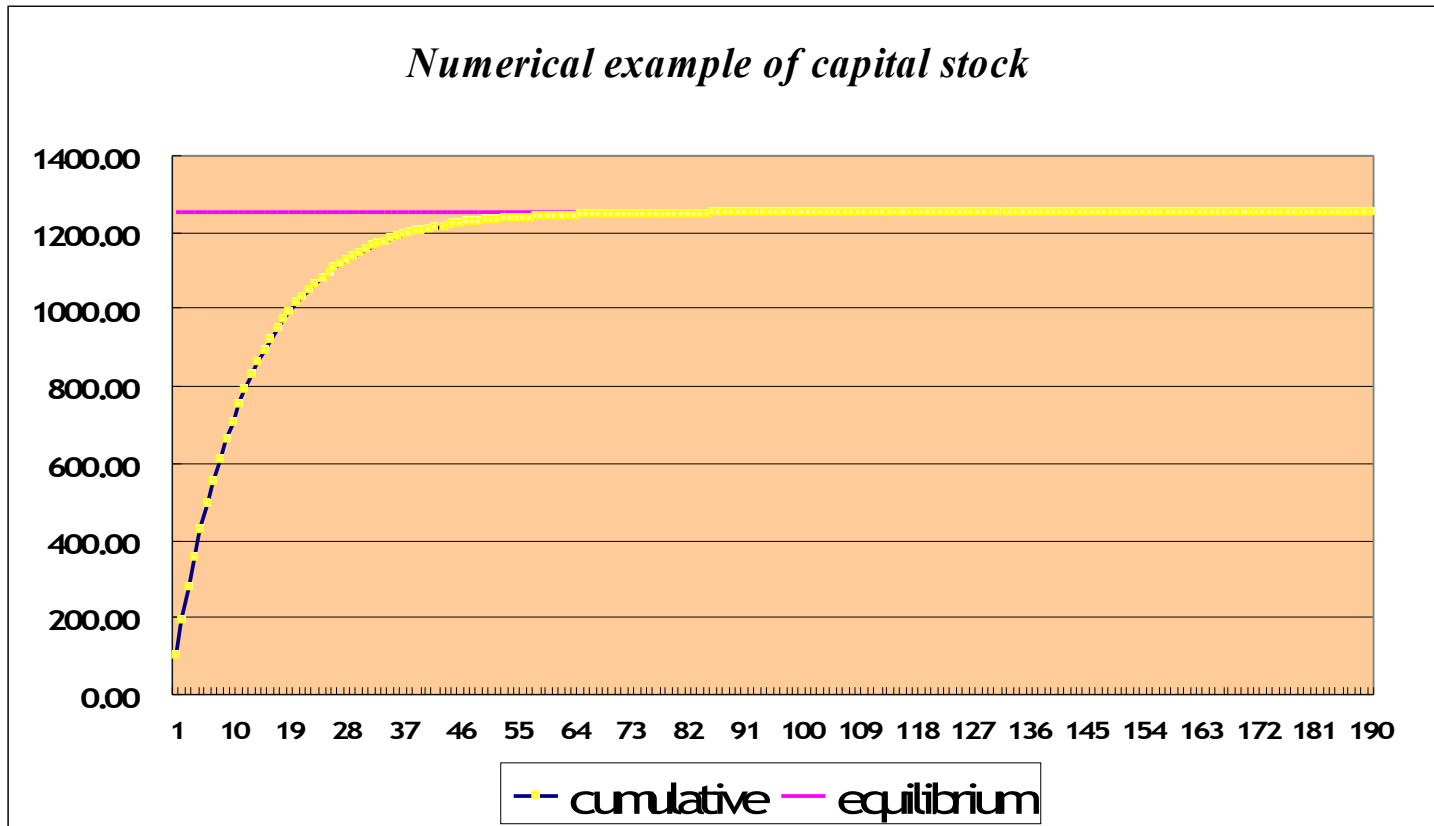
$$y_t = (1 - r)y_{t-1} + x_t$$

- $t > 0, 1 > r > 0$
- where  $x$  : investment flow
- $y$  : capital stock
- $r$  : spill rate of capital goods
- $y = @cum( y, x, r ),$

## *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*





# *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

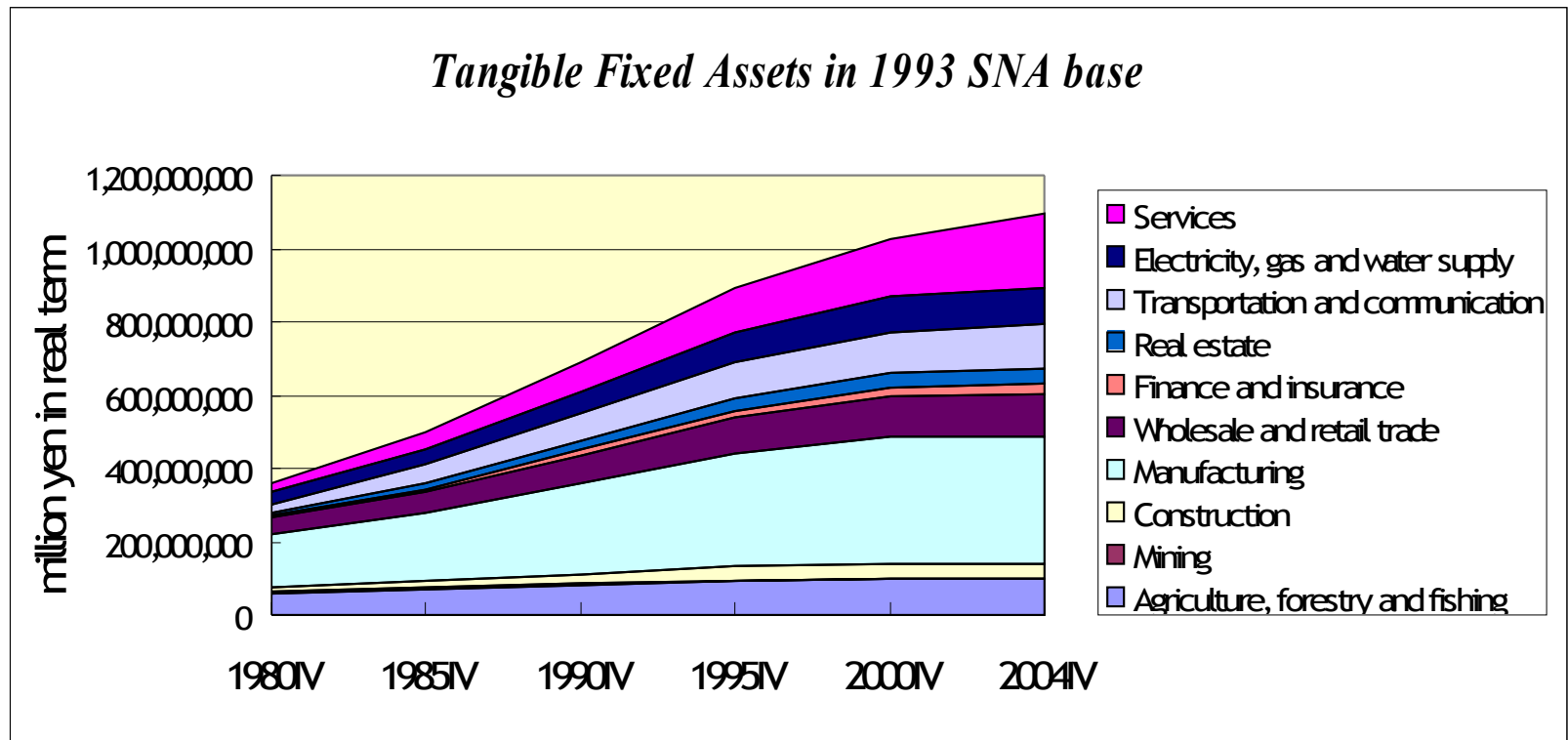
• # Calculate Capital stock			
• add capstkf.add 3	3	"Other Edible	"
• add capstkf.add 4	3	"Non-Edibles	"
• add capstkc.add 5	10	"Fruits ???"	
• add capstkf.add 7	3	"Stock Raise	???"
• add capstkc.add 18	10	"Other Non-M	???"
• add capstkf.add 45	3	"Clothing "	
• add capstke.add 46	5	"Other Textil	"
• add capstkc.add 50	10	"Other Wooden pro"	
• add capstkb.add 51	15	"Furniture ???"	
• add capstkb.add 52	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."	
• add capstkd.add 113	7	"Other Metal Prod."	
• add capstkd.add 114	7	"Mach.for Mining"	
• add capstkd.add 115	7	"Mach. for Agric."	
• add capstkc.add 116	10	"Mach. Tool for M."	
• add capstkc.add 117	10	"Mach. for Met. P"	
• add capstkc.add 118	10	"Mach. for Chem."	
• add capstkb.add 119	15	"Mach. for Textil"	
• add capstkc.add 120	10	"Mach. for Oth.	"
• add capstkc.add 121	10	"Boiler, Turbin	"
• add capstkc.add 122	10	"Other Gene. Mach"	
• add capstke.add 123	5	"Business Mach.	"
• add capstkd.add 124	7	"Radio, TV, Audio"	
• add capstkd.add 125	7	"Other House Elec"	

# *Broadly classified tangible fixed assets*

## Values of Tangible fixed assets by sectors

□	1980I V	1985I V	1990I V	1995I V	2000I V	2004I V
All industries	362,150,	498,725,	692,004,	891,454,	1,028,675	1,093,764
Agriculture, forestry and fishing	59,569, <sup>198</sup> <sub>6</sub>	70,420, <sup>510</sup> <sub>2</sub>	82,020, <sup>742</sup> <sub>1</sub>	91,300, <sup>664</sup> <sub>3</sub>	96,268, <sup>352</sup> <sub>55</sub>	97,253, <sup>155</sup> <sub>90</sub>
Mining	1,902, <sup>91</sup>	2,043, <sup>50</sup> <sub>66</sub>	2,225, <sup>02</sup> <sub>83</sub>	2,603, <sup>43</sup> <sub>35</sub>	2,730,659	2,716,170
Construction	14,239, <sup>2</sup> <sub>4</sub>	18,843, <sup>4</sup> <sub>0</sub>	25,635, <sup>8</sup> <sub>7</sub>	36,951, <sup>0</sup> <sub>0</sub>	40,722,65	39,707,61
Manufacturing	145,127, <sup>11</sup>	187,693, <sup>05</sup>	248,554, <sup>39</sup>	308,891, <sup>07</sup>	346,352, <sup>1</sup>	347,759, <sup>8</sup>
Wholesale and retail trade	43,154, <sup>806</sup> <sub>0</sub>	56,237, <sup>837</sup> <sub>7</sub>	78,171, <sup>723</sup> <sub>5</sub>	97,822, <sup>581</sup> <sub>6</sub>	109,457, <sup>84</sup> <sub>6</sub>	115,158, <sup>25</sup> <sub>0</sub>
Finance and insurance	6,544, <sup>04</sup> <sub>78</sub>	9,213, <sup>06</sup> <sub>53</sub>	14,738, <sup>51</sup> <sub>0</sub>	19,319, <sup>03</sup> <sub>1</sub>	23,191, <sup>04</sup> <sub>84</sub>	26,589, <sup>39</sup> <sub>05</sub>
Real estate	10,312, <sup>0</sup> <sub>0</sub>	14,797, <sup>4</sup> <sub>2</sub>	25,661, <sup>64</sup> <sub>8</sub>	34,625, <sup>20</sup> <sub>6</sub>	39,315, <sup>5</sup> <sub>42</sub>	40,773, <sup>0</sup> <sub>33</sub>
Transportation and communication	21,777, <sup>21</sup> <sub>1</sub>	50,838, <sup>35</sup> <sub>7</sub>	73,482, <sup>25</sup> <sub>6</sub>	99,397, <sup>27</sup> <sub>6</sub>	115,409, <sup>1</sup> <sub>3</sub>	124,394, <sup>6</sup> <sub>1</sub>
Electricity, gas and water supply	35,433, <sup>11</sup> <sub>1</sub>	43,943, <sup>38</sup> <sub>5</sub>	58,325, <sup>22</sup> <sub>1</sub>	77,745, <sup>43</sup> <sub>4</sub>	94,168, <sup>68</sup> <sub>82</sub>	100,213, <sup>89</sup> <sub>2</sub>
Services	24,089, <sup>07</sup> <sub>4</sub>	44,694, <sup>21</sup> <sub>0</sub>	83,189, <sup>74</sup> <sub>1</sub>	122,797, <sup>13</sup> <sub>7</sub>	161,058, <sup>4</sup> <sub>2</sub>	199,198, <sup>76</sup> <sub>7</sub>
Primary industry	59,569, <sup>27</sup> <sub>6</sub>	70,420, <sup>20</sup> <sub>2</sub>	82,020, <sup>04</sup> <sub>1</sub>	91,300, <sup>976</sup> <sub>3</sub>	96,268, <sup>38</sup> <sub>55</sub>	97,253, <sup>45</sup> <sub>90</sub>
Secondary industry	161,270, <sup>19</sup> <sub>7</sub>	208,580, <sup>50</sup> <sub>5</sub>	276,416, <sup>02</sup> <sub>0</sub>	348,445, <sup>43</sup> <sub>3</sub>	389,805, <sup>8</sup> <sub>4</sub>	390,183, <sup>7</sup> <sub>6</sub>
Tertiary industry	141,310, <sup>129</sup> <sub>0</sub>	219,724, <sup>506</sup> <sub>4</sub>	333,568, <sup>300</sup> <sub>0</sub>	451,708, <sup>939</sup> <sub>9</sub>	542,601, <sup>94</sup> <sub>3</sub>	606,326, <sup>13</sup> <sub>6</sub>
	450	754	340	382	00	35

# Government statistics of capital stocks



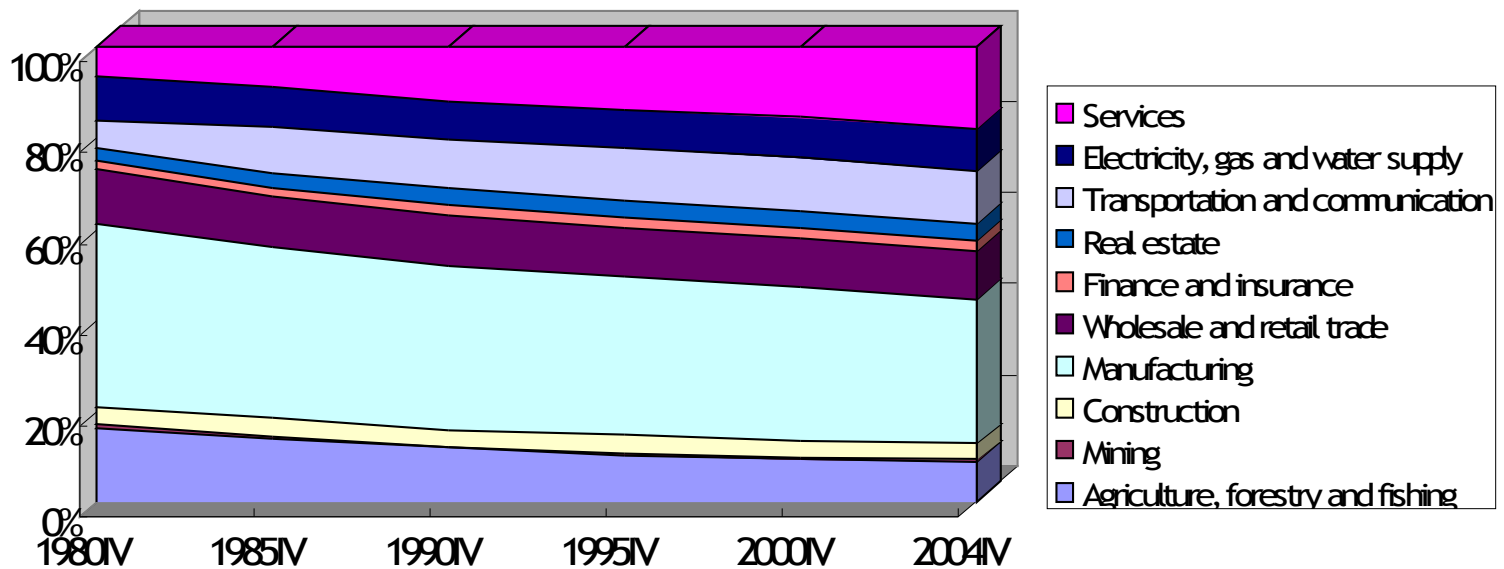
# Share of tangible fixed assets by sectors

Share of tangible fixed assets by sectors

	1980I	1985I V	1990I V	1995I V	2000I V	2004I V
□	100.00%					
All industries	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Agriculture, forestry and fishing	16.45%	14.12%	11.85%	10.24%	9.36%	8.89%
Mining	0.53%	0.41%	0.32%	0.29%	0.27%	0.25%
Construction	3.93%	3.78%	3.70%	4.15%	3.96%	3.63%
Manufacturing	40.07%	37.63%	35.92%	34.65%	33.67%	31.79%
Wholesale and retail trade	11.92%	11.28%	11.30%	10.97%	10.64%	10.53%
Finance and insurance	1.81%	1.85%	2.13%	2.17%	2.25%	2.43%
Real estate	2.85%	2.97%	3.71%	3.88%	3.82%	3.73%
Transportation and communication	6.01%	10.19%	10.62%	11.15%	11.22%	11.37%
Electricity, gas and water supply	9.78%	8.81%	8.43%	8.72%	9.15%	9.16%
Services	6.65%	8.96%	12.02%	13.78%	15.66%	18.21%
Primary industry	16.45%	14.12%	11.85%	10.24%	9.36%	8.89%
Secondary industry	44.53%	41.82%	39.94%	39.09%	37.89%	35.67%
Tertiary industry	39.02%	44.06%	48.20%	50.67%	52.75%	55.43%

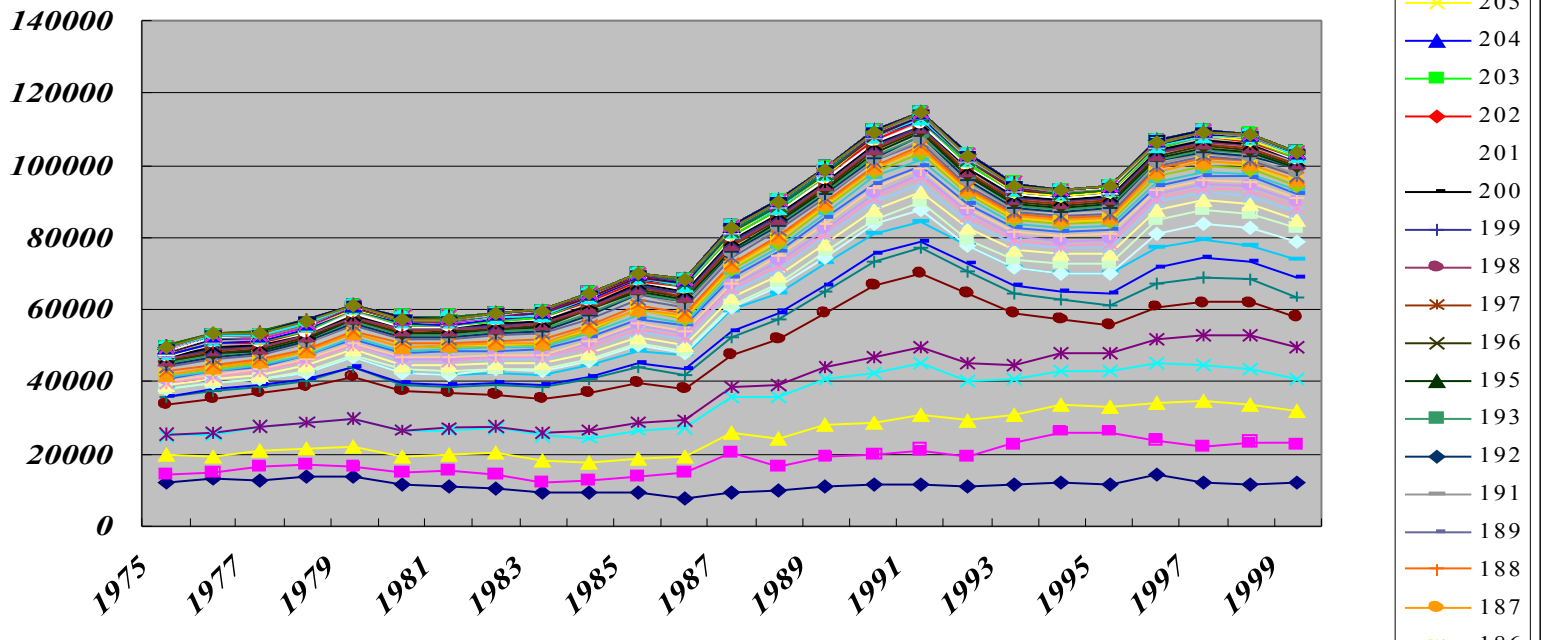
# Gov.'s statistics of capital stock share by sector

*Share of Tangible Fixed Assets by sector in 1993 SNA base*



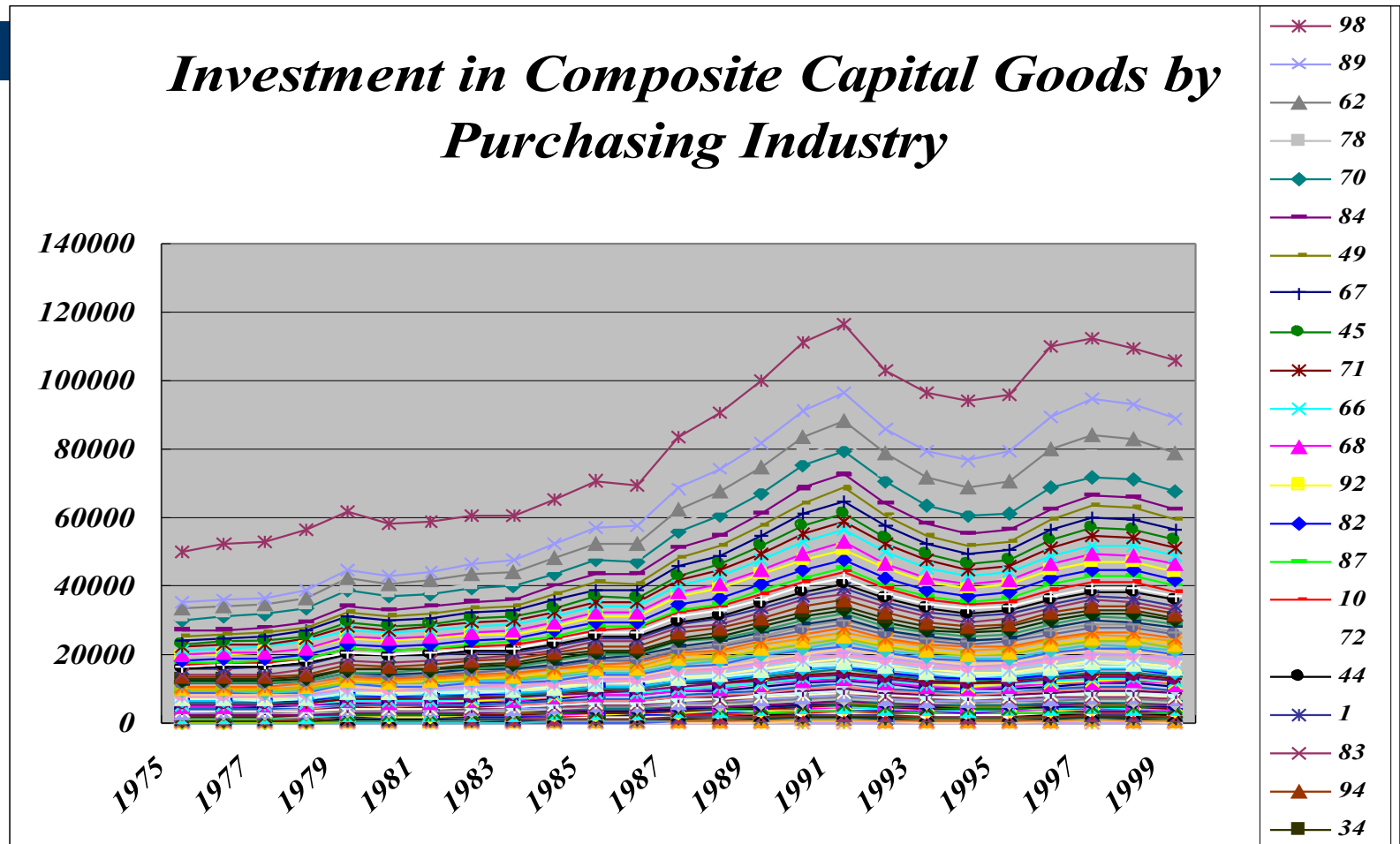
# Investment by Selling Industry

*Piled Carpet in Investment by Selling Industry*



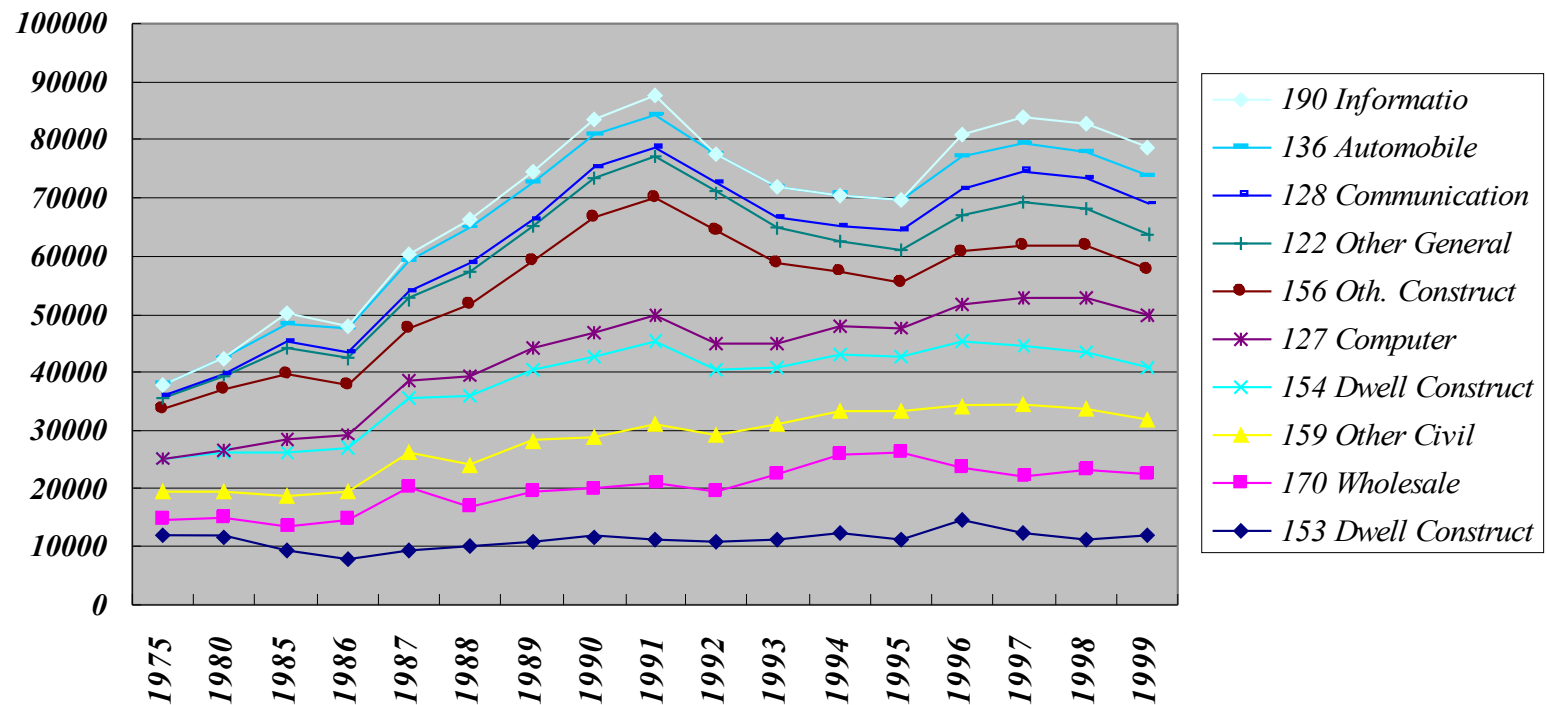


# Investment by purchasing sector



# Major Capital Goods in Investment by Selling Industry

*Top 10 Selling Industries of Investment in Capital Goods*

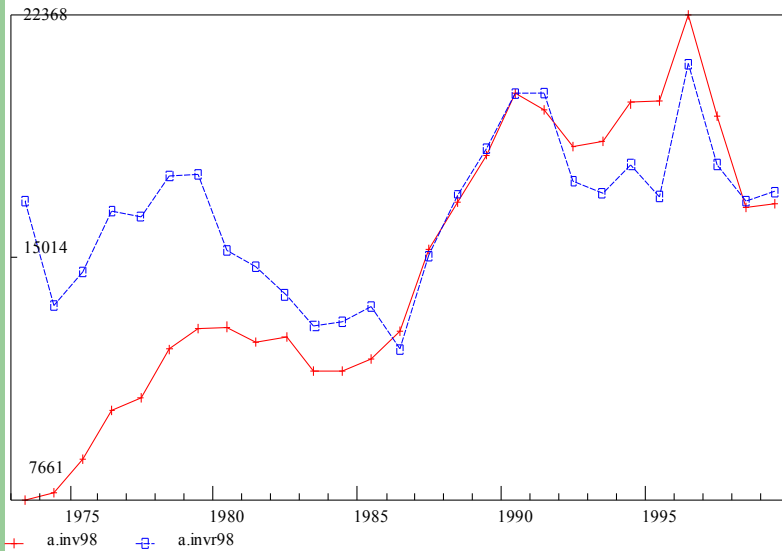


## *Estimation Results of Capital Stock*

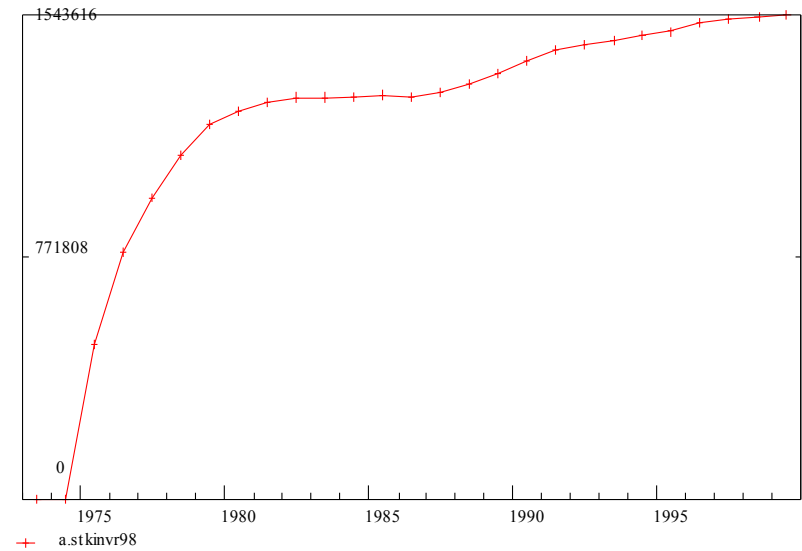
- Since estimated stock data of capital formation does not reach the steady state to some extent, hypothetical path of capital stock might be omitted for the time being if circumstances of data range permit.
- Although **Investment** by sector and in aggregate value have fluctuations, our estimated values 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

Inv ; 98 Office supply

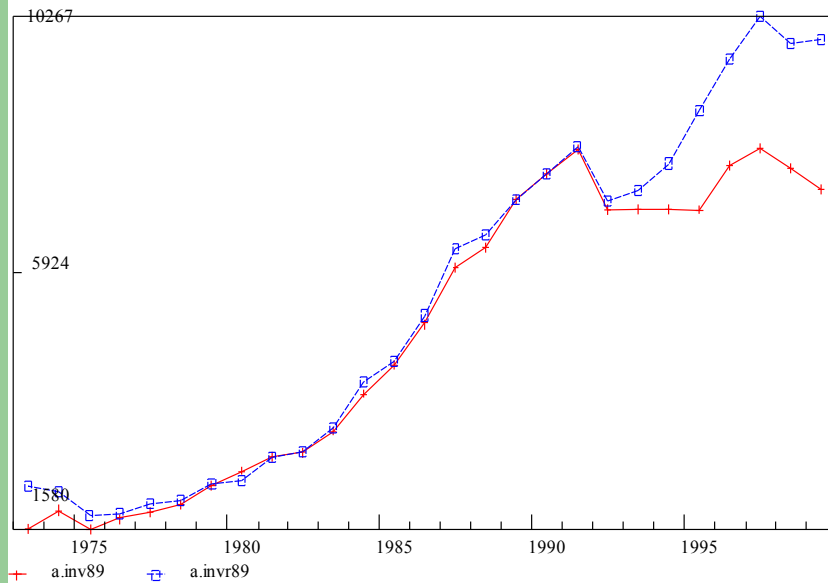


Capital Stock; 98 Office supply

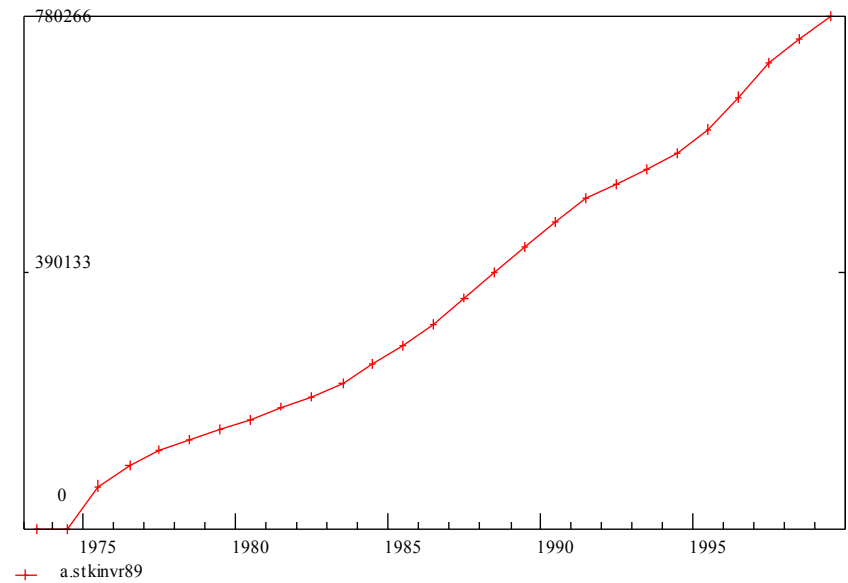


# Investment & Capital Stock in Sector 89

Inv ; 89 Advt,Invest & Information

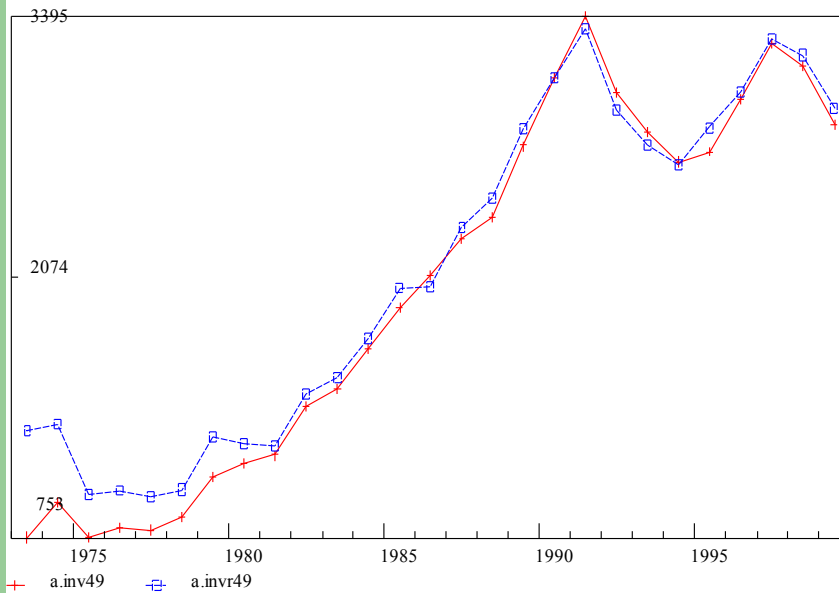


Capital Stock; 89 Advt,Invest & Information

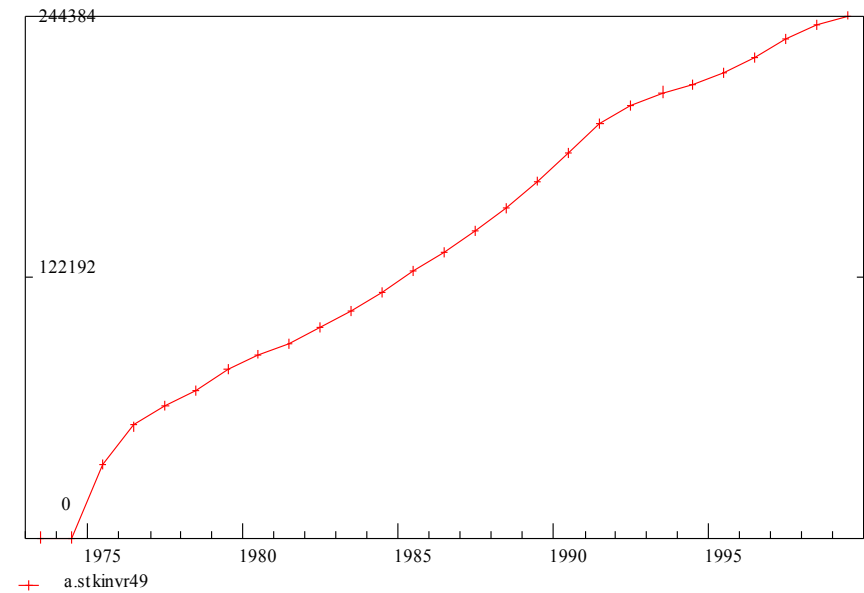


# Investment & Capital Stock in Sector 49

Inv ; 49 Automobile

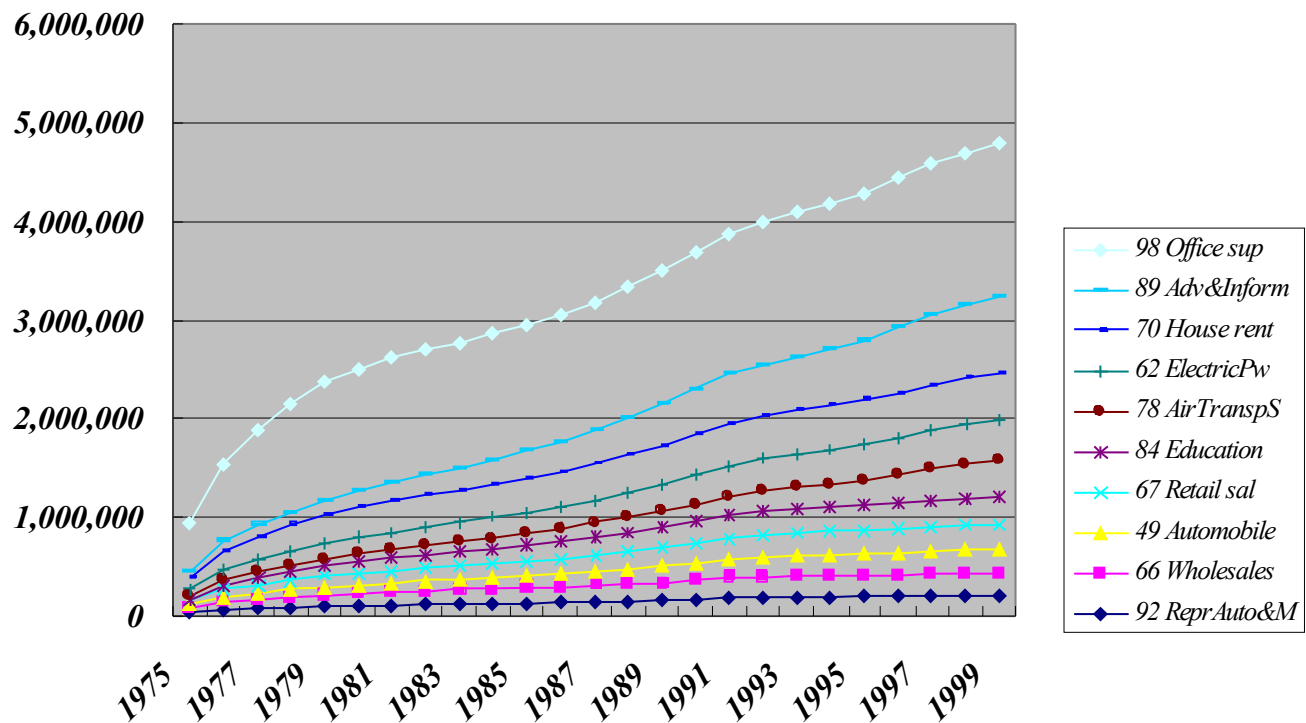


Capital Stock; 49 Automobile



# Estimated Capital Stock in major purchasing sectors

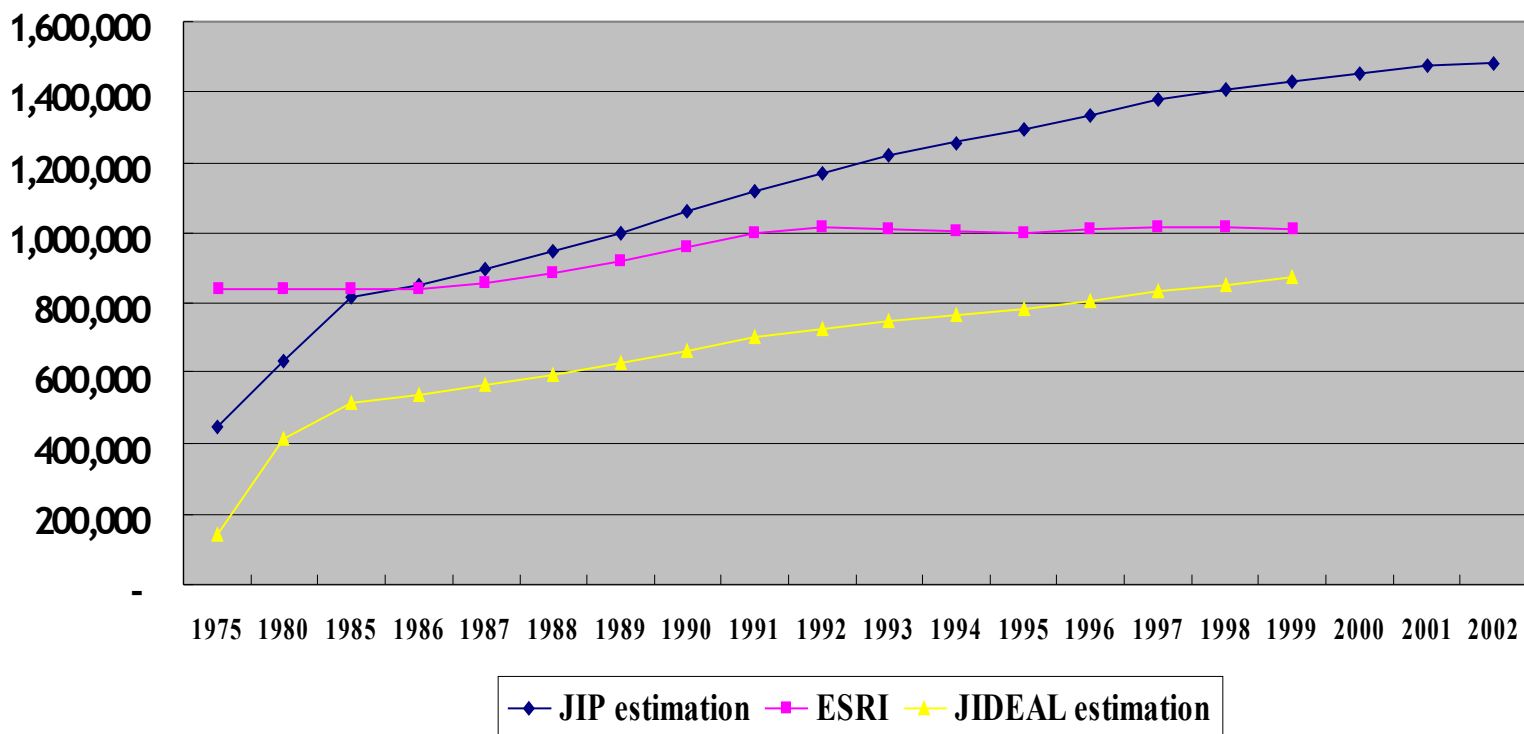
*Capital Stock in Top 10 Purchasing Industries*



# Comparison of estimated capital formation

ESRI: Economic and Social Research Institute

## Total capital formation





# Level & growth rate of capital stock

- 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.