# On the Depreciation Sector of Jidea 6

## -Trial Application of Various methods -

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# Contents

# 1. Introduction

- Depreciation sector as one of the integral parts of I-O table, is not a center piece of the analysis.

Purpose of this study

(1)To complete depreciation sector of Jidea 6.

(2)To try to calculate capital stock data backward by means of depreciation rate estimated as a parameter of depreciation equation, and to make depreciation sector as a main player.

Purpose (1) almost finished.

Purpose (2) complete failure.

# 2. Method

- Definitional Equation of Capital Stock
- $K_t = Kt\text{-}_1 + I_t - Dep_t$ (1)

  $K_t$ : Capital Stock at time t

  $K_{t-1}$ : Capital Stock at time t-1

  $I_t$ : Gross Investment at time t

  $Dep_t$: Depreciation at time t

- $K_t = K_0 + \Sigma(I_t - Dep_t)$ (2)

  $K_0$ : Initial Value of Capital Stock

  $\Sigma(I_t - Dep_t)$: Cumulative Sum of Net Investment

# Depreciation as a function of Cumulative sum of Net Investment

- $Dep_t = \beta K_t = \beta K_0 + \beta\Sigma(I_t - Dep_t)$ (3)

Form of Estimation (equation type a or type b)

- $Dep_t = \alpha + \beta\Sigma(I_t - Dep_t)$ (4)

  β: Depreciation Rate

  $\alpha > 0 \qquad 1 > \beta > 0$

From (3) and (4)

$K_0 = \alpha/\beta$ or $K_t = Dep_t/\beta$

Calculation of $K_0$ or $K_t$ from Depreciation Equation.

# Simplified Version of Equation

$Dep_t = \alpha + \beta sum(netI\ [1],[2],[3])$ (5)

or $Dep_t = \alpha + \beta sum(netI\ [1],\ldots,[5])$ (6)

netI: net investment ($I_t$ - $Dep_t$ )

(5): Equation type f

and (6): Equation type g

Assuming service life of investment goods is three years and five years for (5) and (6) respectively.

# 3. Data and the Results of Estimation

- Data: from Jidea 6 bank

From final demand side

ipr%1: private investment in nominal terms,

iprr%1: private investment in real terms

Converted by

capital matrix for 1985,1990, 1995 and 2000

to and from

inv%1: private investment in nominal terms,

invr%1: private investment in real terms

of value added side.

dep%1: depreciation from value added side.

# Preparation of Data

Depreciation in real terms

```
depr%1= dep%1/(inv%1/invr%1)
```

Net investment in real terms

```
netinvr%1 = (invr%1 – depr%1)
```

Cumulative sum of net investment

```
netkstk%1 = @cum(netkstk%1, netinvr%1, 0)
```

Other Data:

Dummy variables: Dumy85, Dumy90 and Dumy95

Time Trend: timet

# Results of Estimation

- Equation type a (1990-2004)
  depr%1=f(D2, D3, netkstk%1)
- Equation type b (1986-2004)
  depr%1=f(D1, D2, D3, netkstk%1)

- Type d as a variation of type b
  depr%1=f(D1, D2, D3, timet, netkstk%1)

Table-1 Out of 66 sectors estimated by type a or b, only 25 sectors cleared the conditions to select equations.

Table-1 Depreciation Sector (in the Value Added Side)
Preliminary Results of Estimation

| Sector | Type | a | b | K0=a/b | RBSQ | Sector | Type | a | b | K0=a/b | RBSQ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | f | 1372 | 0.1083 | - | 0.472 | 34 | d | 9302.9 | 0.3722 | 14191.6 | 0.836 |
| 2 | d | 44.2 | 0.1162 | 380.4 | 0.786 | 35 | d | 5282.1 | 0.2702 | 3978.9 | 0.501 |
| 3 | b | 229.4 | 0.1509 | 1520.2 | 0.801 | 36 | d | 1075.1 | 0.0508 | 21163.4 | 0.450 |
| 4 | d | 205 | 0.1357 | 1510.7 | 0.933 | 37 | b | 97.3 | 0.1017 | 956.7 | 0.411 |
| 5 | b | 10.6 | 0.0478 | 221.8 | 0.662 | 38 | d | 3827 | 0.0514 | 74455.3 | 0.649 |
| 6 | b | 750.0 | 0.0306 | 24509.8 | 0.911 | 39 | v | 10.3334 | -0.1321 | - | 0.901 |
| 7 | b | 289.8 | 0.0211 | 13734.6 | 0.957 | 40 | b | 176.2 | 0.0110 | 16018.2 | 0.615 |
| 8 | f | 78.0 | 0.1384 | - | 0.733 | 41 | v | 6.0858 | -0.0858 | - | 0.839 |
| 9 | a | 287.3 | 0.8323 | 345.2 | 0.693 | 42 | a | 346.8 | 0.0368 | 9423.9 | 0.424 |
| 10 | d | 636.8 | 0.1552 | 4103.1 | 0.775 | 43 | - | Dependent variable is constant.(zero) | | | |
| 11 | d | 726.4 | 0.2068 | 3512.6 | 0.777 | 44 | d | 5493.3 | 0.1349 | 40721.3 | 0.745 |
| 12 | b | 619.2 | 0.0344 | 18000.0 | 0.454 | 45 | b | 325.7 | 0.0787 | 4138.5 | 0.545 |
| 13 | b | 388.6 | 0.0205 | 18956.1 | 0.876 | 46 | b | 199.0 | 0.0108 | 18425.9 | 0.651 |
| 14 | d | 1821.4 | 0.1095 | 16633.8 | 0.882 | 47 | v | -7.6628 | 0.0667 | - | 0.862 |
| 15 | b | 69.5 | 0.0180 | 3861.1 | 0.633 | 48 | b | 161.1 | 0.0428 | 3764.0 | 0.596 |
| 16 | d | 790.4 | 0.0058 | 136275.9 | 0.653 | 49 | f | 192.6 | 0.0132 | - | 0.532 |
| 17 | d | 1887.7 | 0.1403 | 13454.7 | 0.967 | 50 | b | 215.9 | 0.0501 | 4309.4 | 0.820 |
| 18 | g | 16.1 | 0.1669 | - | 0.610 | 51 | v | -1.1487 | -0.0272 | - | 0.461 |
| 19 | v | 1.2322 | -0.0316 | - | 0.775 | 52 | - | Dependent variable is constant.(zero) | | | |
| 20 | b | 477.5 | 0.1200 | 3979.2 | 0.909 | 53 | d | 13661.9 | 0.2344 | 58284.6 | 0.743 |
| 21 | b | 165.5 | 0.0510 | 3245.1 | 0.751 | 54 | g | 3080.0 | 0.0092 | - | 0.428 |
| 22 | b | 138.5 | 0.1159 | 1195.0 | 0.521 | 55 | b | 293.4 | 0.0665 | 4412.0 | 0.942 |
| 23 | d | 1678.1 | 0.0554 | 30290.6 | 0.756 | 56 | u | -0.9551 | 0.0203 | - | 0.752 |
| 24 | b | 238.7 | 0.1799 | 1326.8 | 0.794 | 57 | b | 3632.4 | 0.0474 | 76632.9 | 0.907 |
| 25 | b | 155.1 | 0.0339 | 4575.2 | 0.718 | 58 | v | -8.2402 | 0.0781 | - | 0.993 |
| 26 | b | 292.6 | 0.0958 | 3054.3 | 0.514 | 59 | f | 3150.8 | 0.0112 | - | 0.844 |
| 27 | b | 42.3 | 0.1568 | 269.8 | 0.464 | 60 | b | 2057.3 | 0.0854 | 24090.2 | 0.964 |
| 28 | b | 150.4 | 0.0643 | 2339.0 | 0.778 | 61 | - | Dependent variable is constant.(zero) | | | |
| 29 | b | 1000.8 | 0.0318 | 31471.7 | 0.427 | 62 | b | 4360.2 | 0.0444 | 98202.7 | 0.668 |
| 30 | d | 347.5 | 0.052 | 6682.7 | 0.773 | 63 | u | -1.464 | 0.008 | - | 0.272 |
| 31 | d | 1306.1 | 0.1433 | 9114.4 | 0.737 | 64 | b | 3106.2 | 0.1035 | 30011.6 | 0.952 |
| 32 | b | 435.2 | 0.1228 | 3544.0 | 0.937 | 65 | b | 2332.1 | 0.0482 | 48383.8 | 0.918 |
| 33 | b | 430.7 | 0.1422 | 3028.8 | 0.844 | 66 | b | 874.4 | 0.0922 | 9483.7 | 0.632 |

Notes for Table-1

Type of Equation

type a 1990-2004
depr = f(D2, D3, netkstk[1])

type b 1986-2004
depr = f(D1, D2, D3, netkstk[1])

type d 1986-2004
depr = f(D1, D2, D3, timet, netkstk[1])

type f 1988-2004
depr = f(D1, D2, D3, sum(invr[1] + ... + invr[3])

type g 1990-2004
depr = f(D2, D3, sum(invr[1] + ... + invr[5])

type u 1988-2004
rdepr =depr/sum(invr[1] + ... + invr[3])
log(rdepr) = f(D1, D2, D3, timet)

type v 1990-2004
rdepr =depr/sum(invr[1] + ... + invr[5])
log(rdepr) = f(D2, D3, timet)

Definition of Variables

depr: Depreciation in real terms of 2000

netkstk: Cumlative sum of net investment in real terms of 2000

invr: Gross investment in real terms of 2000

D1: Dummy variable; 1 for 1986, 87, 88, 89

D2: Dummy variable; 1 for 1991, 92, 93, 94

D3: Dummy variable; 1 for 1996, 97, 98, 99

timet: time trend

Estimation Criteria

Except for type u and type v
Parameter a > 0
Parameter b positive and less than 1
RBSQ > 0.6 (to be changed)

# Makeup of the Results

- Other variation

type f : depr%1 =f(D1, D2, D3, sum(invr[1]+…+invr[3])

type g: depr%1 =f(D1, D2, D3, sum(invr[1]+…+invr[5])

- Changes in criteria to select equation

  from RBSQ > 0.6 to RBSQ > 0.4

55 sectors were chosen.

3 blank sectors.

8 sectors remaining were estimated by time trend.

See also Table-1.

# 4. Alternative Method

- Depreciation rate calculated in value added side Is a weighted average of depreciation rates of various investment goods purchased by the sector.
- Trial to estimate depreciation rate by the fdep%1 converted to final demand side in relation to iprr%1.

By means of capital matrix of 2000, dep%1 to fdep%1.

fdepr%1 by ipr%1deflator, calculation of netiprr%1 and cumulative sum of netiprr%1 as netfstk%1.

# Depreciation Equations in Final Demand Side

- Out of 34 sectors only 7 sectors are acceptable. Complete failure to estimate good equations of depreciation with net investment in final demand side. See Table-2.

Some reasons:

Some of netiprr%1 is always negative. fdepr%1 is overestimated?

Re-examination of data and capital matrix.

Table-2 Depreciation Sector in the Final Demand Side
Preliminary Results of Estimation

| Sector | Type | a | b | K0=a/b | RBSQ |
|---|---|---|---|---|---|
| 1 | w | -9.1008 | 0.0914 | - | 0.815 |
| 8 | w | -10.7852 | 0.1176 | - | 0.736 |
| 9 | w | -5.7095 | 0.0728 | - | -0.181 |
| 10 | w | -8.3788 | 0.0973 | - | -0.031 |
| 11 | w | -11.9747 | 0.1195 | - | 0.729 |
| 29 | - | Dependent variable is constant.(zero) | | | |
| 30 | - | Dependent variable is constant.(zero) | | | |
| 31 | - | Dependent variable is constant.(zero) | | | |
| 32 | x | -8.668 | 0.1048 | - | 0.026 |
| 33 | w | -7.736 | 0.0773 | - | 0.539 |
| 34 | w | -0.5198 | -0.0126 | - | 0.371 |
| 35 | w | -0.1699 | -0.0209 | - | 0.284 |
| 36 | m | 709 | 0.0683 | 10380.7 | 0.826 |
| 37 | m | 1139.2 | 0.289 | 3941.9 | 0.750 |
| 38 | w | -16.6556 | 0.1694 | - | 0.852 |
| 39 | O | 78.7 | 0.4327 | - | 0.795 |
| 40 | m | 1685.6 | 0.3069 | 5492.3 | 0.904 |
| 41 | m | 926.8 | 0.1233 | 7516.6 | 0.652 |
| 43 | - | Dependent variable is constant.(zero) | | | |
| 44 | m | 1085.6 | 0.0754 | 14397.9 | 0.85 |
| 45 | w | -11.4107 | 0.1234 | - | 0.327 |
| 46 | w | 1.4147 | -0.0313 | - | 0.078 |
| 47 | m | 975 | 0.026 | 37500.0 | 0.851 |
| 48 | m | 709.8 | 0.0193 | 36777.2 | 0.898 |
| 49 | p | 111.4 | 0.556 | - | 0.801 |
| 50 | w | -4.5627 | 0.0433 | - | 0.671 |
| 51 | w | 0.9746 | -0.0395 | - | 0.14 |
| 52 | - | Dependent variable is constant.(zero) | | | |
| 53 | x | 3.0207 | -0.0578 | - | 0.244 |
| 57 | p | 16273.2 | 0.3437 | - | 0.741 |
| 59 | w | -3.6913 | 0.0345 | - | 0.005 |
| 61 | - | Dependent variable is constant.(zero) | | | |
| 63 | w | 7.0584 | -0.087 | - | 0.558 |
| 64 | w | 7.4282 | -0.0918 | - | 0.68 |

Type of Equation

type m 1986-2004
fdepr = f(D1, D2, D3, netfstk[1])

Type o 1988-2004
fdepr = f(D1, D2, D3, sum(ipm[1] + ... + ipm[3])

Type p 1988-2004
fdepr = f(D1, D2, D3, timet, sum(ipm[1] + ... + ipm[3])

type w 1988-2004
rdepr =fdepr/sum(ipm[1] + ... + ipm[3])
log(rdepr) = f(D1, D2, D3, timet)

type x 1990-2004
rdepr =fdepr/sum(ipm[1] + ... + ipm[5])
log(rdepr) = f(D2, D3, timet)

Definition of Variables

fdepr: Depreciation in real terms of 2000

netfstk: Cumlative sum of net investment in real terms of 2000

ipm: Gross investment in real terms of 2000

D1: Dummy variable; 1 for 1986, 87, 88, 89 and 91

D2: Dummy variable; 1 for 92, 93 and 94

D3: Dummy variable; 1 for 1996, 97, 98, 99, 01 and 02

timet: time trend

Estimation criteria
Except for type w and type x
Parameter a > 0 Parameter b > 0 and less than 1
RBSQ > 0.6.

# Depreciation rate Equation

- As a supplementary measure, equation of depreciation rate was introduced.

Data: type u and type v (for value added side)

rdepr =fdepr%1/(sum(invr[1] + … + invr[3])

or rdepr =fdepr%1/(sum(invr[1] + … + invr[5])

Data: type w and type x (for final demand side)

rdepr =fdepr%1/(sum(iprr[1] + … + iprr[3])

or rdepr =fdepr%1/(sum(iprr[1] + … + iprr[5])

Equations estimated by semi-logarithmic type

log(rdepr) = f(D1, D2, D3, timet)

Results are also in Table-1 and Table-2.

# 5. Conclusion

- To complete depreciation sector of Jidea 6 is in the final stage. (few more modification, etc)
- Withdrawal to calculate capital stock data backward by depreciation rate. Acceptable equations were not enough, availability of new estimates of private capital stock by Dr Shishido*.
- Remaining studies

To re-challenge estimation of fdep function,

re-examining data and capital matrix.

To ease complexity of capital matrices.

* Database of DEMIOS (2): private capital stock by 81 sectors (1970-2003 at 2000 constant price). Data from *Census of National Wealth* of 1970 as a bench mark, government estimates of private capital stock of 26 sectors as control total disaggregation to 81 sectors by means of depreciation rate available in *Census of Manufactures.*

Estimated social capital stock data is also available.

Waiting for database of DEMIOS (2) open to public.

Caution: difference in sectoral classification, purely private sectors only.