What do we know about value relative prices, prices of production and market prices:Input Output Analysis of Japan for 1951-2000

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Abstract

David Ricardo's idea that market prices fluctuate around natural prices, and that natural prices are determined by the labour requirements producing that commodity will be tested using data for period 1951 to 2000 Japan. The natural price of Ricardo's writings are usually considered as production prices. However, determination of normative general profit rate is rather ambiguous and general profit rates are usually determined as ex-post average profit rates of all industries, where average profit rates are very close to zero and profit rates are sometimes negative in recent years of Japan. In such economic performances, positive general profit rates do not have positive and normative justification. Therefore, value relative prices (general profit rates taken as zero) are taken as natural prices and it will be compared to market prices in the following.

Findings indicate that there are gradual tendency for the market prices to converge towards value relative prices. There are problem with Japanese agriculture, and slight diverging movements in 1970, however the movements of metal and manufacturing industries indicate significant and clear movements of market prices towards value relative prices over 50 years. There are tendency that profitable industry at profitable period to diverge from such trend, however with free entry and free exit such movements donot hold for long period.

1. Comments on Revision
2. Labor Value, Total labour requirements
3. Natural Prices
4. Empirical Results
5. Conclusion

Comments on Revision

This is a revision of my last work which I presented in the Turkey meeting of this IIOA. Major revised points are on labour data. Data on persons engaged in production in agriculture is revised. There is another stream of data on core number of persons engaged in production in agriculture, which is smaller than current data that I have employed here, provided by the Statistical Office of Japan based on Population Census. This stream of data will give results that market prices are much more closer to value relative prices. However, as a time series stream of inter-medium data, I followed RIETI data provided by the Ministry of Economics and Industry. This revision is giving agricultural market prices a little diverging from value relative prices but not so much as the first estimation presented in Turkey in year 2007.

Capital depreciations are taken into account only as fixed cost, and was not dispersed to each industries as depreciation coefficients. Furthur revision on this point may require investigation, however this simplification is expected that it will not influence the trend.

Capital cost other than depreciation is neglected, or the general rate of profits are taken as zero. Opportunity cost of interests may have thought of to replace general rates of profit, however opportunity cost as deposit interest rates vary over time, from around 6 % to 0%. After the recession of 1992, the deposit interest rates in Japan are negligible and are very close to 0% (0.005% for year 2000). Taking into account of this historical reality, I thought there are not clear reasoning what the level of general rates of profit should be. According to these variety of profit rates over years (or different deposit interest rates over years), rate of profits as equal to 0% are taken as standard for time series comparison.

When wages are payed in advance and profit rates are uniform as general profit rates, prices are denoted as

$$P = (1+r)(wl + PA + PD)$$

where the last term denotes depreciation costs. **D** denotes depreciation coefficient matrix.

$$P = (1+r)(wl)(I - (1+r)(A+D))^{-1}$$

Total labour requirements (labor value) are

$$t = l + t(A+D)$$
$$t = l(I - (A+D))^{-1}$$

Therefore, while wages are paid ex ante, and wages and profits are uniform over sectors, prices of production are relative to values when profit rate is equal to zero.
That is, my comparison of market prices to value relative prices includes two components. The first component is the difference between the market prices to prices of production , and the latter is the differences between the prices of production to the value relative prices. The latter depends on the size of general rate of profits, while the former depends on the differences of realized sectoral rate of profits to the general rate of profits, and the difference of actural wage to the average income per persons engaged in production.

David Ricardo thought that market price fluctuates around natural prices, and that natural prices are regulated by the total labor requirements of commodities. That is, total labor required to produce that commodity (total labor requirements) determine the value of that commodity, and that relative prices are determined by its value. This paper tries to examine this discourse using data from input output tables, RIETI labor statistics of Japan. RIETI labor tables are integrated into 32 sectors. Market prices and natural prices for outputs of 32 industries of Japan for years 1951 to 2000 were calculated.

Findings are as follows. (i) When all industries other than agriculture are taken into consideration, market prices converge towards natural prices. (ii) When narrowly defined manufacturing industries,

mainly machineries only are taken into account, market prices converge towards natural prices. These movements may be explained by international competition of free entry and exit as machineries are traded goods and also by the standardized wage negotiation process of manufacturing sectors, especially of machineries. (iii)Profitable industries at profitable periods diverge from natural prices.

There are yet more room for improvements in data, and methodology (treatment of depreciation and capital). However it may be possible to conclude that where there are competition both in commodity market and in factor market, there are tendency for the market prices of output to converge towards value relative prices.

There are stream of works on the determination of prices. While many economists emphasize demand and supply to determine market prices, there are some economists that think that there are some theoretical movements behind market prices.

David Ricardo in his book of "Principle of Political Economy and Taxation" analyzes as follow. Value of commodity is determined by the amount of labor bestowed to produce such a commodity. Natural prices are prices determined relative to such value, and market prices accidentally digress from such prices. However, prices are in a long run determined by natural prices.

My question is, if there are any theoretical movements behind the market prices in the long run. In the long run, there are competition among firms, output markets, intermediate markets, and also in the factor markets. How and where do these competition lead the market prices? This is the question to be asked, and in the following I will construct natural prices (value relative prices) and compare the market prices to value relative prices.

2 Calculation of Labor Value (Total Labor Requirements).

I wish to explain about the method of calculation of labor value or total labor requirements. Labor Value equivalent to total labor requirements are considered as labor bestowed to produce the commodity. Let us denote the total labor requirements of each industry by t_j and its vector by row vector $\boldsymbol{t}$. When a_{ij} is the ij factor of input output coefficient matrix $\mathbf{A}$ and l_j is the direct labor coefficient of industry j , total labor requirement is obtained by direct labor coefficient vector $\boldsymbol{l}$ post multiplied by Leontief Inverse.

$$t = l(I - A)^{-1}$$

This can be explained in two ways. Leontief thought that in order to produce one unit of commodity of each sector it is necessary to produce one unit times Leontief inverse. Therefore, the labor required to produce one net product are net product times Leontief inverse times labor coefficients.

The same equation can be interpreted as equations solving simultaneous equation of n unknowns of total labor requirements. When total labor requirements of sector j is denoted by t_j , row vector of total labor requirements ***t*** can be solved as sum of total labor contained in intermediate inputs plus direct labor requirements.

$$t = tA + l$$

$$t = l(I - A)^{-1}$$

Above solution needs further improvements when applied to real calculation. One problem is depreciation of capital, and another is calculation of imported inputs.

Depreciation of Capital

Capital is always the most problematic issue in input output analysis as input output tables are flow tables. If capital formation table is available, depreciation allowance of each sector can be proportioned to each industry supplying capital goods. That is, the depreciation allowance of sector *j* denoted by Z_j are allocated (proportioned) to each industry of origin as

$$d_{ij} = \frac{K_{ij}}{\sum_i K_{ij}} \frac{Z_j}{X_j}$$

Where K_{ij} is the *i* component of *j* industry's capital formation obtained from the capital formation table. X_j is the total output of *j* industry. Therefore d_{ij} denotes the *i* depreciation coefficient of industry *j*.

Then the equations to obtain total labor requirements are modified as

$$t = t(A + D) + l$$

$$t = l(I - A - D)^{-1}$$

where ***D*** denotes depreciation coefficients matrix.

Import and Export

Treatment of imported commodity may have several ways. One way is to treat all imports as competitive and treat imported commodity exactly as domestically produced products. However results of this treatment did not give good results for Japan. Let us call this treatment as ultra fair trade model. As Japan highly depends on imports of energy, prices of energy related imports requires much higher value relative prices by this replacements.

The (labor) value of imported inputs are unknown. In order to determine the unknown value, a method to replace the imported value by the labor value contended in the same monetary value of exports to purchase the imported inputs is developed in Japanese tradition ( ). This does not necessarily assume balance in the current account of balance of payments, however any purchase are eventually paid (it might be paid by capital return or transfer but as input output analysis does not assume intertemporal equilibrium and so time is not included in the analysis, concept that requires different time horizon are neglected.) Let us assume that in order to purchase imported inputs, tradables (exportables) are produced. Labor value of imported inputs are replaced by the labor value of average export times the monetary value of imported inputs. By denoting average export components by vector ***e***', and row vector of imported inputs by ***m***, the labor value of unit inport which is denoted by t^m must equal ***te'*** (multiplication of each average export contents by its total labor requirements).

Then the equations of total labor value are modified as,

$$t = t(A^d + D) + t^m m + l$$

$$t^m = te'$$

By inserting the second equation the first equation gives,

$$t = t(A^d + D) + te'm + l$$

This can be solved as

$$t = l(I - A^d - D - e'm)^{-1}$$

Export component vector are calculated as $e_j = \frac{e_j}{\sum_j e_j}$ and therefore

$$\sum_j e_j = 1$$

Domestically produced input output coefficients are calculated as the proportion of total output to domestic products using the proportion from the final demands. That is, taking the proportion of total imports to total output as μ, $a_{ij}^d = \frac{1}{1+\mu} a_{ij} = \frac{1}{1 + M_i / X_i} a_{ij}$

Therefore, import coefficients can also be calculated as

$$a_{ij}^m = \frac{\mu}{1+\mu} a_{ij} = \frac{M_i / X_i}{1 + M_i / X_i} a_{ij}$$

Then,

$$m_j = \sum_i a_{ij}^m$$

Import coefficient vector is a row vector of these total imports for sector j, denoted by m_j s.

3. Natural prices (Value relative prices)

The prices that equalizes the income of all labor participated in production are prices which are equal to total labor requirements. The two sets of prices are identical. It can be proved as follows.

By denoting the labor value of commodity as total labor requirements by t,

$$t = l(I - A^d - D - e'm)^{-1}$$

The natural prices of commodities must fulfill the following

$$\frac{p_j}{p_i} = \frac{t_j}{t_i}$$

Assuming

$p_i = \lambda t_i$ holds for any i, then,

$$p = \lambda t = \lambda l(I - A^d - D - e'm)^{-1}$$

Rewriting gives,

$$p(I - A^d - D - e'm) = \lambda l$$

That is,

$$p = p(A^d + D + e'm) + \lambda l$$

Therefore, return for all labor is equal. (Value added per labor are all equal among all sectors.) That is, natural price are prices that give equal return to all labor in production in all sectors. And that lambda should equal to average income per persons engaged in production.

In reality, set of natural prices were obtained as prices that will achieve equal return to all labor participated in production as follows due to resources constraint. That is, natural prices row vector ***p*** are calculated as prices that achieve

$$p = pA + d + y^* l$$

Where y* is average income per labor participated in production (scalar). Depreciation matrix was not obtained, depreciation per output of each industry were added to price equation as vector ***d***. Components of ***d*** vector is Z_j/X_j for every industry j. Solution of the above equation is obtained by solving n simultaneous equations

$$p = (y^* l + d)(I - A)^{-1}$$

However, as I mentioned earlier, this treatment of import and export did not give good result for mineral and oil related industries. Therefore, the calculation was based on the equations that converts the imported

value by the total labor requirements embodied in the same monetary value of exports

$$p = pA^d + pe'm + d + y^* l$$

Therefore the solution was obtained as

$$p = (y^* l + d)(I - A^d - e'm)^{-1}$$

This solution is called as natural prices obtained from program. N simultaneous equations (32 simultaneous equations) were solved. Row vector of the sum of average labor remunerations plus depreciation cost per output taken as fixed cost is post multiplied by the import/export modified Leontief Inverse Matrix.
The transaction table was integrated into 32 sectors for 1951 to 1980, while 32 sector transaction tables were available for 1990 and 2000. Data on labor coefficients were obtained from RIETI labor table for 1970, 1980, 1990, 2000. It is obtained from supporting table for 1960. It is obtained from various tables, both population census and labor statistics for 1951.

The following might be repetition of what I wrote earlier, however, I wish to clarify the idea of measuring the gap between the market price and the natural prices(value relative prices). Natural price of time 1 is different from natural price of time 2. Market prices are normalized to 1 for all sectors for all periods. The ratio between 1 and natural prices, or the difference between 1 and natural prices measure the difference between the market price and natural prices of each period.

When there are discrepancy between demand and supply, the gap will be adjusted either by prices, or by quantities. Price adjustments are called as Walrasian adjustment and quantity adjustment are called Marshallian adjustments. The purpose of this paper is not to show the speed of market price adjustments between equilibrium market price and the distorted real prices. The differences that are measured are the difference between natural prices and the real market prices. Real ex-post market prices are subject to different degree of monopoly or oligopoly, increasing returns, different degree of market shares, different degree of factor market distortions, and other institutional constraints. The aim of following findings are to clarify if there are

tendency of natural (value relative prices) to show the trends of market prices or not.

4. EMPIRICAL RESULTS

Market prices are normalized as 1 for each sector for each period. Difference of market price and natural prices (value relative prices) can be measured by obtaining standard deviation of the two. From calculating standard deviation of natural prices minus market price (value relative price minus 1), all industries show 0.32 (1951), 0.33(1960), 0.38(1970), 0.35(1980), 0.35(1990) and 0.35(2000) as standard deviation. If agriculture is deleted, the standard deviation becomes 0.23(1951), 0.24(1960), 0.27(1970), 0.23(1980), 0.23(1990) and 0.25(2000) on revised data. Therefore there are tendency for the value relative prices to converge towards market prices (other than 1970) for all industries other than agriculture. Or, at the time of boom, there are slight tendency for the standard deviation to increase its value.

Reclassification of service sectors of input output tables took place in 1985, and therefore direct labor data requires another check for service sectors especially for personal services, business services, and other public services. There are activity such as machinery maintenance or repair which was included in the machinery sector before the reclassification, which are included in business service after the reclassification. This change cannot be treated as number of labor associated this activity before 1985 cannot be counted. Such limitation should be kept in mind.

From the overall movements for 1951 to 2000, there are quite clear trend that market prices are converging towards value relative prices. The gap between market prices and value relative prices are decreasing over time.

The only exception is agriculture for all the periods. The noticed movement against these trends (diverging from these trends) are, communication (1990-2000), transport machinery (1970s), iron and steel, and general machinery (1980s). These may be explained as the period that these industries are highly profiatable but free entry to these industries were yet limited or difficult.

The market prices of oil and coal and electricity stay high compared to value relative prices. These are industries where market forces do not work as these are highly protected, monopoly or oligopoly, or regional monopoly except coal.

Even for highly profitable industries as finance and insurance and real estate, market prices are very slowly moving (lowering) towards value relative prices.

Manufacturing industries can be classified to two groups. Value relative prices of light manufactured industries had been higher than market prices. That is, market prices of light manufacturing industries increased toward value relative prices. On the other hand, market prices of heavy industries had been higher than value relative prices. That is, market prices of heavy manufacturing industries had been declining towards value relative prices. Such movements are very clear with industries 8 to 15, metal related machinery industries. This is one of the most clear and significant finding of this study.

Food processing, textile and commerce require increasing of efficiency or increase of market prices towards value relative prices.

More efficiency is required, or even exit from the market might be required in light industries which face low international output prices. Also in commerce, recent construction industry (2000), and personal services need more efficiency. Elderly care also requires revision or restructuring of industry.

More free entry is required in oil plus coal, mining, water, electricity plus energy supply, finance plus insurance and real estate. Output prices of these industries should become lower.

Detailed observation by industrial groups.

From agriculture to oil and coal products

Agriculture Agricultural market prices are diverging from value relative prices. The gap between the market prices and value relative prices are about 2.5. Production of agrucultural output for home consumption might require revision of output data. (income or output data might need to be re-estimated to include these home production).

Oil and coal products. Market prices of this industry remain low. The protected nature of this industry, oligopoly is apparent over time. However if we take ultra-fair trade model (import are taken as purely competitive), this sector's natural price becomes very high (about 3 times). That is, oil and coal products highly depend on imported intermediate inputs, and therefore if competitive assumption is taken, we have to pay very high natural prices=value relative prices.

Mining and Chemical Market prices of mining and chemical also remain low compared to value relaive prices.

Food processing, textiles and pulp and pulp products Food processing, textiles and pulp plus pulp products converge toward value relative prices. Market prices are rising toward value relative prices.

Metal and Machinery (Industry 8 to 15)

The market prices of these industries are clearly converging towards value relative prices. The movements of these industries are so clearly "harmonious". That is, the movements are clearly "together". The output prices are clearly "lowering" towards value relative prices. The general price increase of these era (general GDP deflator is greater than these price increase, and the real growth of these industries (manufacturing) was greater than real GDP growth throughout the period with very few exceptions. The growth of these industries were transmitted to other industries in the development process of Japan.

The only exception of such price movements are, that is, market prices are increasing more than the value relative prices are transportation machinery of 1970s and iron, steel and general machinery of 1980s. These periods can be noticed as periods that these industries were the leading industry of each period.

For metal and machinery industries, the economy was moving towards perfect competition, and that the economy was shifting towards realizing free entry and free exit. In the machinery industry where increasing return may work, free entry and free exit are limited. Besides, life time employment was apparent in Japan until recent, which could have created wage differential among industries. However, uniform negotiation process such as IMF-JC lead wage negotiation created very equal income structure for the manufacturing sectors. Manufactured goods was traded goods facing international competition made output markets to operate as perfect competitive markets.

Service Related Industries

Movements of eight industries in this group are somewhat complex. General tendency is that market prices are converging towards value prices.

Commerce indicates a little exceptional movement, especially for years 1980 to 2000. Market prices remained low compared to value relative prices, either reflecting the inefficiency of this industry, or the keen competition of this industry faced to the international competition after mid 1980s which lowered the output price.

Communication is another exception that market prices are digressing from the value relative prices, especially from the 1980s. Market prices are higher than value relative prices and the gap is increasing from 1980s. This industry is realizing high profit throughout the period.

Market prices of construction fluctuate around the value relative prices. Market price starts from the point that per income of construction labor are higher than the economy's average. Construction achieves high income per labor in the 1990s, but it turned down in the 2000s after the burst of the bubble economy in 1992.

Prices of water and waste is decided in local congress. There are considerable lowering of market price of water and waste towards value relative prices in the 1970s. This reflects that the price adjustment delayed or was sluggish to the inflation of the 1970s. The GDP deflator increase was 13.4% in 1973 and 19.8% in 1974. And yet, water which is supplied by regional monopoly, and waste are achieving market prices that yields high per labor income compared to the whole economy.

Transportation as service industry shows clear well fitted convergence of market price and value relative prices.

Electricity, gas and energy supply remain high market price as these are highly protected regional monopoly prices.

Finance and insurance also remain high market prices, but there are slow tendency to converge towards value relative prices. Market prices move towards value relative prices especially in 1980s and 1990s. 1990s deregulation (big bang) might have worked, but there are slight digression in 2000 data.

Real estate also remain high market prices, but the trend is that the market prices are converging towards value relative prices. The gap is big, but there are slow trend to converge.

Services

Education and public sector may require a little lower output prices, lower income per labor after 1980s. Religious activity was excluded from this sector to other public services for 1951.

Medical service includes elderly care recently after 1985. For this reason, the high income nature of this industry was obscured after 1980s.

Business service shows good convergence of market prices and value relative prices.

Personal services requires higher market prices. It is likely that the labor of this sector are lowly paid.

Other public sector Output data doesnot exit for 1951. The output data for 1970 doesnot coincide with labor data.

Unclassified All the discrepancies are accumulated into this sector. Reclassification of labor data are essential for these industries.

5. CONCUSION

This was my second trial to construct value relative prices and to analyze the movements between actual market prices for 50 years.

Exceptions exist such as the movements of agricultural sector, or the movements between 1960 to 1970, or profitable sector such as communication of 1990s and 2000s, leading sectors of 1970s (transport machinery) and 1980s (iron, steel and general machinery), however, I think it is approved to state that there are tendency for the market prices to converge towards value relative prices. This tendency was clearly apparent for metal and machinery related manufactured industries.

Although labour market remained non competitive for Japanese market (life time employment for large firms), opening of output markets and facing international competition were leading forces for the metal and machinery industry to set market prices close to value relative prices, and also to keep profits rates low. Service sectors outputs of which are non-tradables require more competition, and agriculture requires revision of its industrial structure most sseriously.

Market forces, international competition, and united labor movements existed to achieve equality among industries especially in metal and manufacturing sectors. Equality between industries does not necessarily result in equality among person to person income (and moreover asset) distribution. The fact that personal income distribution after the burst of the bubble economy (year 1992) is worsening in Japan (especially for the asset and for the aged); equality among industries did not necessarily guarantee the inter-personal income equality should be kept in mind.

Data Source

Input Output Tables:
Government of Japan, Keizai Sangyou Chosakai, Interindustry tables for Showa 26-60 (46 sector tables)
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GDP deflator
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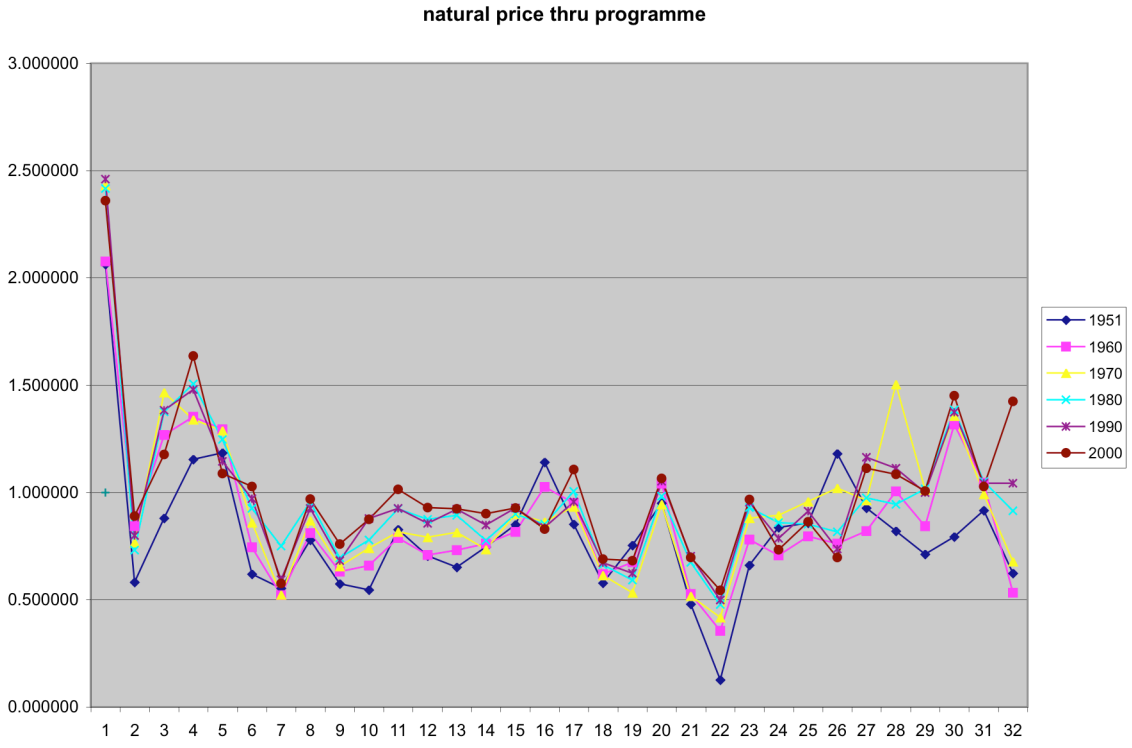
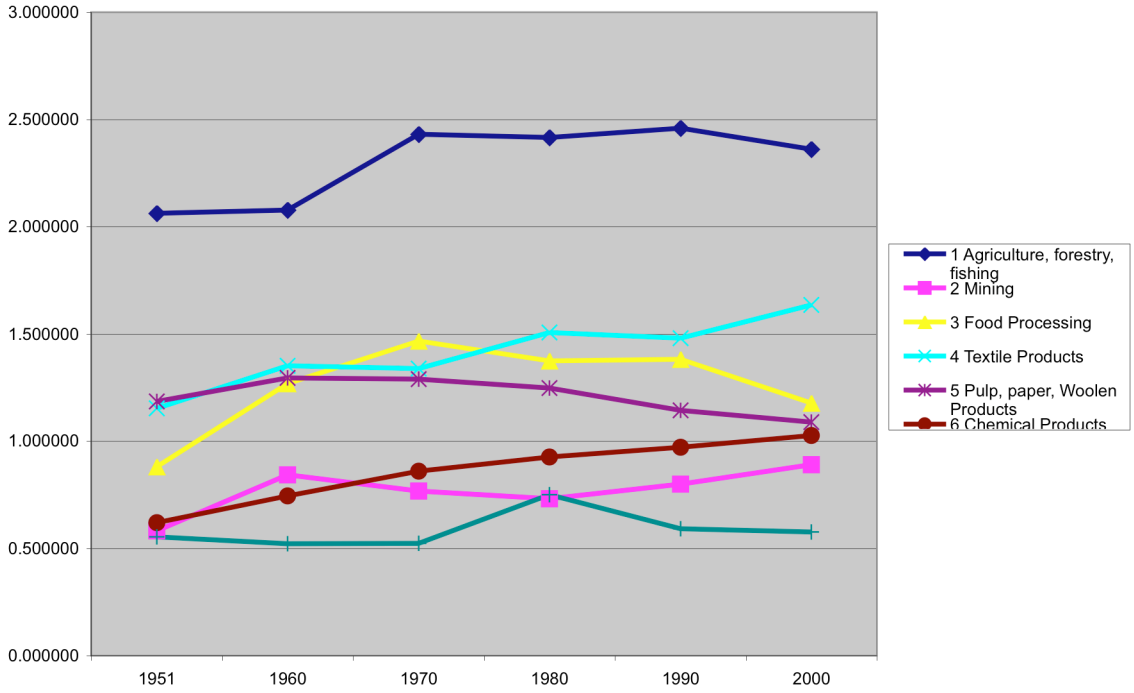
Natural price through programme revised

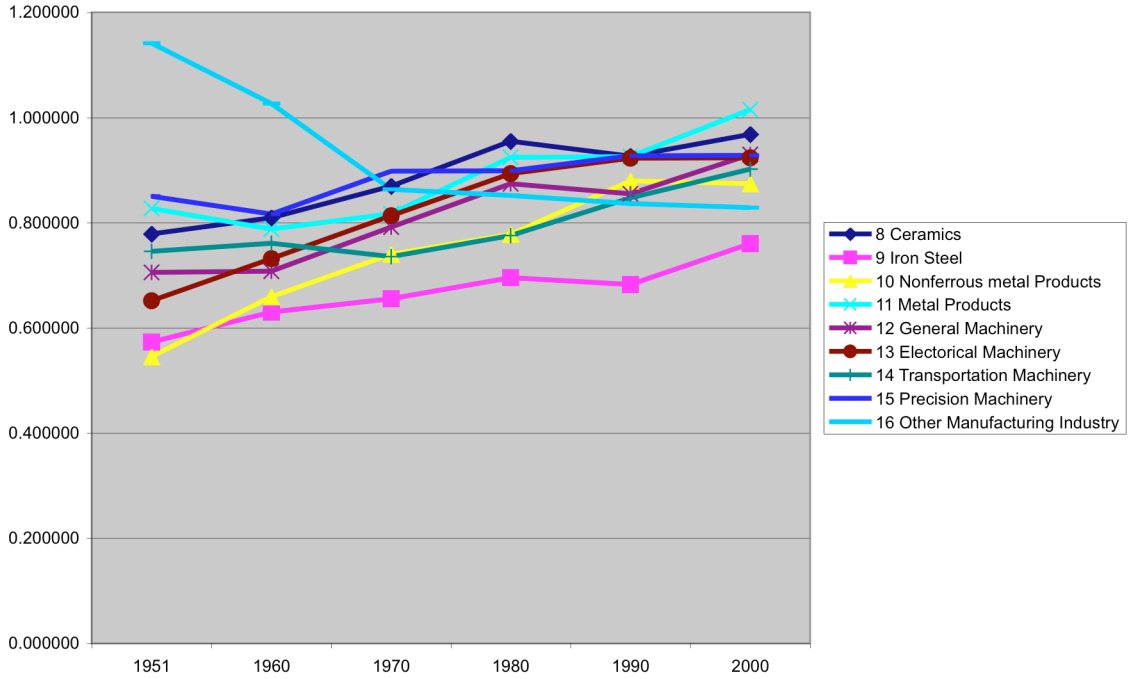


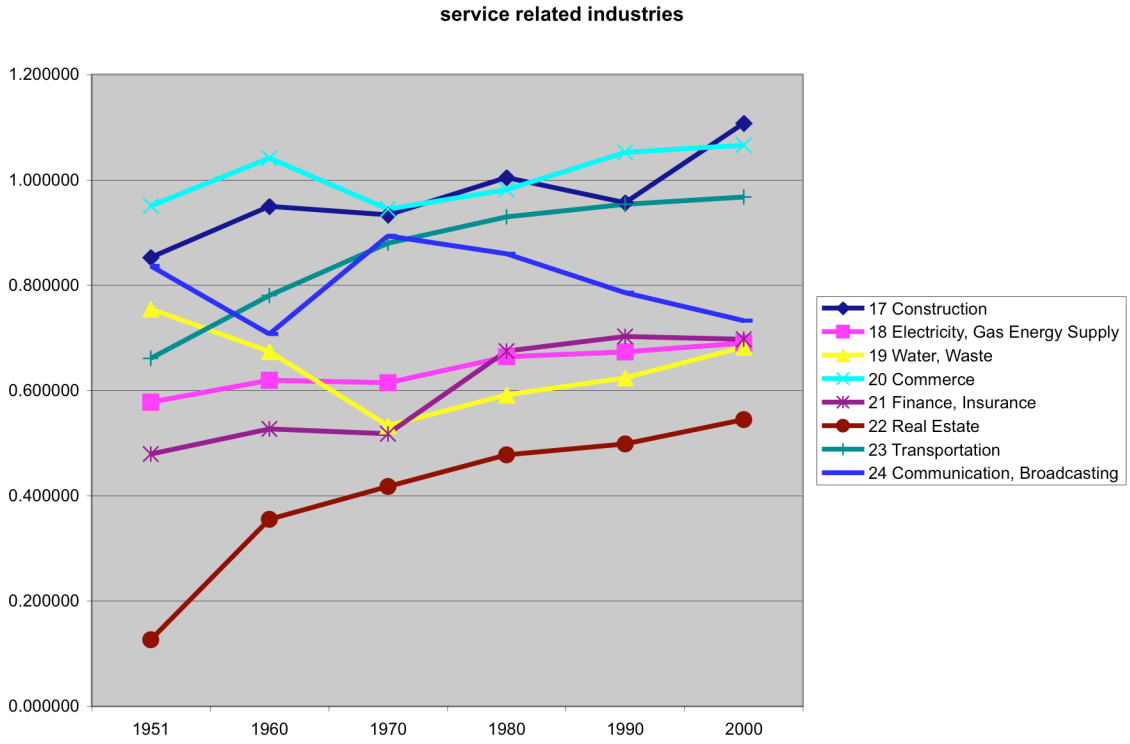
Natural price through programme revised

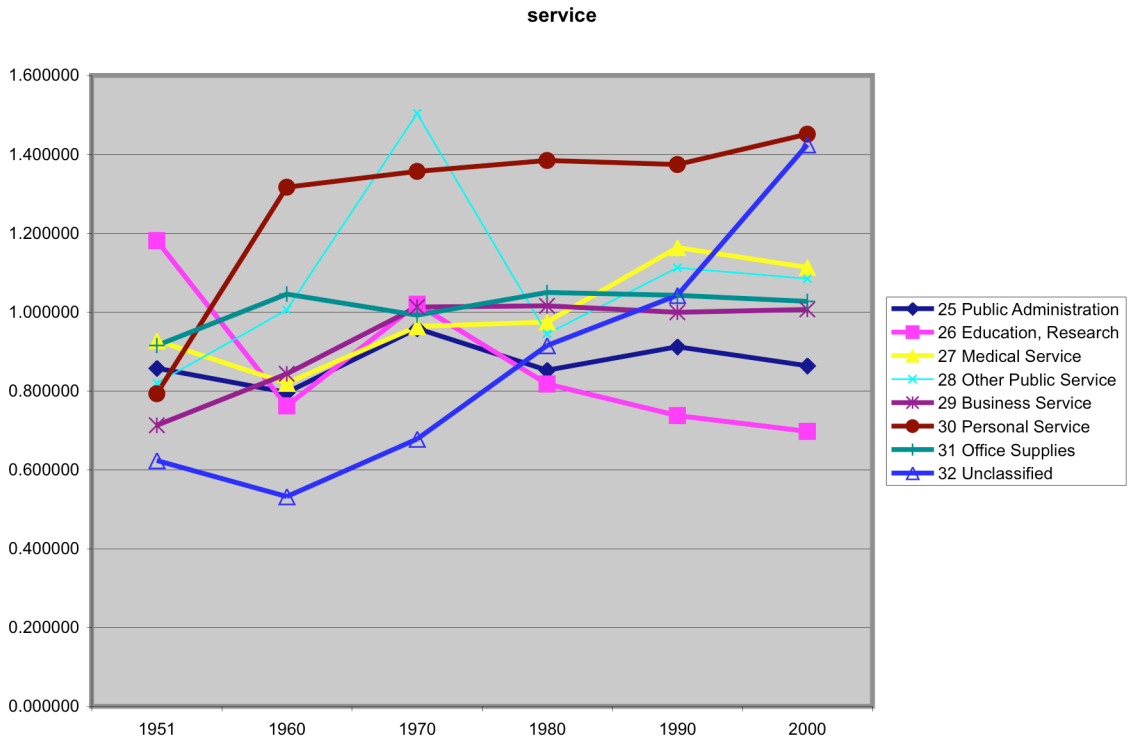
agriculture to oil



metal,machinery and other manufacture







	Persons engaged in production (man)

	1951	1960	1970	1980	1990	2000
Agriculture, forestry, fishing	16690000	15264461	10624740	7389796	5364549	3725296
Mining	510000	536240	260145	148256	102907	71782
Food Processing	852771	1230222	1861516	2046496	2187106	1781658
Textile Products	1377063	2376305	2102609	1859755	1659974	942770
Pulp, paper, Woolen Products	913299	1114616	1449596	1287393	1111298	812757
Chemical Products	430663	484793	1136162	1146846	1328952	1253785
Oil, Coal Products	29215	43991	56537	88659	49086	37753
Ceramics	305613	475741	672473	687432	610274	480941
Iron Steel	303166	450669	581361	509983	397229	281781
Nonferrous metal Products	64808	105665	212860	217243	244079	191582
Metal Products	283837	628823	1090401	1110505	1182393	995843
General Machinery	386580	816958	1508391	1280267	1532854	1339310
Electorical Machinery	204629	706356	1510309	1553620	2331168	1958268
Transportation Machinery	396462	724363	917032	1044409	1179641	1100193
Precision Machinery	78112	162032	282012	321848	298456	206775
Other Manufacturing Industry	631967	1067538	992310	1019473	1225257	1022258
Construction	1130000	3198031	4410814	5877780	6158782	6427033
Electricity, Gas Energy Supply	177958	173050	218998	225152	219601	227682
Water, Waste	46174	83990	101019	153969	197155	253535
Commerce	4716138	6486659	7975358	9492458	10438818	11380218
Finance, Insurance	414792	925417	1298448	1745643	2135915	1906998
Real Estate	16347	173343	351394	603388	940745	1044914
Transportation	1236357	1619200	2428185	2709308	2941740	3153208
Communication, Broadcasting	350078	393267	606960	649620	619573	680437
Public Administration	1130000	1381612	1718630	2055893	2032986	1997226
Education, Research	810754	1042771	1517758	1906070	2100726	2213665
Medical Service	398009	640132	1312859	2148414	2938423	4398725
Other Public Service	410937	328107	436883	498836	481733	451230
Business Service	475967	789768	1766955	2836611	4601543	6088476
Personal Service	1176621	3068806	4504814	5606313	7141439	8347877
Office Supplies	0	0	0	0	0	0
Unclassified	271683	30872	276684	349562	432979	478025
	36220000	46523798	54184216	58570999	64187379	65252000

labour output ratio

unit: man/million yen

		1951	1960	1970	1980	1990	2000
1	Agriculture, forestry, fishing	12.39	4.85	1.49	0.45	0.30	0.26
2	Mining	2.06	1.41	0.27	0.06	0.05	0.05
3	Food Processing	0.96	0.33	0.19	0.07	0.06	0.05
4	Textile Products	1.12	1.02	0.35	0.16	0.11	0.13
5	Pulp, paper, Woolen Products	2.15	0.75	0.24	0.08	0.06	0.05
6	Chemical Products	0.83	0.32	0.19	0.06	0.05	0.05
7	Oil, Coal Products	0.21	0.07	0.02	0.00	0.00	0.00
8	Ceramics	2.06	0.90	0.25	0.08	0.06	0.06
9	Iron Steel	0.31	0.16	0.05	0.02	0.01	0.02
10	Nonferrous metal Products	0.31	0.18	0.08	0.03	0.03	0.03
11	Metal Products	2.48	1.07	0.31	0.11	0.07	0.07
12	General Machinery	1.70	0.61	0.21	0.08	0.05	0.05
13	Electorical Machinery	1.61	0.59	0.21	0.08	0.05	0.04
14	Transportation Machinery	1.68	0.60	0.14	0.04	0.03	0.03
15	Precision Machinery	3.57	1.00	0.31	0.10	0.06	0.05
16	Other Manufacturing Industry	2.20	0.99	0.19	0.06	0.04	0.03
17	Construction	1.84	1.01	0.27	0.11	0.07	0.08
18	Electricity, Gas Energy Supply	1.16	0.29	0.10	0.02	0.01	0.01
19	Water, Waste	3.76	1.14	0.19	0.05	0.03	0.03
20	Commerce	5.40	2.52	0.56	0.18	0.13	0.12
21	Finance, Insurance	2.26	1.07	0.28	0.11	0.06	0.05
22	Real Estate	0.13	0.17	0.06	0.02	0.02	0.02
23	Transportation	2.39	1.00	0.36	0.13	0.09	0.08
24	Communication, Broadcasting	3.95	1.07	0.38	0.11	0.06	0.03
25	Public Administration	5.75	1.69	0.52	0.15	0.08	0.06
26	Education, Research	6.94	1.91	0.63	0.14	0.07	0.06
27	Medical Service	2.94	1.36	0.42	0.14	0.11	0.10
28	Other Public Service	#DIV/0!	2.03	0.97	0.14	0.12	0.11
29	Business Service	2.25	1.00	0.41	0.14	0.09	0.08
30	Personal Service	1.91	2.39	0.67	0.23	0.15	0.14
31	Office Supplies	-	-	-	-	-	-
32	Unclassified	0.34	0.03	0.07	0.04	0.07	0.11

rieti labour data (r labour man) divided by total output.
current price

		total output unit: million yen					
		1951	1960	1970	1980	1990	
1	Agriculture, forestry, fishing	1,347,089	3,150,056	7,113,594	16,417,604	18,052,567	14,369
2	Mining	248,156	379,946	959,231	2,601,207	2,156,352	1,378
3	Food Processing	886,092	3,738,953	9,875,672	29,489,471	39,584,379	38,924
4	Textile Products	1,231,217	2,319,753	6,009,416	11,846,671	14,506,107	7,093
5	Pulp, paper, Woolen Products	424,800	1,482,910	6,040,575	16,056,257	18,944,165	14,861
6	Chemical Products	515,768	1,494,502	6,006,810	20,122,991	26,413,741	26,102
7	Oil, Coal Products	139,973	651,017	3,011,001	17,884,929	11,087,614	12,983
8	Ceramics	148,332	528,932	2,669,889	8,305,282	10,193,580	8,369
9	Iron Steel	973,456	2,820,441	11,285,272	29,087,729	26,664,103	17,159
10	Nonferrous metal Products	208,097	581,902	2,508,035	7,032,454	7,614,576	6,137
11	Metal Products	114,381	585,806	3,522,657	10,183,712	16,763,137	13,452
12	General Machinery	227,975	1,332,984	7,319,120	16,725,614	32,015,005	28,586
13	Electorical Machinery	127,473	1,206,020	7,175,663	20,477,174	50,775,648	53,402
14	Transportation Machinery	235,715	1,214,107	6,701,383	25,108,631	45,396,274	42,667
15	Precision Machinery	21,860	162,692	913,398	3,339,972	4,691,959	3,938
16	Other Manufacturing Industry	287,537	1,081,620	5,162,375	18,527,980	32,618,349	31,073
17	Construction	613,427	3,181,492	16,258,776	52,977,275	89,198,944	77,310
18	Electricity, Gas Energy Supply	153,896	590,203	2,099,603	11,597,661	15,318,015	19,288
19	Water, Waste	12,274	73,883	528,341	3,152,871	5,716,121	7,716
20	Commerce	873,875	2,576,037	14,289,686	51,517,792	82,605,584	97,229
21	Finance, Insurance	183,515	864,086	4,567,385	15,804,066	34,409,394	38,149
22	Real Estate	124,758	1,028,557	5,907,723	26,626,993	47,114,672	65,852
23	Transportation	518,002	1,618,390	6,778,905	21,607,687	34,378,182	38,152
24	Communication, Broadcasting	88,594	367,871	1,598,902	5,974,021	10,974,636	22,139
25	Public Administration	196,537	818,286	3,280,652	13,275,248	24,053,649	36,240
26	Education, Research	116,814	545,572	2,422,293	13,282,797	28,422,046	36,294
27	Medical Service	135,248	471,369	3,108,415	15,623,964	26,820,350	44,006
28	Other Public Service	-	161,918	451,739	3,504,038	4,006,113	4,232
29	Business Service	211,138	790,336	4,287,395	20,194,249	53,072,873	76,245

30	Personal Service	614,642	1,282,317	6,693,103	24,401,586	48,183,782	58,449
31	Office Supplies	44,250	247,312	438,022	1,043,677	1,914,575	1,842
32	Unclassified	794,108	953,084	3,734,734	9,269,055	6,382,794	4,208
	total	11,818,999	38,302,354	162,719,765	543,060,658	870,049,286	947,862

		natural price obtained from programme						
		1951	1960	1970	1980	1990	2000	195
1	Agriculture, forestry, fishing	2.063142	2.077054	2.4315466	2.416682	2.459946 61	2.360451 1	-1.0631
2	Mining	0.581930	0.842904	0.7669585	0.731796	0.798796 39	0.890695 4	0.4180
3	Food Processing	0.880141	1.268239	1.4666684	1.375222	1.382100 79	1.176792 6	0.1198
4	Textile Products	1.153605	1.352070	1.3388696	1.505814	1.479992 4	1.635360 4	-0.1536
5	Pulp, paper, Woolen Products	1.184875	1.294519	1.2883591	1.247172	1.144203 15	1.088158 7	-0.1848
6	Chemical Products	0.620057	0.744996	0.8604785	0.926001	0.970956 28	1.027197 6	0.3799
7	Oil, Coal Products	0.553641	0.521789	0.5236322	0.750054	0.592264 56	0.577052 3	0.4463
8	Ceramics	0.778845	0.809837	0.8697627	0.955296	0.926569 25	0.968445 3	0.2211
9	Iron Steel	0.573412	0.630390	0.6557232	0.695234	0.682117 26	0.760121 9	0.4265
10	Nonferrous metal Products	0.545041	0.659231	0.7401873	0.777883	0.879310 37	0.874008 1	0.4549
11	Metal Products	0.827334	0.788275	0.8170555	0.924166	0.925772 12	1.015099	0.1726
12	General Machinery	0.705582	0.707696	0.7916308	0.874208	0.854987 23	0.930012 8	0.2944
13	Electorical Machinery	0.651662	0.731432	0.8133623	0.893461	0.922427 81	0.923231	0.3483
14	Transportation Machinery	0.745748	0.760717	0.7354733	0.775786	0.847315 92	0.901570 9	0.2542
15	Precision Machinery	0.850176	0.816675	0.8983486	0.898917	0.927538 33	0.928472 9	0.1498
16	Other Manufacturing Industry	1.141713	1.026450	0.8631652	0.851835	0.836665 45	0.828492 3	-0.1417
17	Construction	0.852294	0.949661	0.9336643	1.004139	0.956486 72	1.107571 5	0.1477
18	Electricity, Gas Energy Supply	0.577338	0.619302	0.6142795	0.663841	0.672893 41	0.689925 2	0.4226
19	Water, Waste	0.754618	0.673650	0.5329708	0.591741	0.623845 71	0.682726 5	0.2453
20	Commerce	0.950459	1.041615	0.9444714	0.981478	1.052097 25	1.066090 9	0.0495
21	Finance, Insurance	0.479265	0.526579	0.5173171	0.674416	0.702110 37	0.697303 9	0.5207
22	Real Estate	0.126443	0.354957	0.4173736	0.477335	0.498367 26	0.544338 2	0.8735
2	Transportation	0.660791	0.780546	0.8796199	0.929977	0.953453	0.967084	0.3392

3						77	2	
24	Communication, Broadcasting	0.836178	0.706867	0.8931801	0.859287	0.785822 18	0.732369	0.1638
25	Public Administration	0.857998	0.796178	0.9585897	0.852136	0.912351 6	0.863676 3	0.1420
26	Education, Research	1.181277	0.761512	1.0193571	0.816968	0.737188 86	0.697012 4	-0.1812
27	Medical Service	0.926891	0.819148	0.9637929	0.974349	1.163905 45	1.113570 3	0.0731
28	Other Public Service	0.819550	1.005733	1.5031033	0.945205	1.111952 47	1.084313	0.1804
29	Business Service	0.712206	0.843088	1.0123293	1.015859	0.999374 51	1.006051 2	0.2877
30	Personal Service	0.792895	1.316156	1.3563181	1.384168	1.373830 84	1.45077	0.2071
31	Office Supplies	0.915344	1.045534	0.9923690	1.049645	1.042418 88	1.027328 9	0.0846
32	Unclassified	0.623182	0.531996	0.6782562	0.915062	1.041880 25	1.424479 3	0.3768
	standar deviation of all industries							0.3190
	s.d. except agriculture							0.2261

1951,1970,1980,1990,2000 are revised

		Depreciation Allowances				Unit : Million Yen
		1960	1970	1980	1990	2000
1	Agriculture, forestry, fishing	209799	628330	1751378	1953198	1492401
2	Mining	38456	166767	295691	232356	123679
3	Food Processing	40352	213524	747330	1080447	1324530
4	Textile Products	42647	184991	417490	465203	281771
5	Pulp, paper, Woolen Products	40798	220502	540733	912146	815028
6	Chemical Products	87260	497132	1137208	1755879	1758006
7	Oil, Coal Products	20415	104714	352441	287484	311824
8	Ceramics	23406	177250	497251	609392	619222
9	Iron Steel	80537	500888	1358986	1027261	1089842
10	Nonferrous metal Products	13278	100848	210856	446857	430148
11	Metal Products	9251	112675	407467	995742	762627
12	General Machinery	43418	311181	629850	1875793	1613132
13	Electorical Machinery	34462	257536	803735	3260048	3700736
14	Transportation Machinery	41147	341398	1067308	1493614	1894864
15	Precision Machinery	4830	36726	133260	213207	213319
16	Other Manufacturing Industry	21343	211873	865048	1748578	1703102
17	Construction	59838	662293	2078160	3505989	4054811

18	Electricity, Gas Energy Supply	123975	461891	1254579	3361653	3903834
19	Water, Waste	10670	52860	418365	753873	1124399
20	Commerce	124031	648547	1989385	4072315	4741946
21	Finance, Insurance	26617	159979	604184	2569985	3387912
22	Real Estate	215609	1263531	7278379	1143084 2	2066720 4
23	Transportation	239011	826116	1435847	3554781	3044134
24	Communication, Broadcasting	51453	377842	1322422	2163043	3804360
25	Public Administration	209836	60751	389987	4765094	9439243
26	Education, Research	19868	265284	905780	2708034	4013959
27	Medical Service	20946	142966	652350	1532775	2569879
28	Other Public Service	10328	7020	70776	284117	251411
29	Business Service	26413	134159	837896	5835900	9065136
30	Personal Service	72274	322296	1182124	3147462	4229209
31	Office Supplies	0	0	0	0	0
32	Unclassified	−215542	79303	4600	817366	420694
					6886043 4	9285236 2

	Depreciation / total production	Unit: ratio				
		1960	1970	1980	1990	2000
1	Agriculture, forestry, fishing	0.067	0.088	0.107	0.108	0.104
2	Mining	0.101	0.174	0.114	0.108	0.090
3	Food Processing	0.011	0.022	0.025	0.027	0.034
4	Textile Products	0.018	0.031	0.035	0.032	0.040
5	Pulp, paper, Woolen Products	0.028	0.037	0.034	0.048	0.055
6	Chemical Products	0.058	0.083	0.057	0.066	0.067
7	Oil, Coal Products	0.031	0.035	0.020	0.026	0.024
8	Ceramics	0.044	0.066	0.060	0.060	0.074
9	Iron Steel	0.029	0.044	0.047	0.039	0.064
10	Nonferrous metal Products	0.023	0.040	0.030	0.059	0.070
11	Metal Products	0.016	0.032	0.040	0.059	0.057
12	General Machinery	0.033	0.043	0.038	0.059	0.056
13	Electorical Machinery	0.029	0.036	0.039	0.064	0.069
14	Transportation Machinery	0.034	0.051	0.043	0.033	0.044
15	Precision Machinery	0.030	0.040	0.040	0.045	0.054
16	Other Manufacturing Industry	0.020	0.041	0.047	0.054	0.055
17	Construction	0.019	0.041	0.039	0.039	0.052
18	Electricity, Gas Energy Supply	0.210	0.220	0.108	0.219	0.202
19	Water, Waste	0.144	0.100	0.133	0.132	0.146
20	Commerce	0.048	0.045	0.039	0.049	0.049
21	Finance, Insurance	0.031	0.035	0.038	0.075	0.089
22	Real Estate	0.210	0.214	0.273	0.243	0.314

23	Transportation	0.148	0.122	0.066	0.103	0.080
24	Communication, Broadcasting	0.140	0.236	0.221	0.197	0.172
25	Public Administration	0.256	0.019	0.029	0.198	0.260
26	Education, Research	0.036	0.110	0.068	0.095	0.111
27	Medical Service	0.044	0.046	0.042	0.057	0.058
28	Other Public Service	0.064	0.016	0.020	0.071	0.059
29	Business Service	0.033	0.031	0.041	0.110	0.119
30	Personal Service	0.056	0.048	0.048	0.065	0.072
31	Office Supplies	0.000	0.000	0.000	0.000	0.000
32	Unclassified	– 0.226	0.021	0.000	0.128	0.100
					0.079	0.098

	difference of natural price and market orice					
	1951	1960	1970	1980	1990	2000
1 Agriculture, forestry, fishing	-1.06314	-1.07705	-1.43155	-1.41668	-1.45995	-1.36045
2 Mining	0.41807	0.15710	0.23304	0.26820	0.20120	0.10930
3 Food Processing	0.11986	-0.26824	-0.46667	-0.37522	-0.38210	-0.17679
4 Textile Products	-0.15361	-0.35207	-0.33887	-0.50581	-0.47999	-0.63536
5 Pulp, paper, Woolen Products	-0.18487	-0.29452	-0.28836	-0.24717	-0.14420	-0.08816
6 Chemical Products	0.37994	0.25500	0.13952	0.07400	0.02904	-0.02720
7 Oil, Coal Products	0.44636	0.47821	0.47637	0.24995	0.40774	0.42295
8 Ceramics	0.22116	0.19016	0.13024	0.04470	0.07343	0.03155
9 Iron Steel	0.42659	0.36961	0.34428	0.30477	0.31788	0.23988
10 Nonferrous metal Products	0.45496	0.34077	0.25981	0.22212	0.12069	0.12599
11 Metal Products	0.17267	0.21172	0.18294	0.07583	0.07423	-0.01510
12 General Machinery	0.29442	0.29230	0.20837	0.12579	0.14501	0.06999
13 Electorical Machinery	0.34834	0.26857	0.18664	0.10654	0.07757	0.07677
14 Transportation Machinery	0.25425	0.23928	0.26453	0.22421	0.15268	0.09843
15 Precision Machinery	0.14982	0.18332	0.10165	0.10108	0.07246	0.07153
16 Other Manufacturing Industry	-0.14171	-0.02645	0.13683	0.14816	0.16333	0.17151
17 Construction	0.14771	0.05034	0.06634	-0.00414	0.04351	-0.10757
18 Electricity, Gas Energy Supply	0.42266	0.38070	0.38572	0.33616	0.32711	0.31007
19 Water, Waste	0.24538	0.32635	0.46703	0.40826	0.37615	0.31727
20 Commerce	0.04954	-0.04162	0.05553	0.01852	-0.05210	-0.06609
21 Finance, Insurance	0.52074	0.47342	0.48268	0.32558	0.29789	0.30270
22 Real Estate	0.87356	0.64504	0.58263	0.52267	0.50163	0.45566
23 Transportation	0.33921	0.21945	0.12038	0.07002	0.04655	0.03292
24 Communication, Broadcasting	0.16382	0.29313	0.10682	0.14071	0.21418	0.26763
25 Public Administration	0.14200	0.20382	0.04141	0.14786	0.08765	0.13632
26 Education, Research	-0.18128	0.23849	-0.01936	0.18303	0.26281	0.30299
27 Medical Service	0.07311	0.18085	0.03621	0.02565	-0.16391	-0.11357
28 Other Public Service	0.18045	-0.00573	-0.50310	0.05479	-0.11195	-0.08431
29 Business Service	0.28779	0.15691	-0.01233	-0.01586	0.00063	-0.00605
30 Personal Service	0.20710	-0.31616	-0.35632	-0.38417	-0.37383	-0.45077
31 Office Supplies	0.08466	-0.04553	0.00763	-0.04964	-0.04242	-0.02733
32 Unclassified	0.37682	0.46800	0.32174	0.08494	-0.04188	-0.42448
standar deviation of all industries	0.31902	0.32631	0.38202	0.34616	0.35144	0.34613

s.d. except agriculture	0.226143	0.244545	0.272482	0.225515	0.227908	0.24542

1951,1970,1980,1990,2000 are revised