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The Changes in Intermediate Input Structure of Japanese Manufacturing Sectors

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1. Introduction

Secondary industry was the driving force of Japanese economic growth in the 1950's. In 1968, its share against the whole economy (GNP) reached 36.4%.

However, the share has since been declining, to 25.2% in 1997.

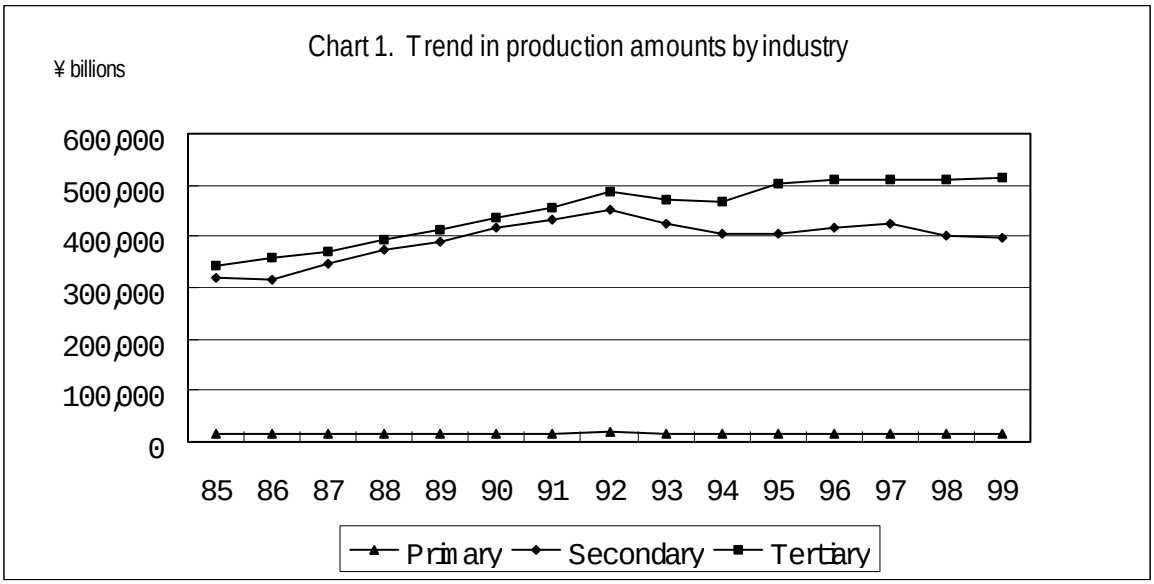
In Japan's growth-leading industries, a gradual change from secondary to tertiary has been observed since the late 1960's.

In this paper, I will try to make clear how Japanese manufacturing sectors are changing, and the relevance of this.

2. Current position of Japanese manufacturing sectors in the economy

Chart 1 depicts trends in Japanese outputs, by industry.

Up to the early 1990's, the output value of the secondary and tertiary industries moved in parallel, but the trend changed in 1992–93. The former decreased, the latter is still increasing at a much smaller growth rate.



Note: 1995 price data Source: JIDEA5 database

Table 1 also shows clearly that the trend has changed since 1992-93.

Table 1. Ratio of secondary to tertiary industry

85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0.94	0.89	0.94	0.96	0.95	0.97	0.96	0.94	0.90	0.88	0.81	0.82	0.83	0.79	0.77

Note: Ratio = share of secondary : share of tertiary Source: JIDEA5 database

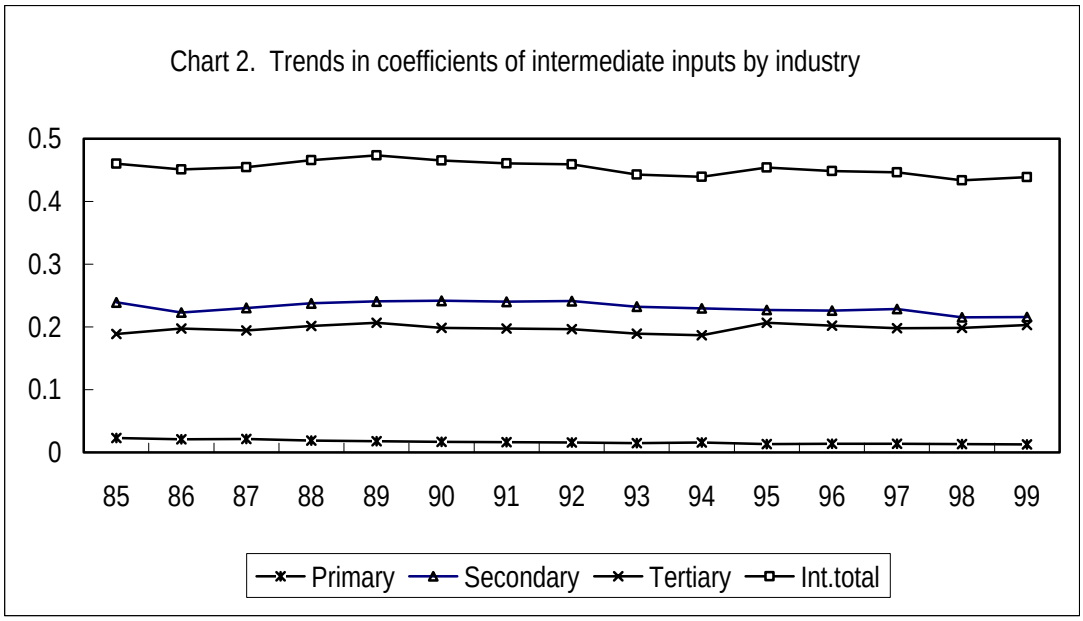
This suggests that there were some changes in secondary industry in Japan.

3. Changes in the intermediate input structure in some manufacturing sectors

Changes observed in 1988

The changes in the intermediate input structure of Japanese secondary industry began to emerge in 1988, although those in production levels were in 1992 or 1993.

Chart 2 depicts the trends in coefficients of intermediate inputs, by industry.



Source: JIDEA5 database

Chart 2 shows that the input structure of Japanese secondary industry was generally stable as a whole between 1985 and 1999.

By industry, Tertiary was very stable because its slope was zero during that period.

Though Primary and the Secondary have negative slopes, at –0.001 they are not so large.

This also means that the value-added ratios are increasing in these industries.

Table 2. The coefficients of intermediate input total by industry, and trends

	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	slope
Primary	0.023	0.021	0.021	0.019	0.018	0.017	0.016	0.016	0.015	0.016	0.013	0.014	0.014	0.013	0.013	-0.001
Secondary	0.239	0.223	0.230	0.237	0.241	0.242	0.240	0.241	0.232	0.230	0.227	0.226	0.229	0.215	0.216	-0.001
Tertiary	0.189	0.198	0.195	0.202	0.207	0.199	0.198	0.197	0.189	0.187	0.207	0.202	0.198	0.199	0.203	0.000
Int. Total	0.460	0.451	0.455	0.466	0.473	0.465	0.461	0.459	0.443	0.439	0.454	0.449	0.447	0.434	0.439	-0.002

Note: Periods analyzed for slopes: 1985-1999 Source: JIDEA5 database

Now I will focus on secondary industry, comprising the *manufacturing*, *mining* and *construction* sectors.

To identify changes in secondary industry, I applied the following model equation:

$$Y_t = a + b \cdot X_t + c \cdot D_t \cdot X_t$$

Given

Y_t: the coefficient of the intermediate input total in the secondary industry

X_t: time

D_t: parameter dummy $D_t = 0$ 1985-1987, $D_t = 1$ 1988-1999

Est. period: 1985–1999 D.W. = 2.1668 $AR^2 = 0.6528$

	Coefficient	T value
Constant	0.250236	65.7267
Variable1	-0.00888	4.1629
Variable2	0.006858	3.6414

This equation result shows that the input structural changes in secondary industry as a whole began in 1988, earlier than those in production by 5 years.

The parameter of the time trends was -0.00888 between 1985 and 1987, becoming

-0.002022 afterward, decreasing in speed of decline.

To view industry in detail, the same method was applied to each of 13 sectors.

(These 13 sectors are the *manufacturing* sectors, except *other manufacturing*, of 25 industry classifications, as listed in Appendix)

$$Y_{it} = a + b \bullet X_t + c \bullet D_t \bullet X_t$$

Given

Y_{it}: the coefficient of intermediate input total of *i* industry

X_t: time

D_t: parameter dummy D_t = 0 1985 – (t-1) D_t = 1 t –1999

	Coefficient 1	Coefficient 2	t-value 1	t-value 2	AR2	D.W.	Turning yr
Food and beverages	-0.0084	-0.0079	3.79	2.56	0.51	1.74	91
Textiles							
Wood products							
Pulp	-0.0015	-0.0018	2.15	4.44	0.91	1.26	90
Chemicals	-0.0034	-0.0031	5.55	3.97	0.67	1.96	87
Coal and oil	-0.0052	-0.0049	4.28	2.46	0.56	1.39	95
Rubber and leather	-0.0035	-0.0032	4.94	4.87	0.63	1.62	90
Ceramics	-0.0024	-0.0026	4.62	3.95	0.94	1.96	90
Iron/steel/non-ferrous metal	0.0044	0.0040	4.37	3.73	0.55	1.68	95
General machinery	-0.0029	-0.0026	3.57	4.15	0.52	1.27	90
Electrical machinery	0.0128		17.45		0.96	1.52	
Transportation machinery	0.0035	0.0038	7.89	2.99	0.91	1.82	86
Precision machinery	-0.0065	-0.0067	9.17	3.49	0.98	2.64	91

Note: Periods analyzed for slopes: 1985-1999

Coefficient1 shows the slopes before the turning points; coefficient 2, after.

Namely, coefficient 2 indicates b+c.

For the *textiles* and *wood products* sectors, no significant results were identified.

The equations indicated the following facts.

The *transportation machinery* sector parameter has increased since 1986. The *ceramics, pulp* and *precision machinery* sector parameters decreased in the early 1990's. *Electrical machinery* showed the highest parameter, though no structural changes were observed. This suggests that the sector experienced the change before 1985.

Table 3. Summary tables of the turning years of input structure by industry

Coefficient	Positive	Negative
Up	transportation machinery (86)	general machinery, rubber and leather (90), chemicals (87), food and beverages (91), coal and oil (95)
Down	iron, steel and non-ferrous metal (95)	ceramics, pulp (90), precision machinery (91)

Note: Figures in parentheses indicate the turning year.

3-2. Increasing the ratios of self-input in electrical machinery and transportation machinery

To eliminate the effects of changes of value-added ratio, I made a share matrix of intermediate demand by dividing the intermediate totals of each sector.

Table 4, made up of the diagonal elements of the share matrix, shows the trends in self-input shares by industry.

Table 4. Shares of self-input elements in their intermediate input total

	FoodBe	Textil	WoodPr	Pulp	Chemic	CoaOil	RubLea	Cerami	ISNMet	GenMac	EleMac	TraMac	PreMac	OtManu
85	0.224	0.465	0.254	0.534	0.428	0.228	0.118	0.219	0.602	0.305	0.305	0.502	0.290	0.109
86	0.243	0.488	0.256	0.550	0.434	0.261	0.123	0.222	0.578	0.309	0.311	0.519	0.285	0.101
87	0.227	0.477	0.240	0.553	0.457	0.248	0.114	0.214	0.596	0.297	0.310	0.530	0.284	0.114
88	0.237	0.480	0.247	0.549	0.457	0.242	0.124	0.209	0.598	0.309	0.345	0.535	0.276	0.105
89	0.245	0.463	0.241	0.548	0.459	0.245	0.118	0.214	0.584	0.313	0.366	0.550	0.273	0.114
90	0.218	0.434	0.271	0.519	0.433	0.242	0.146	0.193	0.597	0.336	0.367	0.543	0.255	0.126
91	0.226	0.464	0.266	0.515	0.434	0.224	0.139	0.184	0.606	0.329	0.373	0.543	0.241	0.146
92	0.232	0.500	0.258	0.507	0.434	0.195	0.132	0.177	0.617	0.318	0.390	0.539	0.224	0.193
93	0.235	0.493	0.280	0.511	0.437	0.196	0.127	0.189	0.628	0.318	0.383	0.552	0.219	0.179
94	0.220	0.479	0.275	0.516	0.445	0.207	0.116	0.185	0.631	0.307	0.409	0.555	0.211	0.135
95	0.216	0.423	0.299	0.503	0.424	0.211	0.130	0.179	0.596	0.316	0.418	0.570	0.206	0.093
96	0.207	0.440	0.280	0.502	0.423	0.224	0.126	0.178	0.601	0.317	0.448	0.563	0.196	0.093
97	0.207	0.443	0.297	0.501	0.432	0.221	0.116	0.173	0.608	0.313	0.477	0.566	0.194	0.090
98	0.227	0.424	0.263	0.500	0.422	0.212	0.107	0.173	0.597	0.306	0.470	0.574	0.176	0.078
99	0.223	0.428	0.262	0.494	0.418	0.212	0.111	0.161	0.610	0.298	0.463	0.571	0.191	0.082
avg.	0.226	0.460	0.266	0.520	0.436	0.224	0.123	0.191	0.603	0.313	0.389	0.548	0.235	0.117
slope	-0.001	-0.003	0.003	-0.004	-0.002	-0.003	-0.001	-0.004	0.001	0.000	0.013	0.004	-0.009	-0.002

Note: Periods analyzed for slopes: 1985-1999 Source: JIDEA5 database

From this table, we can see the following:

The shares of diagonal elements in *electrical machinery* and *transportation machinery* are increasing at a high rate,

Those in precision *machinery, pulp,* and *ceramics* are decreasing greatly.

The following is the background to this observation.

A. Electrical machinery:

Table 5. Changes in input structure in the electrical machinery sector (unit:%)

Electrical machinery	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Coal and oil	5.1	4.9	5.3	4.8	4.7	4.6	4.4	4.1	4.3	4.2	4.2	4.1	3.9	4.0	4.0
Iron/steel/non-ferrous metal	8.1	7.8	8.2	7.5	7.0	7.2	7.3	7.5	7.5	7.2	6.4	5.8	5.7	5.5	5.9
General machinery	5.7	6.1	6.0	5.9	5.6	5.0	4.7	4.3	4.4	4.2	4.0	3.8	3.5	3.4	3.5
Electrical machinery	30.5	31.1	31.0	34.5	36.6	36.7	37.3	39.0	38.3	40.9	41.8	44.8	47.7	47.0	46.3
Electricity, gas and water	2.7	2.5	3.0	3.0	2.8	2.0	1.9	1.8	1.8	1.9	1.7	1.6	1.5	1.5	1.6
Commerce	8.0	8.0	7.7	7.4	7.0	7.6	7.4	6.9	6.9	6.5	9.3	8.1	6.8	6.9	6.9
Finance	3.3	3.9	4.4	4.2	4.4	1.2	1.1	1.0	1.0	1.0	1.3	1.3	1.2	1.3	1.2
Intermediate total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Listed are only those sectors whose change of share from 1985 to 1999 is more than 1 percentage point

Source: JIDEA5 database

The share of self-input is obviously increasing. This is because many Japanese manufacturers have shifted their production sites overseas since the late 1980's, adapting to the rapid appreciation of the Japanese yen against the US dollar. As a result, intra-industry trade has developed, mainly between Japan and Southeast Asian countries, to where many Japanese manufacturers have relocated factories. This is the reason for the increase in self-input share. When analyzing further, in 100-sector classifications, we find that *electric lights, batteries and other light electric appliances* (57), *semiconductor devices and ICs* (54), and *electronics parts* (55) are contributing to the increase in self-input among components.

Table 6. Coefficients of intermediate input of electrical machinery sector (diagonal element) (100-sector classification)

	51 Comp	52 ComE	53 ElAp	54 IC	55 ElPa	56 HeEl	57 LiEl	99 OfSu
85	0.117	0.005	0.089	0.014	0.209	0.078	0.130	0.000
86	0.103	0.006	0.093	0.013	0.194	0.078	0.135	0.000
87	0.093	0.006	0.085	0.013	0.194	0.076	0.139	0.000
88	0.122	0.008	0.109	0.016	0.201	0.083	0.137	0.000
89	0.157	0.008	0.117	0.019	0.198	0.083	0.141	0.000
90	0.136	0.004	0.104	0.021	0.238	0.076	0.175	0.000
91	0.126	0.005	0.101	0.022	0.240	0.075	0.174	0.000
92	0.116	0.006	0.098	0.023	0.246	0.075	0.174	0.000
93	0.110	0.006	0.097	0.021	0.238	0.074	0.168	0.000
94	0.102	0.005	0.081	0.020	0.267	0.068	0.174	0.000
95	0.132	0.005	0.076	0.024	0.193	0.084	0.177	0.000
96	0.149	0.003	0.076	0.027	0.197	0.067	0.173	0.000
97	0.125	0.004	0.078	0.024	0.198	0.071	0.174	0.000
98	0.111	0.006	0.066	0.024	0.214	0.078	0.158	0.000
99	0.115	0.005	0.068	0.023	0.220	0.064	0.148	0.000
slope	0.000	0.000	-0.002	0.001	0.001	-0.001	0.002	0.000

Note: Period analyzed for slopes: 1985-1999 Source: JIDEA5 database

B. Transportation machinery:

Only the share of self-input is increasing.

Table 7. Changes in input structure in transportation machinery sector (unit:%)

Note: Listed are only those sectors whose change of share from 1985 to 1999 is more than 1 percentage point.

Transportation machinery	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Iron/steel/non-ferrous metal	8.9	8.2	8.2	7.6	7.3	7.2	7.3	7.6	7.8	7.7	7.3	7.5	7.1	6.9	7.3
Transportation machinery	50.2	51.9	53.0	53.5	55.0	54.3	54.3	53.9	55.2	55.5	57.0	56.3	56.6	57.4	57.1
Commerce	5.6	5.3	4.8	5.1	4.6	6.2	6.1	6.0	5.5	4.9	5.2	5.0	5.1	4.0	4.3
Services	9.7	7.6	7.2	7.4	7.3	8.1	8.6	9.2	8.8	8.5	7.7	8.4	8.6	8.9	8.4
Intermediate total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: JIDEA5 database

In the 100-sector classification, the *transportation machinery* sector is composed of *motor vehicles* (58), *ships and repair* (59), *railway equipment* (60), *aircraft and repair* (61) and *other transportation* equipment (62). These sectors, except *aircraft and repair* and *other transportation equipment*, are contributing to the increase of self-input. In particular the *motor vehicles* sector was once regarded as a domestically self-sufficient industry based on tight relationships among member companies. However, judging from the increase in self-input coefficient, this industry has also been increasing its purchase of related products from overseas. An example of this is the increase in import of automobile parts and products such as catalytic converters and aluminum wheels.

Table 8. Coefficients of intermediate input in *transportation machinery* (diagonal element) (100-sector classification) Note: Period analyzed for slopes: 1985-1999 Source: JIDEA5 database

	58	59	60	61	62
	MVeh	Ship	Rail	AirC	OtTr
85	0.416	0.103	0.118	0.376	0.287
86	0.434	0.093	0.136	0.344	0.290
87	0.433	0.070	0.131	0.403	0.291
88	0.418	0.071	0.139	0.376	0.282
89	0.434	0.067	0.140	0.417	0.284
90	0.438	0.100	0.192	0.290	0.252
91	0.445	0.105	0.194	0.298	0.251
92	0.451	0.110	0.195	0.304	0.251
93	0.451	0.104	0.204	0.316	0.269
94	0.448	0.111	0.189	0.313	0.250
95	0.461	0.160	0.178	0.239	0.248
96	0.454	0.163	0.182	0.244	0.220
97	0.460	0.156	0.169	0.235	0.220
98	0.468	0.144	0.154	0.207	0.225
99	0.464	0.159	0.190	0.212	0.212
slope	0.003	0.006	0.004	-0.014	-0.006

For your reference, those sectors whose diagonal coefficients of intermediate input are increasing rapidly are shown in Table 9.

Table 9. The sectors whose coefficients of intermediate input are increasing rapidly (100-sector classification)

	1 AgCr	2 AgLi	15 Wood	28 CoaP	39 NonF	44 MaGe	57 LiEl	58 MVeh	59 Ship	60 Rail	69 Elec	71 Watr	74 FiIn	75 ReEs	79 TrWa	82 Coms	98 Pers
85	0.019	0.035	0.105	0.081	0.150	0.158	0.130	0.416	0.103	0.118	0.059	0.002	0.049	0.004	0.248	0.023	0.000
86	0.021	0.042	0.107	0.053	0.123	0.159	0.135	0.434	0.093	0.136	0.001	0.002	0.058	0.004	0.229	0.022	0.000
87	0.021	0.039	0.109	0.028	0.132	0.148	0.139	0.433	0.070	0.131	0.001	0.002	0.056	0.005	0.212	0.022	0.000
88	0.022	0.042	0.107	0.025	0.151	0.156	0.137	0.418	0.071	0.139	0.001	0.002	0.063	0.005	0.225	0.021	0.000
89	0.021	0.045	0.111	0.023	0.154	0.157	0.141	0.434	0.067	0.140	0.001	0.002	0.071	0.005	0.238	0.020	0.000
90	0.020	0.083	0.153	0.090	0.172	0.175	0.175	0.438	0.100	0.192	0.058	0.002	0.080	0.021	0.284	0.033	0.020
91	0.019	0.075	0.152	0.087	0.156	0.174	0.174	0.445	0.105	0.194	0.029	0.002	0.084	0.021	0.274	0.035	0.018
92	0.018	0.065	0.151	0.083	0.140	0.175	0.174	0.451	0.110	0.195	0.001	0.002	0.089	0.021	0.271	0.037	0.015
93	0.020	0.070	0.176	0.072	0.133	0.171	0.168	0.451	0.104	0.204	0.001	0.003	0.075	0.024	0.277	0.049	0.019
94	0.018	0.080	0.163	0.070	0.138	0.159	0.174	0.448	0.111	0.189	0.001	0.003	0.075	0.021	0.287	0.035	0.019
95	0.021	0.086	0.180	0.079	0.099	0.202	0.177	0.461	0.160	0.178	0.096	0.076	0.098	0.027	0.252	0.062	0.022
96	0.022	0.075	0.183	0.082	0.169	0.185	0.173	0.454	0.163	0.182	0.086	0.076	0.102	0.024	0.256	0.057	0.019
97	0.021	0.080	0.189	0.117	0.178	0.178	0.174	0.460	0.156	0.169	0.086	0.077	0.094	0.019	0.295	0.069	0.018
98	0.056	0.072	0.166	0.059	0.173	0.179	0.158	0.468	0.144	0.154	0.075	0.069	0.096	0.026	0.312	0.062	0.021
99	0.055	0.076	0.165	0.090	0.172	0.178	0.148	0.464	0.159	0.190	0.087	0.072	0.093	0.027	0.267	0.069	0.020
slope	0.002	0.003	0.006	0.003	0.002	0.002	0.002	0.003	0.006	0.004	0.006	0.006	0.003	0.002	0.004	0.004	0.002

Note: Listed are only those sectors whose slope is above 0.002 during the period analyzed.

Period analyzed for slopes: 1985-1999 Source: JIDEA5 database

3-3. Diversifying inputs from other sectors in precision machinery, pulp and ceramics

Precision machinery, pulp and *ceramics* are sectors whose shares of diagonal elements in their intermediate input total are decreasing.

C. Precision machinery:

Self-input share decreased drastically from 29.0% in 1985 to 19.1% in 1999. Meanwhile, the shares of inputs from *electrical machinery* and the *services* sectors have been gaining greatly.

When analyzing further in the 100-sector classification, we can find that the inputs from *semiconductor devices and ICs* (54) and *electronics parts* (55) are increasing. Among *service* sectors, inputs from *research institutes* (86) are also increasing.

This can be attributed to the fact that modern precision machinery incorporates complicated electronic devices—an example is computerized medical treatment equipment. The decrease in the diagonal element in the *precision machinery* sector reflects the fact that products are changing in quality from analog- to digital-based.

Table 10. The changes of input structure in precision machinery sector (unit:%)

Precision machinery	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Rubber and leather	3.1	3.2	2.9	2.9	2.8	2.6	2.5	2.4	2.3	2.3	0.9	1.5	1.4	1.5	1.5
Iron/steel/non-ferrous metal	7.7	7.7	8.3	8.2	8.3	5.2	5.6	6.1	6.3	6.2	5.7	5.4	5.2	5.3	5.6
Electrical machinery	5.8	6.5	7.1	7.6	7.3	8.7	8.9	9.2	9.2	10.7	12.9	14.1	16.0	16.9	15.3
Precision machinery	29.0	28.5	28.4	27.6	27.3	25.5	24.1	22.4	21.9	21.1	20.6	19.6	19.4	17.6	19.1
Commerce	7.4	7.0	6.8	6.8	6.7	9.1	8.8	8.4	8.6	8.3	11.7	11.4	9.8	9.2	9.8
Transport/communication	4.8	6.0	5.8	5.4	5.2	3.3	3.5	3.8	3.7	3.6	3.2	3.2	3.3	3.3	3.4
Services	11.8	10.3	9.0	9.7	10.1	16.0	17.7	19.8	19.0	18.6	18.1	18.4	19.1	20.5	19.6
Other	2.8	1.8	1.8	1.7	1.7	1.4	1.1	0.7	0.9	0.9	0.8	0.9	0.9	0.9	0.8
Intermediate total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Listed are only those sectors whose change of share from 1985 to 1999 is more than 1 percentage point.

Source: JIDEA5 database

D. Pulp:

In the *pulp* sector, self-input share has decreased drastically. In this sector the share of input from *wood products* is also decreasing, while those of inputs from *coal and oil, services,* and *transportation and communication* sectors are gaining considerably.

In the 100-sectors classification, *pulp* comprises the *pulp and paper* (17) and *publishing and printing* (18) sectors. The reason for the decrease in share of inputs from *wood products* into *pulp,* is that the input of *timber and wooden products* (15) of the *wood products* sector into *pulp and paper* (17) of the *pulp* sector is decreasing. This may reflect the fact that the used-paper recycling system has developed well and the demand for pulp has decreased. The introduction of non-wood, such as kenaf, paper might also contribute to the decrease.

On the other hand, the increase of the *services* input share into *pulp* can be attributed to increased *research Institutes* (86) input into *pulp and paper* (17). Similarly the increase of *transportation and communication* input share into *pulp* can be attributed to input increase of *road transport* (78) and of *communication* (82) into *publishing and printing* (18). The increase of input share of *coal and oil* into *pulp* reflects the fact that the input of *plastic products* (29) is increasing.

Table 11. The changes of input structure in the *pulp* sector (unit:%)

Pulp	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Wood products	3.9	3.4	3.0	3.0	3.1	3.5	3.3	3.1	2.7	2.7	2.7	2.7	2.7	2.6	2.8
Pulp	53.4	55.0	55.3	54.9	54.8	51.9	51.5	50.7	51.1	51.6	50.3	50.2	50.1	50.0	49.4
Coal and oil	2.7	2.1	2.6	2.5	2.5	3.9	3.7	3.5	3.8	3.6	4.2	4.5	4.4	4.4	4.6
Transport/communication	6.6	8.0	7.7	7.3	7.1	6.1	6.2	6.6	6.5	6.5	7.1	7.4	7.4	7.5	7.7
Services	7.8	8.4	7.3	8.0	8.1	8.7	9.7	11.0	10.1	10.0	8.8	9.3	9.7	9.7	9.0
Intermediate total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Listed are only those sectors whose change of share from 1985 to 1999 is more than 1 percentage point.Source: JIDEA5 database

E. Ceramics:

The *ceramics* sector in the 100-sector classification comprises *glass and glass products* (32), *cement and cement products* (33), *pottery, tiles and earthenware* (34), and *other ceramic, stone and clay products* (35). The share of the diagonal element of the *ceramics* sector also decreased. The share of inputs from the *mining* and the *coal and oil* sectors showed the same trends. The reason for the decrease in the share of the *mining* sector is seen in the decrease of input from *non-metal ores* (7), if we look in detail at the 100-sector classification. In the case of the *coal and oil* sector, the input decrease comes from *petroleum* refinery *products* (27).

These decreases reflect the fact that the efficiency of material utilization has been improving through the introduction of modern manufacturing devices and techniques.

On the other hand, the increase of the share of input ratio from the *services* sectors is outstanding, as are those from *pulp, construction, general machinery* and *iron, steel and non-ferrous metal.*

The sector that has increased most is *services*. This is because the input share from the *research institutes* sector (86) increased from 23% in 1985 to 36% in 1999. This industry seems to be very active in research. According to METI production statistics, production of glass, cement and porcelain, which are the major products of the *ceramics* sector, have been decreasing for a decade.

However, production of fine ceramics is expanding exceptionally. This may lead to a conclusion that the increase of input from the *research Institutes* sector in *ceramics*. can be attributed to the development of new materials and technologies such as fine ceramics.

In this sector, inputs from *chemicals*, and *iron, steel and non-ferrous metal* are also increasing. In the case of the *pulp* sector, the input share increase from the *pulp and paper* (17) into the *glass and glass products* sector (32) can be observed.

Table 12. Changes of input structure in the *ceramics* sector (unit:%)

Ceramics	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Mining	18.1	18.5	17.3	18.0	16.9	17.5	17.2	16.6	16.3	16.6	14.1	14.2	14.7	13.6	13.0
Pulp	2.6	2.6	2.6	2.5	2.5	3.3	3.4	3.5	3.4	3.4	3.7	3.8	3.8	3.8	4.0
Chemicals	3.1	3.0	3.1	3.0	3.1	3.4	3.5	3.7	3.5	3.4	3.8	3.5	3.7	4.0	4.1
Coal and oil	4.6	3.3	4.5	4.3	4.2	3.8	3.8	3.7	4.0	4.0	3.3	3.5	3.7	3.5	3.4
Ceramics	21.9	22.2	21.4	20.9	21.4	19.3	18.4	17.7	18.9	18.5	17.9	17.8	17.3	17.3	16.1
Iron/steel/non-ferrous metal	1.5	1.5	1.9	1.8	1.7	2.4	2.6	2.8	2.7	2.7	2.6	2.5	2.6	2.5	2.6
General machinery	0.9	0.9	0.9	0.9	0.9	1.8	1.7	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.1
Construction	0.7	0.6	0.7	0.7	0.7	2.3	2.4	2.4	2.6	2.8	2.5	2.3	1.9	2.2	2.0
Finance	5.0	5.8	6.9	7.0	7.3	4.5	4.4	4.1	4.0	4.3	5.2	5.7	5.4	5.9	6.0
Services	8.2	6.9	6.2	6.6	6.5	10.2	10.6	11.0	11.0	11.0	12.3	12.8	13.1	14.0	13.6
Other	3.0	3.1	3.0	2.8	2.8	3.4	3.3	3.4	3.4	3.4	0.9	0.9	1.0	1.0	1.0
Intermediate total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Listed are only those sectors whose change of share from 1985 to 1999 is more than 1 percentage point.

Source: JIDEA5 database

Table 13 shows the trends of the raw material consumption index and the unit volume of input in the *manufacturing* sector. The consumption of raw materials, although decreasing in 1992 and 1993, together with the late 1990's, is on the increase. The consumption of processed materials is increasing faster than that of crude materials. This also supports the idea that a structural change of intermediate input usage, from crude materials to processed materials, is proceeding.

The trend in unit volume of input shows that the efficiency of material and energy utilization has been steadily improving.

Table 13. The trend of raw material consumption and unit volume of input

	Raw material consumption				Unit volume of inputs			
	Total	Crude	Processed	Energy	Total	Crude	Processed	Energy
81	85.4	94.2	81.3	93.7	119.9	132.3	114.2	131.6
82	82.3	90.4	78.9	86.5	115.3	126.6	110.5	121.2
83	83.0	90.6	80.2	84.5	112.8	123.1	109.0	114.8
84	89.7	94.0	88.0	88.9	111.3	116.6	109.2	110.3
85	90.6	91.5	89.9	89.8	108.4	109.4	107.5	107.4
86	87.0	88.1	86.2	87.4	104.3	105.6	103.4	104.8
87	88.4	88.2	88.1	87.8	102.4	102.2	102.1	101.7
88	94.9	90.0	96.1	91.9	100.2	95.0	101.5	97.1
89	99.4	93.4	100.9	95.5	99.2	93.2	100.7	95.3
90	104.2	97.6	105.8	99.8	99.9	93.6	101.4	95.7
91	104.9	99.6	106.2	103.1	98.9	93.9	100.1	97.2
92	98.6	97.8	98.8	100.2	99.0	98.2	99.2	100.6
93	94.7	97.7	94.1	97.6	98.7	101.9	98.1	101.8
94	95.8	99.2	95.2	98.1	99.0	102.5	98.3	101.4
95	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
96	101.2	100.2	101.4	101.4	98.9	97.9	99.1	99.1
97	104.4	102.3	104.8	103.9	98.5	96.5	98.9	98.0
98	95.4	95.3	95.3	98.4	96.9	96.8	96.8	99.9
99	96.3	95.2	96.5	95.6	97.0	95.9	97.2	96.3
2000	102.1	98.2	102.9	97.9	97.1	93.3	97.8	93.0
slope	0.91	0.50	1.08	0.75	-1.06	-1.61	-0.82	-1.25

Note: Periods analyzed for slopes: 1985-1999 Index: 1995 = 100

Energy is derived by weighted averages of electricity and heavy oil

Unit volume: (raw material consumption index / industrial production index of manufacturers)×100

Source METI: Annual Report on Industrial Production Index

For your reference, the sectors whose coefficients of intermediate input are diminishing rapidly are shown in Table 14.

Table 14. Sectors whose coefficients of intermediate input are diminishing rapidly (100-sector classification)

	4	10	13	17	19	26	27	32	33	35	36	49	50	53	61	62	63	80	91
	Fore	Food	Text	PuPa	ChFe	ChFn	PetP	Glas	Ceme	OCer	PigI	MaSe	MaHo	ElAp	AirC	OtTr	PreM	TrAi	Info
85	0.375	0.164	0.255	0.319	0.234	0.123	0.055	0.096	0.171	0.071	0.382	0.186	0.164	0.089	0.376	0.287	0.170	0.017	0.050
86	0.366	0.173	0.303	0.323	0.191	0.124	0.052	0.098	0.170	0.068	0.377	0.195	0.156	0.093	0.344	0.290	0.160	0.041	0.096
87	0.373	0.165	0.304	0.325	0.181	0.121	0.044	0.098	0.159	0.065	0.377	0.194	0.127	0.085	0.403	0.291	0.159	0.042	0.109
88	0.323	0.172	0.304	0.322	0.184	0.119	0.038	0.097	0.149	0.073	0.333	0.193	0.148	0.109	0.376	0.282	0.157	0.032	0.132
89	0.336	0.177	0.297	0.318	0.184	0.120	0.036	0.100	0.150	0.078	0.353	0.204	0.140	0.117	0.417	0.284	0.148	0.027	0.162
90	0.342	0.163	0.249	0.311	0.160	0.087	0.019	0.071	0.131	0.066	0.365	0.193	0.145	0.104	0.290	0.252	0.143	0.008	0.020
91	0.330	0.159	0.266	0.290	0.157	0.085	0.018	0.067	0.126	0.063	0.303	0.206	0.141	0.101	0.298	0.251	0.139	0.008	0.032
92	0.314	0.155	0.281	0.268	0.156	0.084	0.016	0.063	0.120	0.061	0.229	0.217	0.137	0.098	0.304	0.251	0.134	0.008	0.042
93	0.324	0.148	0.272	0.255	0.159	0.088	0.016	0.066	0.113	0.063	0.255	0.207	0.126	0.097	0.316	0.269	0.127	0.008	0.035
94	0.343	0.144	0.274	0.257	0.149	0.083	0.016	0.064	0.113	0.061	0.242	0.204	0.121	0.081	0.313	0.250	0.113	0.008	0.039
95	0.237	0.159	0.234	0.303	0.182	0.084	0.023	0.065	0.115	0.059	0.291	0.179	0.112	0.076	0.239	0.248	0.124	0.008	0.026
96	0.237	0.154	0.231	0.288	0.177	0.084	0.045	0.064	0.114	0.056	0.347	0.178	0.111	0.076	0.244	0.220	0.118	0.008	0.026
97	0.179	0.154	0.227	0.281	0.190	0.086	0.017	0.066	0.114	0.055	0.330	0.171	0.110	0.078	0.235	0.220	0.116	0.009	0.023
98	0.218	0.151	0.219	0.279	0.173	0.085	0.023	0.062	0.112	0.053	0.347	0.171	0.100	0.066	0.207	0.225	0.106	0.008	0.026
99	0.224	0.153	0.221	0.276	0.152	0.078	0.023	0.043	0.106	0.047	0.350	0.163	0.082	0.068	0.212	0.212	0.117	0.008	0.028
slope	-0.013	-0.002	-0.006	-0.004	-0.002	-0.003	-0.002	-0.004	-0.005	-0.002	-0.004	-0.002	-0.005	-0.002	-0.014	-0.006	-0.004	-0.002	-0.006

Note: Listed are only sectors whose slopes are below -0.002 during the period analyzed.

Periods analyzed for slopes: 1985-1999

Source: JIDEA5 database

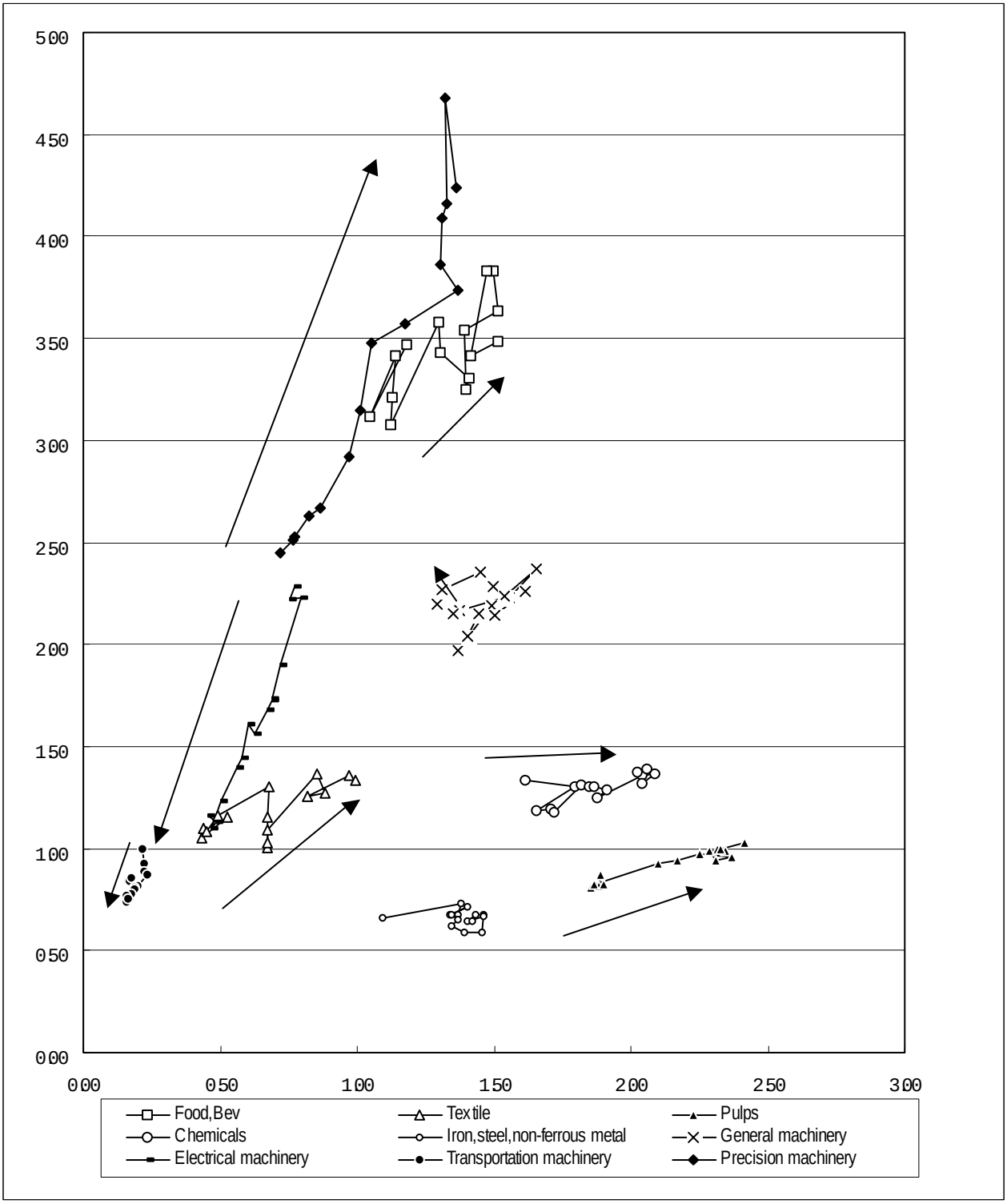
3-4. Two opposite trends: diversification and concentration

Next, I will bring the changing intermediate output structure into consideration.

Charts 3 and 4 show the relationship between the ratio of the diagonal element and the intermediate input (output) excluding the diagonal elements for the 14 manufacturing sectors in the 25-sector definition.

The ratios derived from the Input side are expressed at vertical axes, and from Output at horizontal. The arrow shows the changing directions from 1985 to 1999.

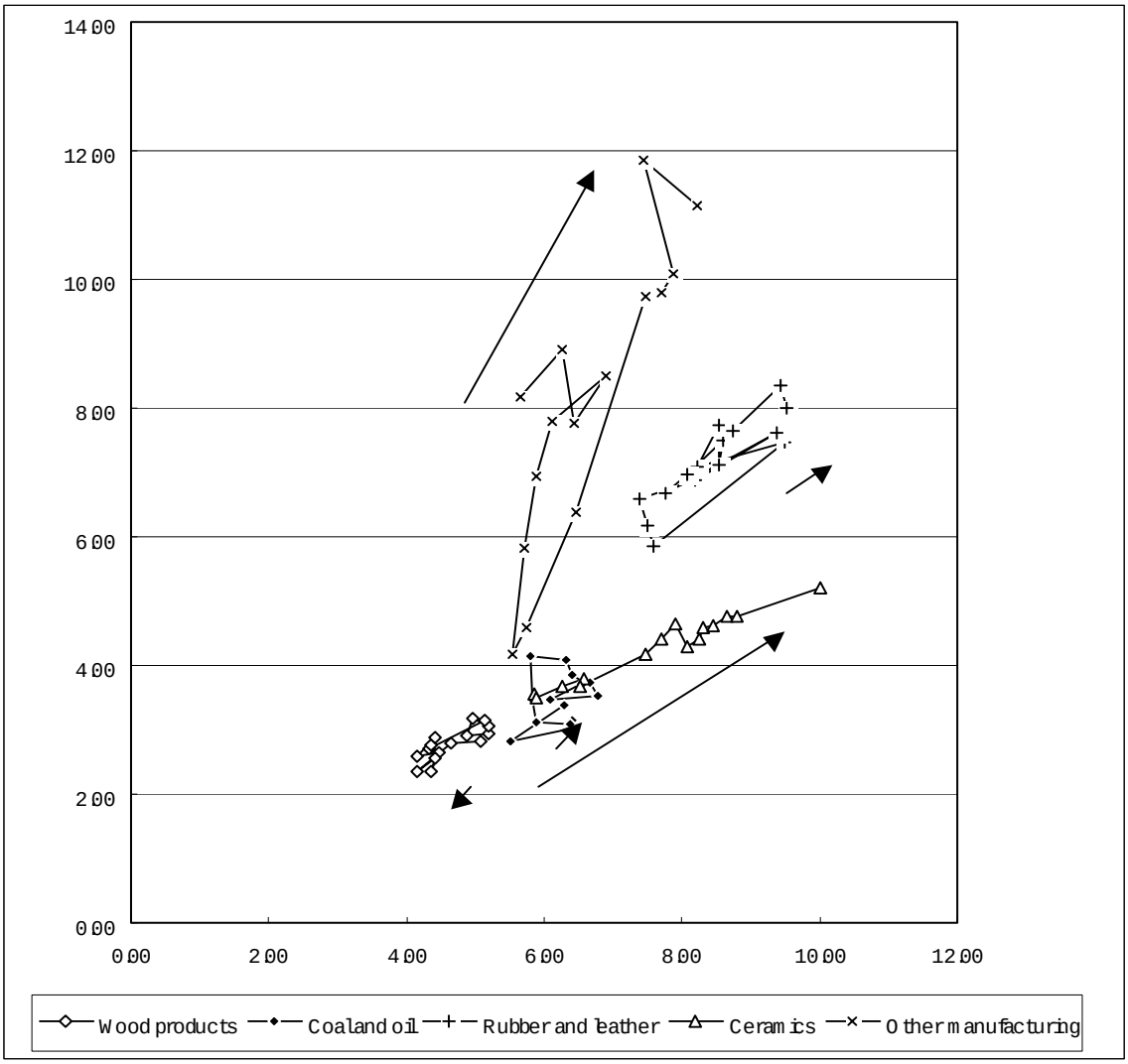
Chart 3. Transitions of the ratio of self-input and the rest by industry: Part 1


500
450
400
350
300
250
200
150
100
050
000
000
050
100
150
200
250
300
Food,Bev
Textile
Pulps
Chemicals
Iron,steel,non-ferrous metal
General machinery
Electrical machinery
Transportation machinery
Precision machinery

Note: Ratio = (coefficient of intermediate total-diagonal element): diagonal element

Source: JIDEA 5 database

Chart 4. Transitions of the ratio of self-input and the rest by industry: Part 2



Source: JIDEA 5 database

Direction of arrows	Sectors
Increasing to upper right	precision machinery, ceramics, pulp, textiles
Decreasing to lower left	electrical machinery, transportation machinery

From the charts, we can conclude that Japanese intermediate input and output structures in the manufacturing sectors are changing in two directions: one is toward diversification and the other toward concentration.

Almost all of the sectors derived using this method coincide with those studied in 3-2, and 3-3.

4. Conclusion

Japanese manufacturing sectors are decreasing in influence over the whole economy when we consider them in terms of production value alone. However, in their intermediate input structure, two contradictory movements are observed.

One of these movements is within sectors moving strongly towards globalization by increasing their ratio of use of imported semi-finished products from within the same industry; the other movement is among those expanding their input sources, not only in manufacturing but also in services.

On the whole, the impact of the former will probably overwhelm that of the latter.

But we should pay attention to the fact that the manufacturing sector also contributes to output expansion in the service sector.

This leads to the conclusion that contraction in production in the manufacturing sector does not necessarily indicate a decline in industry.

In Japan, a source of worry since the late 1980's has been the increase in unemployment due to overseas relocation of Japanese production sites. The above conclusion will give us another viewpoint from which to study the hollowing of industry and its effects on employment.

Appendix Industrial Classification Table

100 sectors			25 sectors			
1	Agriculture for crops	AgCr	Agriculture, forestry, fisheries	AgFoFi	1	Primary
2	Livestock raising and sericulture	AgLi				
3	Agricultural services	AgSe				
4	Forestry and logging	Fore				
5	Fishery	Fish				
6	Metal ores	MetO	Mining	Mining	2	Secondary
7	Non-metal ores	NonM				
8	Coal and lignite	Coal				
9	Crude petroleum and gas	PetG				
10	Food products	Food	Food and beverages	FoodBe	3	
11	Beverages and tobacco	Bevs				
12	Feeds and organic fertilizers	FFer				
13	Fabricated textile products	Text	Textiles	Textil	4	
14	Clothing and other textile products	Clot				
15	Timber and wooden products	Wood	Wood products	WoodPr	5	
16	Wooden and metal furniture, fittings	Furn				
17	Pulp and paper	PuPa	Pulp	Pulp	6	
18	Publishing and printing	Prin				
19	Chemical fertilizer	ChFe	Chemicals	Chemic	7	
20	Inorganic basic chemicals	ChBa				
21	Petrochemical basic products	ChPe				
22	Organic chemical products	ChOr				
23	Synthetic resin	ChRe				
24	Chemical fibers	ChFb				
25	Medicaments	Medi				
26	Final chemical products	ChFn				
27	Petroleum refinery products	PetP	Coal and oil	CoaOil	8	
28	Coal products	CoaP				
29	Plastic products	PlaP				
30	Rubber products	RubP	Rubber and leather	RubLea	9	
31	Leather and fur products	Lfur				
32	Glass and glass products	Glas	Ceramics	Cerami	10	
33	Cement and cement products	Ceme				
34	Pottery, tiles and earthenware	Pott				
35	Other ceramic, stone and clay products	OCer				
36	Pig iron and crude steel	PigI	Iron, steel and non-ferrous metal	ISNMet	11	
37	Steel bar and sheet	Stel				
38	Steel castings and forging	Cast				
39	Non-ferrous metal refinery products	NonF				
40	Processed non-ferrous metal products	PrNF				
41	Metal products for construction	MeCo				
42	Heating equipment	HeEq	General machinery	GenMac	12	
43	Other metal products	MeOt				
44	General machinery	MaGe				
45	Machine tools and robots	MaTo				
46	Special industrial machinery	MaSp				
47	Other general machines and tools	MaOt				
48	Office and vending machines	MaOf				
49	Service machinery	MaSe				

100 sectors			25 sectors			
50	Household electric and electronic equipment	MaHo	Electrical machinery	EleMac	13	Secondary
51	Electronic computing equipment/accessories/devices	Comp				
52	Communication equipment	ComE				
53	Electronic appliances & measuring equipment	ElAp				
54	Semi-conductor devices and integrated circuits	IC				
55	Electronics parts	ElPa				
56	Heavy electrical equipment, generators, motors, etc.	HeEl				
57	Electric lights, batteries and light electric appliances	LiEl				
99	Office supplies	OfSu				
58	Motor vehicles	MVeh	Transportation machinery	TraMac	14	
59	Shipbuilding and repair	Ship				
60	Railway equipment	Rail				
61	Aircraft manufacture and repair	AirC				
62	Other transportation equipment	OtTr				
63	Precision instruments, medical instruments, etc.	PreM	Precision	PreMac	15	
64	Miscellaneous manufacturing products	ManM	Other	OtManu	16	
65	Dwelling construction	DwCo	Construction	Constr	17	
66	Other construction	OtCo				
67	Civil engineering public	CEPu				
68	Civil engineering private	CEPr				
69	Electric power	Elec	Electricity, gas and water	Utilit	18	Tertiary
70	Gas and hot water supply	CGas				
71	Water supply	Watr				
72	Waste treatment	Wast				
73	Trade	Trad	Commerce	Commer	19	
74	Financial and insurance services	FiIn	Finance	Financ	20	
75	Real estate and rental agencies	ReEs	Real estate	RealEs	21	
76	House rents	HoRe				
77	Railway transport	TrRa	Transport and communication	TraCom	22	
78	Road transport	TrRo				
79	Water transport	TrWa				
80	Air transport	TrAi				
81	Transport-related service and storage	TrSe				
82	Communication	Coms				
83	Broadcasting	BrCa				
84	Public administration	Govt	Services	Servic	23	
85	Education	Educ				
86	Research institutes	Rese				
87	Medical services, health and social security	Hosp				
88	Social security services	SoSe				
89	Other public services	OPub				
90	Advertising agencies	Adve				
91	News and information services	Info				
92	Renting and leasing	ReLe				
93	Car and other machinery repair	Repa				
94	Business services	Busi				
98	Personal services, washing, hairdressing, etc.	Pers				
95	Amusement services, films, theater, sports	Amus	Hotel, restaurants, entertainment	HoReEn	24	
96	Hotels	Hote				
97	Restaurants	Rest				
100	Not elsewhere classified	NEC	Other	Other	25	