CARBON DIOXIDE EMISSION PATTERNS IN LINKAGE OF INDUSTRIES WITH INVOLVEMENT OF CONSUMERS' EXPENDITURE

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ABSTRACT: Carbon dioxide emission patterns in 1960-90 were examined in terms of industrial linkages and repercussions with involvement of households. The objective of this study is to clarify direct and indirect carbon dioxide emission patterns with internalization of households, and to discuss about the embodied emission patterns due to export and other final demand corresponding to the phase of rapid industrialization in Japan. The results are as follows: a) increased contribution of households to the emission was recognized in 1970-90 both through induced consumption and income repercussions, b) the trend of coefficients in the extended Leontief inverse matrix weighted by direct emission intensities of carbon dioxide showed patterns that the household sector had been likely to receive repercussion of the emission with reflection of post industrialization, c) the share of households in embodied carbon dioxide due to exports, especially of automobiles and household electric appliances, has rapidly increased following the phase of economic growth.

Keywords: Carbon dioxide, Internalization of household, Income repercussion, I-O analysis

1. INTRODUCTION AND OBJECTIVES

Corresponding to economic growth especially in industrialized countries, households have given greater contribution to carbon dioxide emission both directly and indirectly. Recent papers on I-O analysis related to carbon dioxide emission patterns deal with the household sector as one of final demands. In the approach, known as '*open model*', consumers' expenditure is determined independently of the intermediate industrial sector and rather dominated mainly by its own attribute such as household component, age, life styles, etc.. However, consumers' expenditure has more relevant relationship with industrial sectors comparing to other final demand sectors. Therefore, in this study we attempt to analyze carbon dioxide emission patterns by consumers from the view point of industrial linkage with involvement of households, i.e. income and consumption, regarded as if an industrial sector.

This approach is called '*closed model*', and is often applied for some economic analyses, for example, a projection of economic effect through income repercussion due to independent investment such as a projection for a civil infrastructure[1]. This model imputes direct and indirect carbon dioxide emissions released due to production of goods and services for the other final demands except for households. Therefore, by applying this approach for environmental issues, we would have relevant information to re-interpret consumers' involvement corresponding to the phase of economic growth, especially the involvement in exportation. Moreover, such a Japan's experience would give a perspective for rapidly developing major Asian industrial countries such as NIEs.

The major objectives of this study are, first, to analyze how carbon dioxide emission intensities of households have changed with industrial linkages for the past 30 years, second, to clarify the structure of carbon dioxide emission through income repercussions and induced consumption, and third, to evaluate emission patterns due to export corresponding to the rapid economic growth and consequent change of industrial structure, called as '*wild goose flying*' and '*products cycle*'[2].

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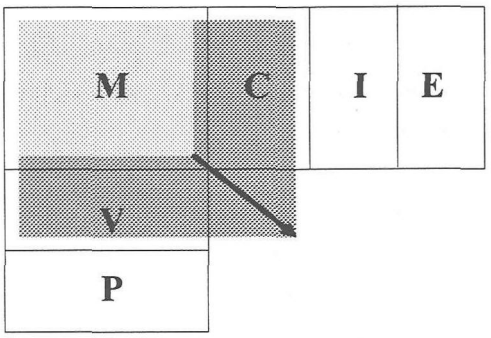
2. METHODOLOGY

2.1 Extended I-O model

Normal equation of industrial input - output is:

$$AX + F = X \text{ or } X = (I - A)^{-1} F \qquad (1)$$

Where, A is a matrix of input coefficient, X is a vector of gross domestic output, F is a vector of final demand.



Where, M is intermmediate demand, V is income / value added, P is profit, C is concumers' expenditure, I is investment, E is Export

Fig. 1 Concept of I-O table with involvement of household

In an extended input-output flow matrix with involvement of households, vectors of the household consumption and income are added as follows (See Fig.1):

$$\begin{pmatrix} A & C \\ V & O \end{pmatrix}\begin{pmatrix} X \\ Y \end{pmatrix} + \begin{pmatrix} F_X \\ F_Y \end{pmatrix} = \begin{pmatrix} X \\ Y \end{pmatrix} \qquad (2)$$

Where, C is a vector of consumption per unit of household income, V is a vector of household income per unit of gross domestic output, F_X is a vector of other final demand, F_Y is external household income, Y is total household income.

As for the extended matrix A_{ex} of input coefficients at the above equation (2), the right column and the bottom row vector of the extended Leontief inverse matrix $(I-A_{ex})^{-1}$, hereinafter the inverse matrix is referred to as B_{ex}, gives ultimate consumption and income repercussion respectively. Moreover diagonal matrix D of the direct carbon dioxide emission intensity, where fossil fuel consumption per unit of gross domestic output and the fuel consumption per unit of income is defined as a direct intensity for the industrial sector and the household sector respectively, multiplied by the extended inverse matrix $(I-A_{ex})^{-1}$ gives embodied carbon dioxide emission intensity matrix T, i.e. direct and indirect emission induced through household and industrial linkage due to a unit of external final demand as follows.

In the equation $T = D\,(I-A_{ex})^{-1}$ with matrix notation,

$$T = \begin{pmatrix} t_{11} & t_{1n} \\ t_{n1} & t_{nn} \end{pmatrix}, \quad D = \begin{pmatrix} d_1 & O \\ O & d_n \end{pmatrix}, \quad B_{ex} = \left(\begin{array}{c|c} I - A & -C \\ \hline -V & 1 \end{array}\right)^{-1} \qquad (3)$$

and embodied carbon dioxide emission intensity T_j for industry j is given by $\sum_{i=1}^{n} t_{ij}$

Also, the extended inverse matrix B_{ex} can be expressed by using $K = (I-VBC)^{-1}$, so called income repercussion multiplier, as follows[3]:

$$B_{ex} = \left(\begin{array}{c|c} I - A & -C \\ \hline -V & 1 \end{array}\right)^{-1} = \left(\begin{array}{c|c} B(I+CKVB) & BCK \\ \hline KVB & K \end{array}\right), \text{ Where } B = (I-A)^{-1} \qquad (4)$$

Here, external final demand F_x induces output of BF_x and $B(CKVB)F_x$ through industrial transactions except households and through induced final consumption of households due to distributed income respectively. Likewise, F_x also induces household income of $KVBF_x$. Consequently elements of the matrix D multiplied by B_{ex} are aggregated into three categories of embodied CO_2 emission intensity, i.e. i) the direct CO_2 emission intensity through income

repercussions, ii) the embodied CO_2 emission intensity through induced consumption, and iii) the direct and embodied CO_2 emission intensity through industrial transaction except household (normal embodied emission intensity). Therefore these three indicators would clarify the interdependence in CO_2 emission patterns between industrial sectors and households especially due to the external final demand such as exports.

2.2 Analytical methodology

Fig. 2 shows methodological flow of the analysis. Detailed measurement is mentioned as follows:

(1) I-O table

Each Japan I-O table[4] for 1960 (159 sectors), 1970 (158 sectors), 1980 (179 sectors) and 1990 (179 sectors) was aggregated into a 112 common sectors table. As inflators are estimated in Joint I-O tables since 1960 respectively, these were applied to convert transaction values at current price to at 1990 constant price in each I-O table. Since no inflator of value added is estimated in joint I-O tables, average inflators were calculated by portion of the difference between intermediate input and gross output both at constant price to gross value added at current price for each I-O sector.

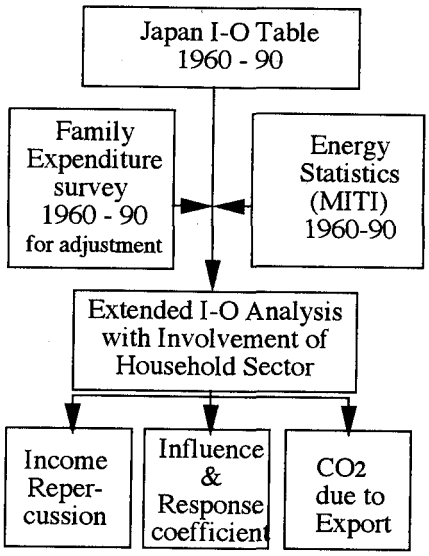


Fig.2 Flow of the analysis

(2) Extended input coefficient

The vector of consumers' consumption in final demand was used as the column sector of household. As for the row household sector, the vector of wages and salaries was applied with modification accompanied by imputation, specifically for house renting. The imputed price of owner-occupied dwelling is treated as operating surplus of house rent sector. Therefore as adjustment for imputation for the row sector of households, amount of the imputed price of owner-occupied dwellings is estimated by using Family Expenditure Survey[5] . In detail, the imputed price was estimated as the expenditure for 'house and land rents' and also payments of debts for 'house and land' multiplied by the number of ordinary households, and transferred to the row sector of wages and salaries.

(3)Energy consumption

Fossil fuel for all sectors, and limestone consumption in cement and steel industry are defined as the emission source of carbon dioxide in this analysis. Data of the physical amount table, so called 'Butsuryo' table in I-O tables were applied for major fuels and limestone. Concerning other fuels, data of Energy Balance Table[6], so called 'Sogo' Energy Statistics, by Agency of Natural Resources and Energy (ANRE) was distributed in a proportion of input from the sector of natural gas, petroleum products and coal products to each energy demand sector. Major adjustments in order to avoid double counting of by-product and non-energy use are as follows:

1) Deduction of oven & gas coke transferred to coke ovens gas & blast furnaces gas from total cokes.

2) Deduction of feedstocks from total consumption in Chemical and Petrochemical sector.

3) Deduction of naphtha and LPG as raw materials in chemical industry sectors (20 % for fuel consumption)[7]

(4)Inverse matrix

Here $[I-A]^{-1}$ type Leontief inverse matrix was applied to calculate the estimate of carbon dioxide emission related to imported goods, with assumption that imported goods are made in the same industrial structure as domestic

products, as generally introduced in recent papers.[8)]

3. RESULT OF THE ANALYSIS

3.1 Trend of embodied CO_2 emission intensity

Embodied carbon dioxide emission intensity with involvement of household sector is shown in Fig.3 (with aggregation of 37 sectors, detailed intensities of 112 sectors in 1990 are shown in appendix). Here, the intensity means the embodied CO_2 emission per unit of other external final demand such as export, fixed capital formation, etc.. Therefore this intensity imputes CO_2 emission from the domestic household to the countries which import from Japan in some sense. Also the intensity was divided into three categories, mentioned at chapter 2.1, to clarify contribution of household.

While export played an important role in high economic growth period, content of exported goods has changed drastically for the past 30 years corresponding to the phase of economic growth. By involving consumers' expenditure into industrial linkage, trend of the embodied emission intensity caused by household would be re-interpreted from the producer's view point. Japan, up to 1960s, is said to trace a typical locus as the late industrial country known as '*Ganko*' or '*wild goose flying*'. Then Japan has become a member of developed industrial countries which are also said to follow '*product cycle*', proposed by R. Vernon et al. (See. Fig.4)[2)].

Each phase of the economic growth in the figure nearly corresponds to the ration of gross domestic output to total domestic demand[2)]. Fig.5 shows the proportion in Japan for the year 1955-1985, where data is obtained from I-O tables and is converted to the average value in 10 year time series. The locus of major products with bold line indicates that goods for final demand is imported first, then produced domestically and consequently exported. Returning to Fig.3, material and machinery sectors shows high intensities in 1960 compared to 1970-90 corresponding to the phase of economic growth. In particular, conspicuous contribution of household is shown in the sector of household electric appliances, which expanded exportation rapidly in 1960, both through direct CO_2 emission due to fuel consumption through income repercussions and embodied CO_2 emission through induced consumption of goods and services. Reflecting the comparatively low income, household itself has a higher intensity of 20tC/M¥ (at 1990 price), compared to the average intensity in other industries of 3.4tC/M¥.

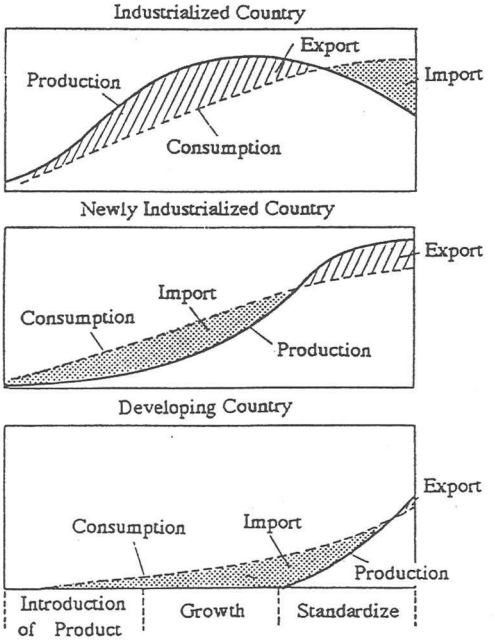


Fig.4 Illustration of product cycle

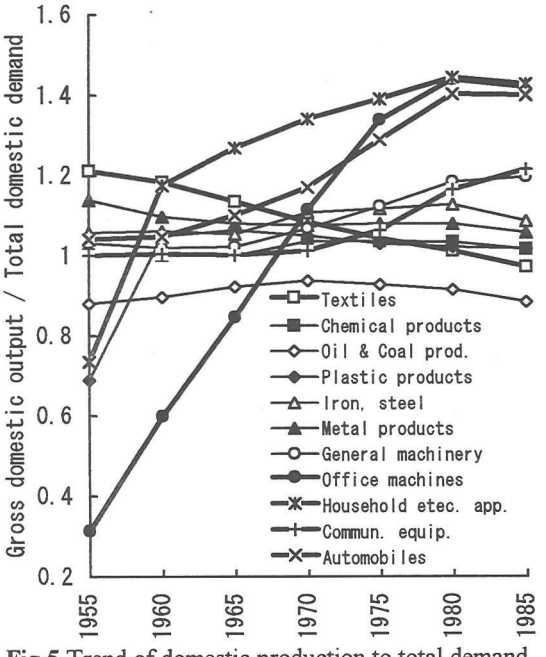


Fig.5 Trend of domestic production to total demand

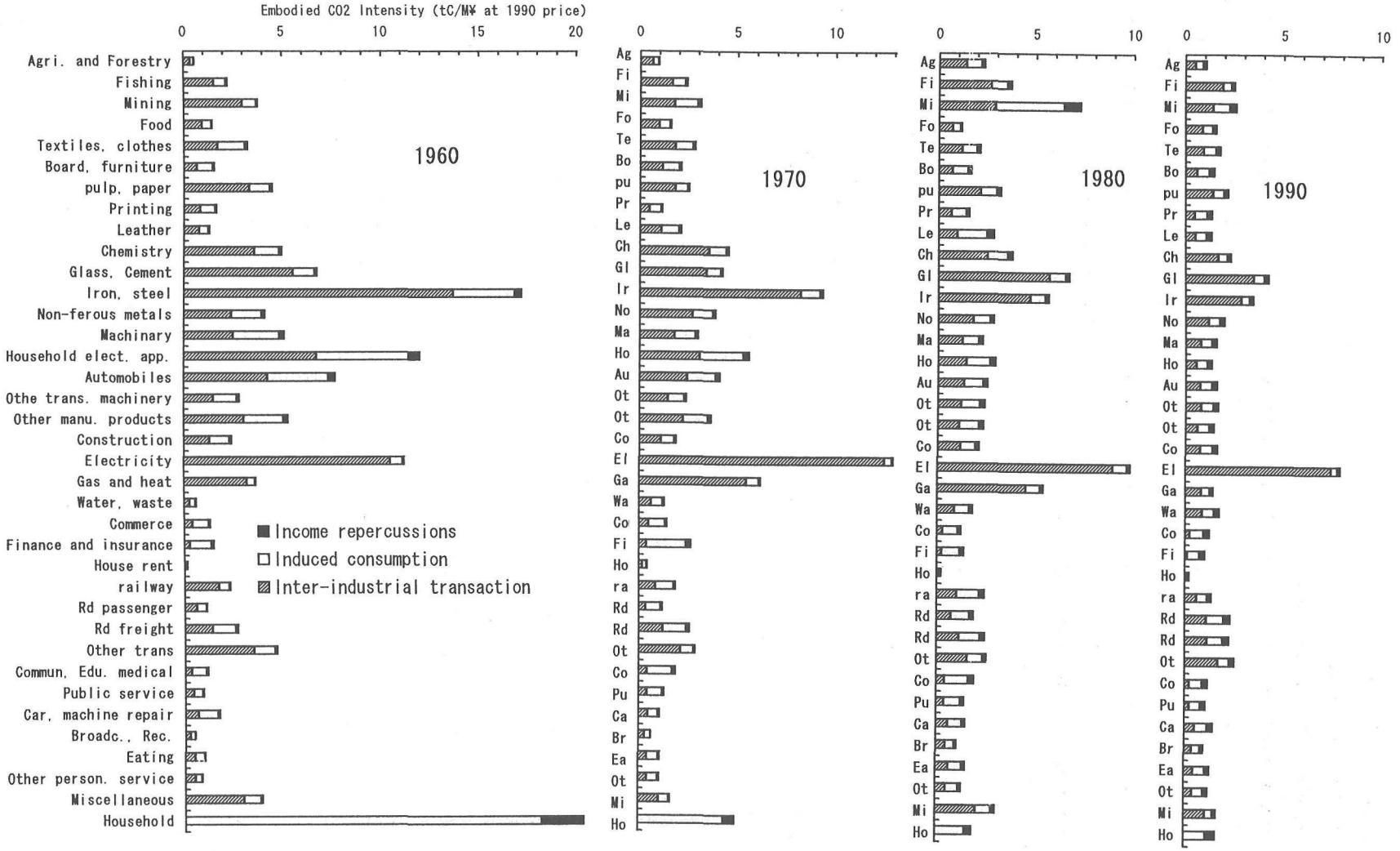


Fig.3 Direct and indirect CO_2 emission intensity with involvement of households

Although intensity itself has been decreasing, its tendency of response to inducement by other industries has been increasing as will be mentioned later.

Fig.6 shows the average carbon dioxide emission intensity in industry sectors except households. The figure indicates how much carbon dioxide emission was induced per unit of average external final demand. Contribution of household (direct CO_2 emission through income repercussions and embodied CO_2 emission through induced

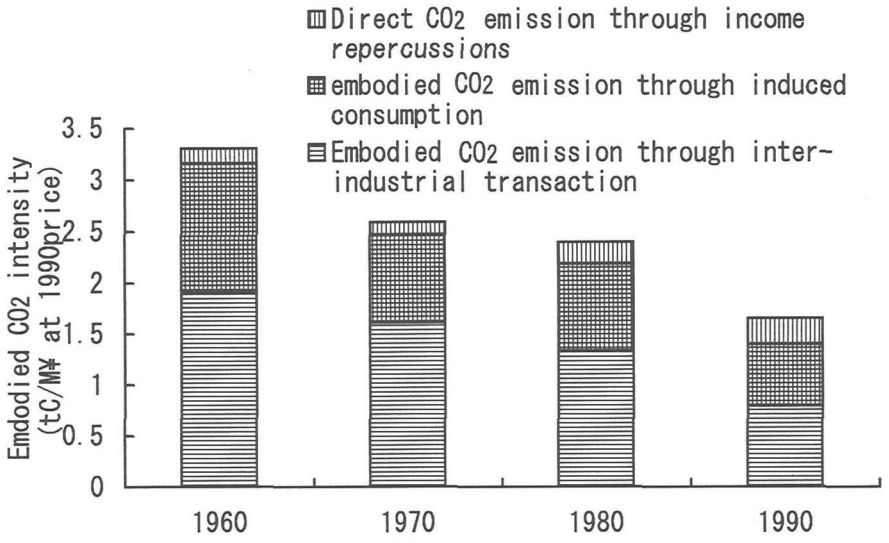


Fig.6 Trend of CO_2 emission intensity of household sector through income repercussions

consumption) has increased from 42% in 1960 to 51 % in 1990 although level of the intensity itself has decreased. In particular, direct CO2 emission due to income repercussions has remarkably increased. This would reflect increasing ratio of value added in the process of post industrialization and change of the lifestyle such as mobilization. The relationship between mobilization and export of automobiles will be discussed afterwards.

3.2 Patterns of CO_2 emission coefficient in households sector

To examine each sector's contribution to inter-industrial repercussions of carbon dioxide emission, especially for the household sector, both response and influence coefficients are calculated for each sector using the following equations respectively:

$$R_i = \left(\sum_{j=1}^{n} T_{ij}\right) / \left(\sum_{k=1}^{n}\sum_{j=1}^{n} T_{kj} /n\right) \qquad I_j = \left(\sum_{i=1}^{n} T_{ij}\right) / \left(\sum_{k=1}^{n}\sum_{i=1}^{n} T_{ik} /n\right) \qquad (5)$$

Where, Matrix T is the diagonal matrix of embodied CO_2 emission intensities denoted in Equation (3), R is a vector of Response coefficients, and I is a vector of Influence coefficients for industrial sector i.

Fig. 7 shows the trend of response and influence coefficients in 1960-90. Response and influence coefficient indicate how each sector passively and positively receives or gives repercussions of embodied carbon dioxide emission with comparison to the average value of 1 for all sectors. In contrast with greater influence in material sectors such as iron and cement, the household sector has become responsive with a rise in response coefficient from 1.7 in 1960-70 to 4.8 in 1990. Usually intermediate transaction is likely to decrease in the process of post industrialization. Although such a change of industrial structure makes the scale of response and influence coefficients small, household sector gives a locus reflecting value added economy instead. In addition recent movement of restructuring and consequent

change of wage structure would give different component of the response and influence coefficients.

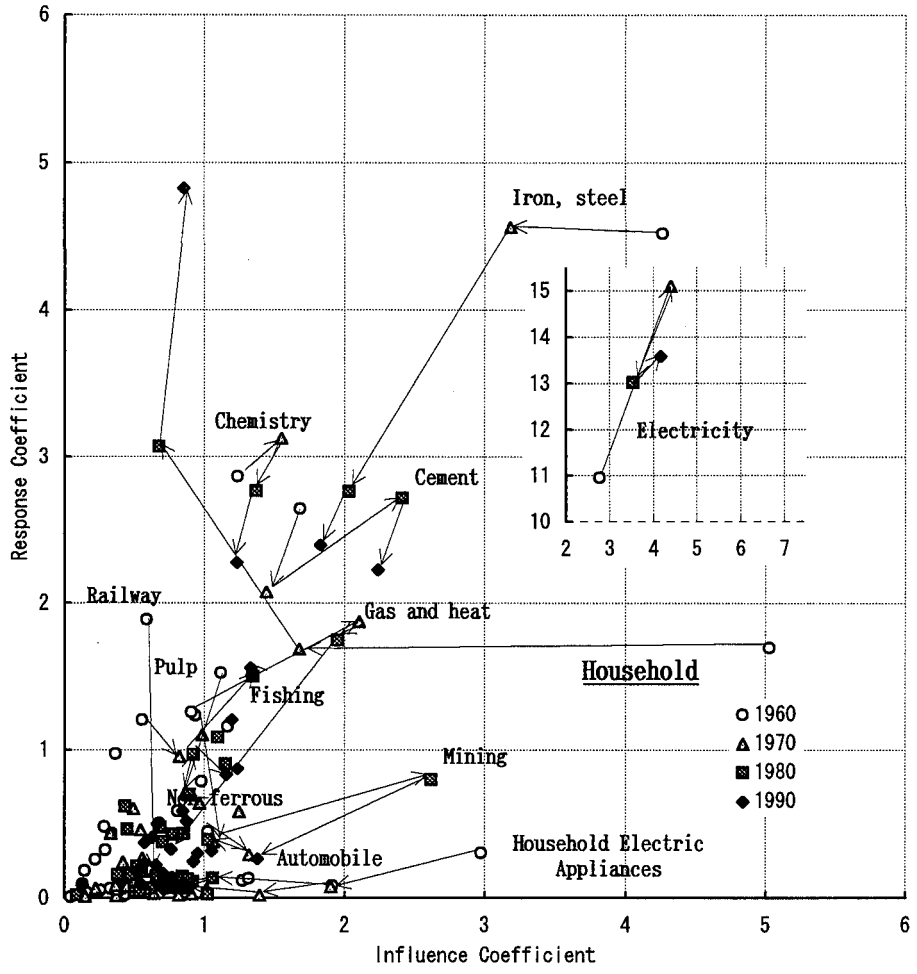


Fig.7 Trend of influence and response coefficients in 1960-90

3.3 Contribution of households to export

(1) Share by inducing sectors and households' contribution in the inducement

As production of extended intermediate sectors is induced by other external final demand, here we attempt to clarify households' yearly contribution patterns to export both through input of labor force and through consumption due to circulation of household income. The share of carbon dioxide emission induced due to export by the inducing sectors is shown in Fig.8 and the share of each category of the repercussion in Fig. 9. While drastic increase of carbon dioxide emission since 1970, Fig. 8 obviously shows a change in the components of the embodied carbon dioxide corresponding to the stage of economic growth. Proportion of automobile and household electric appliances in 1990 to 1960 has considerably increased up to 29 and 17 times respectively comparing to 0.39 of textiles sector (1990/1960). Also each share by automobile and household electric appliances in total amount has increased from 2% and 3% in 1960 to 15% and 13% in 1990 respectively. Fig. 9 shows households' contribution in total amount. While share by consumption except fuel through income circulation has almost the same share of 30%, share by direct fuel consumption through input of labor force has increased from 4% in 1960 to 13% in 1990. Consequently total

contribution of household has increased up to 1.3 times in 1990 to 1960.

Although direct fuel consumption by households is already considered in extended coefficient matrix, for reference, total amount of petrol and diesel oil consumption and its increasing ratio were examined using energy consumption data of I-O physical amount table and ANRE data mentioned previously. Nearly 16MtC of CO_2 due to fuel consumption of automobile in 1990 is more than embodied CO_2 due to export of automobiles including households' contribution. Moreover fuel consumption due to driving in 1990 is 37 times as much as in 1960. This increasing ratio is considerably high comparing to 5.5 times (1990/1960) of other domestic fuel consumption and steeper than that of export mentioned above.

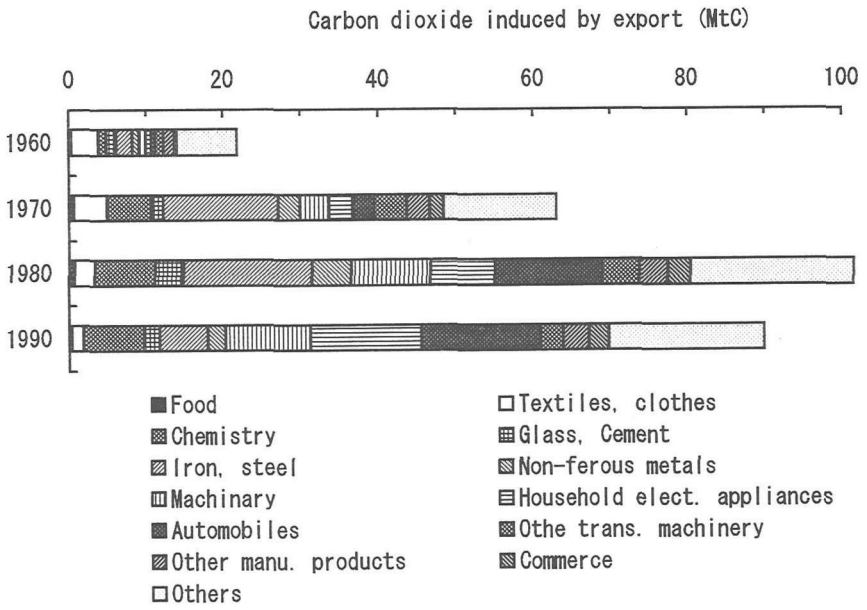


Fig.8 Share of embodied CO_2 emission due to export by inducing sectors

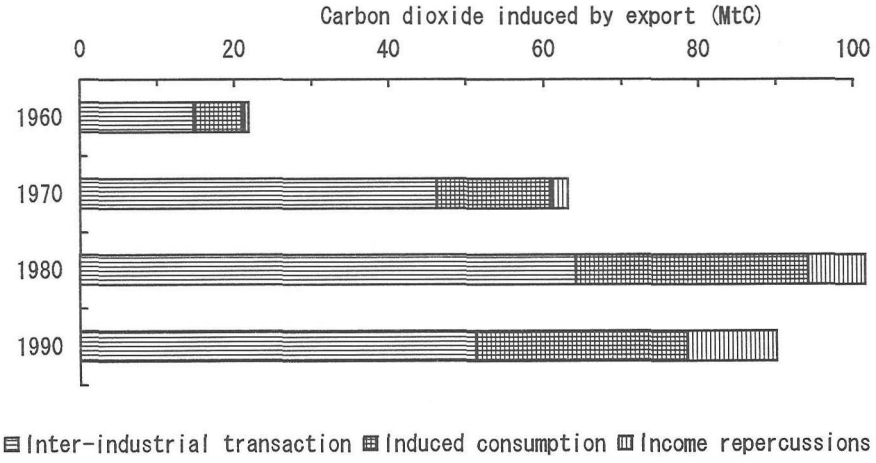


Fig. 9 Share of embodied CO_2 emission due to export by type of inducement

(2)Households' contribution to embodied CO_2 due to export for each sector

Fig. 10 and Fig. 11 show households' contribution to embodied CO_2 due to export for each sector, which is the detailed share of the emission in Fig.9. The horizontal axis shows the amount of contribution and vertical the share by household sector, i.e. income circulation and labor force respectively in each sector's total emission. Fig.10 indicates sectors of household electric appliances and automobiles dominates total contribution through induced consumption both by share and amount. The share of nearly 40% is stable from 1960 to 1990. This might imply that increasing consumption ratio has offset the labor-saving effects. Contribution by the two sectors amount to 11.6 MtC in 1990 corresponding to increase of the exported goods.

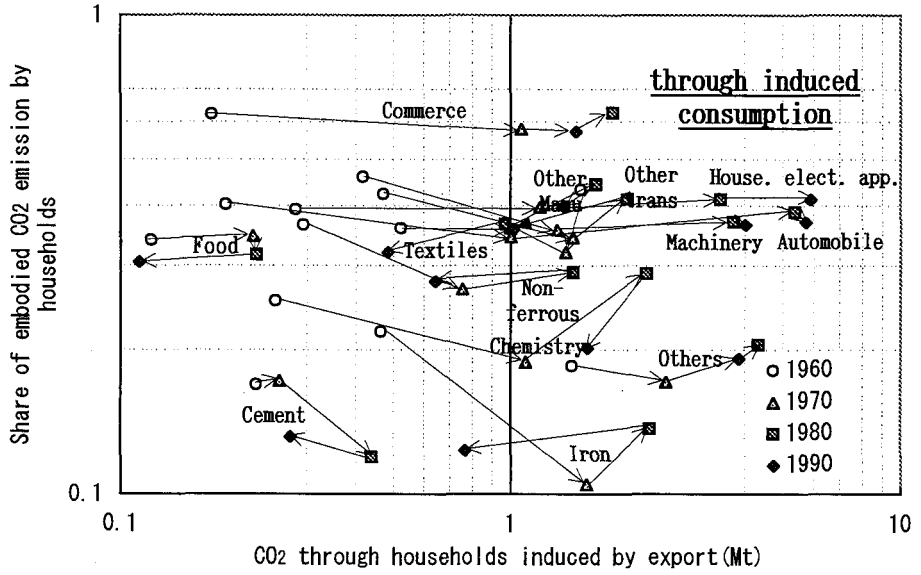


Fig.10 Share and amount of CO_2 emission due to export through induced consumption

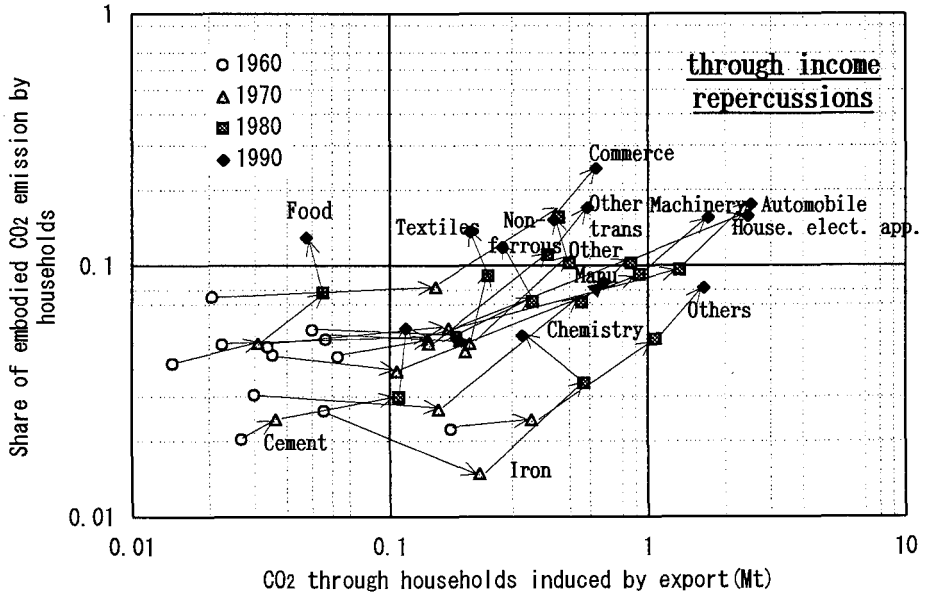


Fig.11 Share and amount of CO_2 emission due to export through income repercussions

In Fig.11, every sector shows yearly increasing share by households and this figure also indicates increasing contribution in the above automobiles and household electric appliances. Although there remains a room for further improvement in imputation of all fuel consumption to household's direct intensity, there is no doubt on the relationship between production sectors and households including qualitative repercussions such as mobilization as mentioned before.

4. CONCLUSIONS

Extended I-O analysis with involvement of households into industrial linkages was applied for the year 1960 to 1990, corresponding to the phase of economic growth in Japan. Result revealed that while increased ratio of contribution to CO_2 emission by households has been dominated by direct CO_2 emission due to fuel consumption through income repercussions corresponding to the increase of value added in post industrialization, share of the contribution by household has steadily increased rather by induced consumption as a reflection of households' shift to a responsive sector. Detailed results are as follows:

1)Embodied carbon dioxide intensity in household sector was about 20tC/M¥ at 1990 real price in 1960, 5.8 times as high as the average intensity for all industry sectors, reflecting the comparatively lower level of income.

2)Trend of CO_2 emission intensity by type of repercussions showed that contribution of households both through income repercussions and induced consumption has increased from 42% in 1960 to 51% in 1990 while total level of the intensity itself has decreased. Such a tendency would be recognized in the highly growing stage of NIEs.

3) In contrast with greater influence in material sectors such as iron and cement, the household sector become responsive with a rise in response coefficient from 1.7 in 1960-70 to 4.8 in 1990. Although a change of industrial structure in the process of post industrialization makes response and influence coefficients small, household sector gives a locus of high response reflecting value added economy instead.

4)Shares of carbon dioxide emission due to export by automobile and household electric appliances sector have increased up to 15% and 13% of total emission (90MtC) in 1990. On the other hand, direct fuel consumption by use of automobile increased up to 16MtC slight rapidly than total emission by exports of automobiles. This would include the effect by qualitative repercussions such as mobilization.

5)The household sector's contribution to export has increased both by share and amount through income repercussions, and has increased by amount through induced consumption. It is of note the sectors of automobiles and household electric appliances are increasing rather geometrically.

REFERENCES

1) Kansai Economic Research Center; Economic Effects due to Kansai Int'l Airport Project, 1994

2) A series of waves of imported, domestically produced , and exported products are recognized particularly in late developed industrial countries, and Akamatsu called this periodical developing process as '*Wild goose flying*'. R. Vernon proposed '*products cycle*' hypothesis of similar concept as *Wild goose flying* , where enterprise's direct investment follows to export.

3) K Miyazawa: Input-Output Analysis of Economic Structure, Toyo Keizai Shinposha, pp.1-242,1963

4) Management and Coordination Agency; Input-Output tables, National Federation of Statistical Associations

5) Management and Coordination Agency; Annual Report on the Family Income and Expenditure Survey

6) Agency of Natural Resources and Energy; General Energy Statistics

7) Y Moriguchi et al. ; Estimation of CO_2 Emission in Japan by Sector and by Origin, Energy and Resources, Vol.14, pp.32-41, 1993

8) Y kondo et al. ; Analysis of the trend of Carbon Dioxide Emission Patterns due to Consumers' Expenditure, Proceedings of the 11th Energy system and Economics Conference, pp.235-240,1995

Appendix : Cardon Dioxide emission intensity with involvment of household sector (113sectors, 1990)

(tC / ¥M at 1990 price)

37sectors	113sectors	Ind.	Con.	Inc.	Emb.
Agriculture	Cereals and potatoes	0.45	0.18	0.08	0.71
	Vegetables	0.29	0.19	0.08	0.55
	Fruits	0.27	0.19	0.08	0.54
	Other crops	0.51	0.23	0.10	0.84
	Livestock	0.55	0.37	0.16	1.07
	sericulture	0.36	0.24	0.10	0.70
	Other agri. services	0.84	0.59	0.25	1.68
	Forestry	0.61	0.60	0.26	1.47
	Logging	0.66	0.69	0.29	1.64
Fishing	Marine fisheries	1.93	0.44	0.19	2.56
	Inland water fish.	1.48	0.36	0.15	1.99
Mining	Iron and ore mining	1.87	0.71	0.30	2.88
	Non-fer. metal ores	0.90	0.66	0.28	1.85
	Coal mining	1.01	0.74	0.31	2.06
	Crude petroleum	0.59	0.51	0.22	1.32
	Natural gas	0.63	0.35	0.15	1.14
	Gravel and quarry	0.56	0.48	0.21	1.25
	Other non-mineral ores	0.93	0.67	0.29	1.89
Food	Slaughtering and meat processin	0.56	0.40	0.17	1.14
	Farm products	0.75	0.49	0.21	1.45
	Farm preservation foods	0.59	0.47	0.20	1.26
	Processed seafoods	1.12	0.48	0.21	1.81
	Grain milling	0.55	0.29	0.12	0.96
	Noodle, bread and confectionery	0.61	0.55	0.23	1.39
	Other foods	0.80	0.55	0.23	1.57
	Alcohol	0.47	0.26	0.11	0.83
	Other liquor	0.72	0.48	0.21	1.41
	Feeds	0.75	0.45	0.19	1.39
	Tabacco	0.19	0.15	0.06	0.41
Textiles, clothes	Reeling and spinning	1.02	0.55	0.23	1.80
	Fabrics	1.17	0.61	0.26	2.04
	Fabric dyeing	1.55	0.60	0.26	2.41
	Other fabric	0.92	0.61	0.26	1.79
	Wearing apparel	0.69	0.64	0.27	1.60
Board, furniture	Lumber and wooden chips	0.63	0.69	0.29	1.61
	Other wooden products	0.48	0.63	0.27	1.38
	Furniture	0.60	0.63	0.27	1.50
pulp, paper	Pulp	1.83	0.58	0.25	2.66
	Paper and paper products	1.40	0.56	0.24	2.20
Printing	Publishing and printing	0.48	0.63	0.27	1.38
Leather	Leather	0.51	0.58	0.25	1.34
Chemistry	Inorganic chemical basic produc	2.85	0.49	0.21	3.55
	Organic chemical basic products	2.55	0.43	0.18	3.17
	Synthetic resin	1.89	0.46	0.19	2.54
	Chemical fabric	1.94	0.54	0.23	2.70
	Medicaments	0.58	0.51	0.22	1.31
	fertilizers	1.39	0.49	0.21	2.08
	Other chemical products	1.01	0.51	0.22	1.73
	Petroleum products	0.88	0.33	0.14	1.36
	Coal products	0.99	0.55	0.24	1.78
	Rubber products	1.11	0.55	0.24	1.90
Glass, Cement	Glass products	1.92	0.49	0.21	2.62
	Ceramic wares	1.12	0.62	0.26	2.00
	Cement	21.71	0.44	0.19	22.34
	Clay products	4.11	0.56	0.24	4.91
Iron, steel	Crude steel	3.81	0.38	0.16	4.36
	Hot rolled steel	3.54	0.40	0.17	4.11
	Steel pipes	2.24	0.45	0.19	2.87
	Cold-finished steel	2.75	0.45	0.19	3.40
	Cast iron	4.35	0.56	0.24	5.16
Non-ferous metals	Other non-ferrous	1.47	0.53	0.23	2.23
	Metal products for const.	1.04	0.57	0.24	1.85
	Other metal products	1.03	0.60	0.26	1.88
Machinary	Metal processing machinery	0.69	0.60	0.25	1.54
	Machinery for industrial use	0.82	0.57	0.24	1.64
	Office machinery	0.50	0.60	0.25	1.35
House. elect. a	Household electric appliances	0.56	0.56	0.24	1.36
Machinary	Rotating electric machinery	0.70	0.59	0.25	1.54
Automobiles	Automobiles	0.76	0.60	0.25	1.62
Othe trans. machinery	Ship building and repairing	0.91	0.63	0.27	1.81
	Railroad cars and repairing	1.11	0.68	0.29	2.08
	Aircraft and repairing	0.51	0.61	0.26	1.38
	Two wheel vehicles and bicycle	0.76	0.58	0.25	1.58
Other manu. products	Optical instruments	0.52	0.64	0.27	1.43
	Watches and clocks	0.49	0.67	0.28	1.44
	Other sensitive instruments	0.46	0.61	0.26	1.32
	Other manufactured goods	0.88	0.54	0.23	1.64
Construction	Residential construction	0.63	0.62	0.26	1.51
	Non-residential construction	0.69	0.60	0.26	1.55
	Building repairing	0.81	0.59	0.25	1.65
	Public utility	0.97	0.63	0.27	1.87
	Other civil engineering	0.89	0.64	0.27	1.80
Electricity	Electricity	7.41	0.35	0.15	7.90
Gas and heat	Gas and heat	0.82	0.43	0.18	1.44
Water, waste	Water and waste	0.86	0.62	0.26	1.75
Commerce	Wholesale trade	0.23	0.71	0.30	1.24
	Retail trade	0.34	0.72	0.31	1.37
Finance and insurance	Financial service	0.13	0.61	0.26	1.01
	Insurance	0.15	0.73	0.31	1.19
House rent	Real estate and rent	0.19	0.32	0.13	0.64
	House rent	0.09	0.11	0.05	0.24
Railway	Railway passenger transport	0.62	0.53	0.23	1.38
Rd passenger	Road passenger transport	1.10	0.87	0.37	2.34
Rd freight	Road freight transport	1.15	0.79	0.33	2.27
Other trans.	Ocean transport	4.59	0.54	0.23	5.35
	Coastal and inland transport	1.72	0.67	0.28	2.67
	Air transport	2.48	0.58	0.25	3.30
	Storage facility service	0.45	0.60	0.25	1.30
	Packing	0.52	0.70	0.30	1.52
	Services relating to transport	0.30	0.49	0.21	1.00
Commun, Edu medical	Communications	0.20	0.62	0.26	1.08
	Public services	0.41	0.92	0.39	1.73
	Education and Research	0.37	0.87	0.37	1.61
	Medical and health service	0.49	0.69	0.30	1.49
Public service	Other public services	0.33	0.83	0.35	1.52
	Business services	0.24	0.58	0.25	1.07
Car, machine r	Motor vehicle repair	0.52	0.66	0.28	1.46
Broadc., Rec.	Broadcasting, amusement and re	0.38	0.43	0.18	1.00
Eating	Drinking and eating	0.48	0.60	0.26	1.34
Other person. s	Other personal services	0.43	0.56	0.24	1.24
Miscellaneous	Office supplies	1.09	0.59	0.25	1.92
	Non classified	1.08	0.41	0.17	1.66
Household	Household	0.00	1.13	0.48	1.62

Remarks

Ind. : CO_2 through inter-industrial transaction
Con. : CO_2 through induced consumption
Inc. : CO_2 through income repercussions
Emb. : Total direct and embodied CO_2