KOBE ECONOMIC & BUSINESS REVIEW

19th

ANNUAL REPORT

THE RESEARCH INSTITUTE FOR
ECONOMICS AND BUSINESS ADMINISTRATION
KOBE UNIVERSITY

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CONTENTS

PATTERNS OF EXPORT TRADE OF ARGENTINA AND BRAZIL: A COMPARATIVE STUDY

Fukuo KAWATA

I. Introduction

The purpose of this paper is to make a comparison of export trade patterns of Argentina and Brazil, which are the two largest and most advanced countries in Latin America.

Firstly, the size of trade of both countries are compared. Before, during and immediately after the Second World War, the amount of Argentine exports were larger than those of Brazil. But since the fifties, the situation has been reversed. Brazilian exports have increased so rapidly that they have exceeded those of Argentina. (See Table I–1.) As to the import trade, we see almost the same tendency.

Table I–1 Size of Argentine and Brazilian Trade (yearly average)
(millions of U. S. dollars)

Period	Export		Import		Balance	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
1936-40	525 (100)	307 (58)	389 (100)	278 (71)	136	29
1941-45	590 (100)	491 (83)	254 (100)	339 (133)	336	152
1946-50	1326 (100)	1147 (87)	1172 (100)	1039 (89)	199	108
1951-55	988 (100)	1542 (156)	1121 (100)	1645 (147)	−133	−103
1956-60	1000 (100)	1334 (133)	1183 (100)	1382 (117)	−183	− 48
1961-65	1290 (100)	1410 (109)	1275 (100)	1356 (106)	15	54
1966-70	1562 (100)	2065 (132)	1330 (100)	2081 (156)	242	− 16
1971	1740 (100)	2704 (155)	1888 (100)	3700 (196)	−148	−996

Note 1: Figures in parentheses denote the percentage of Brazilian trade as against Argentine trade.

Source: U. N., *Yearbook of International Trade Statistics*
IMF, *International Financial Statistics*

Secondly, the rate of export growth is compared. During the twenty years ranging from 1950 to 1970, the annual rate of growth of Argentine exports was

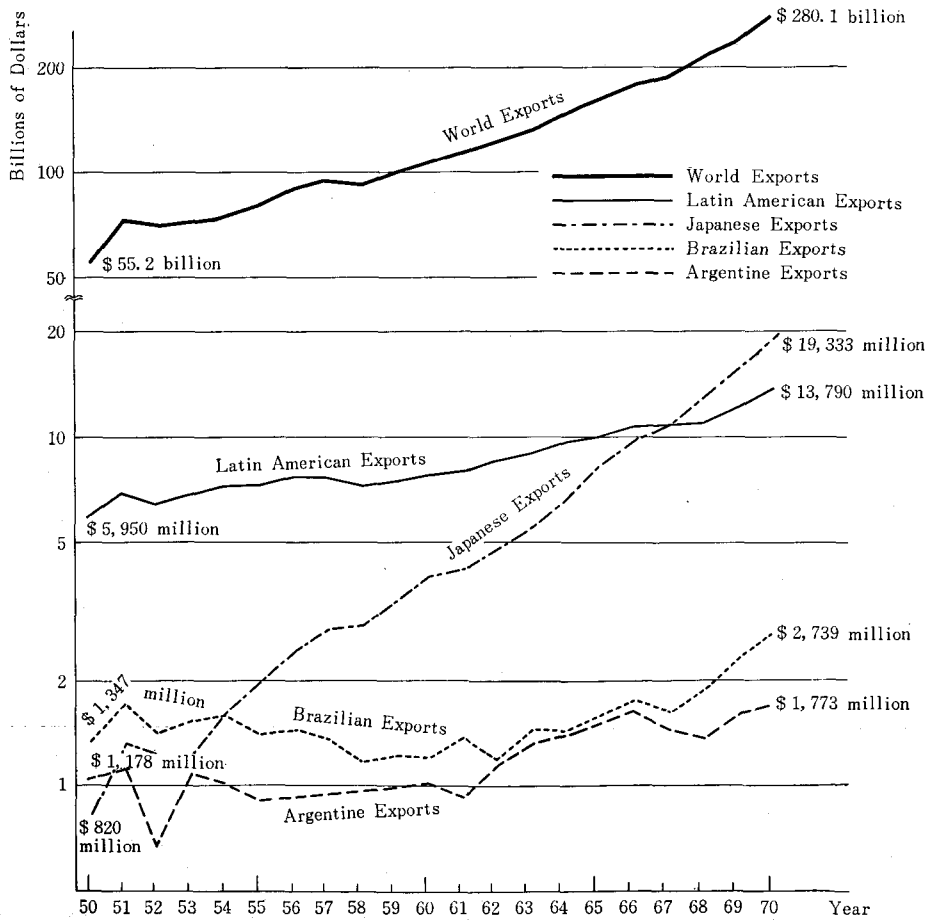
Table I-2 Rate of Export Growth in Argentina and Brazil (%)

Country	1950-55	1955-60	1960-65	1965-70	1950-70
World	8.45	6.23	8.02	11.13	8.46
Latin America	4.27	1.61	4.93	6.39	4.29
Argentina	−4.64	3.04	6.71	3.50	2.03
Brazil	0.98	−2.26	4.68	11.42	3.58
cf					
Japan	19.64	15.05	15.84	17.98	17.12

Source: IMF, *International Trade Statistics*

2.03%, while that of Brazilian exports was 3.58%. Brazilian exports increased about 1.8 times as fast as Argentine exports. But the rate of export growth of these countries is smaller than that of the Latin American average, and less

Figure 1 Comparison of the Development of World, Japanese, Latin American, Argentine and Brazilian Exports (1950-1970)



than half the rate of the world export growth, signifying a relative stagnancy of these countries' exports. In the periods of 1955–1960, and 1960–65, Argentina took the lead, but in other periods fell behind. It is quite remarkable that Brazil expanded rapidly her exports more than 10% annually in the 1965–70 period. (See Table I-2.)

Generally speaking, the rate of export growth of both countries is so small that the share of their exports in the world market tends to decrease. For instance, in 1950, the share of Argentina and Brazil in world exports was 2.13% and 2.44%, but it came down to 0.96% and 1.13% in 1960, and to 0.63% and 0.98% in 1970 respectively. The development of export trade of both countries from 1950 to 1970 is rather stagnant, although in the late 1960's brisk activities were seen in Brazilian exports. (See Fig. 1.)

Thirdly, the ratio of trade to GNP is compared. On the whole, the rate of Argentina is larger than that of Brazil both in exports and in imports. Only during the 1950–54 period, the Brazilian ratio was larger than that of Argentina. The Argentine ratio was higher than 10% during the 1955–59 and 1960–64 periods, but the Brazilian ratio did not reach the 10% level throughout the periods under review.

It has been mentioned that the rate of export growth of both countries has lagged far behind the world average. One of the reasons why their export growth is so slow is that these countries produce and export chiefly those primary products whose rate of growth in the world production and trade is small. For example, Argentina's principal products are wheat, maize, meat and wool, while Brazil's main products coffee, cacao, cotton and sugar. The annual rates of growth in the world production of these commodities range from 1.4% for cacao to 3.1% for sugar during the thirty years from 1938 to 1968, and 2.3% for cacao and wool to 4.2% for sugar in the 1949–68 period. These figures compare quite unfavorably with the growth rates of crude petroleum, crude steel, cement and motor vehicles, whose annual rates of production growth range from 5.4% for crude steel to 7.0% for crude petroleum in the 1938–68 period and from 7.3% for crude petroleum to 8.4% for cement in the 1949–68 period.

Table I-3 Ratio of Trade to GNP in Argentina and Brazil (%)

Period	Export		Import	
	Argentina	Brazil	Argentina	Brazil
1950-54	6.7	8.8	7.3	8.8
1955-59	11.6	6.7	12.4	7.0
1960-64	10.2	7.6	10.4	7.6
1965-69	9.2	7.4	8.2	7.2

Source: IMF, *International Financial Statistics*

Table I–4 Annual Rate of Growth in the Production of World Major Commodities

	1938–68	1949–68	1951–68	1961–68
Wheat	2.1	3.8	3.9	3.9
Maize	2.5	2.5	3.7	2.5
Cotton (ginned)	1.9	3.0	3.0	1.4
Sugar	3.1	4.2	3.9	3.1
Meat	2.5	4.0	3.5	2.8
Wool (greasy)	1.6	2.3	2.3	1.1
Coffee	1.6	2.9	3.3	−1.4
Cacao (beans)	1.4	2.3	2.3	0.6
Crude Petroleum	7.0	7.3	7.5	7.8
Crude Steel	5.4	8.1	5.9	5.5
Cement	6.2	8.4	7.8	6.2
Motor Vehicles	6.9	7.5	5.7	6.9
cf.				
Population	1.5	1.7	1.8	2.0
Rice	2.6	3.0	3.1	2.3
Tea	2.5	3.8	2.8	3.2

Source: U. N., *Statistical Yearbook*, 1969, p. xxi.

II. Commodity Pattern of Exports

Both Argentina and Brazil are specialized in the export of primary products, so that their exports chiefly come under the categories 0, and 2 of the SITC code. The percentage of food and raw materials accounted for more than 90% in 1955, but later their shares in the total exports gradually declined, registering about 80% in Argentina and 86% in Brazil. This is due to the progress of industrialization. The share of manufacturing exports (chiefly SITC 6 and 7) in the total was less than 1% in both countries in 1955, but later this percentage increased both in Argentina and Brazil to 0.7% and 1.2% in 1960, 2.1% and 6.7% in 1965, and 8.1% and 8.0% in 1969 respectively. (See Table II–1, and II–2.)

Rapid as the pace of industrialization in both countries was, the share of industrial products in the total exports is still very small compared with developed countries. Moreover, as is reported in the *Economist* (Sept. 2, 1972) and in the *Banker* (July, 1972)[1] a considerable part (for example 40% in the case of Brazil and 50% in the case of Argentina) of their industrial exports is carried out by multinational companies utilizing Brazil and Argentina as their production base.

The degree of concentration of export commodities is also an important element in the comparison of the export structures of these countries. The coeffi-

(1) J. H. Dunning, "Investment in Argentina," *The Banker*, July 1972, pp. 735–740.

Table II-1 Commodity Composition of Argentine & Brazilian Exports in Value (millions of U. S. dollars)

	1955		1960		1965		1969	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
Total	929	1423	1079	1269	1493	1596	1612	2311
SITC								
0	639	1064	715	937	1123	988	1100	1366
1	0.4	19	1	19	6	27	7	29
2	198	288	244	228	184	398	194	603
3	0	0	0.2	13	9	0	6	3
4	35	25	74	31	89	47	84	63
5	49	10	35	13	40	15	57	32
6	3	6	6	13	15	78	78	124
7	0.4	3	2	2	16	29	52	60
8	1	0.4	2	0.7	11	3	34	10
9	2	7	1	13	0.4	11	0.4	22

Source: U. N., *Yearbook of International Trade Statistics*
Note: SITC code signifies:

0. Food and live animals
1. Beverages and tobacco
2. Crude materials, inedible, except fuels
3. Mineral fuels, lubricants, related materials
4. Animal and vegitable oils and fats
5. Chemicals
6. Manufactured goods classified by materials
7. Machinery and transport equipment
8. Miscellaneous manufactured articles
9. Commodities and transactions, n. e. s.

Table II-2 Commodity Composition of Argentine and Brazilian Exports (%)

	1955		1960		1965		1969	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SITC								
0	68.9	74.8	66.3	73.8	75.2	61.9	68.3	59.1
1	—	1.3	0.1	1.5	0.4	2.3	0.4	1.2
2	21.4	20.3	22.6	17.9	12.3	25.0	12.0	26.1
0-2 Total	90.3	96.4	89.0	93.2	87.9	89.2	80.7	86.4
3	—	0	—	1.0	0.6	0	0.4	0.1
4	3.8	1.8	6.8	2.5	5.9	2.9	5.2	2.7
5	5.3	0.7	3.3	1.1	2.7	0.9	3.6	1.4
6	0.3	0.5	0.5	1.0	1.0	4.9	4.9	5.4
7	—	0.2	0.2	0.2	1.1	1.8	3.2	2.6
8	0.2	0	0.1	0.1	0.7	0.2	2.1	0.4
9	0.2	0.5	0.1	1.0	—	0.7	—	0.9

Source: U. N., *Yearbook of International Trade Statistics*

Table II-3 Concentration Coefficient of Argentine and Brazilian Export Commodities

Year	Argentina	Brazil	cf. Japan	U. K.	U. S.
1955	72.4	77.5	60.9	49.8	43.3
1960	70.5	76.0	54.4	52.1	43.5
1965	76.5	67.1	53.6	56.5	44.7
1969	69.9	65.0	54.0	51.4	49.0

Source: U. N., *Yearbook of International Trade*

Note: The degree of concentration is measured by the Gini-Hirschman coefficient of concentration. The coefficient of commodity concentration of exports of country j, to be denoted by C_{jx}, is defined as

$$C_{jx}=100\sqrt{\sum_i\left(\frac{X_{ij}}{X_j}\right)^2}$$

where X_{ij} stands for the value of country j's exports of commodity i to the rest of the world in the reference period, while X_j represents the total value of country j's exports to the rest of the world in the same period. For convenience, the coefficient is expressed in percentage form. (See Michael Michaely, *Concentration in International Trade*, 1962, ch. 2)

cient of concentration measured with the Gini-Hirschman method under the SITC code (See the note of Table II-3.) reveals us that in the years of 1955 and 1966 the degree of concentration is higher in Brazil than in Argentina, while in 1969, the relation is reversed. In Brazil the coefficient is decreasing from 77.5 in 1955 to 76.0 in 1960, to 67.1 in 1965 and to 65.0 in 1969. In Argentina it is also declining except in 1965. (See Table II-3.) The declining tendency of the concentration coefficient in both countries means that their export commodities tend to become diversified. Although the coefficient of concentration of exports tends to decline in both countries, the degree is still higher than that of industrial countries. For example, the figure registered in 1969 54.0 in Japan,

Table II-4 Principal Items of Argentine Export in Value (average of five years)
(millions of U. S. dollars)

SITC	1951-55	1956-60	1961-65	1966-70
1. 011 Meat	158	254	287	397
2. 041 Wheat	180	144	194	160
3. 044 Maize	62	88	131	205
4. 081 Fodder	46	65	93	99
Sub-total (1-4)	446	551	705	861
5. 211 Hides and Skins undressed	97	85	71	85
6. 262 Wool	146	121	138	103
Sub-total (5-6)	243	206	209	188
7. 442.1 Linseed oil	49	35	48	26
8. 532 Quebracho extracts	35	21	14	19
Total (1-8)	773	812	976	1095

Source: U. N., *Yearbook of International Trade Statistics*

51.4 in the United Kingdom, and 49.0 in the United States. When one commodity group under the SITC code accounts for 100% of the exports, then the coefficient shows 100. But when the exports are distributed evenly to each commodity group, that is each group takes up 10% respectively, then the coefficient registers 31.26. The coefficient ranges, therefore, from the maximum of 100 to the minimum of 31.26.

Major export commodities of Argentina and Brazil are food and raw materials. The principal items of food exports comprise meat, wheat, maize and fodder for Argentina, and sugar, coffee and cacao for Brazil. (See Table II–4 and 6.) The total amount of the main food items accounts in the 1966–70 period for about 55% of the total exports of Argentina, and about 47% of those of Brazil. The relative importance of the main food items has remained almost unchanged in Argentina since the 1950–60 period, but it has been decreasing

Table II–5 Principal Items of Argentine Exports
(averages of five year periods) (%)

SITC	1951-55	1956-60	1961-65	1966-70
1. 001 Meat	15.9	25.4	22.3	25.4
2. 041 Wheat	18.1	14.4	15.0	10.3
3. 044 Maize	6.2	8.8	10.1	13.1
4. 081 Fodder	4.7	6.5	7.2	6.3
Sub-total (1–4)	44.9	55.1	54.6	55.1
5. 211 Hides & Skins undressed	9.7	8.5	5.5	3.7
6. 262 Wool	14.6	12.1	10.6	6.6
Sub-total (5–6)	24.3	20.6	16.1	10.3
7. 422.1 Linseed Oil	4.8	3.5	3.7	1.7
8. 532 Quebracho Extracts	3.5	2.0	1.1	1.2
Total (1–8)	77.5	81.2	75.5	68.3

Source: U. N., *International Trade Statistics*

Table II–6 Principal Items of Brazilian Exports in Value (average of five year periods)
(millions of U. S. dollars)

SITC	1951-55	1956-60	1961-65	1966-70
1. 06 Sugar	18	41	53	95
2. 071.1 Coffee	994	802	714	799
3. 072 Cacao	92	71	34	68
Sub-total (1–3)	1104	914	801	962
4. 263 Cotton	139	47	108	118
5. 281 Iron Ore	22	44	77	133
Sub-total (4–5)	161	91	158	251
Total (1–5)	1265	1005	986	1213

Source: U. N., *Yearbook of International Trade Statistics*

in Brazil. (See Table II–5 and 7.) The principal articles of raw materials exported are wool and hides and skins for Argentina, and cotton and iron ore for Brazil. The amount of exports of these main crude materials is far smaller than that of the major kinds of food for both countries. (See Table II–4 and 6.)

As has been stated above, the share of exports of both countries in the world market has been declining. One of the reasons of their declining share is the fact that their principal exports have been losing their competitiveness. In Argentina, beef exports accounted for 57% of the world in the 1934–38 period, but the share decreased to 38% in the 1948–52 period and to 22% in the 1966–68 period. The declining share of exports in the world market is also noticed in the case of wheat, maize and wool. (See Table II–8.) For Brazil, the share of coffee exports in the world market was 53% in the 1934–38 period, but it fell to

Table II–7 Principal Items of Brazilian Exports (%)

SITC	1951–55	1956–60	1961–65	1966–70
1. 06 Sugar	1.2	3.1	3.6	4.6
2. 071.1 Coffee	64.6	60.1	50.6	38.7
3. 072.1 Cacao	6.0	7.3	2.4	3.3
Sub-total (1–3)	71.8	70.5	56.6	46.6
4. 263 Cotton	9.1	3.6	7.7	5.7
5. 281 Iron Ore	1.4	3.2	5.4	6.4
Sub-total (4–5)	10.5	6.8	13.1	12.1
Total (1–5)	82.3	75.3	69.7	58.7

Source: U. N., *Yearbook of International Trade Statistics*

Table II–8 Share of Argentine Primary Exports in the World Market
(in thousand metric tons)

Commodity		1934–38	1948–52	1956–60	1961–65	1966–68
1. Beef	Argentina	507	268	343	392	345
	World	730	510	959	1380	1577
	A/W (%)	56.7	38.2	35.8	28.4	21.9
2. Wheat	Argentina	3218	1861	2437	3220	3179
	World	13950	20764	25455	44332	50654
	A/W (%)	23.1	9.0	9.6	7.3	6.4
3. Maize	Argentina	6527	1068	1758	2650	3654
	World	10200	4452	8739	20280	27054
	A/W (%)	63.9	23.5	20.1	13.1	13.5
4. Wool	Argentina	111	92	91	123	93
	World	1093	1102	1312	1219	1206
	A/W (%)	10.2	8.3	6.9	10.1	7.7

Source: FAO, *Trade Yearbook*

32% in the 1966–68 period. Such a diminishing share in the world market is also true for cacao. The share of sugar exports, however, has been increasing, and more remarkable is the rising share in the world production for iron ore, although the share is not as large at present as for other traditional exports. The share of cotton exports moved downward from 6% of the 1934–38 period to 2.5% of the 1956–60 period, but later it came up to the level of the 1948–52 period. (See Table II-9.)

Table II–9 Share of Brazilian Primary Exports in the World Market
(in thousand metric tons)

Commodity		1934–38	1948–52	1956–60	1961–65	1966–68
1. Coffee	Brazil	875	1007	942	975	1041
	World	1646	1942	2404	2867	3224
	B/W (%)	52.8	51.8	39.2	34.0	32.3
2. Cacao	Brazil	114	98	109	79	101
	World	687	695	785	1095	1096
	B/W (%)	16.5	14.1	13.9	7.2	9.2
3. Sugar	Brazil	42	97	379	553	1011
	World	10082	11051	15544	18657	19852
	B/W (%)	0.4	0.9	2.4	3.0	5.0
4. Cotton	Brazil	194	140	84	211	224
	World	3067	2383	3321	3770	3829
	B/W (%)	6.3	5.8	2.5	5.6	5.8
			(1951–55)			
5. Iron Ore*	Brazil	—	2127	3853	9433	16020
	World		150940	198480	278520	349466
	B/W (%)	—	1.4	1.9	3.4	4.6

Source: FAO, *Trade Yearbook* *Production of iron ore (Fe contents)

III. Geographical Pattern of Exports

Seeing that Argentine and Brazilian exports are concentrated on primary products, it can easily be imagined that their principal trading partners are industrial nations. Developed countries take up about seventy or eighty per cent of their exports, while developing countries about 25% for Argentine and 15% for Brazilian exports in 1969 and 1970. The share of the Soviet area as a trading partner is rather small, ranging from 4 to 5%, except in 1965. (See Table III–1.) The country-wise distribution of Argentine and Brazilian exports is somewhat different, although their principal partners are industrial or developed nations. Argentina's main customers are European countries, such as EEC and the United Kingdom, while Brazil's largest partner as a single country is the United States, in spite of the fact that the importance of EEC has been increasing

and in 1970 the export to EEC exceeded that to the United States. It is, however, quite noteworthy that the relative weight of the United States' market has been deminishing for both countries under review. (See Table III–2 and 3.)

Argentina's major exports, such as wheat, meat, maize and wool, have traditionally been absorbed by European industrial countries, but they are competitive with the farm products of the United States; while Brazilian coffee, cacao

Table III–1 Regional Distribution of Argentine and Brazilian Export (%)

Region	1961		1965		1969		1970	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
1. Industrial Countries	76.3	78.3	68.1	73.7	61.9	72.6	65.2	73.7
2. Non-Industrial Developed Countries	3.8	5.0	6.2	5.2	8.1	6.6	7.9	7.8
3. Developed Countries(1+2)	80.1	83.3	74.3	78.9	70.0	79.2	73.1	81.5
4. Developing Countries	13.9	11.3	18.7	15.4	25.8	15.2	24.0	13.6
5. Soviet Area	5.9	5.4	13.2	5.6	4.2	5.6	4.3	4.8
Total (3+4+5)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: IMF and IBRD, *Direction of Trade*

Table III–2 Country-wise Distribution of Argentine and Brazilian Exports in Value (millions of U. S. dollars)

Country	1951–55		1956–60		1961–65		1966–70	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
World Total	1011	1538	1000	1335	1230	1411	1563	2079
U. S.	158	703	113	617	104	510	111	606
U. K.	193	74	229	62	177	59	135	89
EEC	253	312	365	240	548	357	600	565
BLEU	28	27	32	22	52	37	56	52
France	55	80	44	45	55	51	55	79
W. Germany	77	121	98	86	100	122	82	174
Italy	54	42	88	35	189	64	237	139
Netherlands	53	43	104	50	154	83	165	119
Other European Industrial Countries	71	112	31	101	31	108	30	156
Japan	31	40	28	34	38	36	56	93
Latin America	185	136	140	112	191	139	324	214
Argentina	—	98	—	75	—	79	—	133
Brazil	114	—	78	—	75	—	120	—
Soviet Area	45	21	61	48	107	85	99	118

Source: IMF and IBRD, *Direction of Trade*

and sugar find their largest market in the United States, because the demand for these Brazilian products in the United States has been very strong. Japan's weight as their trading partner has been increasing, but the percentage was still about 4% in the 1966–70 period. (See Table III–2 and 3.)

Table III–3 Country-wise Distribution of Argentine and Brazilian Exports (%)

Country	1951–55		1956–60		1961–65		1966–70	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
World Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
U. S.	15.6	45.8	11.3	46.2	8.4	36.2	7.1	29.1
U. K.	19.1	4.8	22.9	4.6	14.3	4.2	8.6	4.3
EEC	25.0	20.3	36.5	17.9	44.5	25.3	38.4	27.2
BLEU	2.7	1.8	3.2	1.6	4.2	2.6	3.6	2.5
France	5.4	5.2	4.4	3.3	4.5	3.6	3.5	3.8
W. Germany	7.6	7.9	9.8	6.4	8.1	8.6	5.2	8.4
Italy	5.3	2.7	8.8	2.6	15.4	4.5	15.2	6.7
Netherlands	5.2	2.8	10.4	3.7	12.5	5.9	10.6	5.7
Other European Industrial Countries	7.1	7.2	3.1	7.6	2.6	7.6	1.4	7.5
Japan	3.1	2.6	2.7	2.5	3.1	2.6	3.6	4.5
Latin America	18.3	8.8	14.0	8.4	15.5	9.9	20.7	10.3
Argentina	—	6.4	—	5.6	—	5.6	—	6.4
Brazil	11.3	—	7.8	—	6.1	—	7.6	—
Soviet Area	4.4	1.4	6.1	3.6	8.1	6.0	6.3	5.7

Source: IMF and IBRD, *Direction of Trade*

Table III–4 Principal Countries of Destination of Argentine and Brazilian Exports (millions of U. S. dollars)

Argentina				Brazil			
1960		1970		1960		1970	
1. U. K.	221	1. Italy	271	1. U. S.	564	1. U. S.	676
2. Netherlands	131	2. Netherlands	184	2. W. Germany	90	2. W. Germany	236
3. Italy	128	3. U. S.	159	3. U. K.	65	3. Italy	198
4. U. S.	92	4. Brazil	139	4. Argentina	56	4. Argentina	186
5. W. Germany	87	5. U. K.	123	5. Netherlands	52	5. Netherlands	154
6. Brazil	83	6. Japan	109	6. France	43	6. Japan	145
7. Chile	42	7. W. Germany	105	7. Sweden	42	7. U. K.	137
8. Japan	40	8. Chile	91	8. Italy	39	8. France	110
9. Belgium	37	9. Spain	86	9. Japan	31	9. Spain	107
10. France	37	10. France	70	10. Belgium	25	10. Belgium	72
Total (1–10)	898		1337		1007		2021
Percentage of Total Export	83.2		75.5		79.4		73.8

Source: U. N., *International Trade Statistics*

The ranking of the trading partners of both countries in 1960 and in 1970 is given in the Table III–4. As for Argentina, the United Kingdom ranked first in 1960, followed by the Netherlands, Italy, the United States, but in 1970, Italy came up to the top, the Netherlands held the second place and the United States the third. The United Kingdom fell to the fifth and West Germany to the seventh, while Brazil rose from the sixth to the fourth, and Japan from the eighth to the sixth. With regards to Brazil, the United States is by far the largest customer both in 1960 and in 1970, and West Germany held the second place in both years. The United Kingdom, which took the third position in 1960, fell to the seventh in 1970. In contrast to the United Kingdom, Italy rose from the eighth to the third, and Japan from the ninth to the sixth. Argentina, the Netherlands, and Belgium respectively kept the same position, but France sank from the sixth to the eighth.

The total share of the best ten customer countries declined from 83% to 79% for Argentina, and from 76% to 74% for Brazil, signifying a tendency toward the diversification of trading partners.

Argentina and Brazil are the leading countries in Latin America, playing an important part in the regional trade. Both countries are respectively the largest market of the other country in the region; that is, Brazil is the biggest market for Argentina and Argentina the largest customer of Brazil in Latin America. For example, in the Latin American Free Trade Association (LAFTA), Argentine exports to Brazil accounted for 49% and Brazilian exports to

Table III–5 Distribution of Argentine and Brazilian Export to LAFTA Countries in Value (millions of U. S. dollars)

	1960		1965		1968		1970	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
Argentina	—	56.4	—	141.0	—	118.7	—	185.6
Bolivia	2.3	—	7.6	1.2	13.5	2.8	15.8	7.6
Brazil	82.8	—	107.1	—	129.1	—	138.6	—
Chile	41.7	11.6	53.4	19.0	77.5	23.3	91.5	23.7
Columbia	0.3	—	7.1	2.9	9.3	2.0	13.9	6.7
Equador	0.1	—	0.6	—	1.3	0.2	2.4	0.8
Mexico	0.8	0.2	6.7	8.9	11.3	11.2	16.0	20.4
Paraguay	8.5	—	10.6	2.3	12.8	5.1	15.1	11.2
Peru	15.5	0.4	37.6	12.0	57.8	6.8	31.7	7.7
Uruguay	12.9	16.6	8.0	11.2	18.6	19.2	28.1	22.7
Venezuela	5.4	1.3	7.9	3.2	6.9	4.0	12.6	4.5
LAFTA Total	170.3	86.4	246.6	201.7	338.1	193.3	365.8	290.8

Source: IMF and IBRD, *Direction of Trade*

Table III-6 Distribution of Argentine and Brazilian Export to LAFTA Countries (%)

Country of Destination	1960		1965		1968		1970	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
Argentina	—	65.3	—	69.9	—	61.4	—	63.8
Bolivia	1.3	—	3.1	0.6	4.0		4.3	
Brazil	48.7	—	43.4	—	38.2	—	37.9	—
Chile	24.5	13.4	21.7	9.4	22.9	12.1	25.0	8.1
Columbia	0.2	—	2.9	1.4	2.8	1.0	3.8	2.3
Equador	—	—	0.2	—	0.4	0.1	0.7	0.3
Mexico	0.4	0.2	2.7	4.4	3.3	5.8	4.4	7.0
Paraguay	5.0	—	4.3	1.1	3.8	2.6	4.2	3.8
Peru	9.1	0.4	15.2	5.9	17.1	3.5	8.7	2.6
Uruguay	7.6	19.2	3.2	5.6	5.5	9.9	7.7	7.8
Venezuela	3.2	1.5	3.2	1.6	2.0	2.1	3.4	1.6
LAFTA Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: IMF and IBRD, *Direction of Trade*

Argentina for 65% in 1970. In later years, the weight of the Brazilian market for Argentina gradually declined, falling to 38% in 1968 and in 1970, although it remained the largest market in LAFTA. The second market is Chile and the third Peru.

As for the Brazilian trading partners in LAFTA, Argentina held the foremost position throughout the years under question. Chile had held the second place since 1965, although in 1960 she had occupied the third place following Uruguay, which had held from 1965 till 1970 the third place. It is a quite conspicuous fact that Mexico, which was negligible for the Brazilian market in 1960, made a remarkable progress in later years, rising to the fourth place in 1970. (See Table III-5 and 6.)

It can easily be assumed that the primary products exported by Argentina and Brazil find their market in the developed countries, but the manufactured products do not easily enter the market of developed nations owing to their lack of competitiveness. Manufactured articles produced by relatively labour intensive methods (SITC 6, for example) are exported to developed countries with more ease than those commodities produced by relatively capital intensive methods with high technology (for instance, SITC 7). This is quite natural according to the theory of international trade. It is shown in Table III-7 that labour intensive manufactured goods exported by Argentina and Brazil to developed countries account for about 50% to 60% of the total exports, while capital intensive manufactured goods exported to developed countries take up only about 22% to 26%, about 74% to 78% being absorbed by developing countries.

The primary commodities exported by Argentina are chiefly destined to developed countries (mainly European) with the exception of wheat, which is mainly exported to Latin America. It is very interesting that the percentage of the United States market is negligibly small for the major primary exports of Argentina, such as meat, wheat, maize, fodder, and hides and skins, excepting wool. (See Table III-8.) The primary products of Brazil are also absorbed by developed countries, but in contrast to the case of Argentina, the United States is the largest customer of these commodities except for cotton and iron

Table III-7 Distribution of Argentine and Brazilian Exports to Developed, Developing and Soviet Area Countries (1968) (%)

Commodity	Developed Countries		Developing Countries		Soviet Area	
	Argentina	Brazil	Argentina	Brazil	Argentina	Brazil
SITC 0	73.2	83.4	26.0	9.5	0.9	7.1
1	—	—	—	—	—	—
2	68.0	77.6	12.4	15.8	19.6	6.5
3	—	—	—	—	—	—
4	58.9	89.4	41.0	1.5	0.3	9.1
5	55.3	68.2	37.9	29.1	7.0	2.6
6	58.8	52.8	38.2	45.8	0.3	1.4
7	22.3	26.0	77.9	74.0	—	—
8	28.6	54.3	71.9	43.5	—	—
9	—	—	—	—	—	—
All Commodities	68.4	79.4	27.9	14.2	3.7	6.5

Source: U. N., *Commodity Trade Statistics*
Note: The latest figures available both for Argentina and Brazil are those of 1968. Figures of 1969 for Brazil are available, but not for Argentina.

Table III-8 Destination of Major Export Primary Commodities of Argentina (1968) (%)

Region	011 Meat	041 Wheat	044 Maize	081 Fodder	211 Hides & Skins	262 Wool
Developed Countries	84.8	28.5	93.6	98.5	54.0	73.2
U. S.	1.6	—	0.4	—	3.3	16.6
Western Europe	79.6	28.3	93.2	95.8	48.3	49.2
EEC	40.5	25.5	74.0	86.9	36.1	28.6
EFTA	18.9	2.8	1.9	6.6	3.4	16.0
Japan	3.5	0.1	—	2.4	1.2	8.5
Developing Countries	13.6	71.1	4.7	0.9	6.4	13.1
Latin America	6.5	68.1	4.5	0.4	5.3	10.8
Soviet Area	1.7		1.6	0.7	39.3	13.8

Source: U. N., *Commodity Trade Statistics*

ore. (See Table III-9.)

Table III-9 Destination of Major Export Primary Commodities of Brazil (1969) (%)

Region	071.1 Coffee	072.1 Cacao	061.1 Sugar (raw)	263.1 Cotton	281 Iron Ore
Developed Countries	87.3	55.4	80.7	77.7	91.8
U. S.	44.3	45.9	78.4	—	9.6
Western Europe	40.1	11.0	3.6	59.7	65.0
EEC	20.4	10.4	3.0	48.8	54.3
EFTA	13.4	—	0.6	6.7	9.8
Japan	0.6	—	—	13.0	14.5
Developing Countries	6.7	9.1	19.2	11.3	4.2
Latin America	3.0	9.1	8.9	4.8	4.2
Soviet Area	6.0	33.3	—	11.0	3.9

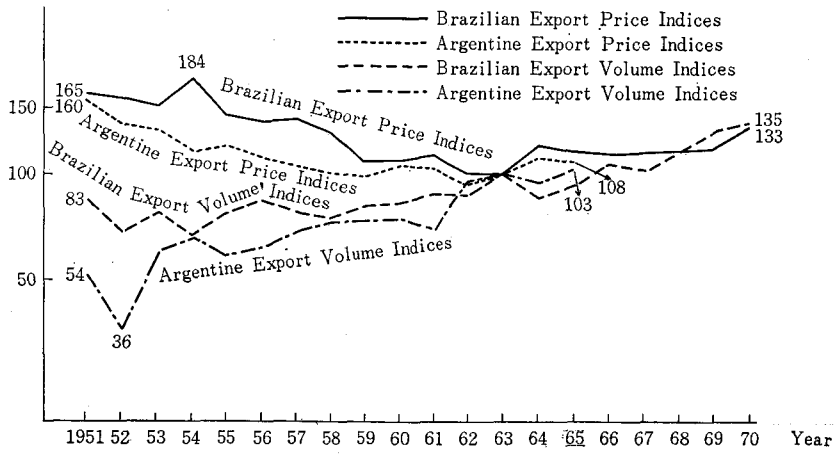
Source: U. N., *Commodity Trade Statistics*

IV. Conclusion

It has already been observed that the export values of both Argentina and Brazil were generally stagnant, except the recent remarkable growth of Brazilian exports. The export values are the products of export prices and export volumes. It is, therefore, necessary to investigate which factor is chiefly responsible for the stagnant exports.

In the first place, the indices of export prices and volumes of both countries are examined based on five year averages. This tells us that the export prices of both countries tend to decrease, while their export volumes are increasing. This

Figure 2 Movements of Argentine and Brazilian Export Price and Export Volume Indices (1963=100)



is an important finding. (See Table IV–1. See also Fig. 2.)

To measure the movement more exactly the linear regression equation ($Y=a+bX$) is applied by using the least square methods, where Y stands for the export price or volume, X denotes years. The results of this calculation are shown in Table IV–2.

As for the movement of the export price, both countries show a downward trend. The absolute value of b is largest in the case of Brazil if we include coffee, and smallest in the case when we exclude coffee. This means the Brazilian export price has a stronger downward tendency than the Argentine one when coffee is included, but when coffee is excluded, the downward tendency is weaker than the Argentine one. The coefficient of variation of the export price is smaller in Argentina than in Brazil.

As far as the export volume is concerned, both countries show an upward

Table IV–1 Movement of Export Price and Volume Indices in Argentina and Brazil (1951–1970) (1963=100)

	1951–55	1953–55	1956–60	1961–65	1966–70
Export Price:					
Argentina	135	(124)	105	103	—
Brazil (incl. Coffee)	163	(163)	127	111	120
Brazil (excl. Coffee)	143	(122)	121	105	114
Export Volume:					
Argentina	55	(61)	70	92	—
Brazil (incl. Coffee)	74	(73)	80	90	114
Brazil (excl. Coffee)	56	(62)	67	101	160

Source: IMF, *International Financial Statistics*
Note: Indices of export price and volume after 1966 are not available for Argentina.

Table IV–2 Linear Regression Equation ($Y=a+bX$) of Export Price and Volume Indices for Argentina and Brazil (1963=100)

Price and Volume	Period	a	b	Standard Error	Arithmetical Mean	Coefficient of Variation
Export price:						
Argentina	1953–1965	214.27	−1.789	8.83	108.72	0.08
Brazil (incl. Coffee)	1953–1970	276.95	−2.444	17.26	126.65	0.14
Brazil (excl. Coffee)	1953–1970	172.94	−0.946	11.84	114.77	0.10
(Note)						
Industrial Countries	1953–1970	49.88	0.857	2.93	102.56	0.03
Export volume:						
Argentina	1953–1965	−139.43	3.663	7.19	76.70	0.09
Brazil (incl. Coffee)	1953–1970	−108.97	3.271	8.74	92.22	0.09
Brazil (excl. Coffee)	1953–1970	−378.84	7.811	18.01	101.54	0.18

Source: IMF, *International Financial Statisitcs*

tendency, with b positive. The value of b is largest in the case we exclude coffee and smallest in the case we include coffee in Brazil. The Brazilian export volume excluding coffee tends to increase with more than twice the rapidity as against the Argentine one, but including coffee, the Brazilian export volume increases more slowly than the Argentine one.

The coefficient of variation of the export volume is the same for both Argentina and Brazil if we include coffee, but when coffee is excluded, the Brazilian figure is twice as high as the Argentine one. To sum up, it can be concluded that the main cause of the exports stagnation of both countries consists not in the trend of the export volume but in that of the export price.

It is to be noted that the trend of the export price of industrial countries shows an upward tendency with b positive, in spite of the downward movement of the Argentine and Brazilian export prices. This is one of the important reasons why developing countries are making every effort to promote industrialization.

ENTREPRENEURSHIP IN AMERICA

Tadakatsu INOUE

On November 9 and 10, 1969, the Business History Society of Japan held its fourth annual meeting at the University of Osaka. While the first day had twelve reports on "free topics" including "Ironmasters in the British Iron and Steel Industry during the Industrial Revolution" by Professor Alan Birch of the University of Hong Kong, the meeting on the second day was devoted to the theme "International Comparisons on Entrepreneurship" which was the "common topic" of the conference. Following the introductory address made by Shinzo Kurita of Kobe University of Commerce, four papers were read before the 100 participants: "The Stagnation of the English Economy and Entrepreneurship" by Professor Seiji Arai of Kansai University, "Entrepreneurship in America" by the present writer, "Entrepreneurship Qualities in India and China" by Professor Keiichiro Nakagawa of the University of Tokyo and Professor Yō Tenō of Kyushu University of Industry, and "Entrepreneurship in Japan" by Professor Kisoo Tasugi of the University of Kyoto. After reading the reports, we went into a panel discussion on the above subject with Professor Mataji Miyamoto of the University of Osaka in the chair.

The following is a résumé of the paper read by the writer at the meeting within a time limit of fifty minutes.

I.

To begin with, the writer gives two notices. First, he intends to define the subject imposed upon him as "American Entrepreneurship in the Era of the Nineteenth and Early Twentieth Centuries." The reason why the writer limits the scope of reference to the United States especially before the Great Depression is wholly convenient, as he has not yet fully understood those changes in business in recent decades that seem to have marked a radical break with the past.

Second, the writer proceeds on the basis of the common understanding among the six reporters that the varying behavior of businessmen in England, India, China, Japan, and America cannot be accounted for in terms of economic factors alone. As Professor Arthur H. Cole says: "While economic conditions may define the (entrepreneurial) problem for the entrepreneurial actors, they do not necessarily decide it." "The latitude of potential, even of likely action, for the entrepreneur is considerable." It is not surprising, thus, that a North

American turning to the study of Latin American entrepreneurial behavior should be strongly impressed by an entrepreneur of that area who "could sit on a mountain of iron ore — and go to sleep!"(1) Then why did the businessman behave as he did? Or why did he operate in a manner different from his counterpart in other countries. In seeking the explanation about observable national differences in entrepreneurial activity, we cannot overlook the operation of compound social and cultural factors.

II.

It may safely be said that in the classic era of the nineteenth and early twentieth centuries American society was one whose habits and values uniquely favored to the growth and development of business. Although the influence of such elements can be seen operating in every entrepreneurial aspect, the most significant is the fact that the social structure of America not only encouraged the flow of the ablest members of the society into business careers, but also led them to devote themselves to business activity in a certain manner.

For understanding the effects of American cultural traditions on entrepreneurial recruitment, comparison with what has taken place in other nations will be effective. For example, in an essay, "Cultural Factors in Economic Growth," Professor Thomas C. Cochran describes the situation in Latin America as follows:

> The Latin American strives more for status not based on business success. This may be a disappearing vestige of agrarian aristocracy, but in Latin America it remains strong. Artistic achievement, professional status, land ownership, and government or military office still outrank anything short of outstanding business success. In Mexico "the best men go into the professions and those who do not, no matter how good their reasons, are always aware that they are considered professionally inferior."(2)

Professor John E. Sawyer finds a similar situation in France:

> The persistence of diffused feudal values and goals has meant that business has not been the "natural" choice of those enjoying the greatest advantages, either of birth or of talent and training. In so far as an occupa-

(1) Arthur H. Cole, *Business Enterprise in Its Social Setting*, 1959, pp. 19–20.
(2) Thomas C. Cochran, "Cultural Factors in Economic Growth," in Hugh G. J. Aitken, ed., *Explorations in Enterprise*, 1965, p. 126.

> tion was in order at all, the ablest tended to follow the well born into careers in the elite services, diplomat and military, the ranking civil service positions like finance, or the professions, politics, journalism, the arts.[3]

By contrast to their counterparts in these countries, American entrepreneurs in general have never been ranked below such social figures as the clergy, the soldiers, the teachers, and the professional men as a whole. Over the classic period, business had a secure and honorable place in American life, and entrepreneurs enjoyed the highest level of prestige. It is unquestionable that the high occupational status of American entrepreneurs drew the talents of the society toward business.

The high social ranking of American entrepreneurs may be ascribed to certain factors in American society. Most striking is the general absence of feudal survivals. In America the beliefs and values of the medieval world, including the tradition of regarding business with contempt, never passed into the society. From the beginning of the American settlement, no social stigma was attached to engaging in any legal activity to acquire personal wealth. At the same time, because of the relative absence of hereditary privilege and prestige, businessmen did not face strong and repressive competition from titled nobility in the struggle for social eminence. For most Americans, business was the broadest and shortest path to public recognition and high social status.

Similarly, the important factor which led to the higher occupational place of business was the Calvinistic or Puritan tradition in America. Whereas elsewhere in the Western world Puritanism had to contend with long established traditions such as Catholicism, monarchism, aristocratism, in America it had a relatively clear sweep of the field.

The special achievement of the Puritan tradition was to give a religious sanction to occupational effort as a value. According to the doctrine, the world exists to serve the clarification of God and for that purpose alone. For everyone, without exception, God's Providence has prepared a calling, which he should find and in which he should work. In doing so, the individual is working for the divine glory. Waste of time is thus the first and the deadliest of sins in principle. Time is infinitely valuable because every hour lost is lost to work for the glory of God. Similarly, the money made should not be wasted on extravagant ostentatious living. After allotting the church its share, the remainder should be used in furthering useful ventures which are also God's. The real moral objection is to the enjoyment of wealth with the consequence of distraction from the pursuit

(3) John E. Sawyer, "The Entrepreneur and the Social Order," in William Miller, ed., *Men in Business*, 1952, p. 14.

of a righteous life. In other words, acquisition of wealth is bad only when it is sought for the purpose of obtaining pleasure. But, as a performance of duty in a calling, it is not only morally permissible, but actually enjoined. As Max Weber remarked in his essay, "Die protestantische Ethik und der Geist des Kapitalismus" (The Protestant Ethic and the Spirit of Capitalism), these doctrines were to give birth to the spirit of capitalism.

According to Weber, the spirit of capitalism is shown with almost classical purity in the writings of Benjamin Franklin. After quoting the sentences extracted from Franklin's *Hints to Those That Would Be Rich* (1736) and *Advice to a Young Tradesman* (1748), Weber summed up Franklin's moral attitudes as follows:

> The peculiarity of this philosophy of avarice appears to be the ideal of the honest man of recognized credit, and above all the idea of a duty of the individual toward the increase of his capital, which is assumed as an end in itself. Truly what is here preached is not simply a means of making one's way in the world, but a peculiar ethic. The infraction of its rules is treated not as foolishness but as forgetfulness of duty. That is the essence of the matter. It is not mere business astuteness, that sort of thing is common enough, it is an ethos.(4)

Franklin's ethic called forth the applause of a whole people. In fact, his poor Richard's Almanac, the little spaces of which were filled by proverbial sentences chiefly on industry and frugality as the means of procuring wealth and thereby securing virtue, was published annually 1732 to 1756. It was a bestseller of the time. Needless to say, in a society bound to the conception of money-making as an end in itself, the businessman was assured self-confidence in the importance and primacy of his work.

III.

The higher occupational place of business in America was not the only factor that drew the talents in the society toward this occupation. It should be noted that such a trend was strengthened by the presence of opportunities for any able individual to achieve a measure of economic independence. In fact, America in the classic era of the nineteenth and early twentieth centuries was the land pre-eminently where the ideal of equality of economic opportunity flourished.

(4) Talcott Parsons, *Translation*, 1930, p. 51.

First, as Frederick Jackson Turner and his disciples explained in their theory of a moving frontier, the underprivileged in the more settled zones could begin life anew as pioneering farmers, because there were present in America great reaches of arable land which were virtually free for taking. While the capitalist farmers of the West were not recruited from the industrial workers of the East, but supplied from the farming class of contiguous states and Europe, there is no doubt that the existence of the moving frontier made it possible for the unsuccessful small farmers and their sons to fill up the West without having been converted easily into industrial workers. These opportunities were found in the American West throughout the whole of the nineteenth centry and, in considerable measure, up to the end of World War I.

Second, as Louis M. Hacker pointed out in his *The Triumph of American Capitalism*, during the seventeenth and eighteenth centuries opportunities for industrial production except in limited fields were closed to Americans because of the mercantilist system imposed by England upon the American colonies. Thus, when the thirteen States freed themselves from such fetters and took steps toward their industrialization, all the future industrial capitalists virtually lined up at the same starting point.

Third, unlike in Russia, China, India, and many Latin American countries, European capital played a relatively minor role in the United States in building her indsutrial production, though it helped lay down her railroad network. Thus, in industrial production, opportunities existed for men of small means.

The reality of equality of economic opportunity in America is best shown by the fact that the annals of American business leaders are filled with the stories of those who, starting obscurely, made immense fortunes. Recent researches have indicated that the American industrial elite of humble origins were less than we expected. It is certain, however, that almost all of them went up the ladders of the economic world by their own efforts, even if they were not of humble origin.

For example, Cornelius Vanderbilt of the New York Central System, who died worth a hundred million dollars, started his career as a boatman of the port of New York. Andrew Carnegie, from an utterly-penniless immigrant family, became a bobbin boy at the age of thirteen. John D. Rockefeller was the son of a peddler of patent medicines. Such was the case with H. C. Frick, G. F. Swift, and Henry Ford. Needless to say, these men, giving tangible proof of the reality of equality of economic opportunity, encouraged the flow of the ablest members of the society into business careers.

IV.

In the United States before the Great Depression the ablest not only aspired to be businessmen but also devoted themselves to business activity. Don't take the dedication of businessmen to business activity as a matter of course, for it was not always true in other countries. For example, Latin-American entrepreneurs had a tendency to divert their resources to achieving prominence in more prestigious fields. In the essay as mentioned above, Professor Cochran gives an example:

> One of the most important Argentinian entrepreneurs, a man unusually engrossed in his business, took the time to study for and achieve an engineering degree at the University, subsequently held an associate professorship and developed a large *estancia*, all during the most active years of his business career.(5)

A tendency similar to this is found in European countries. Quoting an essay of Professor Tibor de Scitovszky, Professor Arthur H. Cole states in his *Business Enterprise in Its Social Setting*:

> ...in Europe, especially England,..."the existence of a feudal aristocracy and landed gentry set a social pattern, which to achieve was the ambition of the newly rising capitalist [entrepreneurial] class." The British entrepreneur of the nineteenth century "wanted to outdo his rivals, not in the scale of his business or wealth, but by being admitted to high society and by becoming a member of Parliament or alderman in his native town. Such ambitions restrained the ruthlessness of industrial warfare and diverted a good deal of time, energy, and money from business."(6)

Unlike the businessman in these countries, the American businessman devoted himself to making profits, defeating his competitors, and increasing the output or productivity of his enterprise. In fact, he was so constantly absorbed in business activity that he often neglected his physique, his literary and artistic accomplishment, and his civic duties. But, in the United States, he lost little prestige through the absence of general cultivation.

The dedication of the American businessman to business activity may be

(5) T. C. Cochran, *op. cit.*, p. 126.
(6) A. H. Cole, *op. cit.*, p. 105.

explained by about the same factors as the writer pointed to concerning the recruitment of businessmen in this country. First, the United States not only skipped the stage of feudalism but also achieved her independence according to the values of the Enlightenment which were in opposition to those of feudalism. In this country, therefore, birth and blood were never regarded as determining social status, which, on the contrary, must be acquired by achieving worldy success. This seems to have made the American businessman more devoted to his business, than his counterpart in countries with feudal residues. Second, American society was so strongly influenced by Puritan teachings that there arose a religious sanction to occupational efforts as a value. Within such a society, as Prof. F. X. Sutton and others note in their *The American Business Creed*, the American businessman had no need of making apologies for a narrow, specialized existence filled with the care of producing and distributing material goods.(7) And, lastly, the reality of equality of economic opportunity must have been a strong incentive for the American businessman to devote himself to business activity.

V.

It should be noted that, while the American businessman devoted his full energy to business activity, he did so in certain ways. First of all he was never afraid of deviant behavior in Prof. T. C. Cochran's terminology(8) or innovation in Prof. J. A. Schumpeter's. Thus, as Prof. J. E. Sawyer said in the essay mentioned above, the United States before the Great Depression provided "an instance of something like a golden age of Schumpeterian entrepreneurship."(9) In fact we can easily list names of entrepreneurs who would belong to this category: Eli Whitney and Simeon North who progressed toward making guns from mass-produced interchangeable parts; Francis Cabot Lowell who founded a new type of cotton textile mill by memorizing the construction of the power loom while on a trip to England; Cyrus Hall McCormick who invented and improved the McCormick reaper, took it west to Illinois, and dominated the farm implement business; Alexander Turney Stewart, Rowland H. Macy, and John Wanamaker whose innovations in retail business were responsible for the rise and development of the department store; John D. Rockefeller and his partners who developed a new and at that time unique system of management which enabled them to

(7) F. X. Sutton and others, *The American Business Creed*, 1959, p. 277.
(8) T. C. Cochran, "Role and Saction in American Entrepreneurial History," H. G. J. Aitken, ed., *op. cit.*, pp. 93–95.
(9) J. E. Sawyer, *op. cit.*, p. 11.

manage effectively the huge Standard Oil combination; and, of course, Henry Ford was the pioneer in introducing and developing mass-production methods in the automobile industry.

While the innovation initiates new ways of doing things, it is the imitator who is responsible for the spread of such new ways from one location to others, from industry to industry, and from plant to plant. The United States was also favored with this type of entrepreneur. To cite one example: the reason why the oil refining industry which started immediately after Drake's discovery of oil in 1859 fell into overproduction as early as the late 1860's was that, attracted by the profits, so many businessmen rushed to build refineries. The capacity then temporarily exceeded the ever-growing demand for the new lighting fluid.

Needless to say, all aggressive entrepreneurs were not successful in their ventures. There must be a number of entrepreneurs who failed, but failure was not necessarily taken seriously. Seeking their comebacks, they spared no pains to work for someone else until they had saved enough to try again. Citing a case of R. H. Macy who failed several times before he succeeded in New York, Prof. T. C. Cochran writes:

> The entrepreneurial vigor created by American resources and American culture has been demonstrated not in unusual acumen or an extraordinary ratio of success to failure, but in a persistent quest for profit-making enterprise.(10)

The American businessman proved himself highly innovative, aggressive, and undaunted on the one side. On the other, he was prudent, industrious and frugal. Take as an example John D. Rockefeller. In 1863, when oil refining was still a gambler's business, he became a partner in a Cleveland firm to start a refinery. He was so fully convinced of the future of oil refining that he labored for a rapid expansion of the firm. At the same time, however, he paid careful attention to every detail of operations. Even *The History of Standard Oil Company* by Ida M. Tarbell, one of Rockefeller's many critics, contains such statement as follows:

> From the start his (John D. Rockefeller's) effect was tremendous. He had the frugal man's hatred of waste and disorder, of middlemen and unnecessary manipulation, and he began a vigorous elimination of these from his business.(11)

(10) T. C. Cochran, *Basic History of American Business*, 1959, p. 56.
(11) Ida M. Tarbell, *The History of Standard Oil Company*, 1904, I, p. 43.

The behavior of the American businessman, which can be characterized as both dynamic and careful, may be attributed to the various factors stated above. The geographical factor seems to have a particularly close relationship to the aggressive side and the religious factor to the prudent side of American entrepreneurship. While we shall have no need of explanation on the latter, we shall need some comments on the former. But it will be sufficient to say that the moving frontier of the vast virgin land formed among Americans a nearly universal sanction for such behavior as expressed by the terms, "adventure, pioneer, and boldness." These qualities characterize the brand of aggressive entrepreneurship which developed in America.

GENERALIZATION OF TWO-GAP THEORY

Hikoji KATANO

I. Introduction

1. One of the main conclusions presented by two-gap theory which has been developed on macro-economic level is:

"Net capital inflow requirement of a developing country from abroad is equal to the major element among *ex-ante* resource-gap and *ex-ante* trade-gap."

$$(1) \quad \underset{\left(\begin{matrix}\text{Net Capital}\\ \text{Inflow}\\ \text{Requirement}\end{matrix}\right)}{L} = max\ [\underbrace{\underset{\text{(Investment)}}{I} - \underset{\text{(Savings)}}{S}}_{\text{(Resource-Gap)}},\ \underbrace{\underset{\text{(Imports)}}{M} - \underset{\text{(Exports)}}{E}}_{\text{(Trade-Gap)}}]$$

Depending on this conclusion, the two-gap theory has presented the following policy measures to adjust difference between two-gaps.

(a) Case I, in which *ex-ante* resource-gap is major elements. In this case,

$$L=I-S.$$

And if this required amount of net capital inflow is supplied from abroad, the developing country may increase imports, then the difference between two-gaps can be closed.

$$(2) \quad \underset{\left(\begin{matrix}ex\text{-}post\\ \text{imports}\end{matrix}\right)}{M^*}=L+E \geqq \underset{\left(\begin{matrix}ex\text{-}ante\\ \text{imports}\end{matrix}\right)}{M}$$

(b) Case II, in which *ex-ante* trade-gap is major element. In this case,

$$L=M-E.$$

And, if the required amount of net capital inflow is supplied from abroad, the developing country may decrease savings, then the difference between two-gaps can be closed.

$$(3) \quad \underset{\left(\begin{matrix}ex\text{-}post\\ \text{savings}\end{matrix}\right)}{S^*}=I-L \leqq \underset{\left(\begin{matrix}ex\text{-}ante\\ \text{savings}\end{matrix}\right)}{S}$$

These sub-conclusions suggest the adjustors to be selected for respective cases. But the two-gap theory considers only imports (to be increased) for Case I and savings (to be decreased) for case II, but not investment (to be decreased) for Case I and exports (to be increased) for Case II. This is due to the following reasons:

(i) Investment should not be an adjustor, because the economic growth is assumed to be kept at a desired rate in this theory.

(ii) Exports can not be an adjustor, because this theory assumes that the exports is maintained at the highest level of growth rate as well as possible in the country.

2. The two-gap theory does not declare its economic meanings satisfactorily. Supplementing to this theory, we consider the following two relations:

$$(4)\quad \underset{\left(\begin{smallmatrix}\text{Domestic}\\ \text{Production}\end{smallmatrix}\right)}{X} \gtreqless \underset{\left(\begin{smallmatrix}\text{Gross Investment}\\ \text{by Domestic}\\ \text{Product}\end{smallmatrix}\right)}{I_d} + \underset{\left(\begin{smallmatrix}\text{Consumption}\\ \text{by Domestic}\\ \text{Product}\end{smallmatrix}\right)}{C_d} + \underset{\text{(Exports)}}{E}$$

$$(5)\quad \underset{\text{(Imports)}}{M} = \underset{\left(\begin{smallmatrix}\text{Gross Investment}\\ \text{by Imports}\end{smallmatrix}\right)}{I_m} + \underset{\left(\begin{smallmatrix}\text{Consumption}\\ \text{by Imports}\end{smallmatrix}\right)}{C_m}$$

Combining these two relations, the two-gap relation is generated.

$$(6)\quad I-S \gtreqless M-E$$

From these relations, we have further economic meanings inhibited behind the two-gap theory.

(1) The resource-gap majority case (Case I) is generated when there is an over-production of domestic product.

(2) The trade-gap majority case (Case II) is generated when there is an under-production of domestic product.

3. These conclusions make clear the economic meanings of policy measures for adjustment proposed by the two-gap theory. As the resource-gap majority case is generated in under-production situation, if a net capital inflow from abroad required is provided by the other countries, the net capital inflow can be used for importing a certain amount of commodities from abroad, and the demand can be filled. In this case, when the imports contain capital goods, this makes productive capacity to be increased, and, then, the *ex-ante* resource-gap has to be decreased.

As the trade-gap majority case is caused by over-production situation, if a net capital inflow from abroad required is financed by the other countries, the net capital inflow takes a place for a part of domestic savings. This decrease in domestic savings helps to make balance between two-gaps. While the replaced part of domestic savings can, in turn, play to increase domestic consumption demand for excess-products.

4. These are concerned with the conclusions proposed by the two-gap theory to be developed in macro-economic level. However, we are not sure whether these conclusions can be still effective and true directions for practical economic growth process of the developing country or not. Because we are not sure

whether these conclusions reduced in macro-economic level can be still effective for multi-sectoral considerations or not. So we attempt, in this paper, to examine the plausibility of these conclusions in multi-sectoral model of two-gap theory.

We shall expect rather negative plausibility of these conclusions in multi-sectoral model of two-gap theory. Each individual industry has its own pattern of commodity balance sheet. And the patterns of industries are different from each other; production of a industry is to be supported by imports for filling domestic use and production of the other industry needs either to increase its domestic use or to expand exports of the products. Thus the adjustment problem should be considered through commodity balance sheet by industry or by commodity. This refuses the adjustment problem to be considered in macro-economic level, because the macro-economic considerations are concerned only with net balance elements of all commodity balance sheets as a whole of the economy.

5. In addition to the multi-sectoral reformulation of two-gap theory we examine, in this paper, the adjustment problem presented by the conventional two-gap theory. The conventional two-gap theory considers adjustors to be imports for resource-gap majority case and savings for trade-gap majority case. We consider no objections in the resource-gap majority case. However, in the trade-gap majority case, we should reexamine the adjustment process through decrease in domestic savings. The trade-gap majority case is generated in over-production situation. But, as the economy is required to grow at a certain rate, we can not expect to decrease investment growth. Exports is considered to be expanded at the highest rate. After all, the conventional two-gap theory should consider domestic savings to be adjustor in this case.

This adjustment is, naturally, to be supported by net capital inflow from abroad as a part of economic aid to the developing country. However, we consider that the economic aid should contribute to increase the welfare level through improvement of industrial structure of the developing country. This means that the economic aid should not be used for direct increase in national welfare level without any round-about expansion of productive capacity. If a developing country may have excess products over domestic use, these excess products should be directed to exports, when the gains from exports should be used for expanding the productive capacity. The conventional two-gap theory, assuming the situation that exports of a developing country are kept at the largest extent as well as possible and can not expect its further expansion by itself, has been forced to assume savings as adjustor for the trade-gap majority case. However, when the developed countries can increase their imports from the developing countries by any means (for example, through the special preference

and the other trade policies), the adjustment problem takes a different phase in which exports may be increased by the help of developed countries. This sort of adjustment is not followed from the net capital inflow from abroad. But we consider this sort of adjustment to be accompanied by a sort of economic aid to help export expansion of the developing countries. Thus, we consider, the net capital inflow is effective for the resource-gap majority case, and the economic aid (for example, the special preference) to expand export of the developing countries is effective for the trade-gap majority case.

II. Model Construction

6. We consider, here, two kinds of industries, that are *export expanding industry* and *import substituting industry*. This is the minimum requirement to develop the two-gap theory in multi-sectoral model. The export expanding industry is the industry in which there is an excess product over domestic use and traditional exports. And the import substituting industry is the industry in which products of the industry can not fill domestic use and imports is needed for filling the shortage. These definitions are specified only for the developing countries, but not necessarily true for the developed countries. In the developed economy in which a foundation of industry is well performed, whether a commodity is to be domestically produced or not depends on a future change in comparative advantage of the commodity. But, in the developing economy in which a foundation of industry is not well performed yet, whether a commodity is to be domestically produced or not depends on the economy's decision how to organize the industrial structure in the future. For the developing economy, the structure of comparative advantages should be improved along the national plan of industrialization. However, all of the imported commodities of the developing economy are not necessary to be substituted by domestic production. Some of the commodities are to be left as imported goods so far. In this paper, we are assuming only two kinds of industries (the export expanding and the import substituting industries), so we define the import substituting industry to be the industry in which a part of products is imported.

7. We specify the i-th industry to belong to the export expanding industry A, and the j-th industry to belong to the import substituting industry B. Considering the characters of these respective industries, we have the relations

$$(7)\quad E_i \leqq X_i + M_i - D_i = E_i^* \qquad i \in A,$$

$$(8)\quad E_j \geqq X_j + M_j - D_j = E_j^* \qquad j \in B,$$

where E* stands for exportable surplus, which is excess supply of domestic

product and import over domestic use.

In the export expanding industry, as equation (1) shows, realized exports are smaller than exportable surplus. When the exportable surplus is larger than the realized exports, if exports can not be further expanded and production level of the exporting commodity can not be reduced, the commodity balance between demand and supply can be realized only through increase in domestic consumption caused by decrease in domestic savings. This adjustment does necessarily need a support through net capital inflow from abroad. However, when the developed countries might give the developing country more market to absorb the country's exportable surplus, the exports of the country could be expanded, and the commodity balance could be realized. This sort of alienation of market should be considered as a part of economic aid to the developing countries in place of capital aid.

In the import substituting industry, as equation (2) shows, realized exports are larger than exportable surplus. But the expression of equation (2) is in relation to the expression of equation (1). Actually, this sort of situation should be considered as a situation in which realized exports are zero and exportable surplus takes negative value.

$$(8^*) \quad 0 \geqq X_j + M_j - D_j = E_j^*$$

For the commodity that is produced in the import substituting industry, the domestic use is always larger than the domestic product, and the commodity balance is realized by more imports supported by net capital inflow from the other countries.

III. Amount of Aid Requirement

8. As we have shown above, there is a surplus of domestic product over domestic use in the export expanding industry, and the product of the import substituting industry comes short of domestic use. These respective situations decide amount of aid requirement in the corresponding industries.

9. At the first stage of our arguments, we assume that the exports of products of the export expanding industries can not be expected to further increase, and the level of production should not be decreased. In this case, the commodity balance can be realized only through decrease in domestic savings and increase in domestic use of the commodities concerned. However, for this sort of adjustment, the developing country needs the following amount of net capital inflow from abroad:

$$(9) \quad \sum L_i = \sum [(M_i - E_i) - (D_i - X_i)] + \sum (I_i - S_i), \; i \in A,$$

where the first term on the right side shows the requirement to decrease domestic savings or to increase domestic use of export expanding commodities, and the second term shows the net capital inflow requirement due to the resource-gap component of the export expanding industries.

As we have an identity

$$D_i - X_i \equiv I_i - S_i,$$

the equation (9) becomes

$$(9^*) \quad \sum L_i = \sum (M_i - E_i).$$

This stands for the trade-gap component of the export expanding industries. And the relation (9*) shows the two-gap thesis of net capital inflow requirement in the trade-gap majority case.

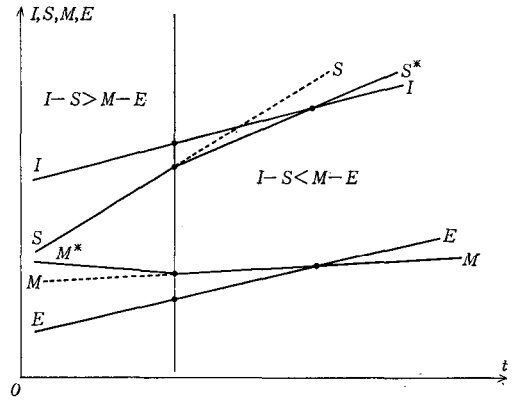


Figure 1

In order to make better explanation of the relation (9), we should consider the factors to decide the net capital inflow requirement as follows: the fundamental factor to decide the net capital inflow requirement is always the resource-gap. This part is shown by the second term of the right side of the relation (9). The basic idea of this sort of consideration is to cover the short of investment over domestic savings by introducing net capital inflow from abroad. However, in the trade-gap majority case in which there is a surplus of domestic product over domestic use, the short of foreign exchange to finance minimum import requirement over export earning is larger than the resource-gap, and this part should be financed by the net capital inflow from abroad, in addition to the net capital inflow requirement to be equal to the resource-gap. This part is shown by the first term of the right side of the relation (9). As mentioned above, in addition to the net capital inflow to be equal to the resource-gap, if the developing country can expect to receive the net capital inflow to be equal to the first term of the right side of the relation (9), the country can decrease its domestic savings

by the same amount, and increase its domestic use of commodities, then realize the commodity balance in the *ex-post* situation.

10. In the import substituting industry, on the other, the domestic product can not satisfy the domestic use. Then the short of domestic product over the domestic use should be supported by import that is financed by the net capital inflow. This adjustment needs the following amount of net capital inflow from abroad:

$$(10)\quad \sum L_j=\sum(I_j-S_j) \\ =\sum[(I_j-S_j)-(M_j-E_j)]+\sum(M_j-E_j),\ j\in B.$$

The net capital inflow requirement of the import substituting industry is equal to the resource-gap. For this case, the two-gap thesis is true in the original form. However, we should notice here that the resource-gap consists of both the part required for realizing commodity balances (the first term of the right side of the relation (10)) and the part to be equal to the short of foreign exchange to finance minimum import requirement over export earning (the second term of the right side of the relation (10)).

11. Thus, for the developing country concerned, total amount of net capital inflow requirement from abroad is

$$(11)\quad \sum L_i+\sum L_j=\sum(M_i-E_i)+\sum(I_j-S_j),\ i\in A,\ j\in B.$$

This is the grand total of the total of trade-gap components of the export expanding industries and the total of resource-gap components of the import substituting industries.

While the conventional two-gap theory has proposed that the net capital inflow requirement as a whole of the economy should be the major element among the resource-gap and the trade-gap, that is

$$(12)\quad L^*=\max\left[\sum(I_i-S_i)+\sum(I_j-S_j),\ \sum(M_i-E_i)+\sum(M_j-E_j)\right], \\ i\in A,\ j\in B.$$

Total amount of net capital inflow requirement shown by the relation (11) does not always equal to the total amount shown by the relation (12). If all industries of the developing country are either the export expanding industry or the import substituting industry, these two values of total amounts should be equalized. But, if not, the value of the relation (11) is always larger than the value of the relation (12).

$$(13)\quad L^*=\sum L_i+\sum L_j \begin{cases} i\in A,\ \phi\in B \\ \phi\in A,\ j\in B \end{cases}$$

$$(14)\quad L^*<\sum L_i+\sum L_j,\ i\in A,\ j\in B$$

No more explanations are needed for the relation (13). When all industries are

the export expanding industries, the total amount of net capital inflow requirement as a whole of the economy equals the total of the trade-gap components. While, if all industries are the import substituting industries, the total amount of net capital inflow requirement becomes the total of the resource-gap components.

For the relation (14), the proof can be given as follows: when the resource-gap is larger than the trade-gap as a whole of the economy,

$$\sum(I_i-S_i)+\sum(I_j-S_j)>\sum(M_i-E_i)+\sum(M_j-E_j),$$

the relation (12) becomes

$$L^*=\sum(I_i-S_i)+\sum(I_j-S_j).$$

On the other hand, the relation (11) requires

$$\sum L_i+\sum L_j=\sum(M_i-E_i)+\sum(I_j-S_j).$$

From these two relations, we have

$$(\sum L_i+\sum L_j)-L^*=\sum(M_i-E_i)-\sum(I_i-S_i),$$

where $\sum(M_i-E_i)$ is the trade-gap component of the expott expanding industry and $\sum(I_i-S_i)$ is the resource-gap component of the same industry. By definition,

$$\sum(M_i-E_i)>\sum(I_i-S_i).$$

Thus we have

$$\sum L_i+\sum L_j>L^*.$$

When the resource-gap is smaller than the trade-gap as a whole of the economy,

$$\sum(I_i-S_i)+\sum(I_j-S_j)<\sum(M_i-E_i)+(M_j-E_j),$$

the relation (12) takes the form

$$L^*=\sum(M_i-E_i)+\sum(M_j-E_j).$$

While, the relation (11) requires

$$\sum L_i+\sum L_j=\sum(M_i-E_i)+\sum(I_j-S_j).$$

From these two relations, we have

$$(\sum L_i+\sum L_j)-L^*=\sum(I_j-S_j)-\sum(M_j-E_j),$$

where $\sum(I_j-S_j)$ is the resource-gap component of the import substituting industry and $\sum(M_j-E_j)$ is the trade-gap component of the same industry. And, by definition,

$$\sum(I_j-S_j)>\sum(M_j-E_j).$$

Thus we have

$$\sum L_i+\sum L_j>L^*.$$

As mentioned above, in both the trade-gap majority case and the resource-gap majority case as a whole of the economy, the relation (14) can be true.

12. For any developing country, it may be not plausible that all industries of the country are either the export expanding industries or the import substituting industries. However, the conventional two-gap theory has assumed this sort

of implausible situation. Thus the two-gap theory should be reconstructed in multi-sectoral level in which both the export expanding industry and the import substituting industry are included. The net capital inflow requirement proposed by the conventional two-gap theory is necessarily smaller than the actual net capital inflow requirement.

IV. Numerical Example

13. Now, let us consider a simple numerical example. We consider four industries. Each industry produces only one kind of commodity. And we assume the commodity balances of respective industries, as shown by Table 1.

Table 1
Commodity Balance Sheet

Industry	E		E^*		X		M		D
(Case I)									
1	2	$<$	4	=	10	+	2	−	8
2	1	$<$	2	=	8	+	2	−	8
3	0	$>$	−1	=	5	+	6	−	12
4	0	$>$	−3	=	4	+	8	−	15
Σ	3	$>$	2	=	27	+	18	−	43
(Case II)									
1	2	$<$	4	=	10	+	2	−	8
2	1	$<$	2	=	8	+	2	−	8
3	1	$<$	3	=	8	+	6	−	12
4	0	$>$	−3	=	4	+	8	−	15
Σ	4	$<$	5	=	30	+	18	−	43

On the macro-economic level, Case I stands for the resource-gap majority case, and Case II shows the trade-gap majority case. And, on the sectoral level, the difference between Case I and Case II is concerned only with the 3rd industry, of which we assume the major trade-gap component in Case I and the major resource-gap component in Case II. The 1st and 2nd industries have their characters to keep the major resource-gap components, while the 4th industry has its character to maintain the major trade-gap component.

Based on these commodity balance sheets, both the resource-gap components and the trade-gap components of respective industries are calculated, as shown by Table 2.

Table 2
Resource-Gap and Trade-Gap Components

Industry	$I-S$		$M-E$
(Case I)			
1	−2	$<$	0
2	0	$<$	1
3	7	$>$	6
4	11	$>$	8
Σ	16	$>$	15

(Case II)			
1	−2	<	0
2	0	<	1
3	4	<	5
4	11	>	8
Σ	13	<	14

Here we calculate the resource-gap components of respective industries in the following way:

$$I_i - S_i = D_i - X_i.$$

Sectoral adjustors are selected according to the major gap component of each industry. This is, in principle, the same method to select the macro-economic adjustor in the conventional two-gap theory. Thus we have the values required for adjustment both in sectoral level and in macro-economic level, as shown by Table 3.

Table 3
Sectoral and Macro-economic Adjustments

Industry	S	M
(Case I)		
1	−2	
2	−1	
3		+1
4		+3
Σ	−3	+4
Net Adjustment in Macro-economic Level		+1
(Case II)		
1	−2	
2	−1	
3	−1	
4		+3
Σ	−4	+3
Net Adjustment in Macro-economic Level		−1

14. These numerical examples illustrate the followings:

Adjustors on the macro-economic level are imports to be increased by 1 in Case I with the major resource-gap, and savings to be decreased by 1 (or domestic use to be increased by 1) in Case II with the major trade-gap.

However, considering sectoral adjustors, we can find that the solution of adjustment problem on macro-economic level is not sufficient. Solution of sectoral adjustment problem in Case I is as follows:

(1) to increase domestic use of commodity 1 by 2,
(2) to increase domestic use of commodity 2 by 1,
(3) to increase imports of commodity 3 by 1, and
(4) to increase imports of commodity 4 by 3.

Over-productions in the 1-st and the 2-nd industries and under-productions in the 3-rd and the 4-th industries are the inhibited situations hebind these sectoral adjustments. The adjustments require to increase imports by 4 and to decrease savings by 3 (to increase domestic use by 3) in the whole economy. The solution of adjustment problem on the macro-economic level (to increase imports by 1) is to consider only the net balance of sectoral adjustments (4—3=1).

Similar findings come from Case II. Solution of sectoral adjustment problem in Case II is as follows:

(1) to increase domestic use of commodity 1 by 2,
(2) to increase domestic use of commodity 2 by 1,
(3) to increase domestic use of commodity 3 by 1, and
(4) to increase imports of commodity 4 by 3.

These are based on over-productions in the 1-st, 2-nd and 3-rd industries and under-production in the 4-th industry. The total adjustment as a whole of the economy is to increase imports by 3 and to decrease savings by 4 (to increase domestic use by 4). Thus, the solutions of adjustment problem on the macro-economic level (to decrease savings by 1 and to increase domestic use by 1) is to consider only the net balance of sectoral adjustments (−4+3=−1).

15. As mentioned above, the adjustment criterion on the macro-economic level has a crucial difficulty, in calculating the net capital inflow requirement from abroad, to consider only the net balance of sectoral adjustments. This causes an under-estimation of the net capital inflow requirement for the developing country. Our numerical examples show the under-estimations as in Table 4.

Table 4
Net Capital Inflow Requirements

Industry	Part due to Under-production		Part due to Over-production
(Case I)			
1			0
2			1
3	7		
4	11		
Σ	18	+	1=19>16
(Case II)			
1			0
2			1
3			5
4	11		
Σ	11	+	6=17>14

For Case I, the conventional two-gap theory, developed on the macro-economic level, estimates 16 of the net capital inflow requirement that is equal to the resource-gap as a whole of the economy. While, the sectoral consideration

suggests 19 of the net capital inflow requirement, in which 1 in the 1-st industry and 1 in the 2-nd industry are needed for increasing domestic uses of commodities 1 and 2 and 7 in the 3-rd industry and 11 in the 4-th industry are required for increasing imports of commodities 3 and 4. This shows that the estimated value 16 in the conventional two-gap theory falls short of the actual net capital inflow requirement. For Case II, sectoral consideration suggests 17 of the net capital inflow requirement. And this value is larger than the estimated value 14 in the conventional two-gap theory.

Thus we consider that the sectoral consideration is inevitably needed for estimating the net capital inflow requirement.

V. Exports Expansion through Aid

16. So far, we have assumed that no more export expansion can be expected than the traditional export expansion can be. Then the excess supply of commodity, if any, has been assumed to be absorbed by increase in domestic use through decrease in domestic savings. In this situation, the adjustment is considered to be supported by the net capital inflow from abroad. Considering that the export expanding industry of the developing country shall be, in many cases, consumer goods industry, this sort of adjustment can increase consumption level of the country, and increase welfare level of the economy. It is clearly desirable to decrease stimulus to save, to increase consumption level and to increase welfare level. However, it may be true only when the developing country can manage the net capital inflow by itself. At the present situation, almost all the developing countries are usually introducing the net capital inflow for their economic development through economic aid from the developed countries. Even if the increase in welfare level is supported by this sort of economic aid, it is rather desirable to increase the welfare level by any means, and the increase in welfare can not be denied. But, considering a general understanding that the developing country should do his best for economic development, it is not always desirable to use the net capital inflow (the aid from the developed country) for directly increasing the welfare level. The aid from the developed country should be used for expanding productive capacity of the developing country, except an emergency. And the increase in welfare level should be considered through the productive capacity expanded by help of the economic aid from the developed country. According to this sort of consideration, it may be not desirable to decrease domestic savings and to increase consumption level and welfare level in the export expanding industry with the major trade-gap component.

So far, we have assumed that no more exports can be expected than the traditional exports can be. Then we have considered the excess-supply of commodities should be absorbed by increase in domestic use through decrease in domestic savings. However, if the developed countries could increase their imports of the commodities from the developing countries in place of the economic aid (the net capital inflow from the developed countries to the developing countries), the excess-supply of the commodities might be absorbed by the expanded market of the developed countries. In this case, it becomes not necessary to increase domestic use of the commodities through decrease in domestic savings in the developing countries. Moreover, if this sort of measure is realized, an earlier closing of resource-gap comes to be realized, because more domestic savings can be maintained for a certain rate of growth of investment. However, we should expect more difficulties in expanding exports, even through the economic aid, not only for the developing countries but also for the developed countries. Opening of the market of the developed countries for the commodities from the developing countries may be possible through the special preference and the other trade policies for the developing countries, but, for making effective results from these trade policies for a long time, some adjustments in the industrial structure of the developed countries become inevitable. This sort of adjustment generates the other difficulties to be solved.

17. Even though we should expect some difficulties on process, the economic aid for the developing countries should take the forms of the net capital inflow and the opening of market for exports from the developing countries. The criterion is as follows: the net capital inflow should be considered as a part to be equal to the resource-gap, and the opening of market should be considered for an excess-part, if any, of trade-gap over resource-gap. The developed countries have agreed with the idea that the developing countries should realize a certain growth rate for taking-off the economies into their self-sustained situations, and that the developed countries should give their economic aid to the developing countries for the purpose. For this purpose, it is desirable that the developed countries will give the economic aid in the forms of the net capital inflow for expanding the productive capacity and of the opening of market for absorbing the excess-supply of commodities.

VI. Conclusion

18. Arguments developed in this paper make clear the following points:

(1) For estimating the net capital inflow requirement for the developing

country, the sectoral considerations are inevitably necessary. When the conventional two-gap theory, developed on macro-economic level, is used for this purpose, the estimated value becomes under-estimated.

(2) Excess-supply of commodity should, if any, be absorbed through export expansion, even though this expansion is supported by help of the developed countries as a part of the economic aid. When this is absorbed through increase in domestic use of the commodity, the economic development process of the developing country becomes less effective.

ACCOUNTING MEASUREMENT AND HOMOMORPHISM

Isao NAKANO

The aim of this paper is to apply the "homomorphism" concept in measurement theory to business accounting and thereby to provide a formal requirement for accurate accounting measurement.

I. Measurement, Isomorphism and Homomorphism

"The basis of accounting is measurement."(1) Measurement, it is said, is a process of mapping empirical characteristics or relationships into a formal model by assignment of numbers to objects and events according to any rule.(2) That is, "the purpose of measurement is to represent a given relation (or given relations) among objects by the predetermined relation (or relations) among the numbers."(3)

Ex. Assignment of a unique number is made to each student for identification (nominal scale). The chronological order of any two persons' years of birth can be determined by comparison of their ages (ordinal scale). The temperature of any object is expressed as a ratio of the difference between the object's warmth and that of the freezing water to the difference between the warmth of boiling water and that of freezing water in case of Celsius expression (interval scale). The number of books in a library is counted as a ratio of the number assigned to the last book counted to unit number 1 (ratio scale).(4)

The measurement theory tells us that whichever kind of number assignment is going to be made one important requirement for a successful representation of the relation among objects (principal) by a relation among the assigned numbers (surrogate) is "isomorphism" or "homomorphism" between both relations.

The term "isomorphism" may be roughly described as follows. Suppose that

(1) R. K. Jaedicke, Y. Ijiri and O. Nielsen (eds.), *Research in Accounting Measurement*, (Introductory Comment), American Accounting Association 1966, p. IX.

(2) S. S. Stevens, "Measurement, Psychophysics and Utility," in: C. W. Churchman and P. Ratoosh (eds.), *Measurement, Definition and Theories*, New York, 1959, p. 20.

(3) Y. Ijiri, *The Foundation of Accounting Measurement, A Mathematical, Economic and Behavioral Inquiry*, Englewood Cliffs, N. J. 1967, p. 22.

(4) Cf. Richard Mattessich, "Accounting and Analytical Methods," Richard D. Irwin, Inc. (Homewood, Ill.) 1964, Chapter 3, *Modern Measurement Theory and Accounting*. Norton M. Bedford, *Income Determination Theory: An Accounting Framework*, Addison-Wesley (Reading, Massachusetts) 1965, especially pp. 52–57.

a relation R has been defined among any two elements of a set A of measurement objects and that the relation is the principal to be represented by the measurement. Next we stipulate a set of those numbers (B) which are to be assigned to each measurement object (i.e. to each element of the set A), and we also define a relation S between two numbers of B. Then, a necessary condition for a proper measurement is that when the relation S is found between two measurement figures there must always exist the relation R (and not any other) between the corresponding measurement objects, because only in this case one can be sure of the existence of the principal relationship R on the basis of the surrogate relationship S. This condition is called "isomorphism."(5) (See Figure 1). A more strict definition of isomorphism is developed in Appendix A of this paper.

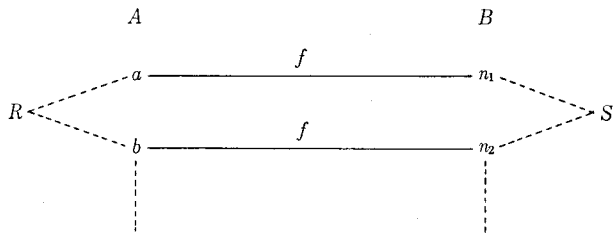


Figure 1

Ex. For identification of students different numbers n_a and n_b should be assigned to students a and b respectively if and only if a and b are different students (nominal scale). The proper representation of an ordinal relation requires that, for example, if and only if a person A was born earlier than another person B the number assigned to A should be smaller (or larger) than that given to B (ordinal scale). In case of measuring temperature, the four numbers n_a, n_b, n_c, and n_d as expressions of the temperatures of four objects a, b, c, and d must have the relationship $n_a \sim n_b > n_c \sim n_d$, if and only if the difference of the warmth between a and b is greater than that between c and d (interval scale). Finally, if and only if the stack of books numbers x times as many as one book, the number x times as large as that given to one book, that is, x should be assigned to the stack (ratio scale).

The isomorphism concept restricts number assignment in such a way that any one number is allowed to correspond to one object only. But in real accounting (and other) measurements it is possible and proper to assign a number to plural objects in the same situation. Hence we must rather adopt a modified concept, "homomorphism," which still requires the proper representation of

(5) P. Suppes and J. L. Zinnes, "Basic Measurement Theory," included in: R. D. Luce, R. R. Bush, E. Galanter (eds.), *Handbook of Mathematical Psychology*, Vol. 1, New York and London 1963, p. 6.

a principal relation R by a surrogate relation S but allows any one number to be assigned to plural objects.

II. Four Kinds of Homomorphism between Ideal Surrogate-Income and Real Surrogate-Income

In considering accounting income measurement, one must clearly distinguish between the "income as a numerical expression," that is, "surrogate-income" (ex. the income of ¥200) and the "income as a substantive object of accounting measurement," which we describe as "principal-income"(6) (ex. a net increase in total service potential of an enterprise in a time period).

But this principal-income cannot be compared with the surrogate-income directly, because the former is something not yet represented by numbers. (Ex. Consider a stack of books not yet counted as the principal of a measurement. When one gets a report that they number 52 one cannot check the correctness of this surrogate measure by means of any direct comparison of those books and that measure.) A comparison must rather be made between a given surrogate measure and another surrogate measure that one knows or acknowledges in advance to be true. So, we are led to introduce a concept, "ideal surrogate-income" as a true and proper numerical representation of the principal-income, whereas the term "real surrogate-income" may be given to that surrogate-income which has resulted from an actual accounting measurement under the conventional and technical restrictions of current accounting practice. In actual situations it would be impossible for a real surrogate-income to be equal to the ideal surrogate income except as a mere coincidence.

Principal-income ⟨ Ideal surrogate-income (conceptual construct)
Real surrogate-income (real existence)

Our problem is this: what specific relation must exist between the amount of an ideal surrogate-income and the amount of the corresponding real surrogate-income when one is justified in concluding that the periodic income is correct. The requirement for a correct income measurement will follow using the homomorphism concept as defined above.

We denote the ideal surrogate-income in period i as P_i and the corresponding real surrogate-income as P'_i. And a set of the ideal surrogate-income figures from period 1 through period n shall be P and a set of the real surrogate income figures during the same time-periods P'. That is,

(6) This distinction was explicitly made by Ijiri. Cf. Yuji Ijiri, "Physical Measures and Multi-Dimensional Accounting," in: *Research in Accounting Measurement, op. cit.*, p. 154.

$$P=\{P_1,\ P_2,\ \dots\ P_n\} \qquad (1)$$
$$P'=\{P'_1,\ P'_2\ \dots\ P'_n\}. \qquad (2)$$

The homomorphism concept requires that in order for an income measurement to be proper, "a certain relation" among the elements P_is in the set of the ideal surrogate-incomes P be homomorphically represented by "some relation" among the elements P'_is in the set of the real surrogate-incomes P'. Then, what is the relation to be represented in this way? There seem to be four alternatives.

(a) Homomorphism on difference (the same-or-not relation)

This kind of homomorphism requires that the existence of a difference among the ideal surrogate-incomes of different periods, if any, be faithfully represented by some relation among the real surrogate-incomes. So, assuming that $P_n=450$, $P_{n-1}=230$, what is necessary is merely to show the fact that P_n and P_{n-1} are different, so that any pair of the following measurements

$$P'_n=450,\ P'_{n-1}=230$$
or $P'_n=300,\ P'_{n-1}=200$
or $P'_n=50,\ P'_{n-1}=70$

will serve the purpose. The only requirement is that the values of the real surrogate incomes P'_n and P'_{n-1} be different from each other.

This kind of information, however, will scarcely satisfy the information needs of the interested groups of a firm. They will further seek such information as the direction and the degree of change in the periodic income. Hence, it will be utterly unrealistic to try to restrict the "relation" to be homomorphically represented by income measurement to this "difference" (the-same-or-not relation).

(b) Homomorphism on ordinal relation

If the "ordinal relation" (in the sense of the greater-or-less relation among things) is the only relation to be pictured on a relation among real surrogate incomes, the fact, say, that the ideal surrogate income for this period P_n is greater than that for some previous period P_m $(m<n)$ should follow the fact that the real surrogate income for this period P'_n is greater than that for the former period P'_m. (Or conversely, the measurement rule may as well be such that the relative increase in the ideal surrogate incomes be represented by the relative decrease in the real surrogate incomes and vice versa). But the important thing to note is that the increased or decreased amount (difference) in the real surrogate income need not be equal to the difference on the part of the ideal surrogate incomes, since the greater-or-less relation is all that is to be expressed. Therefore, when

$$P_n=100>P_m=90,$$

then the following alternatives will be permitted:

$$P'_n=100>P'_m=90$$
or $P'_n=50>P'_m=49$
or $P'_n=2>P'_m=1.$

But it is clear that this sort of income measurement is also too barren for actual accounting. The important information to be provided seems to include the knowledge not only on the increase or decrease as such but also on the extent of these changes.

(c) Homomorphism on the interval relation

As an illustration, the homomorphic representation of the "interval relation" in income measurement denotes the following thing.

Ex. When a sequence of ideal surrogate incomes is

$$P_n=100,\ P_{n-1}=90,\ P_{n-2}=80,\ P_{n-3}=60, \text{ that is,}$$
$$P_n-P_{n-1}(=10)<P_{n-2}-P_{n-3}(=20),$$

this kind of homomorphism requires such a sequence of real surrogate incomes as

$$P'_n=80,\ P'_{n-1}=70,\ P'_{n-2}=60,\ P'_{n-3}=40 \qquad (1)$$
or $P'_n=5,\ P'_{n-1}=4,\ P'_{n-2}=3,\ P'_{n-3}=1 \qquad (2).$

By such number assignments it is possible to secure the relations

$$P'_n-P'_{n-1}<P'_{n-2}-P'_{n-3} \text{ and}$$
$$\frac{P'_n-P'_{n-1}}{P'_{n-2}-P'_{n-3}}=\frac{P_n-P_{n-1}}{P_{n-2}-P_{n-3}}=\frac{1}{2},$$

so that the interval relation (as a quantitative relation among any two pairs) among ideal surrogate incomes is homomorphically represented by some relation among real surrogate incomes.

Certainly, more information will be provided by this measurement than by the measurements only capable of the homomorphic expression of difference (that is, the-same-or-not relation) or the ordinal relation. But the measurement in this category still fails to correctly represent the variation rate of incomes of any two periods. In the above example, the variation rate of the current period's ideal surrogate income to that of the period n−3 is

$$\frac{P_n}{P_{n-3}}=\frac{100}{60}=1.666\ (166.6\%).$$

But on the basis of the sequence of real surrogate incomes (1) above,

$$\frac{P'_n}{P'_{n-3}}=\frac{5}{1}=5.000\ (500\%)\neq 1.666.$$

This illustration will show the insufficiency of the income measurement which is only capable of the homomorphic representation of the interval relation above.

(d) Homomorphism on "ratio relation"

We define the ratio relation as the ratio of income figures of two different periods. So, an income measurement capable of homomorphically representing the ratio relation means such an income measurement that will measure the real surrogate income for each period such that the ratio of ideal surrogate incomes will equal the ratio of corresponding real surrogate incomes. For example, when $P_n=100$, $P_{n-1}=90$, then the pair $P'_n=100$, $P'_{n-1}=90$ or $P'_n=10$, $P'_{n-1}=9$ or $P'_n=20$, $P'_{n-1}=18$ will allow the homomorphic representation of the ratio of P_n and P_{n-1}, because

$$\frac{P_n}{P_{n-1}}=\frac{P'_n}{P'_{n-1}}=\frac{10}{9}.$$

There will scarcely be any room for doubt that an income measurement sufficing the requirement of this "homomorphism on ratio relation" is superior to any other measurement coming up to the standard of any one of the other three homomorphisms. The reasons are twofold: (1) that measurement can produce an accurate report on the variation rate of ideal surrogate incomes of a pair of periods, and (2) a homomorphic measurement of the ratio relation simultaneously provides information about the interval, ordinal, and nominal (the-same-or-not) relations. In reality, the coverage of the content of information provided by each of the four kinds of measurement can be denoted as follows.

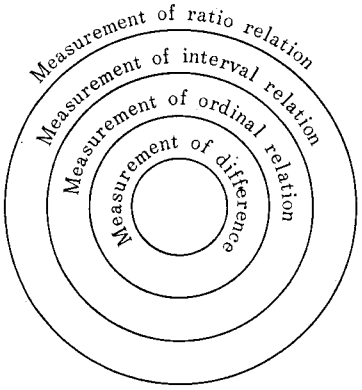


Figure 2

A proof on this point is given in Appendix B of this paper. We will show a numerical example demonstrating the proposition (2) above.

Let ideal surrogate incomes of four periods be $P_n=100$, $P_{n-1}=90$, $P_{n-2}=80$, and $P_{n-3}=60$. We assume a sequence of real surrogate incomes representative of the ratio relations of those income series homomorphically as $P'_n=10$, $P'_{n-1}=9$, $P'_{n-2}=8$, and $P'_{n-3}=6$. An "interval" relation as to that ideal income sequence will be

$$P_n-P_{n-1}(=10)<P_{n-2}-P_{n-3}(=20),$$

whereas the interval relation among the corresponding real surrogate incomes also is

$$P'_n - P'_{n-1}(=1) < P'_{n-2} - P'_{n-3}(=2).$$

Therefore, the interval relation is homomorphically expressed by this measurement (viz. by a measurement capable of homomorphically representing the ratio relation).

Further, the ordinal relation of those ideal incomes, say $P_n=100>P'_{n-1}=90$, is homomorphically represented by the ordinal relation of the corresponding real surrogate incomes $P'_n(=10)>P'_{n-1}(=9)$.

Finally, it would be almost needless to point out that the relation that the ideal income figures of the four periods are different (the-same-or-not relation) is homomorphically expressed by the different figures of the corresponding real surrogate incomes.

III. Homomorphism of Interperiod-Ratio and Homomorphism of Unit-Raito

So far, the homomorphism on ratio scale has been defined as a homomorphic representation of ratios of ideal surrogate incomes of different periods by the ratios of corresponding real surrogate incomes, which we call "homomorphism of interperiod-ratio(s)" (of incomes). Then, it follows that when a series of ideal surrogate incomes are

$$P_n=100,\ P_{n-1}=90,\ P_{n-2}=80,\ P_{n-3}=60,$$

the corresponding real surrogate incomes could be

$$P'_n=100,\ P'_{n-1}=90,\ P'_{n-2}=80,\ P'_{n-3}=60,$$

or $P''_n=10,\ P''_{n-1}=9,\ P''_{n-2}=8,\ P''_{n-3}=6.$

Now assume two firms have earned the same amount of ideal surrogate income in period n, i.e. $P_n=100$. The firm A is measuring income in such a way as to produce the real surrogate income series (P'_n, P'_{n-1}, P'_{n-2}, P'_{n-3}), so that its accounting income for period n, P'_n, is 100. On the other hand, the firm B calculates income such that the real surrogate income sequence (P''_n, P''_{n-1}, P''_{n-2}, P''_{n-3}) will result, so it reports an accounting income $P''_n=10$ for period n. In other words, the two firms A and B with the same earned ideal surrogate income turns out to measure and report different amounts of real surrogate income (100 vs. 10) and therefore show different profitabilities. We are led to conclude that assurance of the "homomorphism" defined above, viz. "homomorphism of interperiod-ratio" does not necessarily enable a correct comparison of income information of different firms.

This is similar to a misleading case where a person calls something "one book" but another insists that it is ten. So, we will have to recommend against the exclusive use of the "homomorphism of interperiod-ratio" as a standard for judging the propriety of accounting income measurement.

Hence we will try to develop a second ratio-homomorphism concept. Let us conceive a set Π consisting of ideal surrogate incomes of the periods 1 through n, i.e. $P_1, P_2, \ldots P_n$, as well as of the numeral 1 (as the unit of the numerical expression of income).

$$\Pi=\{1, P_1, P_2, \ldots P_n\}.$$

Further, another set Π' composed of real surrogate incomes $P'_1, P'_2 \ldots P'_n$ and the numeral 1 (as the unit of quantitative expression of these incomes).

$$\Pi'=\{1, P'_1, P'_2, P'_3 \ldots P'_n\}.$$

The second definition of ratio-homomorphism is that the ratio between each ideal surrogate income P_i and the measurement unit 1 in Π, viz. $P_i/1$ ($i=1, 2 \ldots n$) is homomorphically represented by the ratio between each corresponding real surrogate income P'_i and the measurement unit 1 in Π', that is, $P'_i/1$.

$$\frac{P_i}{1}=\frac{P'_i}{1}$$

$$\therefore \quad P_i=P'_i$$

In short, this kind of homomorphism requires that the amount of each ideal surrogate income be equal to the amount of the corresponding real surrogate income. Since this homomorphism concept involves an homomorphic expression of the ratio of each ideal surrogate income to the measuring unit, we can call it "homomorphism of unit-ratio." It will be clear that an income measurement coming up to the standard of the "homomorphism of interperiod-ratio" does not necessarily suffice the "homomorphism of unit-ratio," but that a measurement fulfilling the latter never fails to assure the former requirement.

Conclusion

I have analyzed the homomorphism concept in the context of accounting measurement. The following five variants of homomorphism have been brought to light:

1) homomorphism on difference,
2) homomorphism on the ordinal relation,
3) homomorphism on the interval relation,
4) homomorphism on the interperiod-ratio,
5) homomorphism on the unit ratio.

These are arranged in the order of increasing correctness of the accounting measurement. Let us assume that the ideal surrogate income concept has been properly defined in a way which fits the informational needs of the interested groups to a maximum degree. Then, the increasing correctness of accounting measurement as compared with this ideal surrogate income will probably correspond to the increasing usefulness of the outputs from this accounting practice.

An interesting research program suggests itself from this reasoning. That would go as follows.

1) Define the accounting income concept in the most (or in a sufficiently) useful way.

2) Derive a series of the ideal surrogate income numbers consistent with this concept.

3) Compare this series with the corresponding series of real surrogate income numbers, and determine, for each level of homomorphism, the extent to which this homomorphism has been achieved.

4) Apply appropriate techniques of statistical analysis to these results. It will enable you to determine the degree of usefulness of the prevalent accounting information.

Appendix A

The Definitions of Isomorphism and Homomorphism

In order for a measurement to be able to properly represent a relation among objects by a relation among numbers, both relations must have "the same structure." The "isomorphism" concept aims at defining this intuitive idea of "the same structure" more accurately.

We begin by defining a "relational system." A relational system is a form of a finite order $\alpha=<A, R_1, R_2 \ldots R_n>$, where A denotes a nonempty set of elements which we call the domain of the relational system and R_i $(i=1, 2 \ldots n)$ means a relation on A.

Ex. 1. Assume that A_1 is a set of all human beings living now, and R_1 a binary relation on A_1 such that aR_1b when and only when as to arbitrary two persons a and b in A_1 a was born earlier than b. Then, $\alpha_1=<A_1, R_1>$ is a relational system.

Next, we will define the "type" of a relational system. Let a sequence of n positive integers be $S=<m_1, m_2 \ldots m_n>$. It is possible that $m_i=m_j$. Then, $\alpha=<A, R_1 \ldots R_n>$ is called "of type S," when the relation R_i denotes a relation among m_i elements.

Ex. 2. The relational system α in the above Example 1 is of type 2.

And, assuming $\alpha_2=<A_2, P_2, T_2>$, where P_2 and T_2 are respectively binary relations on A_2, α_2 is said to be of type $<2, 2>$.

As another preparatory definition, two relational systems are called "similar" when they are of the same type (ex. when both are $<2, 3>$).

Now we are in a position of giving the general definition of "isomorphism." Assume that $\alpha=<A, R_1...R_n>$ and $\beta=<B, S_1...S_n>$ are similar relational systems. If there exists a one to one function f from A onto B and if for each i $(=1...n)$ and for each order of the elements of A $<a_1, a_2\ a_m>$, there exists R_i $(a_1...a_m)$ when and only when there is S_i $(f(a_1)...f(a_m))$, then β is called an "isomorphic image" of α. Instead of the term "isomorphic image," it is also said that α and β are "isomorphic."

When the condition that f is one to one is dropped, the above β is said to be a homomorphic image of α.

(The foregoing is a summary from: Patrick Suppes and Joseph L. Zinnes, *Basic Measurement Theory*, *op. cit.*, pp. 3–7. For a more rigorous explanation of isomorphism and homomorphism of relational systems, refer to: Yuji Ijiri, *The Foundations of Accounting Measurement, A Mathematical, Economic, and Behavioral Inquiry*, *op. cit.*, pp. 167–183.)

Appendix B

The Relation of the Four Kinds of Measurements

(a) The proof that a homomorphic measurement of a ratio-relation is capable of homomorphic measurement of interval relation, ordinal relation and difference (the same-or-not) relation at the same time.

We denote any two elements (components) of the given principal as a and b, and assume that by the measurement (capable of homomorphic representation of a ratio-relation) the numbers $f(a)$ and $f(b)$ are assigned to a and b respectively. We use the symbols a and b also for denoting the ideal surrogate measure of the elements of the principal a and b.

Since this measurement can represent the ratio relation on the principal homomorphically,

$$\frac{a}{b}=\frac{f(a)}{f(b)}=k \qquad -(1)$$

$$(b\neq 0,\ f(b)\neq 0).$$

Let any four elements of the principal be a, b, c and d. Then, the image of the interval relation of the principal $\frac{a-b}{c-d}$ is $\frac{f(a)-f(b)}{f(c)-f(d)}$, where at least either one of $f(c)$ and $f(d)$ is not equal to zero. Assuming $f(c)$ to be non-zero,

$$\frac{f(a)-f(b)}{f(c)-f(d)}=\frac{\frac{f(a)}{f(c)}-\frac{f(b)}{f(c)}}{1-\frac{f(d)}{f(c)}}=\frac{\frac{a}{c}-\frac{b}{c}}{1-\frac{d}{c}}$$

($\because$ this measurement can represent the ratio relation homomorphically)

$$=\frac{a-b}{c-d}. \qquad \text{—(2)}$$

The (2) above shows that a homomorphic measurement of ratio relation can also represent an interval relation homomorphically.

Secondly, taking arbitrarily two elements a and b of the principal P, where neither b nor $f(b)$ is zero,

$$f(a)-f(b)=f(b)\left\{\frac{f(a)}{f(b)}-1\right\}=f(b)\left(\frac{a}{b}-1\right)=\frac{f(b)}{b}(a-b). \qquad \text{—(3)}$$

When $\frac{f(b)}{b}>0$, the ordinal relation (greater-or-less relation) between a and b is evidently represented by the ordinal relation between $f(a)$ and $f(b)$ ($\because$ If $a>b$ then $f(a)>f(b)$. If $a<b$, $f(a)<f(b)$). Next, let $\frac{f(b)}{b}<0$. Then, if $a>b$, then $f(a)-f(b)<0$, that is, $f(a)<f(b)$. If $a<b$, then $f(a)>f(b)$. Therefore, in this case we can infer the ordinal relation of the principal from the ordinal relation of the measures properly, if we set the rule that the ordinal relation of the measures is the opposite of that of the components of the principal.

Finally, as to any two elements a and b of the principal P, from (1)

$$\frac{a}{b}=\frac{f(a)}{f(b)}=k,$$

so that $\frac{f(a)}{f(b)}\neq 1$ if and only if $a\neq b$. Accordingly, the difference (the same-or-not) relation of the components of the principal can be judged on the basis of whether the ratio between the corresponding measures is one.

(Q. E. D.)

(b) The proof that a homomorphic measurement of the interval relation can properly represent the ordinal and difference (the-same-or-not) relations but not necessarily measure the ratio-relation homomorphically.

Since the given measurement g can homomorphically represent the interval relation of the elements, a, b, c and d of the principal,

$$\frac{a-b}{c-d}=\frac{g(a)-g(b)}{g(c)-g(d)} \qquad \text{—(4)}$$

From (4)

$$g(a)-g(b)=\frac{g(c)-g(d)}{c-d}(a-b). \qquad -(5)$$

From (5), if $\frac{g(c)-g(d)}{c-d}>0$, then $g(a)>g(b)$ when and only when $a>b$ and $g(a)<g(b)$ when and only when $a<b$. Hence, this measurement (g) can measure the ordinal relation (the greater-or-less relation) of the principal homomorphically. Conversely, if $\frac{g(c)-g(d)}{c-d}<0$, then $g(a)<g(b)$ when $a>b$ and $g(a)>g(b)$ when $a<b$. Therefore, in this case one can infer the ordinal relation of the principal from that of the measures on the knowledge that the ordinal relation of the measures is the opposite of that on the principal.

Next, in (5), $\frac{g(c)-g(d)}{c-d}\neq 0$ ($\because$ if $\frac{g(c)-g(d)}{c-d}=0$, then $\frac{g(a)-g(b)}{a-b}=0$, which means that though $a-b\neq 0$, $g(a)-g(b)=0$. This, however, contradicts (4)), so that $g(a)=g(b)$ when and only when $a=b$, and $g(a)\neq g(b)$ when and only when $a\neq b$. Therefore, this measurement (g) measures the difference relation homomorphically.

In order to prove that a homomorphic measurement of the interval relation (g) does not necessarily represent the ratio relation homomorphically, it will be sufficient to give a single example, which was already provided on page 47 of this paper.

(Q. E. D.)

(c) The proof that a homomorphic measurement of the ordinal relation can represent the difference relation properly but cannot necessarily measure the interval (hence also the ratio) relation homomorphically.

If a measurement cannot accurately represent the difference relation on the principal, it means that either (a) the fact that $a\neq b$ is expressed as $a=b$, or (b) the situation that $a=b$ is expressed as $a\neq b$. And both of these measurements clearly represent the ordinal relation between a and b incorrectly. Therefore, a homomorphic measurement of the ordinal relation never fails to measure the difference relation homomorphically.

In order to prove that a homomorphic measurement of the ordinal relation cannot necessarily represent the interval relation properly, it will be sufficient to show a single example, which, however, was already given on pp. 46–47 of this paper.

(d) The proof that a homomorphic measurement of the difference relation cannot necessarily reflect the ordinal relation (hence also the interval or ratio relation) homomorphically.

The showing of a single example will be sufficient for this purpose, and such an example was already given on pp. 46 of this paper.

AN INTERPRETATION OF TWO STAGE LEAST SQUARES ESTIMATORS AS INDIRECT LEAST SQUARES ESTIMATORS IN THE OVERIDENTIFIED CASE*

Hiroshi SADAMICHI

The applicability of the indirect least squares method is limited to the just-identified equation, in which case there is proved to be an identity between the two-stage and the indirect least squares estimators. This study is to extend the indirect least squares method to the over-identified case and to derive an identity between the two-stage and the extended indirect least squares estimators.

I. Introduction

The two stage least squares (2SLS) estimators have been interpreted in terms of the instrumental-variables,(1) the k-class,(2) or the double k-class estimators.(3) The 2SLS method was originally elaborated by Theil and Basmann independently in order to cope with the problem of estimating the overidentified equation which the indirect least squares method could not handle. In this note we present an interpretation of the 2SLS estimators, which might be of special interest since it is closely related to that old indirect least squares method in the overidentified case.

II. The Problem

The model we are considering is linear, with G equations, and contains as variables $y_1 \ldots y_G$, $z_1 \ldots z_K$, $u_1 \ldots u_G$, each of which is a column vector of T components. Each component of any variable is defined as the observed value or its equivalent divided(4) by the square root of T.

$$YB = Z\Gamma + U$$

* This is the revision of my original paper which was read at the Kansai conference of the Japanese Association of Theoretical Economics held in June, 1968.

(1) See Klein (1955), Zellner and Theil (1962).

(2) See Theil (1958).

(3) See Maeshiro (1966), Oi (1969), Dhrymes (1969).

(4) The same treatment of variables is done in Basmann (1957).

where $Y=(y_1 \ldots y_G)$, $Z=(z_1 \ldots z_K)$, $U=(u_1 \ldots u_G)$, $B=(\beta_{gh})$, $\Gamma=(\gamma_{jk})$. The y's are the jointly dependent variables. The z's are the predetermined and linearly independent variables and their moment matrix is assumed to be well behaved in the limit.[5]

$$\lim_{T\to\infty} Z'Z=\lim_{T\to\infty} E\ Z'Z=M$$

where both limits exist and M is a nonsingular constant matrix independent of T. The u's are the random variables, which are mutually independent except contemporaneously, and each variable is serially independent and homoskedastic with zero mean.

$$Eu_i=0.\quad Eu_iu_j'=\frac{\sigma_{ij}}{T}\cdot I_T$$

where I_T is the identity matrix of order T and σ_{ij} is a finite constant. The β's and γ's are the constant parameters and some of them are specified a priori to be zero so that each model-equation may be identified. B is assumed to be nonsingular. The reduced form may be written as

$$Y=Z\Pi+V$$

where $\Pi=\Gamma B^{-1}$, $V=UB^{-1}=(v_1 \ldots v_G)$. Each reduced-form random variable is serially independent and homoskedastic with zero mean.

$$Ev_i=0,\quad Ev_iv_j'=\frac{w_{ij}}{T}\cdot I_T$$

where w_{ij} is a finite constant.

Let us consider the i-th model-equation of the model. It contains H jointly dependent and J predetermined variables. Rewriting it as an explicit function of the explained variable and renumbering some variables, we can obtain

$$y_i=Y_i\beta_i+Z_i\gamma_i+u_i$$

where $Y_i=(y_{i_2} \ldots y_{i_H})$, $Z_i=(z_{i_1} \ldots z_{i_J})$, $\beta_i'=(\beta_{i_2} \ldots \beta_{i_H})$, $\gamma_i'=(\gamma_{i_1} \ldots \gamma_{i_J})$. Z may be written as

$$Z=(Z_i,\ Z_i^*)$$

where Z_i^* is the matrix of those predetermined variables which appear in the model but not in the i-th equation. The reduced-form equations corresponding to H jointly dependent variables are then given by

$$y_i=Z_i\pi_{i1}+Z_i^*\pi_{i2}+v_i$$
$$Y_i=Z_i\Pi_{i1}+Z_i^*\Pi_{i2}+V_i$$

where π_{i1}, π_{i2}, Π_{i1} and Π_{i2} are the corresponding submatrices of Π and $V_i=(v_{i_2} \ldots v_{i_H})$. Postmultiplying the second equation by β_i and subtracting from the

(5) See Christ (1966), pp. 354–355.

first equation yields

$$y_i - Y_i\beta_i = Z_i(\pi_{i1} - \Pi_{i1}\beta_i) + Z_i^*(\pi_{i2} - \Pi_{i2}\beta_i) + (v_i - V_i\beta_i).$$

Comparing with the model-equation we have the identifiability relation — the relation between the model-equation parameters and the reduced-form coefficients,

$$\pi_{i1} = \Pi_{i1}\beta_i + \gamma_i$$
$$\pi_{i2} = \Pi_{i2}\beta_i$$

and the relation between the disturbances of the model-equation and the reduced form,

$$u_i = v_i - V_i\beta_i.$$

Since the model-equation is identified the rank of (π_{i2}, Π_{i2}) is (H-1) and β_i is uniquely determined.

Our interest lies in estimating the model-equation parameters β_i and γ_i. We can not obtain the desirable estimators of β_i and γ_i by applying the least squares method to the model-equation since Y_i is correlated with u_i. However the classical least squares estimators of the reduced-form parameters have desirable properties.(6) The idea of the indirect least squares method is to obtain the desirable estimators of β_i and γ_i indirectly from the identifiability relation with the use of the least squares estimators of the reduced-form parameters but not directly from the model-equation in question.

$$\hat{\pi}_{i1} = \hat{\Pi}_{i1}\beta_i + \gamma_i$$
$$\hat{\pi}_{i2} = \hat{\Pi}_{i2}\beta_i$$

where $\hat{\pi}_{i1}$, $\hat{\pi}_{i2}$, $\hat{\Pi}_{i1}$ and $\hat{\Pi}_{i2}$ are the least squares estimators. In the just-identified case where there are as many equations as unknowns the above system can be solved uniquely for β_i and γ_i.

$$\hat{\beta}_i = \hat{\Pi}_{i2}^{-1}\hat{\pi}_{i2}$$
$$\hat{\gamma}_i = \hat{\pi}_{i1} - \hat{\Pi}_{i1}\hat{\Pi}_{i2}^{-1}\hat{\pi}_{i2}$$

These are called the indirect least squares estimators. The trouble with this method is that in the over-identified case where there are more equations than unknowns the rank of $(\hat{\pi}_{i2}, \hat{\Pi}_{i2})$ is H in general and that no set of values of β_i exist that will satisfy the system.

Let us write the classical least squares estimators of the reduced form.

$$\begin{pmatrix}\hat{\pi}_{i1}\\ \hat{\pi}_{i2}\end{pmatrix} = (Z'Z)^{-1}Z'y_i = \begin{pmatrix}\pi_{i1}\\ \pi_{i2}\end{pmatrix} + (Z'Z)^{-1}Z'v_i$$

(6) See Mann and Wald (1943), Durbin (1960).

$$\begin{pmatrix}\hat{\Pi}_{i1}\\ \hat{\Pi}_{i2}\end{pmatrix}=(Z'Z)^{-1}Z'Y_i=\begin{pmatrix}\Pi_{i1}\\ \Pi_{i2}\end{pmatrix}+(Z'Z)^{-1}Z'V_i$$

Substituting into the identifiability relation we have

$$\begin{pmatrix}\hat{\pi}_{i1}\\ \hat{\pi}_{i2}\end{pmatrix}=\begin{pmatrix}\hat{\Pi}_{i1}\\ \hat{\Pi}_{i2}\end{pmatrix}\beta_i+\begin{pmatrix}I_J\\ 0\end{pmatrix}\gamma_i+u_i^+$$

$$u_i^+=(Z'Z)^{-1}Z'u_i.$$

It is no longer exact like the identifiability relation but stochastic. This stochastic property prevents the existence of the unique solution of β_i in the overidentified case when we use the indirect least squares method. Since we can not solve it by neglecting the random part, i. e., by the indirect least squares method, we may estimate it by taking care of the error term. It seems meaningless at first sight to estimate the parameters β_i and γ_i of this stochastic identifiability relation. However we may regard it as an ordinary stochastic model because it is nothing but a linear transform of the model-equation through the transformation matrix given by $(Z'Z)^{-1}Z'$. We shall call it the derived form of the model-equation.

It will be shown that the derived form satisfies all the assumptions of the generalized least squares method asymptotically. The expectation and the covariance matrix of the error term are asymptotically

$$lim\ E\ \sqrt{T}\ u_i^+=0$$

$$lim\ E\ (\sqrt{T}u_i^+)\ (\sqrt{T}u_i^+)'=\sigma_{ii}\ plim\ (Z'Z)^{-1}$$

and the explanatory variables are nonstochastic in the limit.

$$plim\begin{pmatrix}\hat{\Pi}_{i1}\\ \hat{\Pi}_{i2}\end{pmatrix}=\begin{pmatrix}\Pi_{i1}\\ \Pi_{i2}\end{pmatrix}$$

Thus, applying the generalized least squares method(7) to this derived form by using the estimated covariance matrix given by $\frac{\sigma_{ii}}{T}(Z'Z)^{-1}$ we can obtain the estimators of β_i and γ_i which have such desirable properties asymptotically as the generalized least squares estimators do.

$$\begin{pmatrix}\hat{\beta}_i\\ \hat{\gamma}_i\end{pmatrix}=\left[\begin{pmatrix}\hat{\Pi}_{i1} & I_J\\ \hat{\Pi}_{i2} & 0\end{pmatrix}'(Z'Z)\begin{pmatrix}\hat{\Pi}_{i1} & I_J\\ \hat{\Pi}_{i2} & 0\end{pmatrix}\right]^{-1}\begin{pmatrix}\hat{\Pi}_{i1} & I_J\\ \hat{\Pi}_{i2} & 0\end{pmatrix}(Z'Z)\begin{pmatrix}\hat{\pi}_{i1}\\ \hat{\pi}_{i2}\end{pmatrix}$$

We may call them the (extended) indirect least squares estimators, which become indentical with the well-known indirect least squares estimators in the just-identified case. As seen below in the over-identified case they are identical with the 2SLS estimators.

(7) We could apply the classical least squares method to the derived form, in which case the resulting estimators would be less efficient and have nothing to do with the 2SLS estimators.

$$\begin{aligned}\begin{pmatrix}\hat{\beta}_i\\ \hat{\gamma}_i\end{pmatrix}&=\left[\begin{pmatrix}Y_i'Z(Z'Z)^{-1}\\ Z_i'Z(Z'Z)^{-1}\end{pmatrix}(Z'Z)\begin{pmatrix}(Z'Z)^{-1}Z'Y_i, & (Z'Z)^{-1}Z'Z_i\end{pmatrix}\right]^{-1}\\ &\times\begin{pmatrix}Y_i'Z(Z'Z)^{-1}\\ Z_i'Z(Z'Z)^{-1}\end{pmatrix}(Z'Z)\begin{pmatrix}(Z'Z)^{-1}Z'y_i\end{pmatrix}\\ &=\begin{pmatrix}Y_i'Z\ (Z'Z)^{-1}Z'Y_i & Y_i'Z_i\\ Z_i'Y_i & Z_i'Z_i\end{pmatrix}^{-1}\begin{pmatrix}Y_i'Z(Z'Z)^{-1}Z'\\ Z_i'\end{pmatrix}y_i\\ &=\begin{pmatrix}Y_i'Y_i-\hat{V}_i'\hat{V}_i & Y_i'Z_i\\ Z_i'Y_i & Z_i'Z_i\end{pmatrix}^{-1}\begin{pmatrix}Y_i'-\hat{V}_i'\\ Z_i'\end{pmatrix}y_i\end{aligned}$$

where $\hat{V}_i=Y_i-Z(Z'Z)^{-1}Z'Y_i$.

Thus we have shown the identity between the 2SLS and the (extended) indirect least squares estimators. The relationship between the 2SLS estimators and the identifiability relation has also been clarified.

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A NOTE ON THE ONE-DIMENSIONAL RANDOM SEARCH

Komayuki Itow

Recently a number of search methods, called the branch-and-bound methods have been developed: integer programming, nonlinear programming, the travel salesman problem, the quadratic assignment problem, nonmathematical programming applications (see reference [3] for survey of these applications). Various papers exploring some basic characteristics of branch-and-bound methods have been published. Among these, the general formulations of L. G. Mitten is an interesting work. The purpose of our note is to state the one-dimensional random search according to the general formulation by Mitten.

I. The Formulation of L. G. Mitten

Basic element: Let S be an arbitrary set, let $f : S \to R$ be a real valued function and let

$$sup_{x \in S}\ f(x) = f^*.$$

The problem is to find the set of optimal feasible solutions S^*, where

$$S^* = \{x^* \mid x^* \in S \text{ and } f(x^*) = f^*\}.$$

It is assumed that T is a super set of $S (S \subset T)$ with extension g of f,

$$g : T \to R,$$

that is,

$$g(x) = f(x) \text{ for all } x \in S$$

and that $\tau = 2^T$ and $Z = 2^\tau$.

For notational convenience, $U(t)$ will denote

$$\{x \mid x \in \cup T_i,\ T_i \in t \text{ and } t \in Z\}.$$

The computational procedure requires that there exists a collection t_0 where

(a) $U(t_0) \subset T - S$,

(b) all singleton nonfeasible subsets are included in t_0, that is, if $x \in T - S$, then $\{x\} \in t_0$ (see reference [2] for the meaning of these basic elements).

II. Branching

The branching rule is a function $\beta : Z \to Z$ with the following properties:

(a) $U(\beta(t))=U(t)$;
(b) $T_i'\in\beta(t)$ only if $T_i'\subset T_i\in t$;
(c) $\beta(t)\neq t$ if and only if t contains a subset T_i consisting of more than one element.

III. Bounding

(1) The upper bounding rule is a function B: $\tau\to R$ with the following properties:
(a) $g(x)\leqq B(T_i)$ for all $x\in T_i\subset T$;
(b) $B(T_i')\leqq B(T_i)$ if $T_i'\subset T_i\subset T$;
(c) $B(\{x\})=g(x)$.
(2) The lower bounding rule is a function b: $Z\to R$ with the following properties for any collection t:
(a) $b(t)\leqq f^*$;
(b) $b(\beta(t))\geqq b(t)$;
(c) $b(t)\geqq f(x)$ if $x\in S$ and $\{x\}\in t$;
(d) $b(t')=b(t)$ if $t'\subset t$ and for every $T_i\in t-t'$, either $T_i\in t_0$ or $B(T_i)<b(t)$.

IV. Branch-and-Bound

The branch-and-bound recursive operation is a function B: $Z\to Z$ with the property that, if

$$\beta(t')=t,$$

then

$$B(t')=t-t^-$$

where

$$t^-=(t\cap t_0)\cup\{T_i\,|\,T_i\in t \text{ and } B(T_i)<b(t)\}.$$

The operation B yields a sequence $\{t^n\}_{n>0}$ defined $t^{n+1}=B(t^n)$ for $n>0$ if applied to any collection t'.

V. One-dimensional Random Search

Suppose we are confronted with an optimization problem of the form: maximize $f(x)$ subject to
f: an unknown concave unimodal function,
f: $S\to R$,
S: $\{x\,|\,x\in R \text{ and } a<x<b\}$,

R: the set of real numbers.

The function $f(x)$ is unknown. However, any particular value of $f(x)$ can be evaluated. A concave unimodal function $f(x)$ has the following property. There exists a number x_0, $a<x_0<b$ such that $f(x_1)<f(x_2)$ for $(x_1, x_2)\in\{(x_1, x_2) \mid x_1<x_2\leq x_0$ and $x_1, x_2, x_0\in S\}$ and $f(x_1)<f(x_2)$ for $(x_1, x_2)\in\{(x_1, x_2)\mid x_1>x_2\geq x_0$ and $x_1, x_2, x_0\in S\}$.

Now, we are going to introduce the basic structure of our random search (see reference [4] for details).

Assume that $f(x_1)$ and $f(x_2)$ are computed respectively where both $x_1(\in S)$ and $x_2(\in S)$ are random variables with a uniform distribution over S. Let $x_1<x_2$ be assumed. Then, since the function f is unimodal, one of the following cases holds exclusively;

case (a) $f(x_1)<f(x_2)$ for $x_1, x_2\in S$,

case (b) $f(x_1)>f(x_2)$ for $x_1, x_2\in S$.

(We disregard the unit probability event that $f(x_1)\neq f(x_2)$.)

For reasons of symmetry we take $f(x_1)>f(x_2)$ without generality. If $f(x_1)>f(x_2)$, the interval to search is reduced to (a, x_2) for the unimodality of f.

A third additional random variable x_3 with a uniform distribution (a, x_2) is chosen. Note that f has been computed at the point x_1 within the interval (a, x_2) and that x_1 is a point with a uniform probability density on the interval (a, x_2). Thus, x_1 and x_3 are random variables with the uniform distribution over (a, x_2). The interval to search is determined by the same procedure as described above.

Let y_1, y_2 be defined as follows;

$$y_1=\min\{x_1, x_3\}$$
$$y_2=\max\{x_1, x_3\}$$

If

$$f(y_1)<f(y_2),$$

the interval to search is reduced to (y_1, x_2), while, if

$$f(y_1)>f(y_2),$$

the interval to search is (a, y_2). Thus the computed point within the interval to search has a uniform probability density on the interval to search. Therefore, the procedure which corresponds to the n-th search is the same as in the above procedure.

VI. Branch-and-Bound Property of One-dimensional Random Search

The branch-and-bound principle will be applied to the above one-dimen-

sional random search.

We choose

$$T=\{x \mid x\in R \text{ and } a\leq x\leq b\}$$

as the superset of S with extension g of f,

$$g: T\to R.$$

The branching rule β:

$$\beta(t)=\{T_1,\ T_2,\ T_3\}$$

where (let x_1, x_2 be random variables with a uniform distribution over $(c,\ d)$.)

$$t=\{(c,\ x_1),\ (x_1,\ d) \mid c<x_1<d \text{ and } c,\ x_1,\ d\in S\},$$
$$y_1=\min\ \{x_1,\ x_2\},$$
$$y_2=\max\ \{x_1,\ x_2\},$$
$$c,\ y_1,\ y_2,\ d\in S,$$
$$T_1=(c,\ y_1),$$
$$T_2=(y_1,\ y_2),$$
$$T_3=(y_2,\ d)$$

The upper bounding rule B:

$$g(x)\leqq B(T_1)=g(y_1) \text{ for } x\in T_1, \text{ if } g(y_1)<g(y_2),$$
$$g(x)\leqq B(T_3)=g(y_2) \text{ for } x\in T_3, \text{ if } g(y_1)>g(y_2).$$

The lower bounding rule b:

$$b[\beta(t)]=\max\{g(y_1),\ g(y_2)\}.$$

VII. Branch-and-Bound

The branch-and-bound recursive operation B:

$$B(t)=\beta(t)-t^-$$

where

$$T_1\in t^- \text{ if } B(T_1)<b(\beta(t)) \text{ or}$$
$$T_3\in t^- \text{ if } B(T_3)<b(\beta(t)).$$

For some collection t^1, the branch-and-bound recursive operation generates the sequence $\{t^n\}_{n>0}$ with $t^{n+1}=B(t^n)$ for $n>o$. The sequence $\{t^n\}_{n>0}$ converges to $t^*=x_0$ with unit probability in the limit.

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EXCHANGE RATE SYSTEMS AND DISTRIBUTION OF SEIGNIORAGE

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Introduction

Many economists are seeking for an international monetary system in which international trade and payments can operate smoothly. Though the adjustable-peg system has been used, many economists are thinking that the flexible exchange rate system is preferable. Comparing the exchange rate systems, we analyze them in this paper, from the view point of distribution of seigniorage among countries.

For this pupose, we must make clear not only the static properties but also the dynamic properties of the exchange rate systems, because the long-run aspects are important. And we clarify how seigniorage is distributed under fixed or flexible exchange rate systems, among countries.

In section I, we build a growth model for the fixed exchange rate system, then examine its static feature in section II, and we show its dynamic feature in section III. In section IV, the properties of the flexible exchange rate system are discussed, and in section V we make a comparative analysis of the exchange rate systems.

I.

We make a simple model in which the essential parts of the problems are retained.

We begin with the case of the fixed exchange rate system. The following presumptions are made. We take a world composed of two countries, a key currency country and a non-key currency country. Although there are in fact two kinds of currencies, it seems by choosing the currency unit which makes the exchange rate unity that only one currency is used. There is only one sort of goods, which can be used as well for consumption as for investment, for export as well as import. Perfect competition prevails and by the interactions of the behaviour of economic units (governments and private sectors), the equilibriums of the whole markets are reached.

It is convenient to list the notations used here. Note that "per-capita"

implies normalization with the amount of labour in the world and "real" implies representation in terms of goods.

k_a: per-capita quantity of capital stock in country A
k_b: per-capita quantity of capital stock in country B
m_a: per-capita amount of currency in country A
m_b: per-capita amount of currency in country B
l_a: per-capita amount of demand for currency in real terms in country A
l_b: per-capita amount of demand for currency in real terms in country B
y_a: per-capita level of national income produced in country A
y_b: per-capita level of national income produced in country B
b: per-capita balance of payments in real terms of country B
p: price level of money (inverse of general price level)
e_a: per-capita quantity of government expenditure in country A
e_b: per-capita quantity of government expenditure in country B
t_a: per-capita tax in country A
t_b: per-capita tax in country B
θ: rate of increase of the amount of key currency
r_a: marginal productivity of capital goods in country A
r_b: marginal productivity of capital goods in country B
π_e: expected rate of increase of P
n: rate of growth of labour
s_a: marginal or average propensity to save in country A
s_b: marginal or average propensity to save in country B

For the government sector, we assume the following behaviour. In the key currency country (country A), the government expenditure is met by taxation and creation of new currency. In the other country (country B), a balanced budget is adopted. Further we assume that the government expenditure in each country is directed to consumption goods only. The newly issued amount of currency in country A is equal to the budget deficit and some part of it flows out to country B, corresponding to the balance of payments deficit of country A, then the amount of domestically circulating currency increases in country B. Therefore, three kinds of policy instruments are available, money creation in country A and taxations in both countries.

We formulate the policies of the government sectors as follows. For country A:

$$(e_a-t_a)/P=\theta(m_a+m_b) \qquad (1)$$

that is, the government deficit of country A is equal to the amount of increase in total currency of the world. And for country B:

$$e_b = t_b \tag{2}$$

Both capital and labour are used to produce goods, but there are no international movements of production factors. We assume that they have the same quality in both countries and the amount of labour is growing at the same rate n. Production functions have the usual neoclassical well-behaved properties such as homogeneity of degree one, decreasing marginal productivity etc., and also are identical in both countries. So, the level of per-capita national income produced and the marginal productivities y_a, r_a and y_b, r_b are determined by capital-labour ratios k_a and k_b, respectively.

We specify the demand pattern of each private sector as follows. The demand for goods is determined by disposable income; for simplicity it is assumed to be a certain proportion of the disposable income. The demand for financial assets is determined by the income produced and the rate of returns for assets. Generally, the total value of assets is also an element which affects the amount of demand for assets, but we may neglect it, assuming that there is no market for capital goods. The demand for investment goods is the difference between the savings and the amount of the increased demand for financial assets.

Supposing that the amount of demand for currencies in real terms l_a and l_b are determined respectively by y_a, r_a, π^e and y_b, r_b, π^e, the market equilibrium of currency can be formulated as:

$$P(1+\theta)(m_a+m_b) = l_a(y_a, r_a, \pi^e) + l_b(y_b, r_b, \pi^e) \tag{3}$$

presuming that there are no markets for capital stock and price changes of them need not be considered. Though there are two markets, goods and currency, one of them is not independent by the Walras' Law.

The balance of payments of country B in real term is defined as:

$$b \equiv l_b - Pm_b \tag{4}$$

that is, as the monetary approach shows, the excess demand for currency is filled with the balance of payments surplus. Some parts of the increased amount of country A's currency are held by country B:

$$e_a - t_a = b + l_a - Pm_a \tag{5}$$

When k_a, k_b, m_a, m_b are constant, θ is given and π^e is determined exogenously, the equation (3) gives the static equilibrium value of P. As the left hand side of the equation (3) is an increasing function of P and the right hand side of it is

(1) The case where country B also increases the amount of domestic currency, will be referred to in the later sections.

independent of P, the equilibrium price level is determined uniquely and this system is stable.

II.

The properties of this static system can be seen by analyzing the equation (3). As its left hand side is constant, the amount of currency and its price level move inversely, which is a quantity theory of money.

We proceed to the analysis of comparative statistics. By differentiating the equation (3) with respect to k_a and k_b, we can see the directions of changes of the price level:

$$\frac{dP}{dk_a}=\frac{\alpha}{(1+\theta)(m_a+m_b)} \tag{6}$$

$$\alpha\equiv l_y^a y_k^a+l_r^a r_k^a$$

$$\frac{dP}{dk_b}=\frac{\beta}{(1+\theta)(m_a+m_b)} \tag{7}$$

$$\beta\equiv l_y^b y_k^b+l_r^b r_k^b$$

where, $l_y^a\equiv\partial l_a/\partial y_a$, $l_r^a\equiv\partial l_a/\partial r_a$, $y_k^a\equiv\partial y_a/\partial k_a$, $r_k^a\equiv\partial r^a/\partial k_a$ for country A, and similar notations are used for country B. Since l_y^a, l_y^b, y_k^a, y_k^b are positive and l_r^a, l_r^b, r_k^a, r_k^b are negative, dP/dk_a and dP/dk_b are positive. As the capital stock increases, its marginal productivity decreases and a demand shift from capital to currencies occurs. There are increases of the levels of per-capita income, which in turn increase the amount of the demand for currencies. Thus, the price level of the currency increases.

By the changes of monetary policy, P is affected as follows:

$$\frac{dP}{d\theta}=-\frac{P}{1+\theta}<0 \tag{8}$$

that is, the increase of the rate of supply of currency, accompanying a rise in the general price level. Furthermore, when π^e changes, it becomes:

$$\frac{dP}{d\pi^e}=\frac{l_\pi^a+l_\pi^b}{(1+\theta)(m_a+m_b)}>0 \tag{9}$$

because $l_\pi^a\equiv\partial l_a/\partial\pi^e$, $l_\pi^b\equiv\partial l_b/\partial\pi^e$ are usually positive. As an increase of the rate of returns of the currency induces an increase of the amount of currency demanded, the general price level decreases.

The effects to the balance of payments are seen by differentiating the equation (4) and taking account of the equations (6) and (7):

$$\frac{db}{dk_a}=-\frac{dP}{dk_a}m_b$$

$$=-\frac{\alpha m_b}{(1+\theta)(m_a+m_b)}<0$$

$$\frac{db}{dk_b}=\beta-m_b\frac{dP}{dk_b}$$

$$=\beta\left\{1-\frac{m_b}{(1+\theta)(m_a+m_b)}\right\}>0$$

The increase of the quantity of capital stock in country A causes the general price level to decline, but the amount of real demand for currency in country B does not change, and the balance of payments b decreases. Contrary to it, b increases in the case of the increase in the quantity of capital stock in country B, because the positive effect of the increase in the amount of currency demanded in country B is larger than the negative effect through the price change.

It is easily seen that the increase of the growth rate of the amount of currency in country A induces a balance of payments increase of country B. Using the equation (8), we get:

$$\frac{db}{d\theta}=-m_b\frac{dP}{d\theta}$$

$$=m_b\frac{P}{1+\theta}>0$$

III.

In this section, we clarify the dynamic properties of the model.

Usually, the disposable income is defined as the national income produced minus taxes plus capital gain through holding financial assets. However, neglecting capital gain requires no serious corrections in the conclusions and makes the analysis easier, the per-capital disposable incomes are defined as (y_a-t_a) and (y_b-t_b) in country A and B respectively in this paper. Due to the assumptions for the saving functions, capital accumulation in each country is formulated as follows, taking account of the increases of the amount of currencies held:

$$\dot{k}_a=s_a\,(y_a-t_a)-(\dot{l}_a+n l_a)-nk_a \tag{10}$$

$$\dot{k}_b=s_b\,(y_b-t_b)-(\dot{l}_b+n l_b)-nk_b \tag{11}$$

where the dots $\cdot$ indicate the differential with respect to time.

We assume that the expected rate of price change is θ minus n, that is, the price level on a steady growth path is expected (assuming the adaptive expectation for π^e needs no serious corrections of the conclusions in this model).

$$\pi^e=n-\theta \tag{12}$$

Adding that the rate of increase of currency θ and taxes t_a, t_b are constant, the whole dynamic system is completely determined.

Expanding the equations (10) and (11) in the neighborhood of the equilibrium values, we get the characteristic equations to obtain the following stability conditions of this system.

$$s_a y_k^a - n(\alpha+1) < 0$$
$$s_b y_k^b - n(\beta+1) < 0$$

By the assumptions as for the production functions, these conditions are satisfied and the variables of the system converge to their equilibrium values. The equilibrium values indicated with an asterisk, satisfy the following equations:

$$s_a\{y_a(k_a^*) - t_a\} - nl_a\{y_a(k_a^*),\ r_a(k_a^*)\} - nk_a^* = 0 \tag{13}$$
$$s_b\{y_b(k_b^* - t_b\} - nl_b\{y_b(k_b^*),\ r_b(k_b^*)\} - nk_b^* = 0 \tag{14}$$

The rate of changes of price in a steady state is:

$$\left(\frac{\dot{P}}{P}\right)^* = n - \theta$$

and this is equal to π^e from the equation (12). The absolute level of price is determined, if the initial conditions for the amount of currencies are given. These relations can be called a "dynamic version" of the quantity theory of money. The quantity of capital stock, the amount of labour and the amount of currency in real terms are increasing at the same rate. The balance of payments of country B can be given by substituting k_b^* in the equation (4). As l_b^* and Pm_b are constant — a change of P is just offset by a change of m_b —, b^* becomes constant, though the absolute value of the balance of payments is increasing at the same rate as the amount of labour.

These properties on the steady growth path are fundamentally the same as those of the Mundell's graphical analysis.(2) In short, among the four — general price level, supply of currency, economic growth rate, and balance of payments — there are relations which might be called a "dynamic version" of the quantity theory of money.

The properties of the steady growth path can be seen in the analysis of the comparative statics. By totally differentiating the equations (13) and (14), we get the following equations:

$$\{s_a y_k^a - (1+\alpha)n\}dk_a^* = -(y_a - t_a)ds_a + s_a dt_a + nl_\pi^a d\pi^e$$
$$\{s_b y_k^b - (1+\beta)n\}dk_b^* = -(y_b - t_b)ds_b + s_b dt_b + nl_\pi^b d\pi^e$$

(2) See R. A. Mundell [6].

Thus, for country A:

$$\frac{dk_a^*}{ds_a}=-\frac{(y_a-t_a)}{s_a y_k^a-(1+\alpha)n}>0 \tag{15}$$

$$\frac{dk_a^*}{dt_a}=\frac{s_a}{s_a y_k^a-(1+\alpha)n}<0 \tag{16}$$

$$\frac{dk_a^*}{d\pi^e}=\frac{nl_\pi^a}{s_a y_k^a-(1+\alpha)n}<0 \tag{17}$$

We obtain the same relations for country B:

$$dk_b^* / ds_b>0,\ dk_b^* / dt_b<0,\ dk_b^* / d\pi^e<0$$

that is, when the propensity to save increases the capital labour ratios will increase and the increase of the tax reduces them. The increase of π^e also reduces them, through a demand shift between currency and capital goods.

As easily seen, the many properties of the usual neoclassical growth model[3] are retained in this model, too.

IV.

In the case of a flexible exchange rate system, there exist independent currencies and the ratios of the level of the prices vary.

Adopting the simplifying assumption that each country holds only a domestic currency, we can obtain the essential properties of the flexible exchange rate system (this assumption will be relaxed later). Governments behave as follows, which correspond to the equation (1):

$$(e_a-t_a) / P_a=\theta_a m_a \tag{1-1}$$

$$(e_b-t_b) / P_b=\theta_b m_b \tag{1-2}$$

Corresponding to the equation (3); the static market equilibrium equations are:

$$P_a(1+\theta_a)m_a=l_a\{y_a(k_a),\ r_a(k_a),\ \pi_a^e\} \tag{3-1}$$

$$P_b(1+\theta_a)m_b=l_b\{y_b(k_b),\ t_b(k_b),\ \pi_b^e\} \tag{3-2}$$

where, P_a, P_b are the price levels of currencies, θ_a, θ_b the rates of increase of currencies and π_a^e, π_b^e the expected rates of increase of P_a, P_b respectively (suffix indicates country A and B). If k_a, k_b, m_a, m_b, π_a^e, π_b^e are given, the static equilibrium values P_a, P_b are determined uniquely and this system is stable according to the same reasoning as mentioned before.

The analysis of comparative statics is similar to the one in the above section. Corresponding to the equation (6), (7), (8) and (9), we get the following results:

$$\frac{dP_a}{dk_a}=\frac{\alpha}{(1+\theta_a)m_a}>0 \tag{6-1}$$

(3) See D. K. Foley & M. Sidrauski [2].

$$\frac{dP_b}{dk_b}=\frac{\beta}{(1+\theta_b)m_b}>0 \tag{7-1}$$

$$\frac{dP_a}{d\theta_a}=-\frac{P_a}{(1+\theta_a)}<0 \tag{8-1}$$

$$\frac{dP_b}{d\theta_b}=-\frac{P_b}{(1+\theta_b)}<0 \tag{8-2}$$

$$\frac{dP_a}{d\pi_a^e}=\frac{l_\pi^a}{(1+\theta_a)m_a}>0 \tag{9-1}$$

$$\frac{dP_b}{d\pi_b^e}=\frac{l_\pi^b}{(1+\theta_b)m_b}>0 \tag{9-2}$$

Using these results, we can easily see the effects to the exchange rate level (P_a/P_b). The following results indicate an important aspect of the flexible exchange rate system:

$$\frac{dP_b}{dk_a}=0,\ \frac{dP_a}{dk_b}=0,\ \frac{dP_b}{d\theta_a}=0,\ \frac{dP_a}{d\theta_b}=0,\ \frac{dP_b}{d\pi_a^e}=0,\ \frac{dP_a}{d\pi_b^e}=0.$$

Each economy is separated from the other through the changes of the exchange rate level. These results are due to the assumption that each country holds a domestic currency only. When the amount of currencies held by foreigners is relatively small, those results obtained under that assumption need not be corrected.

Because dynamic equations are the same as the equations (10) and (11), the equilibrium values of k_a and k_b are determined and system is stable. Corresponding to the equation (12) we assume:

$$\pi_a^e=n-\theta_a \tag{12-1}$$

$$\pi_b^e=n-\theta_b \tag{12-2}$$

that is, the expected rates of increase of the price levels are equal to the price levels on a steady growth path. Then, a "dynamic version" of the quantity theory of money holds here, too. The rate of changes of the exchange rate level on a steady growth path is:

$$\begin{aligned}(\dot{p}_a/p_b)^*/(p_a/p_b)^*&=(\dot{p}_a/p_a)^*-(\dot{p}_b/p_b)^*\\&=\theta_b-\theta_a\end{aligned}$$

that is the exchange rate level is changing at a constant rate, which is the difference of the rates of supply of currencies in both countries. The dynamic properties of this system are similar to those in the previous section, that is:

$$\frac{dk_a}{ds_a}>0,\ \frac{dk_b}{ds_b}>0,\ \frac{dk_a}{dt_a}<0,\ \frac{dk_b}{dt_b}<0,\ \frac{dk_a}{d\pi_a^e}<0,\ \frac{dk_b}{d\pi_b^e}<0.$$

V.

The seigniorage is proportional to the amount of currency issued, if the cost of producing and maintaining one unit of currency and the rate of interest (the discount rate) are constant.(4) The above analysis shows that when neither country holds any foreign currency in the case of the flexible exchange rate system, there is no international distribution of seigniorage and when only one country issues new currency in the fixed exchange rate system, the seigniorage is obtained only by the country.

In this section, we relax the assumptions which were useful to make clear the properties of each exchange rate system and see how seigniorage is distributed internationally in this case.(5)

At first, we analyze the case of the fixed exchange rate system. If the balance of payments equilibrium is maintained by a trade policy, no international distribution of seigniorage will occur. But the cost for the continuation of the policy will be high when a basic disequilibrium exists. In the case that country B cannot issue domestic currency without increasing its foreign reserve, as in the above case, the international equity of distribution of seigniorage is attained in a growing economy only when the increase of the amount of the key currency is zero. If this assumption is relaxed and both countries can issue currency independently, the international equity can be attained, even if we assume that the currency of country B is not held by country A.

We can describe this case in the following way. Equity is attained only when each country increases the amount of the domestic currency just to meet the amount of the increased demand for it. As the amount of increased domestic currency is exactly equal to the amount of the demand for the currency in country B, the balance of payments equilibrium is maintained. In this case, however, the ratio of the foreign reserve to the amount of the domestic currency is decreasing, and this policy cannot easily be continued, unless the currency control is perfect. This is the case which R. A. Mundell calls a "Defensive monetary expansion in B."(6) Though country A can continuously get seigniorage, country B cannot, because the amount of foreign reserve cannot be negative.

Next, we analyze the case of the flexible exchange rate system. If each country hold foreign currency, the problems of the international distribution

(4) See H. G. Grubel [3] and H. G. Johnson [4].
(5) Empirical analysis was under taken by B. J. Cohen [1].
(6) See R. A. Mundell [6], pp. 380–390.

of seigniorage occur.[7] Because the international movement of currencies is not equal zero, even if the foreign exchange markets are cleared. The model of this case is almost the same as the one in the previous section, except that the rates of the returns of foreign currencies enter into the demand functions for currencies. The balance of payments is defined for convenience as an increase of the amount of currency which country B holds in country A minus the increase of the amount of currency which country A holds in country B. On the steady growth path, the exchange rate is changing at a constant rate and the surplus of payments in real terms remains constant.

If the currency of country A is used for international transaction, country A gets seigniorage, this is the same as in the case of the fixed exchange rate system. But, if the currency of country B is as a profitable asset in country A, both countries can get seigniorage. The determination of the share of distribution depends on the balance of payments as defined above. The amount of currency over-issued in country A must be held in country B, but, it is not so easy as in the case of the fixed exchange rate system for country A to get seigniorage, because the rate of returns of the currency of country A has decreased. As the rate of returns of country B's currency has increased relatively, the amount of demand for it increases and the share of seigniorage distribution to country A is not very large. Thus country B can get a larger share of distribution of seigniorage by controlling the rate of returns of her own currency.

We cannot say definitely, which exchange rate system has superior properties in distributing the seigniorage internationally. Even in the case of the flexible exchange rate system, there may be an unfair distribution of seigniorage, if the amount of demand for foreign currency in each country is large. However, it is important that the results depend on monetary policy, such as the control of the rate of increase of the amount of currency or on international arrangements for payment mechanisms or for the limitation to the demand for currencies.

Concluding Remarks

Whatever exchange rate system may be used, it is always easy to get seigniorage for a country whose currency is used for international transactions. Thus, from the view point of equity of international distribution of seigniorage, fair system are those where all currencies are used equally.[8] The system in which only special currencies, issued by an international bank, are used for international

(7) See R. I. McKinnon [5], pp. 17–23, especially p. 18, where he comments on Grubel [3].
(8) See H. G. Grubel [3], pp. 280–281.

transactions and in which domestic currencies of each country circulate only domestically, is one of them. The gold standard system is alike to it.

In the case of the fixed exchange rate system, mechanisms to maintain the balance of payments equilibrium, must be introduced. They may be internationally cooperated monetary policies or liquidity distributions by some international monetary organization.(9)

In the case of the flexible exchange rate system, mechanisms or systems to make the demand for foreign currency small are necessary such as the well established forward exchange market or an international cooperation system to reduce speculative, transactions and precautionary demands for foreign currencies.

Indeed the international distribution of seigniorage is important, we must remember that it is only one of the many elements which must be taken into account when we consider international monetary systems or the exchange rate systems.

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(9) H. G. Grubel [3] calls it a "demand solution."

KOBE ECONOMIC & BUSINESS REVIEW

CONTENTS

NO. 14 (1967)

NO. 15 (1968)

NO. 16 (1969)

NO. 17 (1970)

NO. 18 (1971)

KOBE UNIVERSITY ECONOMIC REVIEW 18, 1972

Edited by Faculty of Economics,
Kobe University, Kobe, Japan

CONTENTS

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CONTENTS

KOBE UNIVERSITY LAW REVIEW
International Edition No. 8, 1972

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Kobe University, Kobe, Japan

CONTENTS

THE RESEARCH INSTITUTE FOR ECONOMICS AND BUSINESS ADMINISTRATION, KOBE UNIVERSITY

HISTORICAL SKETCH

In 1919, a research organization named the Institute for Commerce was founded in Kobe Higher Commercial School, one of the chief predecessors of Kobe University, with a gift made by F. Kanematsu & Company, a leading mercantile firm in Kobe. The organization was designed to carry on and facilitate integrated research on business and commerce and to formulate and publish the results of these studies and investigations in such form as to make them available to the business community.

With the founding of Kobe University of Commerce, successor of Kobe Higher Commercial School, in 1929, the Institute extended its research activities by adding several divisions. One was the famous Latin-American Library, which soon became the center of research in this field in Japan. A room for statistics equipped with various computing machines was established and began publication of *Juyo Keizai Tokei* monthly and *Sekai Boeki Tokei* annually. A filing room was prepared to deposit press clipping files systematically arranged by topics and dates. Another room was designed to become the center of all possible original records and data having to do with the beginning and progress of Japanese business.

On the campus of Kobe University of Commerce, another organization named the Institute for Business Mechanization was founded in 1941 utilizing business machines donated by the IBM Corporation and others. With Professor Yasutaro Hirai as its head a broad and forward-looking plan for business mechanization in Japan was developed.

In 1944, Kobe University of Commerce changed its name to Kobe University of Economics. After the war, however, the University was consolidated with three other colleges in Hyogo Prefecture to become Kobe University. With this development, the two Institutes were also amalgamated into the Research Institute for Economics and Business Administration, Kobe University. At present, the Institute, with its twenty full-time professional staff members, carries on studies and investigations in international economy, business administration, and information systems in Japan.

LOCATION AND BUILDINGS

The Research Institute for Economics and Business Administration is located on the campus of Kobe University, Rokko, Kobe. It is a three-storied building named the Kanematsu Kinenkan and has a floor space of about 2,900 square meters, which includes a president's room, forty-one offices, six rooms used as a library, a room for statistics, three conference rooms, etc. Adjoining is a one-story building recently built to install business machines.

ORGANIZATION

Under the directorship of the president, the Institute operates with two research groups, each has five sections respectively. Each research group and its sections are as follows:

A Group of International Economy

(1) International Trade
(2) International Finance
(3) Maritime Economy
(4) Economy of Latin-America
(5) International Law of Economy

B Group of Business Administration

(1) International Management
(2) Business Administration and Information Systems
(3) Accounting
(4) Business Statistics
(5) International Labor Problems

Besides the regular work of the Institute, research committees may be created to carry on any special work requiring the joint study of academic and business circles. At present, there are three committees, that is, International Finance Committee, the Committee of International Economic Cooperation and Overseas Business Operations in 1970's and Information Systems Committee.

For convenience and greater efficiency in carrying out its research activities, the Institute has a general office which is responsible for 1) the collection and preservation of a comprehensive collection of books, periodicals, pamphlets, and original records and data of finance, trade, commerce, industry and business generally; 2) the classification, cataloguing, indexing, arranging, annotation and

compilation of these research materials; and 3) the formulation and publication of the results of the investigations and studies accomplished by the professional staff members of the Institute.

As an affiliated institute, the Documentation Center for Business Analysis has been established. It is the first systematic information facility in the field of business administration in Japan that has been recognized and authorized by the Ministry of Education. The purpose is to collect and to make intensive control of all kinds of materials on business administration and to make them available to scholars, universities, governments, and business world with the aid of modern documentation techniques.