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The Position of Metalworking Industries in the Structure of an Industrializing Economy[1]

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Harvard Economic Research, Project.1583, Massachusetts Avenue Cambridge, Massachusetts August 1966.

ABSTRACT

Estudios de Economía Aplicada includes in its Contributions section, both forgotten texts form relevant authors, and other specially interesting studies of general scope.

This time, we have selected an unpublished study of Wassily Leontief written in 1966 jointly with Anne Carter (member of EEA Editorial's Board) in the unforgettable framework of the Harvard Economic Research Project.

This work, that was presented at a Moscow meeting, shows an example of Input-Output utilization to perform a production sector analysis and programming, applied to metalworking industries, a key sector for capital accumulation processes.

Some time comparisons (between 1947 and 1858) and other spatial ones (between Japan and United States) are presented, and reduced forms from the full model are computed in order to show the high interdependence between the metalworking industries.

It is very interesting to see how capital coefficients are computed because of their relevance to understand the key role played by this sector in economic development. The Dynamic Model application is also interesting in this analytical framework.

This text, that deals with the role of input-output analysis in the economic development planning, is still relevant in the field of investment selection, both for newly industrialized countries, and for developed countries where firms have to take long term decisions that should be coherent in a future interdependent structural framework.

Keywords: Input-output, sectorial analysis and programming, metalworking industries.

Situación estructural de las industrias metal-mecánicas en las economías industrializadas

RESUMEN

En la sección Contribuciones, Estudios de Economía Aplicada pública, junto con trabajos que por su naturaleza no se adaptan a las publicaciones científicas especializadas, algunos textos olvidados de autores de indiscutible relevancia. En esta ocasión incluimos un testo inédito de Wassily Leontief elaborado en 1966 junto a Anne Carter (miembro del consejo editorial de EEA), en el inolvidable marco del Harvard Economic Research Project.

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Se trata de una comunicación presentada en Moscú en la que se desarrollan de manera ejemplar posibles aplicaciones del input-output para la programación de un sector productivo, en este caso el sector de la industria metal-mecánica, sector clave en todo proceso de acumulación de capital.

Se establecen comparaciones en el tiempo (entre 1947 y 1958) y en el espacio (entre Japón y Estados Unidos), y se calculan formas reducidas que contribuyen a explicar la interdependencia interna del grupo de industrias metal-mecánicas. Es relevante observar el cálculo de los coeficientes de capital, indispensable para comprender el papel de este sector en al economía, y la aplicación que se hace del modelo dinámico en este contexto.

Este texto, centrado en la aportación que el input-output puede hacer a la planificación del desarrollo, sigue siendo relevante en todo proceso de selección de inversiones, tanto en los países industriales emergentes, como en aquellos más avanzados en los que las empresas tienen que tomar decisiones a largo plazo que exigen coherencia y prospectiva de las interdependencias estructurales.

Palabras Clave: Input-Output, programación y analisis sectorial, industrias metal-mecánicas.

1. INTRODUCTION

In this paper we describe the relationships of industries that make up the so-called metalworking complex to each other and to all other sectors of an industrial economy. Systematic quantitative information presented in it should facilitate the translation of the preliminary aggregative outlines of a national developmental plan into terms of specific industrial programs which, in their turn, should provide a firm basis for detailed design and assessments of individual investment projects.

The emphasis in this intermediate stage of developmental planning is on interindustrial balance, on the provision for each newly established branch of production of aan appropriate supply of raw and semi-finished materials, of power, and of other kinds of inputs on the one hand, and of a properly assured outlet for its output on the other. The analytical procedures described and the factual information presented below are intented to facilitate the planning of the expansion of metalworking industries within the framework of balanced growth of all the other sectors of a developing economy.

In an industrial economy, metalworking sectors perform a special function as the chief suppliers of durable capital goods to all sectors. Indeed, metalworking and construction sectors are the only major suppliers of durable capital goods. In 1958, United States metalworkers contributed 31 percent of all gross private capital formation, the bulk of the remainder coming from the construction industry. In contrast, their contribution of current account inputs: of materials, parts and components, and services to other industries in the economy was relatively small. Because we are

1. The input-output data presented in this paper are drawn from many sources, published and unpublished. Principal data sources are cited in Appendix I. The authors wish to thank the many members of the Harvard Economic Research Project who contributed to this paper and to acknowledge, in particular, the work of Darlene Butler and Brookes Byrd.

especially interested in capital producing sectors, we must give particular attention to problems of capital accumulation, of growth and replacement, if we are to understand the economic functions of the metalworking industries. But we must begin with certain general back-ground material to establish the input-output framework for considering these problems.

2. CURRENT ACCOUNT INPUT-OUTPUT TABLES

The presentation will be organized around a series of tables, each designed to throw light on a particular aspect of industrial interdependence. Table I[2], in the small appended reprint booklet, is an input-output table for the United States in 1958. It tells the dollar value of sales by establishments in each of the 81 industries of the economy to each other and to final consumers (see overleaf): households, government, exports and imports, net change in inventories, and gross capital formation. Imports are shown as negative entries, i.e., as an offset to other Final Demand items[3]. Each row describes the industrial destinations of an industry´s products; each column details an industry´s purchases from the other sectors. If we divide the purchases by each industry (in a given column) by that industry´s output, we obtain a set of "input-output" coefficients". These are shown in Table II. The coefficients in each column are essentially a recipe for a unit of its output. They tell, for example, how much coal, ore, and scrap are purchased by the steel industry per unit of steel output.

Throughout the world, input-output tables have been made for more than fifty countries varying in stage of industrial development and type of economic organization. Economies differ quite a bit, and so, naturally, do the input-output tables which describe them. Look, for example, at the input-output tables for India and Japan, included as Tables III and IV. While it is not easy to compare them (the transactions are in different currencies, and prices and the sectoring plans are not the same), important resemblances and differences are apparent. Sales and purchases by manufacturing and particularly by metalworking sectors have much greater relative importance in Japan than in India. In both countries, however, primary metals producers and other metal-working sectors supply the bulk of metalworkers´ inputs.

A country which is formulating its development plan will want, naturally, to base its analysis on its own input-output table insofar as possible. In the discussion which follows, we shall refer most often to the most recent material for the United States economy, since this is the material most readily available to us. Because the United

2. Editor's Note: Tables I, II, and V for the United States (flows, direct coefficient s and Inverse matrix coefficients) in 1958, have not been included in this text because of their lack of relevance and large size. See Appendix I for sources of these tables.
3. For further explanation, see below, p.6.

Table III. Input-output table for the indian economy, 1960-1961. Current Account Inter-Industry Transactions (1950-60 prices) (ten millions of rupees)

Sector	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CONSTRUCTION, URBAN AND INDUSTRIAL	1															
CONSTRUCTION, RURAL	2															
ELECTRICAL EQUIPMENT.	3			2	1	2	2									
TRANSPORT EQUIPMENT.	4				7											
NON-ELECTRICAL EQUIPMENT.	5	23	3	6	1	6	3	0			1				7	
IRON AND STEEL	6	214	26	4	22	71	43									
IRON ORE.	7						5									
CEMENT.	8	44	5													
OTHER METALS.	9			10	3	44	12			8						
OTHER MINERALS.	10			0			7		6	5						
PLANTATIONS.	11															
LEATHER AND LEATHER PRODUCTS.	12			0							0		46			
ANIMAL HUSBANDRY	13												42		16	
FOOD INDUSTRIES.	14												2	55	48	
FOOD GRAINS.	15													97	23	421
COTTON AND OTHER TEXTILES	16			0												
CHEMICAL FERTILIZERS.	19											6				15
GLASS, WOODEN, and NON-METALLIC		280	35	2	1	1		0			0	3			1	
FORESTRY PRODUCTS	21	61	8	1	11					0			9			
MOTOR TRANSPORT.	22															
PETROLEUM PRODUCTS	23	14		1	2	1	2		0	0		0	1		5	12
CRUDE OIL	24															
RUBBER PRODUCTS	25			0	8	0										
RUBBER	26															
CHEMICALS	27			3	4	5	6			0		2	12	19	7	4
RAILWAYS	28															
ELECTRICITY	29			2	3	4	6	0	3	1	1	0	1		6	6
COAL	30			0	0	3	11		6	0		1	0		3	0
OTHERS	31			40	27	28	14	0	4	0	2	11	6		90	9
INTERMEDIATE SUM.	32	636	77	72	90	164	112	1	26	16	4	25	119	171	984	472
VALUE ADDED.	33	314	309	45	91	130	111	7	20	13	41	168	47	932	271	3489
MARGIN	34	251	30	9	20	50	47	0	7	4	1	3	23	27	67	13
VALUE OF OUTPUT	35	1201	416	126	201	344	269	8	53	32	45	196	189	1130	1323	3974

Sector	No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CONSTRUCTION, URBAN AND INDUSTRIAL	1															
CONSTRUCTION, RURAL	2															
ELECTRICAL EQUIPMENT.	3															
TRANSPORT EQUIPMENT.	4															
NON-ELECTRICAL EQUIPMENT.	5		1			1			8		0		2			4
IRON AND STEEL	6															
IRON ORE.	7															
CEMENT.	8					3										
OTHER METALS.	9												3			
OTHER MINERALS.	10					6							8			
PLANTATIONS.	11										16					
LEATHER AND LEATHER PRODUCTS.	12	4														
ANIMAL HUSBANDRY	13	10											3			
FOOD INDUSTRIES.	14	6											11			
FOOD GRAINS.	15															
COTTON AND OTHER TEXTILES	16	18	0			0					7		0			
CHEMICAL FERTILIZERS.	19			9												
GLASS, WOODEN, and NON-METALLIC		6				8							7			
FORESTRY PRODUCTS	21					59							13			
MOTOR TRANSPORT.	22															
PETROLEUM PRODUCTS	23	7	0	6	0	10		104	0		0		3	23	3	0
CRUDE OIL	24								44							
RUBBER PRODUCTS	25							17			1					
RUBBER	26										1					
CHEMICALS	27	34	3	2	4	26			1		4		63			
RAILWAYS	28															
ELECTRICITY	29	22	4	2	0	7			2		1		6	3		3
COAL	30	6	1		1	6					0		3	32	14	7
OTHERS	31	72	6		3	39	9	29	26	0	5		14	18	13	5
INTERMEDIATE SUM.	32	490	78	104	10	167	9	150	81	0	35		137	75	29	19
VALUE ADDED.	33	277	49	1992	9	198	171	173	56	3	25		122	378	66	89
MARGIN	34	34	3	1	2	33		2	3		8		25	0	8	1
VALUE OF OUTPUT	35	800	130	2097	21	398	180	375	237f)	3	68		284	454	103	109

Sector	No.	INTERMEDIATE SUM (COLS 1-30) 31	OTHERS 32	HOUSEHOLD CONSUMPTION 33	GOVERNMENT CONSUMPTION 34	EXPORTS 35	IMPORTS 36	GROSS FIXED CAPITAL FORMATION 37	STOCKS 38	OUTPUT 39
CONSTRUCTION, URBAN AND INDUSTRIAL	1		133		104			344		1201
CONSTRUCTION, RURAL	2							416		416
ELECTRICAL EQUIPMENT.	3	6		33	17	1	-57	124	2	126
TRANSPORT EQUIPMENT.	4	7		39	46	1	-69	173	5	201
NON-ELECTRICAL EQUIPMENT.	5	65		113	31	3	-299	345	16	344
IRON AND STEEL	6	380	-4			10	-121		4	269
IRON ORE.	7	5				2			0	8
CEMENT.	8	53				0	-0		-0	53
OTHER METALS.	9	80	-1			0	-99		2	32
OTHER MINERALS.	10	32	-1			24	-10			45
PLANTATIONS.	11	16		74		110	-9		6	196
LEATHER AND LEATHER PRODUCTS.	12	51	18	96		24	-0		1	189
ANIMAL HUSBANDRY	13	71		1057		21	-19			1130
FOOD INDUSTRIES.	14	122		979	94	36	-10		102	1323
FOOD GRAINS.	15	541		3520			-145		58	3974
COTTON AND OTHER TEXTILES	16	26		703	11	55	-4		9	800
CHEMICAL FERTILIZERS.	19	30	-0				-11		1	21
GLASS, WOODEN, and NON-METALLIC		345		63		2	-11		-2	398
FORESTRY PRODUCTS	21	161	12			12	-5			180
MOTOR TRANSPORT.	22	165	63	97						325
PETROLEUM PRODUCTS	23	195	12	81	27	4	-83g)			237
CRUDE OIL	24	44					-40			3
RUBBER PRODUCTS	25	26	4	40		1	-3		0	68
RUBBER	26	1					-2		1	0
CHEMICALS	27	200		179		10	-111		6	284
RAILWAYS	28	278	87	89						454
ELECTRICITY	29	83	6	11	5				-2a)	103
COAL	30	95	4	6		2	-1		2	109
OTHERS	31	468			185b)	7	-11			14716
INTERMEDIATE SUM.	32	4353	530	7942	520	468	-1091h)	2002	231	15598
VALUE ADDED.	33	9594	3224		860					13678e)
MARGIN	34	671		4663		165		276		
VALUE OF OUTPUT	35	14715	530	12605	1380	633	-1091	2278	231	

NOTE: FLOWS UNDER 5 MILLION RUPIES ARE REPRESENTED BY ZERO

a) Represents Adjustment for exaggerated industrial consumption shown in table; b) Inclusive of Margin.; c) Inclusive of "others".
d) No interindustry transactions shown for rows 22 & 28. Subtotal for row 32 is therefore less than subtotal for column 31 by 443.0; e) Gross value added.
f) Includes RS. 98.1 crores of taxes on petroleum products; g) Includes RS. 33.6 crores of taxes on petroleum products; h) 1090,5 = C.I.F. value of imports, excluding RS. 33.6 Crores of taxes on Petroleum products; i) Petroleum products measured at market prices.

Table IV. Input-ouput table fof the japanese economy, 1960. Current Account Inter-Industry Transactions (Billions of yen)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AGRICULTURE, FORESTRY, and FHISHERIES	1	490	10	2	1541	339	332	46	0	1	50	58	5	2	2	1	-1	5	13
COAL, PETROLEUM, and NATURAL GAS	2	0	3	2	5	6	1	11		0	2	25	255	22	5	1	1	0	0
METAL and OTHER MINING	3	1		1	8		0	3	0		0	33	0	46	176				2
FOOD PRODUCTS and TOBACCO	4	125			527	6	0	1	0	18		20		0		0		0	2
TEXTILES and APPAREL	5	35	2	0	2	892	5	4	2	4	38	7	1	2	5	16	6	5	3
WOOD PRODUCTS and FURNITURE	6	7	2	0	15	5	90	16	1	0	0	21	2	2	6	23	15	1	15
PULP, PAPER, etc.	7	4	1	1	28	8	3	280	120	0	0	70	2	16	5	12	3	4	15
PRINTING and PUBLISHING	8	1	2	1	4	7	1	20	6	0	0	5	1	2	10	13	1	0	1
LEATHER PRODUCTS	9	0			1	18	0	0	0	8		0			0	2	1	3	3
RUBBER PRODUCTS	10	2		0	0	7	1	0	0	0	5	1		0	4	26	95	1	0
CHEMICALS	11	149	4	3	85	248	21	19	15	2	26	468	7	11	26	36	16	5	92
PETROLEUM and COAL PRODUCTS	12	41	1	3	19	10	3	7	0	0	5	55	19	24	125	20	5	2	4
CERAMIC, STONE, and CLAY PRODUCTS	13	4	0	0	38	0	1	1	0	0	2	8	0	44	27	29	10	2	1
PRIMARY METALS	14	8	5	2	25	11	32	2	2	2	1	22	5	15	2186	680	168	23	20
MACHINERY, except TRANSPORTATION EQUIP.	15	21	6	3	3	13	3	3	4	0	2	13	5	3	40	818	256	9	1
TRANSPORTATION EQUIPMENT	16	14	1	0	1	0	1					0	0	1	2	12	203		
PRECISION INSTRUMENTS	17	0	0	0	0	1	0	0	1	0	0	0	0	0	1	23	4	32	0
MISCELLANEOUS MANUFACTURING	18	7	0	0	8	4	3	0	1	2	3	1	1	0	1	39	8	2	5
CONSTRUCTION	19	16	2	5	12	5	3	1	1	1	1	8	2	5	10	8	5	1	1
ELECTRICITY and GAS	20	6	17	6	17	24	6	33	2	0	3	53	3	23	66	25	13	1	3
TRADE	21	34	4	3	145	88	30	20	11	3	11	57	8	27	71	68	36	6	16
REAL ESTATE	22	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
TRANSPORTATION and COMMUNICATION	23	26	5	5	64	31	19	21	20	1	4	48	15	34	67	66	24	5	8
SERVICES	24	28	6	3	48	31	11	9	12	1	3	52	5	12	31	59	26	9	12
UNDISTRIBUTED	25	21	6	12	114	41	11	10	19	1	6	54	34	13	90	118	47	10	15
INTERMEDIATE TOTAL	26	1036	80	52	2710	1795	577	507	216	45	162	1080	368	304	2953	2096	940	126	230
BUSINESS CONSUMPTION	27	7	7	6	33	20	13	5	15	0	3	22	6	7	29	52	15	5	6
WAGES AND SALARIES	28	224	107	56	182	251	100	67	88	6	35	149	16	91	318	399	207	40	43
PROFIT	29	1615	10	32	176	184	56	59	59	4	36	139	100	91	385	401	125	30	55
DEPRECIATION	30	210	21	13	47	47	11	24	8	1	5	91	21	22	100	69	42	5	5
INDIRECT TAXES	31	48	6	4	510	12	7	4	2	0	1	20	123	7	13	50	32	11	9
SUBSIDIES	32	-1	-0	-0	-29							-0							
VALUE ADDED	33	2103	150	111	919	515	188	159	173	12	80	451	266	219	845	972	422	91	118
TOTAL PRODUCTION	34	3138	230	163	3629	2310	764	666	389	56	242	1531	634	523	3798	3067	1362	217	349

		19	20	21	22	23	24	25	26 INTERMEDIATE TOTAL	27 NON-HOUSEHOLD CONSUMP. EXPEND	28 PRIVATE CONSUMPTION EXPEND	29 GOV'T EXPEND. On CURRENT ACCOUNT	30 DOMESTIC FIXEX CAPITAL FORMATIO	31 NET INVENTORY INCREASE	32 EXPORTS	33 SUBTOTAL	34 IMPORTS	35 TARIFFS	36 TOTAL OUTPUTS
AGRICULTURE, FORESTRY, and FHISHERIES	1	26	0	-1	0	0	7	24	2949	29	556	1	14	100	61	761	-567	-5	3138
COAL, PETROLEUM, and NATURAL GAS	2	0	88			15	7	2	450		10	2		-6	0	6	-218	-7	230
METAL and OTHER MINING	3	51	-1					3	324		3			5	1	8	-169	0	163
FOOD PRODUCTS and TOBACCO	4			2			2	24	725	372	2556			86	61	3075	-118	-53	3629
TEXTILES and APPAREL	5	33	1	21	0	12	17	101	1212	24	647	5	3	67	364	1109	-10	-1	2310
WOOD PRODUCTS and FURNITURE	6	380	1	22	0	2	18	3	645	6	50	2	20	8	37	123	-4	-0	764
PULP, PAPER, etc.	7	12	0	31	0	3	15	18	650	2	-8	3		14	17	28	-12	-0	666
PRINTING and PUBLISHING	8	6	1	31	0	11	128	0	255	2	113	15		5	3	138	-4	-0	389
LEATHER PRODUCTS	9	0					0	1	37		15	0		2	4	21	-1	-0	56
RUBBER PRODUCTS	10	4	0	0		1	6	11	163	1	35	1		13	31	80	-1	-0	242
CHEMICALS	11	25	0	1		2	93	41	1394	41	122	7		37	61	269	-119	-13	1531
PETROLEUM and COAL PRODUCTS	12	53	13	50	0	122	21	26	629	0	33	18		22	13	85	-77	-3	634
CERAMIC, STONE, and CLAY PRODUCTS	13	293	1	-1	0	0	5	11	477	2	-10	0		14	46	52	-5	-0	523
PRIMARY METALS	14	524	4	13		2	8	57	3816	4	15	2	-78	51	189	183	-195	-6	3798
MACHINERY, except TRANSPORTATION EQUIP.	15	244	32	1	0	7	12	46	1541	10	178	11	1143	149	155	1645	-109	-10	3067
TRANSPORTATION EQUIPMENT	16	45	0	33	0	123	3	25	466		71	43	597	36	178	924	-26	-2	1362
PRECISION INSTRUMENTS	17	8	1	3	0	1	35	4	113	0	47	1	28	12	31	119	-14	-2	217
MISCELLANEOUS MANUFACTURING	18	30	0	3	0	1	20	25	165	3	87	1	5	12	81	188	-3	-1	349
CONSTRUCTION	19	3	25	31	79	16	56	0	293			6	2877		6	2889	-0		3182
ELECTRICITY and GAS	20	6	5	23	1	24	57	6	422		157	7		0	4	169	-1		590
TRADE	21	155	9	39	0	29	78	23	971	102	1099	13	158	23	136	1532	-14		2489
REAL ESTATE	22	1	0	7	0	2	8		23		596					596			619
TRANSPORTATION and COMMUNICATION	23	132	23	104	0	76	114	99	1010	10	486	51	13	7	145	713	81		1804
SERVICES	24	49	4	166	8	32	283	107	1007	277	1600	1471			5	3353	-5	-1	4354
UNDISTRIBUTED	25	99	12		5	100	83	0	918		1	-11		22	90	102	-55	-6	959
INTERMEDIATE TOTAL	26	2177	220	577	93	580	1073	659	20654	885	8456	1649	4780	678	1719	18166	-1646	-110	37064
BUSINESS CONSUMPTION	27	40	12	200	1	45	191	146	885										
WAGES AND SALARIES	28	455	92	689	3	627	1766		6010										
PROFIT	29	447	62	793	294	242	960	71	6457										
DEPRECIATION	30	56	125	149	161	283	277		1793										
INDIRECT TAXES	31	7	80	82	68	26	88	87	1299										
SUBSIDIES	32					-0		-3	-34										
VALUE ADDED	33	1005	370	1912	526	1224	3281	300	16410										
TOTAL PRODUCTION	34	3182	590	2489	619	1804	4354	959	37064										

NOTE: FLOWS UNDER 5 HUNDRED MILLION YEN ARE REPRESENTED BY ZERO

States already has a highly developed metalworking complex, we can use it to provide examples of the interrelationship among metalworking and other sectors. Later, imports are introduced as an alternative source of metalworking products. The analytical procedures which are presented can, indeed should, be applied to data for other economies as well.

In the Tables I and II just presented, sectors have been arranged roughly in "triangular order ", i.e., the industries producing primarily final goods (machinery, clothing, processed foods) are placed at the top of the chart, followed by the producers of intermediate products (engines and turbines, electronic components, machine-shop products), and still below that by producers of raw materials, energy, etc. If production were always a "one-way street", the arrangement would be perfectly triangular: there would be no transactions in the upper triangle of the input-output table. But this is not the case. Chemicals are used to make paper, but paper is used to package chemicals. Steel is used to make blast furnaces, but blast furnaces are used to make steel. Nuts, bolts, and screws go into machines, but are also made by machines, etc. These circular or backfeeding aspects are very important in a complex industrialized economy. It is important to insure balance among these interdependent processes in planning or forecasting economic development.

A standard input-output computation permits us to trace the impact of any given change in deliveries to Final Demand on all inter-industry flows on current account, and hence on all industries´ outputs. If more automobiles are to be produced for consumers or for export, then the economy will have to deliver more steel, metal products, textiles, and power to the automobile industry. To supply these additional inputs to automobiles, the steel industry will have to consume more coal, ore, and scrap, the metal products industry still more steel, the textile industry more chemicals and natural fibres, etc. To supply this second "round" of additional inputs, still more ore, coal and scrap, more chemicals, more coal, and so on, are needed. To compute all the direct and indirect requirements of a given change in Final Demand, we compute the so-called "inverse coefficient matrix"[4]. Table V in the appended booklet is such an inverse matrix. Each element of Table V tells how much of the products of the industry on the left are required per unit increase in Final Demand for the product listed at the top. The inverse coefficient for steel into automobiles tells how much the total production of steel in the economy must increase per dollar increase in deliveries

4. [2](I-A)-1, where A is the matrix of flow coefficients

$$\text{coefficients}: \left\{ \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & \ddots & \vdots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & \cdots & \cdots & a_{11} \end{bmatrix} \right\} \text{as exemplified in Table V}$$

of automobiles to Final Demand. Inverse coefficients will always be equal to or larger than direct input-output coefficients (Table II) because they include indirect, in addition to direct, production requirements.

3. FOREIGN TRADE AND IMPORT SUBSTITUTION

In tracing the direct and indirect effects of changes in the Bill of Final Demand on domestic outputs, Exports must be added to the other items included in the Final Demand, while Imports have to be entered in it as a column of negative figures. If, for example, a country were to increase its export of electric motors, the output of the electric motors industry and of its various direct and indirect suppliers would have to increase by the same amount by which they would have to be raised if the additional motors were produced for domestic use. Increased imports of electric motors would have just the opposite effect.

Import substitution is nothing but a combination of a cut in imports and an equal rise in domestic output (with the level of domestic Final Demand remaining the same as it was before). The combined direct and indirect impact of the two shifts on every sector of the economy can be estimated through simple summation of the separate effects of each one of them. In general, given a complete export program and a corresponding import program of a country, their total effect on the level of output in each branch of domestic industry can be estimated through subtraction of the direct and indirect effects of all types of imports from the combined (positive) effects of all the different kinds of exports.

Using the tale of technical input coefficients, it is even simpler to compute the import requirements for raw material, semi-finished and finished goods –or the export surpluses- corresponding to any combination of projected output levels of domestic industries with given quantities of their respective products allocated to exports and absorbed in final domestic use. The inputs required by each industry to attain the projected level of output can be determined on the basis of the appropriate input coefficients. These inputs combined with projected deliveries to Final Use will yield estimates of total domestic demand for each type of goods. Comparing these with the projected total domestic outputs, we arrive at the figures of required imports or exportable surpluses.

4. LABOR AND CAPITAL COEFFICIENTS: AGGREGATION TO A 38 –SECTOR CLASSIFICATION

Large coefficients in the United States coefficient table in the inverse coefficient table are colored pink. They represent relatively important direct or indirect linkages between a given selling industry (identified on the left) and purchasing industry (identified at the top). Sectors 9-35 (Sector 15 can be excluded) in Tables I, II, and V are metalworking sectors.

With large capacity high-speed computing equipment, it is not difficult to deal with 80-odd sector input-output tables, or even much larger ones. On the other hand, it is still very clumsy to print and reproduce large matrices on a single page of paper. To facilitate presentation here, we have chosen to consolidate or "aggregate" the United States input-output materials to a 38-order classification. The consolidated flow and coefficient tables are given as Tables VI and VII. Since we are concentrating on the metalworking sectors, we have kept full detail in the twenty-five metalworking industries, but aggregated the non-metalworking sectors into only thirteen sectors[5]. Metalworking sectors are renumbered 1-25. The last five rows in the coefficient table, VII, show total fixed capital requirements (dollars per dollar of output), labor requirements in man-years per thousand dollars of output, for three different types of labor skills, and total labor requirements. Multiplying the output levels for each of the 38 industries by these labor coefficients, we can obtain estimates of each of the three types of labor required in each producing sector. Comparison of these estimates of labor requirements with projections of skilled labor supply or manpower training plans will tell whether a given set of output levels is indeed feasible.

Supplies of other factors of production which may introduce bottlenecks can be treated analogously. If an economy has only a limited supply of, say, an ore, or petroleum, which cannot be increased in the short run, then their requirements can be computed as in the case of skilled labor, and the feasibility of a given program evaluated. Imports can sometimes fill the gap

Capital requirements should be treated in exactly the same way in the short run. Given sufficient time, of course, skilled labor can be "produced" through education and industrial training programs and capital goods can be manufactured. The role of metalworking industries in the investment process is considered in detail later on. (See below, p. 20 ff.)

A solid yellow line is drawn around the industries in the metalworking bloc in Tables VI and VII. Note that there are very few sizeable entries beyond 26 (Construction) in the 1-25 band of metalworking suppliers. Within the bloc, however, there are strong elements of interdependence. Before going further into the relation of metalworking to other sectors, let us survey the internal structure of metalworking more carefully.

5. The classification scheme underlying the aggregation is given in Appendix II.

Table VI. 38 sector input-output table for united states economy, 1958 (millions of dollars) current account inter-industry transactions only

Sector	No.	1	2	3	4	5	6	7	8	9	10	11	12	13
AIRCRAFT and PARTS	1	2414	17	9	15	15	1	52	1			2	9	2
SHIPS, TRAINS, TRAILERS, and CYCLES	2	3	251	20		1	7	1				4	8	15
MOTOR VEHICLES and EQUIPMENT	3	81	50	6795		28	8	1	53			10	7	45
OFFICE and COMPUTING MACHINES	4	6			193			7	1		13	1	4	1
SERVICE INDUSTRY MACHINES	5	8	9	29		106	104	4		2		2	12	2
HOUSEHOLD APPLIANCES	6	28	19			143	39	2	4	1	2		3	1
RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7	344	6	119	21	7	1	330	7	5	90		23	2
BATTERIES, X-RAY., and ENGINE ELECTRICAL EQUIPMENT	8	46	5	352	1		1	2	57	67	2	2	1	5
ELECTRICAL LIGHTING and WIRING EQUIPMENT	9	16	13	96	9	15	28	69	57	92	21	3	1	3
ELECTRONIC COMPONENTS and ACCESORIES	10	76		18	92			1088	21	8	162		7	1
MATERIALS HANDLING MACHINERY and EQUIPMENT	11	5	16	5		3						41	12	17
SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12	6	1	6	12	6		2			1	5	125	6
CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13	2	20	10		1	1	1	2	1	2	54	19	173
FARM MACHINERY and EQUIPMENT	14	2	19	24		1			1	1		5	7	54
ENGINES and TURBINESS	15	20	114	87		4			2			15	1	80
MACHINE SHOP PRODUCTS	16	126	13	147	5	2	4	6	12	4	3	17	10	14
OPTICAL, OPHTHALMIC, and PHOTOGRAPHIC EQUIPMENT	17	26		1			5	14	1		1		5	
SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOCKS	18	197	5	100	8	29	109	33	6	6	13	1	4	2
ELECTRICAL APPARATUS and MOTORS	19	43	125	50	52	200	149	100	36	78	88	53	97	35
METALWORKING MACHINERY and EQUIPMENT	20	246	19	257	21	7	28	28	22	13	15	17	58	52
GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	138	58	130	14	35	39	8	26	3	3	73	139	176
HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	131	79	823	13	59	119	72	7	40	36	23	42	40
STAMPINGS, SCREW MACHINE PRODUCTS, and BOLTS	23	245	18	709	25	79	193	112	37	63	62	19	32	32
HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24	8	171	23		52	57	4		5	1	13	27	49
AUTOMOTIVE REPAIR SERVICES	25	2	3	8	1	2	1	1	1	1		1	4	3
NEW and MANTENANCE CONSTRUCTION; GLASS, STONE, and CLAY PRODUCTS	26	72	51	370	8	22	37	55	16	82	105	5	14	19
PRIMARY IRON and STEEL MINING and MANUFACTURING	27	405	442	2005	49	154	275	56	47	155	54	117	224	475
PRIMARY NONFERROUS METAL MINING and MANUFACTURING	28	360	68	261	42	114	153	117	164	122	119	13	112	22
MISCELLANEOUS MANUFACTURING AND SERVICE SECTORS	29	90	60	134	59	29	41	129	23	45	67	45	49	39
CHEMICALS, PLASTICS, RUBBER, DRUGS, and PRINTS	30	119	101	829	30	55	166	112	113	102	70	24	41	57
LUMBER and WOOD PRODUCTS; PAPER and PAPER PRODUCTS	31	68	141	138	29	51	70	219	13	50	62	3	23	11
TEXTILES and LEATHER GOODS	32	19	12	310	2	2	17	7	2	3	4	3	9	3
FOOD, TOBACCO, and METAL CONTAINERS	33												1	
COAL, PETROLEUM, and UTILITIES	34	102	43	171	11	19	27	25	12	16	24	8	28	34
RADIO, and TELEVISION BROADCASTING; COMMUNICATIONS	35	56	10	47	9	8	15	20	5	6	8	4	24	10
TRANSPORTATION and WAREHOUSING	36	112	65	426	18	34	57	69	20	31	28	13	28	44
WHOLESALE and RETAIL TRADE	37	229	178	688	107	122	151	211	52	144	145	46	97	109
OTHER BUSINESS and PERSONAL SERVICES	38	177	78	774	91	73	345	209	54	67	103	37	79	87
TOTALS		6028	2282	15972	938	1477	2247	3167	875	1211	1300	678	1386	1719

Sector	No.	14	15	16	17	18	19	20	21	22	23	24	25	26
AIRCRAFT and PARTS	1	5	22	5		56	6	20	63	5	6	12		1
SHIPS, TRAINS, TRAILERS, and CYCLES	2	5	20	5	1	5	26	1	19	5	1	57	10	3
MOTOR VEHICLES and EQUIPMENT	3	41	56	6		51	8	173	24	32	98	32	1131	9
OFFICE and COMPUTING MACHINES	4			1	1	46	3			1	2	3		
SERVICE INDUSTRY MACHINES	5	1		1		6	2	7	33	9	7	67		219
HOUSEHOLD APPLIANCES	6	9				3	3	7		13	9	54		266
RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7			1	7	38	52		7	2	1	1		59
BATTERIES, X-RAY., and ENGINE ELECTRICAL EQUIPMENT	8	19	39	3	6	3	11		4	2	1		118	20
ELECTRICAL LIGHTING and WIRING EQUIPMENT	9	2	1	1	6	12	86	2	4	15	15	17	33	951
ELECTRONIC COMPONENTS and ACCESORIES	10					102	140		1	5	3	8		4
MATERIALS HANDLING MACHINERY and EQUIPMENT	11	1	3	1			2	9	29	7	1	8		281
SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12	7	3	10	2	6	6	31	25	16	2	29		6
CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13	31	61	5		2	6	7	28	19	1	24		268
FARM MACHINERY and EQUIPMENT	14	92	30	1		1	1	6	8	7	4	14		3
ENGINES and TURBINESS	15	120	202	8			81	7	48	7	6	32		2
MACHINE SHOP PRODUCTS	16	37	66	107	1	26	9	22	22	19	14	33	105	8
OPTICAL, OPHTHALMIC, and PHOTOGRAPHIC EQUIPMENT	17				86	20	3		1	1	2	1		1
SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOCKS	18	3	2	2	22	202	67	3	23	21	7	71	16	213
ELECTRICAL APPARATUS and MOTORS	19	15	38	8	21	120	341	99	193	25	15	91	6	514
METALWORKING MACHINERY and EQUIPMENT	20	44	37	29	7	43	59	207	67	171	42	44	1	14
GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	140	71	15		20	45	118	257	54	3	92		303
HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	17	6	33	16	57	43	75	72	248	98	253	114	1021
STAMPINGS, SCREW MACHINE PRODUCTS, and BOLTS	23	80	49	8	9	63	76	97	42	129	100	155		131
HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24	6	3	3		4	15	14	69	57	29	150		6080
AUTOMOTIVE REPAIR SERVICES	25	3	1	2	1	1	3	2	3	6	3	17	133	313
NEW and MANTENANCE CONSTRUCTION; GLASS, STONE, and CLAY PRODUCTS	26	16	16	34	47	24	51	35	48	52	35	89	245	7126
PRIMARY IRON and STEEL MINING and MANUFACTURING	27	367	224	127	9	67	299	277	400	1262	739	1920		2562
PRIMARY NONFERROUS METAL MINING and MANUFACTURING	28	19	72	123	42	141	369	106	106	439	241	587		1177
MISCELLANEOUS MANUFACTURING AND SERVICE SECTORS	29	32	32	22	20	106	123	70	63	109	59	115	107	673
CHEMICALS, PLASTICS, RUBBER, DRUGS, and PRINTS	30	97	16	4	108	69	107	21	27	128	72	57	342	2433
LUMBER and WOOD PRODUCTS; PAPER and PAPER PRODUCTS	31	19	17		62	66	73	7	26	148	78	99	14	5136
TEXTILES and LEATHER GOODS	32	5	3	5	3	51	8	4	7	21	7	13	36	29
FOOD, TOBACCO, and METAL CONTAINERS	33	3				24		1		5	13	3		264
COAL, PETROLEUM, and UTILITIES	34	26	20	29	12	18	53	41	37	78	58	94	189	2074
RADIO, and TELEVISION BROADCASTING; COMMUNICATIONS	35	6	6	11	5	16	21	30	34	18	9	32	55	162
TRANSPORTATION and WAREHOUSING	36	40	27	15	22	34	61	28	49	86	57	143	74	2618
WHOLESALE and RETAIL TRADE	37	100	59	49	55	133	155	102	170	219	108	290	671	6702
OTHER BUSINESS and PERSONAL SERVICES	38	100	65	58	124	113	131	139	102	189	103	225	679	3827
TOTALS		1509	1265	733	695	1748	2544	1768	2106	3627	2047	4932	4079	45472

Sector	No.	27	28	29	30	31	32	33	34	35	36	37	38	FINAL DEMAND 39	GROSS DOMESTIC OUTPUT 40
AIRCRAFT and PARTS	1	1		32	18	19	2	7			163	68	1561	8085	12693
SHIPS, TRAINS, TRAILERS, and CYCLES	2	18	6	15	2	9		23	13	5	303	13	70	2778	3723
MOTOR VEHICLES and EQUIPMENT	3	37	15	140	2	6	1	58	16		88	208	209	13318	22836
OFFICE and COMPUTING MACHINES	4	1		34	7	10			8		2	44	508	1321	2217
SERVICE INDUSTRY MACHINES	5	2	2	12	3	15					2	35	149	1401	2249
HOUSEHOLD APPLIANCES	6	2	4	36	4	5	5	5				24	279	2630	3594
RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7	1	8	137	6	8			8	151	18	64	405	4079	6008
BATTERIES, X-RAY., and ENGINE ELECTRICAL EQUIPMENT	8		50	8	2	1		32	2	4	73	49	48	496	1534
ELECTRICAL LIGHTING and WIRING EQUIPMENT	9	10	56	16	14	30	6	26	8		7	18	83	443	2287
ELECTRONIC COMPONENTS and ACCESORIES	10		2	11	2	2	2		11	5	25	10	387	454	2649
MATERIALS HANDLING MACHINERY and EQUIPMENT	11	2	1	4	9	6			11		14	13	8	575	1081
SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12	24	2	32	136	102	65		9			28	15	1784	2509
CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13	39	29	10	15	1			139			28	29	2057	3084
FARM MACHINERY and EQUIPMENT	14	27		11	1	1	1	201				18	154	1745	2439
ENGINES and TURBINESS	15	3	1	3					17		81	11	155	1094	2200
MACHINE SHOP PRODUCTS	16	144	34	47	24	8	1	16	2		7	22	11	438	1587
OPTICAL, OPHTHALMIC, and PHOTOGRAPHIC EQUIPMENT	17	2	1	23	18	53	3					36	430	805	1542
SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOCKS	18	5	4	55	39	14	15	1	2		26	42	447	1683	3498
ELECTRICAL APPARATUS and MOTORS	19	85	40	39	24	12	1	10	52		31	23	182	2012	5103
METALWORKING MACHINERY and EQUIPMENT	20	129	73	14	19	20	4	40	15		23	15	156	1575	3629
GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	60	34	23	14	23	3	16	86		14	29	12	1468	3744
HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	336	109	126	187	461	59	180	411	3	41	63	54	875	6440
STAMPINGS, SCREW MACHINE PRODUCTS, and BOLTS	23	126	94	121	58	72	5	225	23		15	44	28	311	3686
HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24	49	3	34	7	33	1	10	10		1	98	24	925	8035
AUTOMOTIVE REPAIR SERVICES	25	7	6	8	27	101	15	395	59	17	821	826	479	4639	7913
NEW and MANTENANCE CONSTRUCTION; GLASS, STONE, and CLAY PRODUCTS	26	484	63	60	371	365	62	1561	716	301	1259	1005	6978	58387	80285
PRIMARY IRON and STEEL MINING and MANUFACTURING	27	5181	205	308	305	240	6	921	89		38	7	30	-141	19900
PRIMARY NONFERROUS METAL MINING and MANUFACTURING	28	368	4021	328	251	88	5	64	37	23	49	16	51	-170	10220
MISCELLANEOUS MANUFACTURING AND SERVICE SECTORS	29	683	486	458	723	802	724	2256	331	185	769	2060	2793	-367	13944
CHEMICALS, PLASTICS, RUBBER, DRUGS, and PRINTS	30	324	294	466	7204	1329	2168	2232	775	8	345	484	1487	8041	30459
LUMBER and WOOD PRODUCTS; PAPER and PAPER PRODUCTS	31	123	56	1662	925	11660	462	1846	157	130	144	1222	6812	6690	38513
TEXTILES and LEATHER GOODS	32	18	29	340	690	419	13168	261	11	14	45	144	658	16295	32675
FOOD, TOBACCO, and METAL CONTAINERS	33	7	1	2246	728	1117	1802	52154	133		138	693	2451	89750	121535
COAL, PETROLEUM, and UTILITIES	34	1152	310	54	1398	671	267	1949	16653	81	1692	2648	2284	17176	49587
RADIO, and TELEVISION BROADCASTING; COMMUNICATIONS	35	70	30	29	108	245	84	298	75	148	271	1012	3084	4760	10841
TRANSPORTATION and WAREHOUSING	36	1007	214	2725	834	1174	502	3495	1313	19	2106	396	971	14332	33290
WHOLESALE and RETAIL TRADE	37	701	338	675	916	1458	1133	4412	608	67	1004	1582	2767	68498	95250
OTHER BUSINESS and PERSONAL SERVICES	38	538	265	1354	2048	1881	965	6460	2998	834	2279	11799	20014	180035	189549
TOTALS		11768	6888	11699	17138	22461	21532	79153	24797	1995	11896	24898	56264	470327	842028

NOTE: FLOWS LESS THAN .5 MILLION ARE REPRESENTED BY DOTS; COMPONENTS MAY NOT ADD TO TOTAL BECAUSE OF ROUNDING.

Table VII. 38-sector input-output coefficients for united states economy, 1958 (dollars per dollar)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
AIRCRAFT and PARTS	1	0,19			0,01			0,01								0,01			0,02		0,01	0,02																	0,01
SHIPS, TRAINS, TRAILERS, and CYCLES	2		0,07													0,01				0,01		0,01			0,01												0,01		
MOTOR VEHICLES and EQUIPMENT	3	0,01	0,01	0,30		0,01			0,03			0,01		0,01	0,02	0,03			0,01		0,05	0,01		0,03		0,14				0,01									
OFFICE and COMPUTING MACHINES	4				0,09														0,01																				
SERVICE INDUSTRY MACHINES	5					0,05	0,03															0,01			0,01														
HOUSEHOLD APPLIANCES	6		0,01			0,06	0,01																		0,01														
RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7	0,03		0,01	0,01			0,05			0,03		0,01						0,01	0,01										0,01						0,01			
BATTERIES, E-RAY., and ENGINE ELECTRICAL EQUIPMENT	8			0,02					0,04	0,03					0,01	0,02										0,01													
ELECTRIC LIGHTING and WIRING EQUIPMENT	9					0,01	0,01	0,01	0,04	0,04	0,01									0,002							0,01		0,01										
ELECTRONIC COMPONENTS and ACCESORIES	10	0,01			0,04			0,18	0,01		0,06								0,03	0,03																			
MATERIALS HANDLING MACHINERY and EQUIPMENT	11											0,04		0,01								0,01																	
SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12				0,01								0,05				0,01				0,01	0,01																	
CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13		0,01									0,05	0,01	0,06	0,01	0,03						0,01																	
FARM MACHINERY and EQUIPMENT	14		0,01											0,02	0,04	0,01																							
ENGINES and TURBINESS	15		0,03									0,01		0,03	0,05	0,09	0,01			0,02		0,01																	
MACHINE SHOP PRODUCTS	16	0,01		0,01					0,01			0,02			0,02	0,03	0,07		0,01		0,01	0,01				0,01		0,01											
OPTICAL, OPHTHALMIC, and PHOTOGRAPHIC EQUIPMENT	17																	0,06	0,01																				
SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOKS	18	0,02				0,01	0,03	0,01										0,01	0,06	0,01		0,01			0,01														
ELECTRICAL APPARATUS and MOTORS	19		0,03		0,02	0,09	0,04	0,02	0,02	0,03	0,03	0,05	0,04	0,01	0,01	0,02		0,01	0,03	0,07	0,03	0,05			0,01		0,01												
METALWORKING MACHINERY and EQUIPMENT	20	0,02	0,01	0,01	0,01		0,01		0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02		0,01	0,01	0,04	0,02	0,03	0,01	0,01			0,01	0,01										
GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	0,01	0,02	0,01	0,01	0,02	0,01		0,02			0,07	0,06	0,06	0,06	0,03	0,01		0,01	0,01	0,03	0,07	0,01		0,01														
HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	0,01	0,02	0,04	0,01	0,03	0,03	0,01		0,02	0,01	0,02	0,02	0,01	0,01		0,02	0,01	0,02	0,01	0,02	0,02	0,04	0,03	0,03	0,01	0,01	0,02	0,01	0,01	0,01	0,01			0,01				
STAMPINGS, SCREW MACHINE PRODUCTS, and BOLTS	23	0,02		0,03	0,01	0,04	0,05	0,02	0,02	0,03	0,02	0,02	0,01	0,01	0,03	0,02	0,01	0,01	0,02	0,01	0,03	0,01	0,02	0,03	0,02			0,01	0,01	0,01									
HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24		0,05			0,02	0,02					0,01	0,01	0,02								0,02	0,01	0,01	0,02		0,08												
AUTOMOTIVE REPAIR SERVICES	25																									0,02											0,02	0,01	
NEW and MANTENANCE CONSTRUCTION; GLASS, STONE, and CLAY PRODUCTS	26	0,01	0,01	0,02		0,01	0,01	0,01	0,01	0,04	0,04		0,01	0,01	0,01	0,01	0,02	0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,03	0,09	0,02	0,01		0,01	0,01		0,01	0,01	0,03	0,04	0,01	0,04
PRIMARY IRON and STEEL MINING and MANUFACTURING	27	0,03	0,12	0,09	0,02	0,07	0,08	0,01	0,03	0,07	0,02	0,11	0,09	0,15	0,15	0,10	0,08	0,01	0,02	0,06	0,08	0,11	0,20	0,20	0,24		0,03	0,26	0,02	0,02	0,01	0,01		0,01					
PRIMARY NONFERROUS METAL MINING and MANUFACTURING	28	0,03	0,02	0,01	0,02	0,05	0,04	0,02	0,11	0,05	0,04	0,01	0,04	0,01	0,01	0,03	0,08	0,03	0,04	0,07	0,03	0,03	0,07	0,07	0,07		0,01	0,02	0,39	0,02	0,01								
MISCELLANEOUS MANUFACTURING and SERVICE SECTORS	29	0,01	0,02	0,01	0,03	0,01	0,01	0,02	0,02	0,02	0,03	0,04	0,02	0,01	0,01	0,01	0,01	0,01	0,03	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,03	0,05	0,03	0,02	0,02	0,02	0,02	0,01	0,02	0,02	0,02	0,01
CHEMICALS, PLASTICS, RUBBER, DRUGS, and PAINTS	30	0,01	0,03	0,04	0,01	0,02	0,05	0,02	0,07	0,04	0,03	0,02	0,02	0,02	0,04	0,01		0,07	0,02	0,02	0,01	0,01	0,02	0,02	0,01	0,04	0,03	0,02	0,03	0,03	0,24	0,03	0,07	0,02	0,02		0,01	0,01	0,01
LUMBER and WOOD PRODUCTS; PAPER and PAPER PRODUCTS	31	0,01	0,04	0,01	0,01	0,02	0,02	0,04	0,01	0,02	0,02		0,01		0,01	0,01	0,04	0,02	0,01		0,01	0,01	0,02	0,02	0,01		0,06	0,01	0,01	0,12	0,03	0,30	0,01	0,02		0,01		0,01	0,04
TEXTILES and LEATHER GOODS	32			0,01															0,01											0,02	0,02	0,01	0,40						
FOOD, TOBACCO, and METAL CONTAINERS	33																		0,01											0,16	0,02	0,03	0,06	0,43				0,01	0,01
COAL, PETROLEUM, and UTILITIES	34	0,01	0,01	0,01		0,01	0,01		0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,02	0,01	0,02	0,01	0,02	0,03	0,06	0,03		0,05	0,02	0,01	0,02	0,34	0,01	0,05	0,03	0,01
RADIO, and TELEVISION BROADCASTING; COMMUNICATIONS	35												0,01				0,01				0,01	0,01				0,01						0,01				0,01	0,01	0,01	0,02
TRANSPORTATION and WAREHOUSING	36	0,01	0,02	0,02	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,01	0,03	0,05	0,02	0,20	0,03	0,03	0,02	0,03	0,03		0,06		0,01
WHOLESALE and RETAIL TRADE	37	0,02	0,05	0,03	0,05	0,05	0,04	0,04	0,03	0,06	0,05	0,04	0,04	0,04	0,04	0,03	0,03	0,04	0,04	0,03	0,03	0,05	0,03	0,03	0,04	0,08	0,08	0,04	0,03	0,05	0,03	0,04	0,03	0,04	0,01	0,01	0,03	0,02	0,01
OTHER BUSINESS and PERSONAL SERVICES	38	0,01	0,02	0,04	0,04	0,03	0,10	0,03	0,04	0,03	0,04	0,03	0,03	0,03	0,04	0,03	0,04	0,08	0,03	0,03	0,04	0,03	0,03	0,03	0,03	0,09	0,05	0,03	0,03	0,10	0,07	0,05	0,03	0,05	0,06	0,08	0,07	0,12	0,11
TOTAL CAPITAL	A	0,3	0,4	0,2	0,7	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,6	0,4	0,4	0,4	0,6	0,6	0,3	0,4	0,6	0,5	0,5	0,5	0,4	1,1	0,5	0,5	0,6	0,6	0,8	0,6	0,9	0,5	2,0	1,9	0,2	0,4	0,1
PROFESSIONAL, TECHNICAL, and CLERICAL WORKERS	B	21,1	13,7	5,6	17,9	11,9	12,1	20,4	19,3	15,5	20,7	16,8	19,3	14,0	14,0	12,2	27,3	20,3	19,1	18,2	19,6	16,4	14,4	17,9	14,0	21,8	1,7	8,7	8,4	8,2	14,0	19,8	11,1	7,1	7,3	57,0	25,0	105,7	19,5
SKILLED WORKERSSS	C	21,5	24,9	6,0	18,7	12,4	12,4	12,3	11,7	11,2	12,5	17,5	20,1	14,6	14,5	12,7	28,4	12,1	11,6	11,0	20,4	17,1	13,8	16,6	13,0	70,1	1,4	13,0	8,1	4,9	5,8	14,4	5,6	8,0	6,3	16,9	15,4	8,0	3,5
SEMI-SKILLED and UNSKILLED WORKERS	D	19,2	20,0	14,9	23,4	15,7	16,7	33,9	32,2	27,0	63,4	22,0	25,2	18,4	18,3	16,0	35,7	34,4	32,8	30,3	25,6	21,5	24,8	33,6	26,2	15,3	5,3	22,8	19,3	14,1	18,4	30,8	59,3	57,3	9,1	2,3	39,9	21,7	6,1
TOTAL LABOR	E	61,8	58,6	26,4	60	40	41,2	66,6	63,2	53,8	67,6	56,4	64,6	47	46,7	40,9	91,4	66,8	63,5	59,6	65,6	55	52,9	68,1	53,1	107,2	8,9	44,5	35,8	27,2	38,2	65	76	67,4	22,7	76,2	80,1	135,4	59,1

NOTE: COEFFICIENTS LESS THAN .005 ARE REPRESENTED BY DOTS; COMPONENTS MAY NOT ADD TO TOTAL BECAUSE OF ROUNDING

5. THE INTERNAL STRUCTURE OF THE METALWORKING COMPLEX

Summing the transactions within the yellow box (Table VI), we observe that the total value of transactions among the metalworkers themselves is 28 percent of their combined total output. Thus, a fair proportion of metalworking activity is "taking in each other´s wash". Makers of, say, engines and turbines purchase bolts and nuts and stampings from other metalworkers and, in turn, furnish marine engines to boat builders. Intra-industry transactions along the "diagonal" may often consist of sales of specialized parts made in one establishment to assembling plants included in the same industry. Thus, for example, the very large volume of sales among automobile establishments reflects the American practice of decentralizing automobile assembly plants throughout the country.

Table VIII presents direct input-output coefficients for the metalworking sectors alone for the United States in 1958[6]. Metalworking industries are specially arranged in that table to highlight their internal organization: industries which specialize in components for other metalworking industries are placed near the bottom of the table, and producers who specialize primarily in final metal products are located near the top. Final metal products are divided into three major groups: transportation equipment (automobiles, aircraft, railroad equipment, cycles, etc), electrical equipment (electrical transmission equipment, radio and TV sets, household appliances, office and computing machines) and nonelectrical equipment (industrial processing equipment, farm machinery, materials-handling equipment, metalworking machinery, etc.). Industries listed near the top of each final product group or "bloc", like office, computing and accounting machinery, and materials-handling machinery, sell little or nothing to other metalworking sectors on current account[7].Below them are listed sectors like electronic components and electric lighting and wiring equipment, which provide current inputs to electrical machinery producers at later stages, or engines and turbines, which produces components for industrial and transportation equipment manufacturers. The bottom rows of the table consist of industries which perform more general metalworking functions not specialized to a particular final metal product: stampers, makers of ball and roller bearings, etc. These provide components for all the later stages of metalworking production.

Note the "bloc" character of the electrical and nonelectrical machinery sectors. These blocs buy relatively little from each other, although both groups purchase from the "general intermediate" metalworkers detailed at the bottom of the table. Transportation equipment manufacturers do not form a self-contained bloc. They

6. Coefficients in Tables VIII and IX exclude some fictitious "secondary product" transfers included in Tables II and VII.
7. However, they do sell to other metalworkers on capital account. See below, p. 21.

Table VIII. Internal structure of metalworking United states, 1958.
Input-output coefficients excluding secondary transfers
(Dollars per dollar)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TRANSPORTATION EQUIPMENT	AIRCRAFT and PARTS	1	0,19																								
	SHIPS, TRAINS, TRAILERS, and CYCLES	2		0,07																							
	MOTOR VEHICLES and EQUIPMENT	3		0,01	0,30											0,01											0,14
ELECTRICAL EQUIPMENT	OFFICE AND COMPUTING MACHINES	4																		0,01							
	SERVICE INDUSTRY MACHINES	5					0,05	0,02																			
	HOUSEHOLD APPLIANCES	6		0,01				0,01																			
	RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7	0,02						0,05																		
	BATTERIES, X-RAY, and ENGINE ELECTRICAL EQUIPMENT	8			0,01					0,04	0,02					0,01	0,02										0,01
	ELECTRIC LIGHTING and WIRING EQUIPMENT	9					0,01	0,01	0,01	0,02	0,04										0,01						
	ELECTRONIC COMPONENTS and ACCESSORIES	10	0,01			0,04			0,17	0,01		0,06								0,03	0,02						
NON-ELECTRICAL EQUIPMENT	MATERIALS HANDLING MACHINERY and EQUIPMENT	11											0,04														
	SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12												0,05													
	CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13													0,06												
	FARM MACHINERY and EQUIPMENT	14														0,04											
	ENGINES and TURBINES	15		0,03									0,01		0,01	0,05	0,09										
	MACHINE SHOP PRODUCTS	16	0,01		0,01								0,01			0,01	0,03	0,07		0,01							0,01
GENERAL METALWORKING	OPTICAL, OPHTALMIC, and PHOTOGRAPHIC EQUIPMENT	17																	0,06								
	SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOCKS	18	0,01				0,01	0,03												0,06						0,01	
	ELECTRICAL APPARATUS and MOTORS	19		0,03		0,02	0,09	0,04	0,01	0,01	0,02		0,05	0,03	0,01	0,01	0,01		0,01	0,02	0,07	0,02	0,04			0,01	
	METALWORKING MACHINERY and EQUIPMENT	20	0,02		0,01	0,01		0,01		0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,01		0,01	0,01	0,06	0,01	0,02	0,01		
	GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	0,01	0,01		0,01	0,01	0,01		0,02			0,05	0,04	0,05	0,06	0,02				0,01	0,03	0,07			0,01	
	HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	0,01	0,02	0,04	0,01	0,02	0,03	0,01		0,02	0,01	0,01	0,01	0,01			0,01	0,01	0,01	0,01		0,01	0,04	0,02	0,03	0,01
	STAMPING, SCREW MACHINE PRODUCTS, and BOLTS	23	0,02		0,03	0,01	0,03	0,05	0,02	0,02	0,03	0,02	0,01	0,01	0,01	0,03	0,02		0,01	0,02	0,01	0,01	0,01	0,01	0,03	0,01	
	HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24		0,04									0,01	0,01	0,01								0,01			0,02	
	AUTOMOTIVE REPAIR SERVICES	25																									

NOTE: COEFFICIENTS LESS THAN .005 ARE EXCLUSED

Table IX. Internal structure of metalworking United states, 1947 input-output coefficients excluding secondary transfers (dollars per dollar)

				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TRANSPORTATION	EQUIPMENT	AIRCRAFT and PARTS	1	0,11																								
		SHIPS, TRAINS, TRAILERS, and CYCLES	2		0,08																							
		MOTOR VEHICLES and EQUIPMENT	3		0,01	0,26																						0,19
ELECTRICAL	EQUIPMENT	OFFICE AND COMPUTING MACHINES	4				0,03																					
		SERVICE INDUSTRY MACHINES	5					0,06	0,02																			
		HOUSEHOLD APPLIANCES	6					0,03	0,03																			
		RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7							0,13			0,07															
		BATTERIES, X-RAY, and ENGINE ELECTRICAL EQUIPMENT	8			0,01					0,02	0,01		0	0,01			0,02										0,03
		ELECTRIC LIGHTING and WIRING EQUIPMENT	9							0,01		0,06								0,01								0,01
		ELECTRONIC COMPONENTS and ACCESSORIES	10							0,06			0,06															
NON-ELECTRICAL	EQUIPMENT	MATERIALS HANDLING MACHINERY and EQUIPMENT	11											0,03														
		SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12												0,03													
		CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13													0,02	0,01											
		FARM MACHINERY and EQUIPMENT	14													0,01	0,05											
		ENGINES and TURBINES	15		0,04									0,02		0,05	0,08	0,05				0,01		0,01				
		MACHINE SHOP PRODUCTS	16		0,03				0,01							0,01		0,01	0,01									0,02
GENERAL	METALWORKING	OPTICAL, OPHTALMIC, and PHOTOGRAPHIC EQUIPMENT	17																	0,07								
		SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOCKS	18	0,01				0,01	0,01												0,09						0,01	
		ELECTRICAL APPARATUS and MOTORS	19		0,03		0,01	0,09	0,07	0,01	0,01	0,02	0,01	0,05	0,03	0,02		0,01		0,01	0,01	0,05	0,02	0,03			0,02	
		METALWORKING MACHINERY and EQUIPMENT	20	0,01		0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01		0,01	0,01	0,05	0,01	0,02	0,01	0,01	
		GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	0,01		0,01		0,01	0,01		0,01			0,03	0,03	0,03	0,03	0,04	0,01		0,01	0,01	0,02	0,04			0,01	0,01
		HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	0,01	0,02	0,02	0,02	0,03	0,03	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,03	0,02	0,03	0,02
		STAMPING, SCREW MACHINE PRODUCTS, and BOLTS	23	0,02	0,01	0,04	0,02	0,06	0,08	0,03	0,02	0,05	0,03	0,02	0,02	0,02	0,04	0,03	0,01	0,04	0,03	0,02	0,01	0,01	0,03	0,01	0,04	
		HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24		0,02																			0,01			0,03	
		AUTOMOTIVE REPAIR SERVICES	25																									

NOTE: COEFFICIENTS LESS THAN .005 ARE EXCLUSED purchase from both the electrical and the nonelectrical blocs as well as from each other[8].

One should not, of course, expect metalworking complexes to be fully developed in all economies. Relatively few metalworking activities will be represented in the input-output table for a developing economy, and within each input-output category the "mix" of such activities will be very different. The expansion, proliferation, and balancing of these activities is an essential part of economic development. Even among highly industrialized countries, specialization patterns vary to some extent.

Some variations in the division of labor within the metalworking bloc appear from a comparison of Tables VIII, IX, and X. Table VIII, above, shows the interdependence of metalworking sectors for the United States in 1958. Table IX shows the same kind of picture for the United States in 1947. Although we know that there were many dramatic changes in metalworking techniques used during the period 1947-1958, the overall pictures are quite similar: the relative dependence of each of the sub-blocs on the others does not change substantially, and the importance of general intermediate metalworkers in the overall picture remains about the same. This paradox of input-output coefficient stability in the face of known instances of changing techniques should not be surprising. New cutting techniques, for example, are introduced gradually, affecting only a very small portion of actual operation at first. Some qualitative changes in the design of components may not be discernible in terms of the present industry classification.

Table X describes the Japanese metalworking complex for 1960. While the basic industrial classification is different from that of the United States, it was possible to subdivide the complex into roughly the same general bloc categories used in Tables VIII and IX. Note the resemblances between the specialization patterns of the two countries: the relative paucity of above diagonal entries, the relative self-sufficiency of blocs and the prominence of general intermediate metalworking sectors. These latter seem to be less important in Japan than in the United States, while transactions among establishments within each sector seem to be relatively large. It is not clear whether this difference represents real differences in specialization patterns of Japanese and United States establishments or differences in accounting conventions.

8. The specialization pattern observed in the United States input-output table for metalworking must be interpreted in the light of the conventions of the input-output accounting. The statistics are compiled for establishment units and classified in terms of the principal activity of each establishment. Common metalworking processes like stamping, sheet-metal work, die making, wire work, etc., are actually performed within many product-specialized metalworking establishments, but are "transferred" fictitiously to the special processing sectors in the input-output accounts. Furthermore, where several processing stages are integrated within an establishment, they may never appear as transactions at all. Thus, Table VI and the derived coefficients in Table VIII d not tell us exactly how much stamping activity was actually performed in the American economy, but only what stamping products were purchased or sold.

Table X. Internal structure of metalworking japan, 1960. input-output coefficients including secondary transfers (yen per yen)

				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
TRANSPORTATION	EQUIPMENT	SHIPBUILDING	1																						
		RAILROAD EQUIPMENT	2		0,04																				
		MOTORCYCLES and BICYCLES	3			0,02																			0,03
		MISCELLANEOUS TRANSPORTATION EQUIPMENT	4				0,41																		
		AIRCRAFT	5					0,11																	
		MOTOR VEHICLES	6						0,14																0,29
ELEC.	EQUIP.	HOUSEHOLD MACHINES	7							0,13															
		HOUSEHOLD ELECTRICAL APPLIANCES	8								0,17												0,01		
		OFFICE MACHINES	9									0,07													
NON-ELECT.	EQUIP.	INDUSTRIAL MACHINERY	10							0,05			0,17												
		MACHINERY and EQUIPMENT for GENERAL USE	11										0,04	0,14	0,01		0,01								
		MACHINE TOOLS and METAL FORMING MACHINES	12									0,01			0,14										
		PRIME MOVERS, BOILER	13	0,12		0,14			0,15				0,02	0,01		0,21						0,01			0,08
INSTRU-	MENTS	OPTICAL INSTRUMENTS	14														0,13								
		WATCHES and CLOKS	15								0,02							0,14							
		PRECISION MACHINES	16	0,01				0,02				0,02	0,01	0,02	0,01		0,04		0,13						
GENERAL	METALWORKING	MISCELLANEOUS BATTERIES and WIRING DEVICES	17	0,02	0,01	0,07	0,01	0,01	0,04	0,01	0,15					0,01				0,25	0,04				0,03
		HERVY ELECTRIC MACHINERY and APPARATUS	18	0,01						0,05	0,01		0,03	0,03	0,01					0,01	0,15				
		METAL PRODUCTS for CONSTRUCTION	19				0,01						0,01	0,01								0,03			
		MISCELLANEOUS METAL PRODUCTS	20	0,02		0,01			0,01	0,01	0,01		0,01	0,01		0,02		0,01		0,01		0,02	0,01		0,01
		BALL and ROLLER BEARINGS and OTHER COMMON PARTS	21	0,02	0,02	0,04	0,07	0,02	0,02	0,04	0,02	0,16	0,05	0,04	0,09	0,03	0,02	0,05	0,03	0,01	0,04			0,04	0,02
		REPAIR OF AUTOMOBILES	22					0,01					0,01	0,01										0,01	

NOTE: COEFFICIENTS LESS THAN .005 ARE EXCLUDED

(Perhaps the Japanese count plants making wire products for household machines in the household machinery rather than the wire products industry).

General intermediate metalworkers sell the bulk of their output as current inputs. They furnish parts and components to other metalworking sectors. Products of the later stages of metalworking, the so-called "final metalworking" products, are delivered to both metalworking and non-metalworking sectors on capital account: They become part of the stocks of durable goods essential for modern industrial technology. Referring back to the national input-output table, Table I or Table VI, we note that transactions between metalworkers and other industrial sectors are really very small. Metalworkers supply important inputs only to other metalworkers, and changes in Final Demand for sectors other than metalworking have very little direct or indirect impact on metalworking sectors. The characteristic dependence of all sectors on the metalworking complex becomes apparent only when the capital account is considered. (See below, Section 7.)

6. REDUCED INPUT-OUTPUT TABLES

Being interested primarily in metal products, we should like to ignore all the other sectors of the economy except insofar as they contribute to and in their turn depend upon the growth of the metalworking complex in the framework of an overall developmental plan. We shall now introduce an analytical device that will permit us to center all attention on a selected group of industries –in this case, the metalworking complex- with the assurance that the requirements of all the other sectors of the economy are automatically taken into account. In order to explain the practical meaning of the analytical transformation that leads to the construction of what we call the reduced input-output matrix of a national economy, we will ask you to visualize a situation in which -for trading purposes- all industries of a country have been divided in two groups. The industries belonging to Group I are "contracting" industries; those in Group II are identified as "subcontracting" industries.

Each contracting industry covers its direct input needs for the products of other Group I industries by direct purchases and each Group II industry makes direct purchases from other Group II industries. However, the products of Group II industries delivered to Group I industries are manufactured on the basis of special work contracts. Under such a contract, the Group I industry placing an order with a Group II industry provides the latter with its own products and also the products of all other Group I industries, in amounts required to fill the particular order. To be able to do so, it must, of course, first purchase all these goods -from Group I industries that manufacture them- on its own account. The relationship between a contracting, Group I, and a subcontracting, Group II, industry is thus analogous to the relationship between a tailor and his customer who buys the cloth himself and then brings it to the tailor to be made up into a suit.

In planning its purchases from other sectors, each Group I industry has, under these conditions, to take into account, not only its own immediate input requirements, but also the input requirements of the Group II industries to which it will have to deliver correct amounts of the products of various Group I industries (including, frequently, its own) to be processed under contract. For planning purposes, a Group I industry might as well account for the amounts of the product of Group I industries that it will have to supply to the Group II industries working for it, as if they were elements of its own input structure. That is exactly what is being done in constructing a reduced input-output table.

The relationship of the reduced table to the original table from which it is derived is similar to the relationship of an abbreviated train time table to the complete, detailed time table which also lists the intermediate stations. The subdivision of all the sectors of an economy into Groups I and II must, of course, depend on the specific purpose of the proposed analysis.

Using a reduced table for planning purposes, we can be sure that if the input-output flows among the Group I industries shown in it are properly balanced, the balance between the outputs and inputs of all the other industries omitted from it will also be secured, at least with respect to the supply and demand for commodities and services classified in Group I.

In the process of consolidation, the technical details of which we will not describe here, the labor and the capital coefficients of each of the selected principal industries can also be transformed, that is, recomputed, in such a way that these coefficients will reflect not only its own labor and capital requirements, but also the capital and labor requirements of all the Group II industries which deliver their products to it. It is as if, under the imaginary contracts described above, each Group I industry provided the Group II industries working for it, not only with the inputs coming from all the different Group I sectors, but also with all the capital and labor employed by the Group II industries in filling their contractual orders. Thus, the output levels of all the primary industries as projected on the basis of reduced input-output table will -if multiplied with the appropriate consolidated capital and labor coefficients- account not only for the capital and labor requirements of these Group I industries, but also for those of all the Group II industries without whose support these output levels could not be attained.

Table XI is a reduced coefficient table derived from Table VII. All of the metalworking industries, construction, and ferrous metals are included in Group I, and all other industries are considered to be in Group II. Thus, while Table VII has 38 endogenous sectors, Table XI has only 27-order reduced table are equal to or greater than the corresponding coefficients in the original 38-order table. For example, the coefficient showing Ferrous Metal inputs into Construction and Mining Equipment (row 27, col. 13) is (.15) in the original table and (.16) in the reduced table. This is because the reduced table´s coefficient includes both iron and steel used directly to

Table XI. "Reduced" input-output coefficients for united states economy, 1958 (dollars per dollar)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
AIRCRAFT and PARTS	1	0,19	0,01		0,01	0,01		0,01								0,01			0,02		0,01	0,02						
SHIPS, TRAINS, TRAILERS, and CYCLES	2		0,07											0,01		0,01				0,01		0,01			0,01			
MOTOR VEHICLES and EQUIPMENT	3	0,01	0,01	0,30		0,01			0,04			0,01		0,02	0,02	0,03			0,02		0,05	0,01	0,01	0,03		0,14		
OFFICE and COMPUTING MACHINES	4				0,09						0,01								0,01									
SERVICE INDUSTRY MACHINES	5					0,05	0,03															0,01			0,01			
HOUSEHOLD APPLIANCES	6		0,01			0,06	0,01																		0,01			
RADIO, TELEVISION, and COMMUNICATION EQUIPMENT	7	0,03		0,01	0,01			0,06	0,01		0,03		0,01					0,01	0,01	0,01								
BATTERIES, X-RAY., and ENGINE ELECTRICAL EQUIPMENT	8			0,02					0,04	0,03						0,01	0,02									0,02		
ELECTRIC LIGHTING and WIRING EQUIPMENT	9					0,01	0,01	0,01	0,04	0,04	0,01									0,02							0,01	
ELECTRONIC COMPONENTS and ACCESORIES	10	0,01			0,04			0,18	0,01		0,06								0,03	0,03								
MATERIALS HANDLING MACHINERY and EQUIPMENT	11											0,04		0,01								0,01						
SPECIAL INDUSTRY MACHINERY and EQUIPMENT	12				0,01								0,05				0,01				0,01	0,01						
CONSTRUCTION, MINING, and OIL-FIELD MACHINERY	13		0,01									0,05	0,01	0,06	0,01	0,03						0,01						
FARM MACHINERY and EQUIPMENT	14		0,01											0,02	0,04	0,01												
ENGINES and TURBINESS	15		0,03									0,01		0,03	0,05	0,09	0,01			0,02		0,01						
MACHINE SHOP PRODUCTS	16	0,01		0,01					0,01			0,02			0,02	0,03	0,07		0,01		0,01	0,01				0,01		0,01
OPTICAL, OPHTHALMIC, and PHOTOGRAPHIC EQUIPMENT	17																	0,06	0,01									
SCIENTIFIC, CONTROLLING INSTRUMENTS, and CLOKS	18	0,02				0,01	0,03	0,01			0,01							0,01	0,06	0,01		0,01			0,01			
ELECTRICAL APPARATUS and MOTORS	19		0,03		0,02	0,09	0,04	0,02	0,02	0,03	0,03	0,05	0,04	0,01	0,01	0,02	0,01	0,01	0,03	0,07	0,03	0,05			0,01		0,01	
METALWORKING MACHINERY and EQUIPMENT	20	0,02	0,01	0,01	0,01		0,01	0,01	0,02	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,06	0,02	0,03	0,01	0,01			0,01
GENERAL INDUSTRIAL MACHINERY and EQUIPMENT	21	0,01	0,02	0,01	0,01	0,02	0,01		0,02			0,07	0,06	0,06	0,06	0,03	0,01		0,01	0,01	0,03	0,07	0,01		0,01			
HARDWARE, PLATING, VALVES, and WIRE PRODUCTS	22	0,01	0,02	0,04	0,01	0,03	0,04	0,01	0,01	0,02	0,02	0,02	0,02	0,01	0,01		0,02	0,01	0,02	0,01	0,02	0,02	0,04	0,03	0,03	0,02	0,02	0,02
STAMPINGS, SCREW MACHINE PRODUCTS, and BOLTS	23	0,02	0,01	0,03	0,01	0,04	0,05	0,02	0,03	0,03	0,02	0,02	0,01	0,01	0,03	0,02	0,01	0,01	0,02	0,02	0,03	0,01	0,02	0,03	0,02			0,01
HEATING, PLUMBING, and STRUCTURAL METAL PRODUCTS	24		0,05			0,02	0,02					0,01	0,01	0,02								0,02	0,01	0,01	0,02		0,08	
AUTOMOTIVE REPAIR SERVICES	25																									0,02	0,01	
NEW and MANTENANCE CONSTRUCTION; GLASS, STONE, and CLAY PRODUCTS	26	0,01	0,02	0,02	0,01	0,02	0,02	0,01	0,02	0,04	0,05	0,01	0,01	0,01	0,01	0,01	0,03	0,04	0,01	0,02	0,01	0,02	0,01	0,02	0,02	0,04	0,10	0,03
PRIMARY IRON and STEEL MINING and MANUFACTURING	27	,03	0,12	0,09	0,02	0,07	0,08	0,01	0,04	0,07	0,02	0,11	0,09	0,16	0,15	0,10	0,08	0,01	0,02	0,06	0,08	0,11	0,20	0,20	0,24		0,03	0,26
TOTAL CAPITAL	A	0,04	0,06	0,04	0,09	0,06	0,06	0,04	0,07	0,06	0,06	0,06	0,08	0,06	0,06	0,05	0,08	0,09	0,06	0,07	0,08	0,07	0,08	0,08	0,6	1,3	0,08	0,09
PROFESSIONAL, TECHNICAL, and CLERICAL WORKERS	B*	26,8	26,0	15,2	29,8	25,6	28,8	31,5	33,7	31,0	35,1	28,1	30,6	22,7	25,2	20,4	37,7	36,6	31,4	29,2	28,5	27,1	26,1	28,9	25,1	41,0	21,7	21,1
SKILLED WORKERS	C*	23,0	27,9	8,1	21,0	15,6	16,0	15,0	15,9	14,8	15,8	19,8	22,8	16,3	16,8	14,7	31,2	16,0	14,7	14,2	22,3	19,3	17,1	19,8	14,0	72,9	5,9	16,5
SEMI-SKILLED and UNSKILLED WORKERS	D*	23,1	28,2	21,6	29,7	24,1	26,4	41,2	43,8	36,8	43,3	28,8	32,4	22,8	24,6	21,1	42,6	44,9	42,9	38,9	30,5	27,2	33,7	42,4	34,0	23,1	17,0	31,8
TOTAL LABOR	E*	72,9	86,2	44,8	80,5	65,3	71,1	87,8	93,4	82,6	94,2	76,7	85,8	61,8	66,6	56,2	111,5	97,4	89,1	82,3	81,4	73,6	76,9	91,1	75,1	137,1	44,6	69,3

NOTES.* LABOR ROWS B-E ARE MAN YEARS PER THOUSAND DOLLARS OF OUTPUT

COEFFICIENTS UNDER .005 ARE EXCLUDED

make construction and mining equipment and iron and steel used directly and indirectly to make the products which construction machinery manufacturers purchase from Group II industries: pit props for coal mines, steel sheet for metal containers used to package paint, repair parts for rubber and plastics producers´ machinery used in the production of plastic parts and tires, etc. The last 5 rows of both tables show labor (subdivided by skill types) and total capital requirements on the original and the reduced form basis respectively. Total capital requirements for Farm Equipment in Table XI include not only capital goods used directly in making farm equipment, but also capital requirements for making paints used in manufacturing farm equipment.

The reader will note that the differences between corresponding "input coefficients" in Tables XI and VII are very small indeed. Most of the differences between corresponding entries were small enough to disappear when the coefficients were rounded to two decimal places. On the other hand, differences between corresponding labour and capital coefficients in the original and reduced tables are sizeable. This feature brings out, once again, the unique position of metalworking industries in relation to the rest of the economy. As was pointed out before, metalworkers furnish only a very small proportion of their products to non-metalworkers "on current account". Thus, as members of Group I, they are not required to contribute appreciable amounts of metalworking products to their "subcontracting" suppliers in Group II. Direct purchases by metalworkers from other metalworkers account for most of all current account metalworking product requirements in the reduced table. Metalworkers do have to supply relatively large amounts to Group II industries on capital account, if the latter are to be able to furnish requisite non-metalworking inputs to Group I industries; but this is a quite different matter that will be taken up below in the context of dynamic input-output analysis. Similarly, under this new system of accounting, metalworking sectors are called upon to supply labor not only for their own production but also for the production of all their inputs from Group II industries. Comparison of the last rows in Tables II and VII shows that these amounts are far from trivial.

The transformation of the original input-output table to reduced form also requires, of course, an appropriate consolidation of the column containing the Final Bill of Goods. These deliveries to final users are recomputed in the same way as the inputs to a Group I industry: purchases from sectors classified in Group II are not shown as such. Instead of that, the amount of the product of each of the Group I industries absorbed by all the Group II industries in the production of their deliveries to final users are added to the amounts of the same goods directly purchased by the final users. Thus, the consolidated final bill of goods will not show any purchases from the chemical sectors, when Chemicals is classified as a Group II industry.

The figure representing the final deliveries from Ferrous Metals industry will, however, be augmented by the amount of Ferrous Metals absorbed in the manufacture of Chemicals actually purchased by the final users. Thus, in the reduced, compact

Table XII. "Reduced" input-output table for united states economy, 1958
Current Account Inter-Industry Transactions only
(millions of dollars)

Final Demand, in Year O, for Products of Industry

	1								
YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,000	0,001	0,002	0,005	0,012	-0,011	1,167
2	0,001	0,002	0,004	0,008	0,017	0,035	0,076	0,160	0,028
3	0,000	0,001	0,001	0,002	0,005	0,011	0,029	0,037	0,004
4	0,001	0,001	0,003	0,007	0,014	0,030	0,061	0,162	0,235
5	0,000	0,000	0,001	0,002	0,004	0,009	0,021	0,038	0,250

	2								
YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,000	0,001	0,002	0,004	0,013	-0,018	0,015
2	0,001	0,002	0,003	0,007	0,015	0,032	0,071	0,109	1,137
3	0,000	0,000	0,001	0,002	0,005	0,010	0,022	0,034	0,000
4	0,001	0,001	0,003	0,006	0,013	0,027	0,052	0,181	-0,245
5	0,000	0,000	0,001	0,002	0,004	0,009	0,019	0,027	0,144

	3								
YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,000	0,001	0,002	0,003	0,009	-0,009	0,005
2	0,001	0,001	0,003	0,006	0,012	0,026	0,056	0,111	-0,065
3	0,000	0,000	0,001	0,002	0,004	0,008	0,018	0,038	1,158
4	0,001	0,001	0,002	0,005	0,010	0,022	0,045	0,119	-0,168
5	0,000	0,000	0,001	0,002	0,003	0,007	0,015	0,026	0,042

	4								
YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,001	0,001	0,002	0,005	0,007	0,064	-0,071
2	0,001	0,002	0,004	0,009	0,018	0,038	0,079	0,205	-0,174
3	0,000	0,001	0,001	0,003	0,006	0,012	0,029	0,063	-0,055
4	0,001	0,002	0,003	0,007	0,015	0,032	0,073	0,085	0,899
5	0,000	0,001	0,001	0,002	0,005	0,010	0,021	0,058	-0,015

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,001	0,001	0,002	0,005	0,014	0,008	-0,020
2	0,001	0,002	0,004	0,009	0,018	0,039	0,085	0,109	-0,152
3	0,000	0,001	0,001	0,003	0,006	0,012	0,027	0,059	-0,084
4	0,001	0,002	0,003	0,007	0,015	0,033	0,065	0,190	-0,265
5	0,000	0,001	0,001	0,002	0,005	0,010	0,023	0,052	1,284

1 = RAILROAD FARM and CONSTRUCTION EQUIPMENT 2 = AUTOS, AIRCRAFT, and INTERMEDIATE METALWORKERS 3 = ELECTRICAL EQUIPMENT and INSTRUMENTS 4 = CONSTRUCTION 5 = FERROUS METAL

EACH ENTRY TELLS THE OUTPUT IN A GIVEN YEAR OF THE INDUSTRY DESIGNATED BY NUMBER AT THE LEFT (SEE KEY TO INDUSTRY, ABOVE), REQUIRED PER DOLLAR INCREASE IN FINAL DELIVERIES IN YEAR O OF THE INDUSTRY DESIGNATED BY NUMBER AT THE TOP input table, the balance between total supply and the total demand for the products of all the Group I industries will be accounted for as fully as in the original table.

Table XII is a reduced input-output flow table corresponding to the 38-order flow table, Table VI. Note that the total output levels for the 27 industries included in Group I are the same in both tables. Corresponding final demand entries for each Group I industry are larger in Table XII than in Table VI. This is because final demand for, say, Materials-handling Equipment, in the reduced table, includes not only Materials-handling Equipment, directly purchased for the expansion of industrial capacity but also repair and maintenance parts furnished by the producers of this equipment to the manufacturers of Food, Chemicals, Textiles, and other excluded Group II items in final demand.

By using a compact input-output table with the corresponding complement of appropriately enlarged technical coefficients, the planner can center his attention on a selected group of industries without worrying that any particular decision concerning the levels of output in these industries may turn out to be abortive because of unforeseen capital or labor shortages or insufficient supplies of materials –produced by these Group I industries- in any other sectors.

7. THE CAPITAL ACCOUNT

Let us shift our attention, now, to the economy´s capital account. Table XIII is a capital stock matrix for the United States economy in 1958. Each entry shows the value of the stock of goods produced by the industry identified on the left, held by the industry identified at the top of the table. While input-output flow tables report actual transactions, sales and purchases among industries over a given time period (generally a year), the stock table presents the inventory of buildings, machines and all other facilities held by each industry at a given point of time. Thus a flow table is analogous to the income account and a stock table to the physical assets in the capital account. They show different aspects of the same productive process. Strictly speaking, all items which are reported as flows should also appear as stocks, perhaps in the form of inventories: material, goods in process, and finished goods. So-called "fixed capital goods" are distinguished by their relative longevity: the sizes of their stocks will be large relative to their annual flows. Compared with inventories, a machine or building tends to remain in the stock for a relatively long period of time -three, five, ten, even fifty years before it is replaced. Actually, the stocks in Table XIII do not include the relatively short-lived inventory items, but only stocks of durable capital goods.

Table XIII has two outstanding features. First, notice the importance of metalworking products in the stocks of durable capital.

More than 42 percent of the economy´s capital originated in metalworking industries. In contrast to the current account picture shown in Table VI , metalworking stocks appear to be important across the entire table, that is, in virtually all using industries. Second, note the preponderance of stocks held outside the manufacturing sectors. While we are accustomed to thinking of steel, automobiles, cement, as the prototypes of capital intensive industries, much larger actual volumes of capital goods are required in our networks of communication, transportation and trade. This feature is important in newly developing countries, as well. In the American economy, these coordinating sectors are growing in relative importance, and so are their capital requirements. Agricultural capital is also far from negligible in the general picture.

The ratio of stock appearing in each cell to the annual rate of output of the industry which uses it is called a "capital coefficient". A table, or matrix, of capital coefficients tells the value of the stocks of the various types of durable or "capital" goods required per unit of output. (Here the notion of capacity output is important because of the possibility of idle capital goods). Table XIV is a matrix of (fixed or durable) capital coefficients. To make the table less cumbersome, only capital coefficients greater than 005 are cited in the table. This simplification tends once again to emphasize the concentration of capital originating in a few metalworking sectors. Total capital required per unit of capacity is given, for each sector, at the bottom of the table. These total capital coefficients vary greatly from industry to industry, particularly outside of manufacturing[9].

8. ACCUMULATION OF REQUIRED CAPITAL STOCKS

How do we relate stock requirements, described in Table XIII, to interindustry flow requirements pictured in Table VI? It takes time to produce and accumulate stocks of capital goods. In the short run, therefore, the stock of capital invested in, that is, possessed by, various producing sectors of the economy sets an upper limit on the flow of outputs that they can produce. The capital coefficient table tells us what durable goods we must have to produce any given set of outputs.

Realistically, if these capital goods (largely metalworking products) are not available, the projected levels of production cannot take place. As time goes on, a step-by-step accumulation of domestically produced -or imported- capital increases the productive capacities of an economy and, if these are properly balanced, permits it to increase its output and deliveries to Final Demand. In the last section of this

9. Complete sets of capital coefficients, such as those cited in Table XIV, are not yet available for many countries. A set was developed for the Indian economy on a fairly aggregated classification basis, and sets of total capital coefficients (corresponding to the column sums in Table XIV) are available for several years for Japan. Rough preliminary intercomparison suggests that the Japanese capital coefficients are of the same order of magnitude as those for the United States. Those for India appear to be roughly double the American ones. The source of the differences, real or statistical, has still to be studied in some detail.

Table XIII. Stocks of capital goods in the united states economy 1958, (millions of dollars)

	YEAR OF OUTPUT:	-8	-7	-6	-5	-4	-3	-2	-1	0
RAIL ROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	0,0001	0,0002	0,0005	0,0010	0,0023	0,0041	0,0144	0,1010	-0,1102
	LABOR**	0,0096	0,0201	0,0429	0,0910	0,1977	0,3569	1,2553	8,8320	-9,6368
	CAPITAL***	0,0001	0,0002	0,0003	0,0007	0,0015	0,0027	0,0093	0,0657	-0,0717
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	0,0008	0,0018	0,0038	0,0080	0,0169	0,0354	0,0825	-0,0078	-0,0827
	LABOR	0,0630	0,1340	0,2850	0,6030	1,2830	2,6830	6,2590	-0,5930	-6,2740
	CAPITAL	0,0005	0,0011	0,0024	0,0051	0,0108	0,0225	0,0526	-0,0050	-0,0527
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	0,0003	0,0006	0,0012	0,0025	0,0052	0,0109	0,0245	0,0649	-0878
	LABOR	0,0224	0,0474	0,1000	0,2121	0,4510	0,9409	2,1137	5,5978	-7,5745
	CAPITAL	0,0002	0,0003	0,0007	0,0015	0,0033	0,0068	0,0152	0,0417	-0,0544
CONSTRUC-TION	OUTPUT	0,0007	0,0015	0,0031	0,0067	0,0141	0,0308	0,0548	0,1898	-0,2635
	LABOR	0,0312	0,0660	0,1400	0,2975	0,6271	1,3737	2,4423	8,4642	-11,7534
	CAPITAL	0,0006	0,0012	0,0025	0,0054	0,0113	0,0247	0,0439	0,1522	-0,2113
FERROUS METALS	OUTPUT	0,0002	0,0005	0,0010	0,0021	0,0045	0,0094	0,0222	0,0391	-0,0526
	LABOR	0,0153	0,0326	0,0700	0,1477	0,3148	0,6546	1,5407	2,7119	-3,6466
	CAPITAL	0,0002	0,0004	0,0009	0,0019	0,0040	0,0084	0,0198	0,0348	-0,0468

	YEAR OF OUTPUT:	-8	-7	-6	-5	-4	-3	-2	-1	0
RAIL ROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	-0,0001	-0,0003	-0,0006	-0,0013	-0,0029	-0,0053	-0,0197	-0,0285	-0,1181
	LABOR**	-0,0122	-0,0262	-0,0551	-0,1164	-0,2537	-0,4636	-1,7225	-2,5142	-10,3349
	CAPITAL***	-0,0001	-0,0002	-0,0004	-0,0009	-0,0019	-0,0035	-0,0128	-0,0185	-0,0769
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	-0,0011	-0,0023	-0,0048	-0,0102	-0,0217	-0,0456	-0,1032	-0,0368	-0,1966
	LABOR	-0,0812	-0,1723	-0,3658	-0,7765	-1,6493	-3,4576	-7,8329	-2,7901	-14,9189
	CAPITAL	-0,0007	-0,0015	-0,0031	-0,0065	-0,0139	-0,0290	-0,0658	-0,0234	-0,1253
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	-0,0003	-0,0007	-0,0015	-0,0032	-0,0067	-0,0140	-0,0323	-0,0800	0,0105
	LABOR	-0,0285	-0,0604	-0,1285	-0,2725	-0,5804	-1,2108	-2,7864	-6,9027	0,9055
	CAPITAL	-0,0002	-0,0004	-0,0009	-0,0020	-0,0042	-0,0087	-0,0200	-0,0495	0,0065
CONSTRUC-TION	OUTPUT	-0,0009	-0,0019	-0,0040	-0,0086	-0,0181	-0,0395	-0,0170	-0,2599	0,3617
	LABOR	-0,0401	-0,0852	-0,1802	-0,3827	-0,8068	-1,7613	-3,1666	-11,5929	16,1309
	CAPITAL	-0,0007	-0,0015	-0,0032	-0,0069	-0,0145	-0,0317	-0,0569	-0,2084	0,2900
FERROUS METALS	OUTPUT	-0,003	-0,0006	-0,0013	-0,0027	-0,0058	-0,0122	-0,0287	-0,0656	-0,0797
	LABOR	-0,0201	-0,0423	-0,0895	-0,1900	-0,4050	-0,8439	-1,9866	-4,5459	-5,5236
	CAPITAL	-0,0003	-0,0005	-0,0012	-0,0024	-0,0052	-0,0108	-0,0255	-0,0583	-0,0708

	YEAR OF OUTPUT:	-8	-7	-6	-5	-4	-3	-2	-1	0
RAIL ROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	0,0001	0,0002	0,0005	0,001	0,0022	0,0041	0,0147	0,0688	-0,0712
	LABOR**	0,0096	0,0201	0,0429	0,0892	0,1951	0,3552	1,2851	6,0143	-6,2277
	CAPITAL***	0,0001	0,0002	0,0003	0,0007	0,0015	0,0026	0,0096	0,0447	-0,0463
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	0,0008	0,0018	0,0037	0,0079	0,0167	0,0350	0,0805	0,0349	-0,0803
	LABOR	0,0622	0,1328	0,2816	0,5966	1,2675	2,6550	6,1100	2,6497	-6,0917
	CAPITAL	0,0005	0,0011	0,0024	0,0050	0,0107	0,0225	0,0513	0,0223	-0,0512
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	0,0003	0,0005	0,0012	0,0024	0,0052	0,0108	0,0242	0,0298	-0,0324
	LABOR	0,0216	0,0466	0,0992	0,2096	0,4459	0,9297	2,0853	2,5682	-2,7924
	CAPITAL	0,0002	0,0003	0,0007	0,0015	0,0032	0,0067	0,0150	0,0184	-0,0200
CONSTRUC-TION	OUTPUT	0,0007	0,0015	0,0031	0,0066	0,0139	0,0304	0,0545	0,1977	-0,2741
	LABOR	0,0308	0,0651	0,1383	0,2439	0,6199	1,3550	2,4325	8,8183	-12,2244
	CAPITAL	0,0006	0,0012	0,0025	0,0053	0,0112	0,0244	0,0437	0,1586	-0,2198
FERROUS METALS	OUTPUT	0,0002	0,0005	0,0010	0,0021	0,0045	0,0093	0,0219	0,0387	0,0119
	LABOR	0,0153	0,0326	0,0687	0,1463	0,3113	0,6476	1,5179	2,6828	0,8217
	CAPITAL	0,0002	0,0004	0,0009	0,0019	0,0040	0,0083	0,0195	0,0344	0,0105

Table XIV. Fixed capital coefficients for united states economy, 1958 (dollars per dollar per year)

YEAR		1	2	3	4	5	6	7	8	9	10
HOUSEHOLD CONSUMPTION		20,0000	20,800	21,6000	22,4000	23,2000	24,2000	25,2000	26,2000	27,2000	28,2000
EXPORTS		1,0000	1,0300	1,0600	1,0900	1,1200	1,1500	1,1800	1,2200	1,2600	1,3000
IMPORTS		1,5000	1,5450	1,5900	1,6350	1,6800	1,7250	1,7700	1,8300	1,8900	1,9500
RAILROAD, FARM,	OUTPUT	0,1511	0,1553	0,1603	0,1681	0,1963	0,2024	0,2093	0,2145	0,2228	0,2513
and	LABOR	13,2200	13,5900	14,0200	14,7100	17,1700	17,7100	18,3100	18,7600	19,4900	21,9800
CONSTRUCTION EQUIPMENT	CAPITAL	0,0983	0,1011	0,1043	0,1094	0,1278	0,1317	0,1362	0,1396	0,1450	0,1635
AUTOS, AIRCRAFT,	OUTPUT	0,9609	0,9978	1,0421	1,1031	1,1628	1,2068	1,2542	1,3058	1,3737	1,4420
and INTERMEDIATE	LABOR	72,9300	75,7300	79,1000	83,7300	88,2600	91,6000	95,1900	99,1100	104,2600	109,4500
METALWORKERS	CAPITAL	0,6127	0,6362	0,6644	0,7033	0,7414	0,7695	0,7997	0,8326	0,8759	0,9194
ELECTRICAL	OUTPUT	0,4419	0,4572	0,4744	0,4967	0,5321	0,5502	0,5685	0,5889	0,6095	0,6535
EQUIPMENT and	LABOR	38,1100	39,4300	40,9100	42,8400	45,8900	47,4500	49,0300	50,7900	52,5600	56,3600
INSTRUMENTS	CAPITAL	0,2735	0,2830	0,2936	0,3074	0,3293	0,3405	0,3518	0,3645	0,3772	0,4044

* BASED ON ASSUMPTION OF 4 PERCENT ANNUAL GROWTH RATE OF HOUSEHOLD CONSUMPTION AND 3 PERCENT ANNUAL GROWTH RATE OF EXPORTS IMPORTS

paper, after we have examined the working parts, a numerical example of a simple dynamic input-output model of a developing economy will be assembled.

Purchases of capital goods by the various industries are not reported in a conventional input-output table as current account transactions, but are relegated to a special gross capital formation column in Final Demand (Table I overleaf). This column tells the total amounts of office machinery, trucks, electrical transmission equipment supplied to the whole economy in a given year. In the absence of capital imports over the years, all additions to equipment stocks must pass through the gross capital formation account. The single gross capital formation column is a sum of additions to capital stock made by all using industries. It combines new tractors bought by agriculture with those bought by mining and construction. Given the detailed statistical information, one could elaborate this single capital formation column into a complete matrix of many columns which would tell gross additions of each kind of capital goods in each industry in a given year[10]. Thus, we would distinguish separately the tractors bought by agriculture and by construction, the materials-handling equipment bought by food processing and chemicals and automobiles, etc.

Each element in the gross capital formation vector, or in a capital flow matrix, in turn combines two elements: capital goods to replace or renew existing stocks, and capital to expand productive capacity by net addition to previously accumulated stocks. In a highly industrialized country, a relatively large proportion (perhaps 60 percent in the United States) of annual capital goods purchases is devoted to renewal or modernization, and 40 percent to expansion. In developing countries, the percentages for expansion will be much higher.

Table XV gives rough estimates of the split of the gross capital formation vector into a replacement and an expansion portion for the United States in 1958. To simplify the present exposition, it will be assumed that replacement requirements are fixed, say, at approximately the levels given in column 2 of. Table XV[11]. Beyond the maintenance and replacement of existing stocks, additional capital goods are required for the expansion of capacity. Let us see how this second component of gross capital formation is determined.

10. Such a "capital flow" table has already been made for the United States for 1958 in connection with the Bureau of Labor Statistics Interagency Growth Project, but it has not yet been published.

11. One can argue that roughly the same proportion of capital stock must be renewed each year. Since capital stock requirements are, in turn, proportioned to output, one can then justify converting the replacement capital flows to coefficients and adding them to the coefficients of the original flow matrix. This procedure is obviously a gross oversimplification, particularly if applied in analysis of a highly industrialized economy. In many instances, it is difficult to distinguish replacement from expansion expenditures, and the development of new technological alternatives makes replacement a matter of economic advantage rather than pure technical necessity. In developing countries, where a large proportion of equipment is a recent origin, and new capital goods are relatively difficult to obtain, it will generally be rational to restrict replacement to a minimum level close to that required by absolute technological necessity.

Table XV. Expenditures on fixed capital equipment (excluding construction) for replacement and expansion of capacity, u.s. Economy 1958. (Millions of Dollars)

Capital Producing Sectors	Total Fixed Capital Expenditures	Expenditures For Replacement& Modernization	Expenditures For Expansion Of Capacity
Aircraft and Parts	360	291	69
Ships, Train, Trailers & Cycles	1,175	966	209
Motor Vehicles & Equipment	3,561	3,027	534
Office & Computing Machines	1,017	379	638
Service Industry Machines	950	278	672
Household Appliances	93	28	65
Radio, T.V. & Communication Equip.	1,006	269	737
Batteries, X-Ray, & Engine Electrical Equipment	83	34	49
Electric Lighting & Wiring Equipment	25	9	16
Electronic Components & Accessories	27	12	15
Materials Handling Machinery & Equip.	350	197	153
Special Industry Machinery & Equip.	1,467	819	648
Construction, Mining & Oil-Field Mach.	1,316	618	698
Farm Machinery & Equipment	1,670	1,386	284
Engines & Turbines	576	216	360
Optical, Ophtalmic & Photographic Equipment	161	49	112
Scientific, Controlling Instruments & Clocks	530	176	354
Electrical Apparatus & Motors	1,618	552	1,066
Metalworking Machinery & Equipment	1,152	673	479
General Industrial Machinery & Equip.	1,051	536	515
Hardware, Plating, Valves & Wire Products	166	78	88
Heating, Plumbing, Structural Metal Products	706	313	393
Miscellaneous Manufacturing & Service Sectors	1,115	469	646
Chemicals, Plastics, Rubber, Drugs & Paints	53	17	36
Lumber & Wood Prod.; Paper & Paper Products	930	315	615
Textiles & Leather Goods	49	17	32
Food, Tocacco & Metal Containers	10	5	5
Radio & T.V. Broadcasting; Communications	362	72	290
Transportation & Warehousing	507	233	274
Trade & Services	3,744	1,736	2,008
TOTAL	25,830	13,770	12,060

Table XVI. Direct and indirect effects of a hipothetical 20 percent increase in private consumption expenditures on industrial outputs and gross fixed capital requirements, united states 1958. (Millions of Dollars)

Producing Sectors	Increase in Consumption Expenditures (1)	Additional Output Required On Current Account (2)	Additional Capital Required To Produce (2) (3)
1. Aircraft and Parts	5	108	298
2. Ships, Train, Trailers & Cycles	145	235	425
3. Motor Vehicles & Equipment	1,840	3,083	1,162
4. Office & Computing Machines	12	110	489
5. Service Appliances	49	114	446
6. Household Appliances	483	546	226
7. Radio, T.V. & Communication Equip.	273	401	1,344
8. Batteries, X-Ray, & Engine Electrical Equipment	52	170	48
9. Electric Lighting & Wiring Equipment	63	159	230
10. Electronic Components & Accessories	30	194	107
11. Materials Handling Machinery & Equip.	0	16	1,189
12. Special Industry Machinery & Equip.	4	74	2,766
13. Construction, Mining & Oil-Field Mach.	0	58	766
14. Farm Machinery & Equipment	2	72	2,697
15. Engines & Turbines	25	96	722
16. Machine Shop Products	0	101	0
17. Optical, Opthalmic & Photographic Equipment	94	193	30
18. Scientific, Controlling Instruments, Clocks	70	232	405
19. Electrical Apparatus and Motors	3	175	3,176
20. Metalworking Machinery and Equipment	6	148	1,942
21. Gen´l Industrial Machinery & Equipment	0	118	966
22. Hardware, Plating, Valves & Wire Products	76	582	403
23. Stampings, Screw Machinery Product & Bolts	50	365	116
24. Heating, Plumbing, Structural Metal Products	14	200	1,019
25. Automotive Repair Services	887	1,337	0
26. New & Mainten. Construction; Glass, Stone, Clay	72	2,779	26,119
27. Primary Iron & Steel Mining & Manufacturing	4	1,403	348
28. Primary Non-Ferrous Metal Mining and Mfg.	2	724	235
29. Misc. Mfg. And Service Sectors	1,276	3,396	141
30. Chemicals, Plastics, Rubber, Drugs & Paints	1,052	4,189	93
31. Lumber & Wood Prod.; Paper & Paper Prod.	1,205	5,070	1,098
32. Textiles and Leather Goods	3,265	6,376	57
33. Food, Tobacco & Metal Containers	10,966	22,768	3
34. Coal, Petroleum and Utilities	3,116	7,808	42
35. Radio & TV Broadcasting; Communications	782	1,643	8
36. Transportation & Warehousing	1,732	4,222	535
37. Wholesale and Retail Trade	12,313	15,368	0
38. Other Business & Personal Services	17,365	26,629	2,019
TOTAL	**57,332**	**112,697**	**51,668**

Column components may not correspond to totals due to rounding.

If we begin in a situation of full utilization of capacity in consumption goods industries, additional capital requirements will be proportional to the increase in output levels in each industry. Suppose a change in consumption demand calls for higher levels of output in consumer goods and supporting industries. Higher output levels will be possible only if necessary additional capital stocks are also forthcoming. For each industry, the amounts of the different kinds of capital goods per unit of additional output are given by a column in the capital coefficient matrix. To produce an output 2 million dollars greater than 1958´s, the Food industry must acquire additional capital stocks of 2 X (.117) of Farm Machinery, 2 X (.026) of Motor Vehicles, 2 X (.189) of Construction, and similarly prescribed amounts from other metalworking sectors. These are the additions to capital stock which must be delivered, that is, included in the gross capital formation column, if the given expansion program is to be possible. Thus, if we increase the consumption column in Final Demand, we must also add to the capital formation column. But this latter addition to Final Demand will itself generate further output increases, in turn, further additional capital requirements, and so on.

As an illustration, column 3 of Table XVI shows the amounts of additional capital goods which must be supplied by the various sectors of the economy in order to support a 20 percent increase in household consumption. It is obtained by:

1.- multiplying the increase in household consumption, detailed in column (1), by the inverse coefficient matrix. This gives total outputs required on current account to deliver the specified increase in consumption (column (2));

2.- multiplying the increase in total output levels for each industry (column (2)) by the corresponding capital coefficients, given in Table XIV. The sum totals of all capital requirements from each supplying sector are given in column (3).

Note that direct increases in household demand (column (1)) and their indirect current account impact (column (2)) affect, primarily, non-metalworking sectors. (The only important exceptions to this occur in automobiles and other consumers´ durable sectors. These elements are usually much less important during the early stages of industrial development). The capital impact (column (3)), of course, is heaviest in metalworking and construction.

The current consumption and capital formation vectors in final demand are in fact interrelated through stringent technological requirements. In the absence of idle capacity, our increase in household consumption required a total volume of capital formation almost as great as the initial increase in final demand. Going one step beyond Table XVI, we could show that the capital formation in column (3) itself requires additional capacity and hence still more capital in the metalworking and construction industries.

Available capacity in the capital goods industries limits the rate at which consumer goods industries can expand. Further more, the production and installation of new capacity does not take place instantaneously: there are appreciable lags between the production of goods that go into the creation of new productive capacities and the utilization of those leading to an increase in current output flows.

9. THE TIMING OF INVESTMENT IN METALWORKING INDUSTRIES IN A DEVELOPING ECONOMY

An increase in the rate of output in one or several differents sectors in any given year has to be preceded by a sequence of investments properly distributed over a number of preceding years.

It is the task of dynamic input-output analysis to describe direct and indirect intertemporal dependence among the levels of output, investment, and employment in all the different sectors of a growing economy. A dynamic input-output table, similar in its structure to a static one, can be constructed, in which all flows of goods and services are identified not only in terms of their sectoral origin and destination, but also in terms of the time, for example, the year, in which the particular transaction that they describe took place. The total output, the final deliveries, and the labor inputs of each sector are entered on such a time-phased input-output table separately for each year. For purpose of developmental planning, steel demanded and supplied in the year 1966 has to be distinguished from the steel demanded and supplied in 1967. In a sense, these are now different goods. A dynamic input-output table describing the development of a national economy, broken down, say, into twenty sectors, over a period of ten years, would have two hundred (20 X 10) rows and two hundred columns. The final Deliveries of each type of goods –to consumption and exports, as well as the imports (entered as negative figures)- will be entered in such a table in the form of a "dated" Bill of Goods showing the deliveries from each sector separately for each year.

Investment, i.e., additions to the stock of capital goods productively employed in various sectors, can now be shifted out of the externally prescribed column of Final Demand into the main body of the input-output table describing interindustrial transaction. A rise in output in any given year requires creation of appropriate productive capacities, i.e., additional investment, in the preceding years. If the magnitudes of the appropriate capital coefficients are known, the direct and indirect linkages between the Final Deliveries of one year and the corresponding input and output changes -some of them charged to the capital account- in the preceding years, can be computed through "inversion" of a dynamic input-output matrix.

Because, as we have seen before, the products of the metalworking industries are used mainly for investment purposes, a proper integration of their output into an overall developmental plan depends to a very large extent on proper timing. To illustrate the use of dynamic input-output computations for this purpose, we have constructed and solved a dynamic input-output system.

The flow, capital and labor coefficients incorporated in that dynamic matrix, as in some of our previous examples, are those of United States industries for 1958. The product mixes in the Household Consumption, the Export, and the Import vectors used in these computations are based on Indian input-output studies. They seem to represent fairly well the structure of Final Demand which prevails in a developing economy. New productive capacities created from the output of one year are assumed to be put into operation in the following year.

The inverse of the dynamic matrix is essentially very similar to the inverse of a static input-output matrix. It describes the changes in the output of each industry required –directly and indirectly- to deliver one additional unit (for example, one million dollars´ worth in fixed base year prices) of the output of any given industry to Final Demand. In a dynamic system that change cannot, however, be described by a single figure. It consists of a whole train of successive changes in the output of the industry in questions, distributed over a number of years preceding the year in which the final delivery is actually to be made. The sequence of figures shown below represents, for example, a single element of a dynamic inverse. It shows the successive changes in the output of the Auto, Aircraft and Intermediate Metalworking industry -distributed over the preceding nine-year period –that would be required, directly and indirectly, in order to enable the national economy to deliver an additional dollars´ worth of products of the Electrical Equipment and Instruments industry to Final Demand in the last year, i.e., the year 0.

Year	-8	-7	-6	-5	-4	-3	-2	-1	0
change in output	0.001	0.001	0.003	0.006	0.012	0.026	0.056	0.111	-0.065

Theoretically, the chain stretches backward over an infinite number of years. Its earlier members, however, are so small that for all practical purposes they can safely be neglected.

The large negative entry in the last year, i.e., the year in which the delivery to Final Demand is actually made, requires explanation. It reflects an abrupt reduction in the utilization of previously accumulated productive capacities that would become idle as soon as the Final Delivery has been made. Actually, an increase in the Final Delivery of Electrical Equipment and Instruments in year 0 is most likely to be followed by an equal, or possibly even a greater increase, projected or planned for the following year, i.e., for year +1. The effects on the industry in questions of these two elements of a given dynamic –that is, time-phased- Bill of Goods should be superimposed. They are described, in this instance, by a summation of the two series.

Year	-8	-7	-6	-5	-4	-3	-2	-1	0	+1
Change	0.001	0.001	0.003	0.006	0.012	0.026	0.056	0.111	-0.065	
In output		0.001	0.001	0.003	0.006	0.012	0.026	0.056	0.111	-0.065
Total	0.001	0.002	0.004	0.009	0.018	0.038	0.082	0.167	0.046	-0.065

The productive capacities built up for the delivery of an additional dollar´s worth of Electrical Equipment and Instruments in year 0 are not set free as they were in the previous example. Instead, they are utilized to fill additional capacity requirements serving the next year´s needs. The sum total of two superimposed trains of additional outputs of Autos, Aircraft and Intermediate Metalworkers contributed (directly and indirectly) by that industry for Final Delivery of one dollar´s worth of Electronic Equipment and Instruments in year 0 and another dollar´s worth of Electronic Equipment and Instruments in year +1 now turns out to be positive in year 0. True, it becomes negative in the year +1. However, the requirements generated by subsequent deliveries to Final Demand in years +2, +3 and so on will obviously postpone the "final liquidation" of idle capacities indefinitely.

The combined total effects, on the output levels of a particular industry, of any given sequence of Final Deliveries planned or projected over a number of years, can thus be computed by summing the properly weighted elements of the dynamic inverse year by year.

The "inverse", that is, the generalized numerical solution of the dynamic system described above, is reproduced in full in Table XVII. Each one of its elongated rectangular cells holds nine figures, representing a sequence of nine annual changes in the output level of the industry named on the left of the row. These changes represent the required direct and indirect contributions of that industry to the delivery by the industry listed at the head of the corresponding column of one additional unit of its respective output to Final Demand in the last year, year 0.

As in most other input-output computations, the unit in terms of which the output of each sector is measured (unless specified otherwise) is a "dollar´s worth" in base year prices. Base year prices are the prices in terms of which we compiled the basic sets of technical coefficients that went into the construction of the dynamic input-output system. Wherever some of the coefficients –for example, the labor coefficients or the electric energy consumption coefficients- are described in physical units such as man-years or kilowatt-hours, the corresponding output and input levels in the inverse of the dynamic matrix will be expressed in such units, too. Incidentally, there exists no objection to the simultaneous use of base year price measures in some parts of the system and direct physical measures in others.

The total annual Final Bill of Goods projected or planned for a particular national economy is usually described in terms of several different bundles of goods destined to satisfy different kinds of Final Demand. For purposes of present analysis we distinguish three such bundles. One –by far the largest- consists of the combination of goods and services absorbed in private Household Consumption; another is destined for Export, and the third represents Imports. To determine the direct and indirect effects of a change in the level of Household Consumption; another is destined for Export, and the third represents Imports. To determine the direct and indirect effects of a change in the level of Household Consumption or of Exports and Imports, in any

Table XVII. Dymanic inverse

Final Demand, in Year O, for Products of Industry

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1									
1	0,000	0,000	0,000	0,001	0,002	0,005	0,012	-0,011	1,167
2	0,001	0,002	0,004	0,008	0,017	0,035	0,076	0,160	0,028
3	0,000	0,001	0,001	0,002	0,005	0,011	0,029	0,037	0,004
4	0,001	0,001	0,003	0,007	0,014	0,030	0,061	0,162	0,235
5	0,000	0,000	0,001	0,002	0,004	0,009	0,021	0,038	0,250

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
2									
1	0,000	0,000	0,000	0,001	0,002	0,004	0,013	-0,018	0,015
2	0,001	0,002	0,003	0,007	0,015	0,032	0,071	0,109	1,137
3	0,000	0,000	0,001	0,002	0,005	0,010	0,022	0,034	0,000
4	0,001	0,001	0,003	0,006	0,013	0,027	0,052	0,181	-0,245
5	0,000	0,000	0,001	0,002	0,004	0,009	0,019	0,027	0,144

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
3									
1	0,000	0,000	0,000	0,001	0,002	0,003	0,009	-0,009	0,005
2	0,001	0,001	0,003	0,006	0,012	0,026	0,056	0,111	-0,065
3	0,000	0,000	0,001	0,002	0,004	0,008	0,018	0,038	1,158
4	0,001	0,001	0,002	0,005	0,010	0,022	0,045	0,119	-0,168
5	0,000	0,000	0,001	0,002	0,003	0,007	0,015	0,026	0,042

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
4									
1	0,000	0,000	0,001	0,001	0,002	0,005	0,007	0,064	-0,071
2	0,001	0,002	0,004	0,009	0,018	0,038	0,079	0,205	-0,174
3	0,000	0,001	0,001	0,003	0,006	0,012	0,029	0,063	-0,055
4	0,001	0,002	0,003	0,007	0,015	0,032	0,073	0,085	0,899
5	0,000	0,001	0,001	0,002	0,005	0,010	0,021	0,058	-0,015

YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
1	0,000	0,000	0,001	0,001	0,002	0,005	0,014	0,008	-0,020
2	0,001	0,002	0,004	0,009	0,018	0,039	0,085	0,109	-0,152
3	0,000	0,001	0,001	0,003	0,006	0,012	0,027	0,059	-0,084
4	0,001	0,002	0,003	0,007	0,015	0,033	0,065	0,190	-0,265
5	0,000	0,001	0,001	0,002	0,005	0,010	0,023	0,052	1,284

1 = RAILROAD FARM and CONSTRUCTION EQUIPMENT 2 = AUTOS, AIRCRAFT, and INTERMEDIATE METALWORKERS 3 = ELECTRICAL EQUIPMENT and INSTRUMENTS 4 = CONSTRUCTION 5 = FERROUS METAL

EACH ENTRY TELLS THE OUTPUT IN A GIVEN YEAR OF THE INDUSTRY DESIGNATED BY NUMBER AT THE LEFT (SEE KEY TO INDUSTRY, ABOVE), REQUIRED PER DOLLAR INCREASE IN FINAL DELIVERIES IN YEAR O OF THE INDUSTRY DESIGNATED BY NUMBER AT THE TOP

Table XVIII. Annual sequences of industrial outputs, labor, and capital required for an increase of one dollar in selected final demand bundles in year o.

	YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
RAILROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	0,0001	0,0002	0,0005	0,0010	0,0023	0,0041	0,0144	0,1010	-0,1102
	LABOR**	0,0096	0,0201	0,0429	0,0910	0,1977	0,3569	1,2553	8,8320	-9,6368
	CAPITAL***	0,0001	0,0002	0,0003	0,0007	0,0015	0,0027	0,0093	0,0657	-0,0717
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	0,0008	0,0018	0,0038	0,0080	0,0169	0,0354	0,0825	-0,0078	-0,0827
	LABOR	0,0630	0,1340	0,2850	0,6030	1,2830	2,6830	6,2590	-0,5930	-6,2740
	CAPITAL	0,0005	0,0011	0,0024	0,0051	0,0108	0,0225	0,0526	-0,0050	-0,0527
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	0,0003	0,0006	0,0012	0,0025	0,0052	0,0109	0,0245	0,0649	-0878
	LABOR	0,0224	0,0474	0,1000	0,2121	0,4510	0,9409	2,1137	5,5978	-7,5745
	CAPITAL	0,0002	0,0003	0,0007	0,0015	0,0033	0,0068	0,0152	0,0417	-0,0544
CONSTRUC-TION	OUTPUT	0,0007	0,0015	0,0031	0,0067	0,0141	0,0308	0,0548	0,1898	-0,2635
	LABOR	0,0312	0,0660	0,1400	0,2975	0,6271	1,3737	2,4423	8,4642	-11,7534
	CAPITAL	0,0006	0,0012	0,0025	0,0054	0,0113	0,0247	0,0439	0,1522	-0,2113
FERROUS METALS	OUTPUT	0,0002	0,0005	0,0010	0,0021	0,0045	0,0094	0,0222	0,0391	-0,0526
	LABOR	0,0153	0,0326	0,0700	0,1477	0,3148	0,6546	1,5407	2,7119	-3,6466
	CAPITAL	0,0002	0,0004	0,0009	0,0019	0,0040	0,0084	0,0198	0,0348	-0,0468

	YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
RAILROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	-0,0001	-0,0003	-0,0006	-0,0013	-0,0029	-0,0053	-0,0197	-0,0285	-0,1181
	LABOR**	-0,0122	-0,0262	-0,0551	-0,1164	-0,2537	-0,4636	-1,7225	-2,5142	-10,3349
	CAPITAL***	-0,0001	-0,0002	-0,0004	-0,0009	-0,0019	-0,0035	-0,0128	-0,0185	-0,0769
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	-0,0011	-0,0023	-0,0048	-0,0102	-0,0217	-0,0456	-0,1032	-0,0368	-0,1966
	LABOR	-0,0812	-0,1723	-0,3658	-0,7765	-1,6493	-3,4576	-7,8329	-2,7901	-14,9189
	CAPITAL	-0,0007	-0,0015	-0,0031	-0,0065	-0,0139	-0,0290	-0,0658	-0,0234	-0,1253
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	-0,0003	-0,0007	-0,0015	-0,0032	-0,0067	-0,0140	-0,0323	-0,0800	0,0105
	LABOR	-0,0285	-0,0604	-0,1285	-0,2725	-0,5804	-1,2108	-2,7864	-6,9027	0,9055
	CAPITAL	-0,0002	-0,0004	-0,0009	-0,0020	-0,0042	-0,0087	-0,0200	-0,0495	0,0065
CONSTRUC-TION	OUTPUT	-0,0009	-0,0019	-0,0040	-0,0086	-0,0181	-0,0395	-0,0170	-0,2599	0,3617
	LABOR	-0,0401	-0,0852	-0,1802	-0,3827	-0,8068	-1,7613	-3,1666	-11,5929	16,1309
	CAPITAL	-0,0007	-0,0015	-0,0032	-0,0069	-0,0145	-0,0317	-0,0569	-0,2084	0,2900
FERROUS METALS	OUTPUT	-0,003	-0,0006	-0,0013	-0,0027	-0,0058	-0,0122	-0,0287	-0,0656	-0,0797
	LABOR	-0,0201	-0,0423	-0,0895	-0,1900	-0,4050	-0,8439	-1,9866	-4,5459	-5,5236
	CAPITAL	-0,0003	-0,0005	-0,0012	-0,0024	-0,0052	-0,0108	-0,0255	-0,0583	-0,0708

	YEAR OF OUTPUT	-8	-7	-6	-5	-4	-3	-2	-1	0
RAILROAD FARM and CONSTRUCTION EQUIPMENT	OUTPUT*	0,0001	0,0002	0,0005	0,001	0,0022	0,0041	0,0147	0,0688	-0,0712
	LABOR**	0,0096	0,0201	0,0429	0,0892	0,1951	0,3552	1,2851	6,0143	-6,2277
	CAPITAL***	0,0001	0,0002	0,0003	0,0007	0,0015	0,0026	0,0096	0,0447	-0,0463
AUTOS AIR-CRAFT and INTERMEDIATE METALWORKERS	OUTPUT	0,0008	0,0018	0,0037	0,0079	0,0167	0,0350	0,0805	0,0349	-0,0803
	LABOR	0,0622	0,1328	0,2816	0,5966	1,2675	2,6550	6,1100	2,6497	-6,0917
	CAPITAL	0,0005	0,0011	0,0024	0,0050	0,0107	0,0225	0,0513	0,0223	-0,0512
ELECTRICAL EQUIPMENT and INSTRUMENTS	OUTPUT	0,0003	0,0005	0,0012	0,0024	0,0052	0,0108	0,0242	0,0298	-0,0324
	LABOR	0,0216	0,0466	0,0992	0,2096	0,4459	0,9297	2,0853	2,5682	-2,7924
	CAPITAL	0,0002	0,0003	0,0007	0,0015	0,0032	0,0067	0,0150	0,0184	-0,0200
CONSTRUC-TION	OUTPUT	0,0007	0,0015	0,0031	0,0066	0,0139	0,0304	0,0545	0,1977	-0,2741
	LABOR	0,0308	0,0651	0,1383	0,2439	0,6199	1,3550	2,4325	8,8183	-12,2244
	CAPITAL	0,0006	0,0012	0,0025	0,0053	0,0112	0,0244	0,0437	0,1586	-0,2198
FERROUS METALS	OUTPUT	0,0002	0,0005	0,0010	0,0021	0,0045	0,0093	0,0219	0,0387	0,0119
	LABOR	0,0153	0,0326	0,0687	0,1463	0,3113	0,6476	1,5179	2,6828	0,8217
	CAPITAL	0,0002	0,0004	0,0009	0,0019	0,0040	0,0083	0,0195	0,0344	0,0105

given year, on the time-phased production program of a particular industry, we have only to add together the separate effects of the Final Deliveries from each industry that make up that particular bundle of Final Demand. In other words, we have to compute a properly weighted average of the corresponding elements of the dynamic inverse.

The final results of such a computation are summarized in Table XVIII. It shows how an additional composite unit (say, an additional "dollar´s worth in base year prices") of Household Consumption, of Exports, or of Imports, would affect the production programs of the three metalworking sectors, of the Ferrous.

Metals and of the Construction industries over the nine-year stretch at the end of which the final deliveries are actually to be made. The product mixes ascribed to the Household Consumption bundle, the Export bundle, and the Import bundle are based on the projected composition of these three vectors for India in 1970

All sequences of output changes can be of course translated into corresponding nine-year sequences of changes in investment and employment. These are entered in Table XVIII, too. In interpreting these investment and employment figures, it is important to remember that the entire computation is based on a reduced input matrix in which only the five listed industries were included in Group I, all others being treated as belonging to Group II. Hence, the capital and the labor figures shown for each of the five selected industries satisfy not only its own requirements, but also requirements of capital and labor for Group II industries intermediate inputs to it.

Finally, we wish to show how the elements of the dynamic inverse are used as building blocks in the construction of a developmental plan for metalworking industries. In actual planning, we must sum all the direct and indirect requirements for metalworking outputs generated by the whole chain of annual Final Bills of Goods specified over the entire stretch of time covered by a particular overall projection. Because of the retroactive effects of each annual Bill of Goods, the given projection of the Final Demand must be extended for a number of years beyond the last year of the period of time covered by the detailed program of sectoral production, investment, and employment.

Table XIX presents such a hypothetical production program and investment program for the three metalworking industries covering a time span of ten years.

The sequence of annual deliveries to Final Demand that these production programs are intended to serve was projected for eight years beyond the last year covered by the detailed sectoral programs. It is described in terms of levels of Household Consumption, of Exports, and of Imports given for the first year and growing at three constant, but different prescribed rates for the years that follow. For the first year, the relative magnitudes of the total levels of Household Consumption, of Exports, and of Imports are set at 20.0 : 1.0 : 1.5 (which implies an aggregate Final Demand or Gross National Product of 20.0 + 1.0 – 1.5 = 19.5). The excess of Imports above Exports

Table XIX. Annual sequences of industrial outputs, labor and capital requirements for assumed annual rates of growth of final demand bundles*

YEAR		1	2	3	4	5	6	7	8	9	10
HOUSEHOLD CONSUMPTION		20,0000	20,800	21,6000	22,4000	23,2000	24,2000	25,2000	26,2000	27,2000	28,2000
EXPORTS		1,0000	1,0300	1,0600	1,0900	1,1200	1,1500	1,1800	1,2200	1,2600	1,3000
IMPORTS		1,5000	1,5450	1,5900	1,6350	1,6800	1,7250	1,7700	1,8300	1,8900	1,9500
RAILROAD, FARM,	OUTPUT	0,1511	0,1553	0,1603	0,1681	0,1963	0,2024	0,2093	0,2145	0,2228	0,2513
and	LABOR	13,2200	13,5900	14,0200	14,7100	17,1700	17,7100	18,3100	18,7600	19,4900	21,9800
CONSTRUCTION EQUIPMENT	CAPITAL	0,0983	0,1011	0,1043	0,1094	0,1278	0,1317	0,1362	0,1396	0,1450	0,1635
AUTOS, AIRCRAFT,	OUTPUT	0,9609	0,9978	1,0421	1,1031	1,1628	1,2068	1,2542	1,3058	1,3737	1,4420
and INTERMEDIATE	LABOR	72,9300	75,7300	79,1000	83,7300	88,2600	91,6000	95,1900	99,1100	104,2600	109,4500
METALWORKERS	CAPITAL	0,6127	0,6362	0,6644	0,7033	0,7414	0,7695	0,7997	0,8326	0,8759	0,9194
ELECTRICAL	OUTPUT	0,4419	0,4572	0,4744	0,4967	0,5321	0,5502	0,5685	0,5889	0,6095	0,6535
EQUIPMENT and	LABOR	38,1100	39,4300	40,9100	42,8400	45,8900	47,4500	49,0300	50,7900	52,5600	56,3600
INSTRUMENTS	CAPITAL	0,2735	0,2830	0,2936	0,3074	0,3293	0,3405	0,3518	0,3645	0,3772	0,4044

* BASED ON ASSUMPTION OF 4 PERCENT ANNUAL GROWTH RATE OF HOUSEHOLD CONSUMPTION AND 3 PERCENT ANNUAL GROWTH RATE OF EXPORTS IMPORTS

implies foreign aid or private capital inflow. Consumption is assumed to expand at an annual rate of 4 percent and Exports and Imports at the rate of 3 percent.

The time-phased direct and indirect output requirements corresponding to one unit of annual Final Deliveries of each kind are shown in Table XVIII. Changes in the annual levels of each one of the three components of Final Demand and the corresponding growth in the output level of each one of the three metalworking industries are shown in Table XIX. Total investment and employment in each sector is shown for each year, too. The projected growth curves of the three components of Final Demand extend beyond the last year for which the sectoral production programs were actually computed. While these later projections were used in the computations, they are not reproduced in the table.

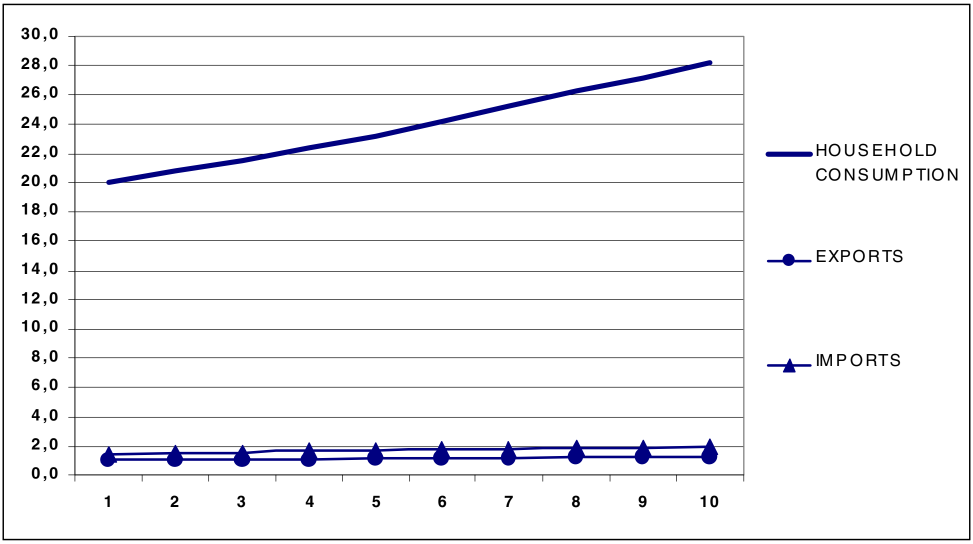
The total levels of Consumption, Exports, and Imports, together with the corresponding levels of Investment and Employment in the three metalworking industries, are also depicted on the attached graph. (See Fig. 1.) The vertical scale is logarithmic, so that the steeper slopes represent higher, the gentler slopes lower, rates of growth.

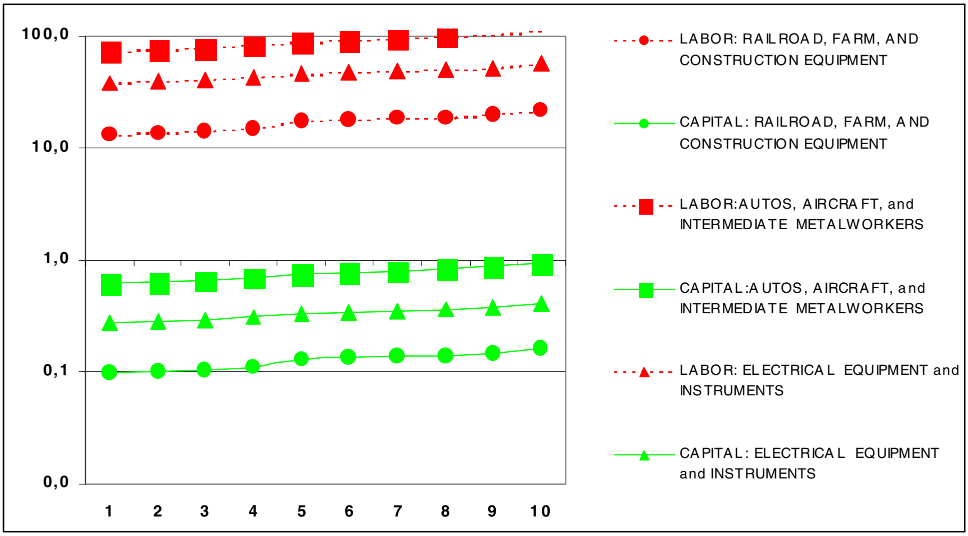
The metalworking outputs shown in Table XIX grow more rapidly than the assumed rate for Households, 4 percent. (Unfortunately, the differences in rate of growth are too small to be apparent in figure 1.) The relatively high rates of growth of all metalworking industries are explained by the fact that both Exports and Imports are in this case assumed to expand less rapidly (3 percent) than Household Consumption (4 percent). Since imports contain more manufactured metal products than either exports or domestic consumption, their relatively lower growth rate has to be compensated by accelerated expansion of domestic metalworking industries called upon to cover a greater and greater proportion of the total demand for manufactured metal products. We have here a typical instance of import substitution.

The assumption of a constant rate of growth for each component bundle of Final Demand was used only to simplify the computation and the presentation of its details. The figures contained in the numerical inverse of a dynamic input-output system permit us to determine, through a simple process of addition and subtraction, a mutually consistent set of time-phased production programs corresponding to any given –also, time-phased- combination of Final Deliveries.

The time profile of final deliveries represents a country´s specific goals and projections and must be tailored to its specific needs and policies. Ideally, of course, the dynamic inverse itself should be tailored to the special features of each developing area. This requires expert judgment as to the appropriate input-output and capital coefficients to choose as a basis for planning. Practical planners already know that collection and selection of basic data is still the most difficult part of their task.

Figure 1. Relative rates of growth of consumption, exports, imports, and of labor and capital in three metal working industries





APPENDIX I. SOURCES

United States Input-Output Table, 1958.

"The Interindustry Structure of the United States –a report on the 1958 input-output", Morris R. Goldman, Martin L. Marimont, and Beatrice N. Vaccara, Survey of Current Business, November, 1964.

"The Transactions Table of the 1958 Input-Output Study and Revised Direct and Total Requirements Data", National Economics Division Staff, Survey of Current Business, September, 1965.

United States Input-Output Table, 1947.

This table was published at a 50-order level and is described in "The Interindustry Relations Study for 1947", W.D. Evans and M. Hoffenberg, The Review of Economics and Statistics, Volume XXXIV, Nº. 2, May, 1952. The original matrix of 450 sectors, prepared by the Bureau of labor Statistics, was obtained by the Harvard Economic Research Project some years ago on IBM cards. This 450-order matrix was aggregated and price-inflated to 83 intermediate sectors at the Harvard Economic Research Project under the direction of Anne P. Carter.

United States Capital Coefficients, 1958.

"Capital Expansion Planning Factors, Manufacturing Industries", National Planning Association, Washington, D.C. Data por non-manufacturing sectors was prepared at the Harvard Economic Research Project.

United States Capital Formation, 1958.

Data supplied by the Interagency Growth Project, U.S. government and the Office of Business Economics, Department of Commerce. Replacement and expansion ratios were estimated at the Harvard Economic Research Project from various published sources.

United States Labor Coefficients, 1958.

"Interindustry Employment Requirements", Jack Alterman, Monthly Labor Review, July 1965. Additional data were obtained from the Interagency Growth Project, U.S. government. Detailed breakdown of labor by skill class was prepared at the Harvard Economic Research Project.

Japanese Input-Output Table, 1960

The table was prepared by the Economic Research Institute, Economic Planning Agency, Japanese Government, Kasumigaseki, Chiyoda-Ku, Tokyo, Japan.

Indian Input-Output Table, 1960.

The matrix and final demand vectors prepared by the Indian Statistical Institute Planning Unit, May, 1964.

Final Demand Vectors, 1970

1970 final demand vectors were developed primarily from the "Projection of Interindustry Transactions, India, 1970-71" and the accompanying text, "Studies in the Structure of the Indian Economy" prepared jointly by the Indian Statistical Institute, Planning Unit and the Center for International Studies, Massachusetts Institute of Technology. Adjustments were estimated on the bases of these and other published sources.

APPENDIX II

Aggregation schemes for 38-order and 5-order classifications

38-Order Sector	81- Order Sector*	5-Order Sector	81-Order Sector
1	11	1	22, 21, 23, 12
2		12	
3	26		
4	20	2	31, 34, 35, 14, 25, 9,
27, 32, 26, 11			
5	17		
6	18		
7	13		
8	24	3	20, 17, 29 18, 28, 13,
30, 24, 19, 16			
9	28		
10	30		
11	14		
12	9	4	41, New Construction
77,43,40			
13	23		
14	21		
15	22		
16	32	39, 38	
17	16	5	
18	19		
19	29		
20	25		
21	27		
22	35		
23	34		
24	31		
25	68		
26	41, New Construction,		
77, 43, 40			
27	39,38		
28	37, 36		
29	15, Non-Competitive		
	Imports, 80, 79, 81		
30	59, 58, 57, 7, 52, 50		
31	47, 46, 3, 2, 45, 44, 42		
32	51, 49, 5, 6, 53, 1		
33	54, 55, 48, 56, 8, 4, 33		
34	62, 63, 60, 61		
35	74, 69		
36	65		
37	72		
38	73, 76, 67, 75, 78, 70, 71		