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IMPACT OF DEMOGRAPHIC CHANGE ON INDUSTRY STRUCTURE IN AUSTRALIA

A joint study by the Australian Bureau of Statistics, the Industries Assistance Commission, the Department of Labor and Immigration and the Department of Manufacturing Industry.

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INPUT-OUTPUT ACCOUNTING AND THE ORANI MODULE

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I. INTRODUCTION

The ORANI module incorporates an extensive input-output (hereafter I-O) framework.[1] The I-O data base employed in ORANI is constructed from I-O tables published by the Australian Bureau of Statistics. It is intended that the base year for ORANI will be 1971/72, the necessary I-O data being derived from an updated version of the 1968/69 I-O tables which are currently being prepared by the ABS. Preliminary versions of ORANI are based on the 1962/63 Australian I-O tables.[2] This paper reviews the main features of those tables and describes how they have been used in constructing an I-O data base for ORANI.

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1. For a description of the ORANI module, see Peter B. Dixon, "The Theoretical Structure of the ORANI Module," Impact of Demographic Change on Industry Structure in Australia, Working Paper No. O-01, Industries Assistance Commission, Melbourne, October, 1975.

2. See Commonwealth Bureau of Census and Statistics, Australian National Accounts, Input-Output Tables, 1962-63, Canberra, 1971.

II. THE ACCOUNTING CONVENTIONS OF THE AUSTRALIAN 1962/63 I-O TABLES

The conventions of I-O accounting and the problems associated with them are documented in a number of places.[1] This paper concentrates on the issues which arise in the use of the 1962/63 Australian I-O tables as a data base for the construction of parameters for the ORANI module. Three tables were employed and are described as follows:[2]

Table I : An industry by industry I-O table at basic values with indirect allocation of competing imports.

Table II : An industry by industry I-O table at basic values with direct allocation of competing imports.

Table III : An industry by industry I-O table at purchasers' prices with indirect allocation of competing imports.

The tables described above are all of the form illustrated in Figure 1. They are industry by industry flow tables so that the rows represent the disposition by each industry of its products to intermediate and final users. Similarly within the intermediate sector the columns represent the composition of the input structure of each industry. The industry rather than the commodity is the basic unit of classification. Where the output of an industry group consists of a heterogeneous collection of products which have

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1. See for example CBCS, 1971, op. cit..
   United Nations, Problems of Input-Output Tables and Analysis : Studies in Methods, Series F, No. New York, 1973.
   Chenery, H. B. and P. G. Clark, Interindustry Economics, Wiley, New York, 1959.

2. See CBCS, 1971, op. cit., p. 28.

Figure 1 : Format of the Australian 1962/63 I-O Tables

	Intermediate users 1 105	1 Current consn.	2 Current expend. (public)	3 GFCE private	4 GFCE public	5 Stocks	6 Exports	TOTAL SUPPLY
Industry 1 105								
Wages, salaries & supplements								
GOS								
Commodity taxes less subsidies								
Indirect taxes (nec)								
Sales by final buyers								
Complementary imports + duty								
Competing imports + duty								
Compet. intermed. imports + duty								
TOTAL SUPPLY								

diverse input requirements, some ambiguity may be involved in using the table to predict the effects of an increase in an industry's output on its input requirements. The industry technology assumption is implied by such a use of the tables. For example, if industry i produces products "a" and "b" and experiences an increase in demand for product "a" alone, then use of industry based I-O tables will predict the increase in input requirements that would be experienced following an increase in demand of the same value but composed of a weighted increase of "a" and "b". If both "a" and "b" in fact have the same input structures this is correct but the prediction is erroneous to the extent that the input structures diverge.

A related problem is that of secondary products. These are goods which, although produced in an establishment belonging to some industry i (say), are the primary products of some other industry. The production of non-ferrous castings in a predominantly ferrous metalworks and the output of sulphuric acid as a by-product of metal processing are two examples.[1] It should be noted that considerable efforts to choose industry groupings which minimize this problem were made by the compilers of the data tables. The concentration ratios for the industry groups used in those tables are generally very high.[2]

The tables are presented "net" of all intra-industry flows so that the main diagonal in the inter-industry quadrant of each of them is empty. To include intra-industry flows in I-O tables may greatly increase the value of output ascribed to industries, and in any case the entries on the main diagonals are essentially arbitrary. Even if measurement of intra-industry flows is confined to flows between different enterprises so that problems of imputing

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1. Ibid., pp. 10 and 11, para. 16.

2. The concentration ratio for industry i is defined as :

$$\frac{\text{value of outputs primary to i produced by i}}{\text{value of total output of industry i}} .$$

values to intra-enterprise flows are avoided, the amounts measured will be sensitive to changes in ownership structure within the industry. For these reasons "net" tables are preferred.

Tables I-III contain precisely the same data but the conventions employed in presenting them are different. The differences between the three tables reflect two of the major problems in I-O accounting : the problem of valuing flows and the problem of treatment of imports.

A commodity flow of the type represented in I-O tables may be valued at the price received by the seller, at the price paid by the user, or at some intermediate price. I-O accounting conventionally employs three methods of valuation. Valuation at prices paid by users is said to be at purchasers' prices. Purchasers' price valuation includes margins (i.e., commodity taxes *less* subsidies, and mark-up on transactions in the form mainly of wholesaling, retailing and transport services). Valuation which excludes mark-ups but includes commodity taxes *less* subsidies is said to be at producers' prices. Finally, if commodity taxes less subsidies also are excluded, valuation is at basic values. Schematically :

Producers' price = basic value + commodity tax *less* subsidy

Purchasers' price = producers' price + mark up .

Valuation of imports c.i.f., duty paid, at port of entry is equivalent to valuation of domestically produced goods at basic values and customs duties are therefore allocated together with the relevant imports in all three data tables. The sole exception in the 1962/63 Australian tables is duty on imported petrol and diesel fuel which is treated as if it were a commodity tax.[1]

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1. See CBCS, 1971, *op. cit.*, p. 25, para. 43.

Similarly, valuation of exports f.o.b. at port of exit is equivalent to valuation of domestically sold goods at purchasers' prices.

In Tables I and II, both of which are at basic values, mark-ups and commodity taxes are shown as flows from the mark-up, or commodity tax, rows to the purchaser of the products on the sale of which the mark-up or tax accrues. The purchases from mark-up and commodity tax shown as made by (say) purchaser j in a basic values I-O table are then to be interpreted as the sum of mark-up and commodity tax paid by j in respect of all his purchases.[1] Purchases by j from a non-mark-up source, industry i (say), are then shown at a value excluding the mark-up and tax on the sale.

Table III is at purchasers' prices. In such tables mark-up and commodity tax on a transaction are shown as purchased by the seller of the relevant commodity. The sale of that commodity to its users is then shown at a value which includes the mark up and tax. The purchases by industry j from mark-up and commodity taxes in a table at purchasers' prices represent the aggregate margin paid in respect of the sales made by that industry.[2]

There are basically two ways in which imports are allocated in I-O accounting. Direct allocation procedures show imports allocated along the imports row directly to the columns of their ultimate purchasers. Under indirect allocation, imports are allocated first to the columns of the domestic industries to which the imported commodities would be classified were they domestically produced. The imports are then distributed to their eventual users, along with the equivalent domestic output, in the row of the industry to which they were intially allocated.

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1. Purchases from mark-up industries for other than mark-up purposes will also be included. (See page 10, footnote 1.)

2. Non-mark-up purchases from the mark-up industries are once again included.

The 1962/63 Australian tables distinguish between complementary, competing and competing intermediate imports. Complementary imports are those for which there is judged to be no close, domestically produced substitutes. Rubber is an example. These are allocated directly in all tables. In Tables I & III competing imports are allocated indirectly. In Table II they are allocated directly. As explained above, customs duty is always allocated along with the imports on which it is payable. The third category of imports, competing intermediate imports, presents something of a complication. These are goods which are used as intermediate inputs by the industries in which they would have been produced had they been domestically produced. Motor vehicle parts is the most important example. Competing intermediate imports are allocated directly in all three of the data tables. The way in which these imports are dealt with in ORANI is described in detail in section IV(a) of this paper.

III. COMPARISON OF THE 1962/63 I-O TABLES AND THE I-O DATA BASE FOR ORANI

Figure 2 illustrates the form of the I-O data base required by ORANI. It presents essentially the same information as do the three data tables. Some important differences in accounting between Figure 2 and tables of the form of Figure 1 are, however, obvious.

Figure 1 has six categories of final demand. The correspondence between these and the treatment of final demand in ORANI is shown in Table A.

Figure 2 : I-O Data Base Required by ORANI

			Intermediate users	Final demand: Capital formation	Final demand: Current consn.	Final demand: Exports	Final demand: Other	
			← 105 →	← 105 →	← 1 →	← 1 →	← 1 →	
	Domestic output	105	A	B	C	D	E	Row sums = total domestic supply (except for mark-up industries*)
			(Basic values - excludes margins)					
	Competing imports	105	F	G	H	I	J	Row sums = total competing imports
			(C.I.F. plus duty - excludes margins)					
Margin type 1	Domestic output	105	K_1	L_1	M_1	N_1	O_1	Row sums = total margin (type 1) on sales of domestic output
Margin type 1	Competing imports	105	P_1	Q_1	R_1	S_1	T_1	Row sums = total margin (type 1) on sales of imports
Continues through margin types 2 - 6								
Margin type 7 (tax)	Domestic output	105	K_7	L_7	M_7	N_7	O_7	Row sums = total margin (tax) on sales of domestic output
Margin type 7 (tax)	Competing imports	105	P_7	Q_7	R_7	S_7	T_7	Row sums = total margin (tax) on sales of imports
Primary inputs	Labour	9	U					
Primary inputs	Capital	1	V					
Primary inputs	Land	1	W					
	Other costs	1	X					
			Column sums = total intermediate inputs at basic values					

* Row sum for mark-up industries = total "other service" supply

Table A : Comparison of the Treatment of Final Demand in the ORANI Data Base and the 1962/63 I-O Tables

ORANI data base	1962/63 I-O Tables
2. GFCE (105 × 105)	Q3. GFCE - private (105 × 1) * Q4. GFCE - public (105 × 1)
3. Personal consumption (105 × 1)	Q1. Current expenditure - personal consumption (105 × 1)
4. Exports (105 × 1)	Q6. Exports of goods and services (105 × 1)
5. Other final demand (105 × 1)	Q2. Current expenditure - public authorities and financial enterprises (105 × 1) Q5. Increase in value of stocks (105 × 1)

* The procedures employed in the expansion of the investment vectors into an investment matrix are described in detail in section IV(b) below.

In the data tables, competing imports appear explicitly only as row vectors, the totals being allocated to the column according to either the direct or indirect allocation procedures described above. In Figure 2, the import vectors are transformed into import flow matrices. The industry by user flow matrix of the I-O table is split into matrices representing flows of domestically produced and imported commodities separately on the basis of comparison between I-O tables employing direct and indirect allocation of competing imports. The method employed to produce this split is described in detail in section IV(a) below.

Tables of the form of Figure 1 display mark-up and commodity taxes less subsidies in the rows corresponding to the mark-up industries and to commodity taxes less subsidies. The j^{th} element (say) of a mark-up industry row contains the purchases by the j^{th} industry from the mark-up industry for purposes other than mark-up,[1] plus the mark-up on the j^{th} industry's purchases or sales according to whether valuation in the table is at basic values or purchasers' prices.

ORANI requires separation of "mark-up" and "other service" components of purchases from the mark-up industries. The "other service" flows are retained in the basic flows sectors of the ORANI I-O data base (A - J in Figure 2). Mark-up purchases are shown as disaggregated into the margins matrices and vectors (K_1 - T_6 in Figure 2). Each element of these contains an estimate of the mark-up of a particular type associated with the corresponding flow in the basic flows sector of the data base. The required information can be estimated on the basis of comparisons between I-O tables following different valuation procedures. Under the assumptions initially made in ORANI, complete mark-up vectors are required in the construction of parameters only for non-investment final demand. (Vectors M_n - O_n and R_n - T_n in Figure 2). For intermediate usage and capital formation only the column totals of the relevant mark-up matrices (K_n, L_n, P_n and Q_n in Figure 2) are required. A complete set of commodity tax less subsidy matrices and vectors (K_7 - T_7) is however necessary. The treatment of margins in the ORANI module is described in detail in section IV(c) below.

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1. In the 1962/63 Australian I-O tables such purchases are referred to as "other service" purchases. For a split of the total output of each of the six mark-up industries into its "mark-up" and "other service" components, see CBCS, op. cit., Table D. Table E of the same volume provides an allocation of the "other service" component to intermediate usage in total and to each category of final demand.

The final major differences between Figure 2 and the published I-O tables concern the treatment of primary inputs. The correspondence between the treatment of primary inputs in the published tables and the ORANI data base is shown in Table B.

Table B : Comparison of the Treatment of Primary Inputs in the ORANI Data Base and the 1962/63 I-O Tables

ORANI data base	1962/63 I-O Tables
(G + 1)1 Labour (9 × 105)	P1 Wages, salaries and supplements (1 × 105) P2 Gross operating surplus (part) - to reflect imputed wages to owner occupiers in the rural sector (1 × 105)
(G + 1)2 Fixed capital (1 × 105)	P2 GOS (part) - returns to fixed capital (1 × 105)
(G + 1)3 Land (1 × 105)	P2 GOS (part) - rent on land (1 × 105)
(G + 2) Other costs (1 × 213)	P2 GOS (part) - returns to working capital (1 × 105) P4 Indirect taxes nec. (1 × 111) P5 Sales by final buyers (1 × 111) P6A (+ P7A) Complementary imports (+ duty) (1 × 111)

Details of the treatment of primary inputs in ORANI are given in section IV(d) below.

IV. THE CONSTRUCTION OF AN I-O DATA BASE FOR ORANI

(a) Separation of Imports from Domestic Flows.

The distinction between the domestic and imported sources of commodities plays an important role in ORANI. Commodities of the same type, but from different sources, are treated as less than perfect substitutes in both production and utility functions so that the model avoids the result, common in neo-classical trade models, that the duty paid, cif price of imports, is always the same as the basic price of domestic output.[1] An increase in the tariff on imported commodity i, for example, will increase the basic value (and therefore the purchasers' prices) of imported supplies of good i but will not directly affect the prices of domestically produced i. Of course the prices of domestically produced i may subsequently rise as users substitute between sources. With the prices of domestically produced and imported commodities of the same type allowed to diverge, the module requires separate representation of flows from the two sources. Matrcies A - J in Figure 2 provide the empirical basis for the treatment of these effects in ORANI.

As a preliminary step in the formation of these matrices adjustments to the data tables (I - III) must be made to revise the treatment of competing intermediate imports. In the data tables, these are treated as inputs to the equivalent Australian industries and are always directly allocated. That is, imports of unassembled Japanese cars (say) are allocated, in the competing intermediate imports row, to the column of the Australian motor industry. The subsequent purchase of these vehicles is then shown as a purchase from the

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1. See, for example, the literature on effective rates of protection.

Australian motor industry row. To allocate them indirectly as an input to the Australian motor industry would require an entry on the main diagonal of the intermediate sector of the I-O table. The semi-finished Japanese cars would have first to be allocated, in the competing imports row, to the equivalent domestic industry, as is the case with direct allocation. The domestic industry would then have to be shown as purchasing these imported inputs from itself by means of an entry on the diagonal. As explained above the data tables are all "net" tables, purged of intra-industry transactions, so that indirect allocation of these imports as inputs to their own industry group is inconsistent with the convention adopted.

Models based on I-O tables which allocate competing intermediate imports directly, as in the Australian 1962/63 tables, cannot distinguish between Japanese cars which are just assembled in Austalia and fully Australian produced vehicles. Both are regarded as coming from the domestic source and must be deemed to have the same input structure which, of course, includes apportionments of the competing intermediate imports. The "industry technology" of the Australian motor industry is taken to apply to both types of vehicle. This is just a special case of the problems caused in I-O analysis by heterogeneity in the product mix of an industry group.

In ORANI competing intermediate imports are excluded from Australian production and treated as if they were finished commodities. Semi-finished Japanese cars, then, are treated as if they were fully built up imports. They are allocated indirectly as final products in a manner analogous to other competing imports.

Following the ORANI convention, I-O tables with indirect allocation of competing imports should continue to show the Japanese semi-finished cars as purchased by the Australian motor industry and distributed to eventual users in the Australian motor industry row. The only change necessary is to amalgamate the competing intermediate imports row (and duty thereon) with other competing imports (or duty). This excludes the competing intermediate imports from the Australian production sub-total. When direct allocation of competing imports is adopted, however, the competing intermediate imports should be shown as purchased directly by their eventual users from the competing imports row.[1]

The effect of the ORANI convention is that an increase in demand for Japanese cars (say) will not now entail any increase in inputs to the Australian motor industry. Under the convention employed in the data tables such an increase in demand requires exactly the same increase in inputs to the Australian motor industry as would an increase in demand of the same size but for wholly Australian produced vehicles. Neither convention is entirely satisfactory. Some resources are required in the Australian motor industry to "finish" the imported item (assemble a Japanese car, for example). ORANI treats competing intermediate imports as wholly imported rather than wholly domestically produced in order to allow substitution between the domestic and imported sources. A further effect of adopting the convention chosen for ORANI is that there is some overstatement of the demand by the Australian motor industry for inputs following an increase in demand for domestically produced cars. This is because the resources which are in fact required to finish the semi-finished Japanese imports are now implicitly allocated to domestic production.

Once the necessary adjustments have been made to the data tables we can simply employ Tables I & II (adjusted) to produce matrices A and F in Figure 2. The inter-industry quadrant of Table II forms matrix A directly.

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1. For details see Appendix A.

Its typical element $X^{(1)}_{(i1)j}$ already shows the flow, at basic values, of domestically produced input i to intermediate user j.[1] The typical element $X^{(1)}_{(i.)j}$ of the inter-industry quadrant of Table I shows the flow of domestically produced plus imported input i to intermediate user j. The difference $(X^{(1)}_{(i.)j} - X^{(1)}_{(i1)j})$ is then the flow of the imported input alone and this is what is required for matrix F. Matrix F, therefore, is derived by the subtraction of the intermediate quadrant of Table II from that of Table I.

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1. The conventions generally employed in ORANI for sub- and super-scripts on variables or parameters are as follows.

   Superscript (k) indicates use and may take the following values:

   1 = intermediate usage
   2 = capital formation
   3 = private current consumption
   4 = export
   5 = other final demand .

   First subscript i indicates type of commodity and may take the following values:

   1 ... G = output from one of the G I-O industry classifications
   G + 1 = primary inputs
   G + 2 = other costs of production.

   Second subscript s indicates source and may take the following values:

   - for i = 1 .... G, s = 1 : domestic production
     = 2 : imports ;
   - for i = G + 1, s = 1 : labour
     = 2 : capital
     = 3 : land .

   Third subscript j indicates purchaser and may take the following values:

   - for k = 1 or 2, j = 1 ... G : an I-O industry
   - for k = 3, 4, 5 the third subscript is omitted since there is no distinction between purchaser within these demand categories.

Footnote continued p. 16

The final demand vectors, C, D, E, H, I and J in Figure 2, are obtained in an exactly analagous manner. Final demand vectors for domestically produced commodities (C, D, E, Figure 2) are obtained directly from the relevant columns in the adjusted Table II. Subtraction of these columns from the corresponding columns in the adjusted Table I yields final demand vectors for imported commodities (H, I, J, Figure 2).

(b) The Investment Matrices.

The two GFCE columns in the data tables show the inputs from each industry group into private and public fixed capital formation respectively. ORANI is required to trace the effects of changes in the price of any input on the costs of capital formation in any industry. Matrices of the form of B and G in Figure 2 are therefore required. The typical elements $X^{(2)}_{(i1)j}$ and $X^{(2)}_{(i2)j}$ show, respectively, the input at basic values of domestically produced and imported input i into capital formation in industry j. From such matrices the share in the costs of capital formation in each industry which is accounted for by the input of each type and source can be computed.

The first step in the formation of matrices B and G (Figure 2) from the GFCE vectors of the data tables is to obtain four separate vectors of domestically produced and imported inputs at basic values into private and public GFCE. These are derived from Tables I & II by procedures

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continuation of footnote from p. 15 ....

Thus $X^{(k)}_{(is)j}$ is the amount of commodity i from source s purchased by user j for purpose k.

For a more complete description of the notational conventions employed in ORANI as well as for a list of variable definitions, see John Sutton, "The Solution Method for the ORANI Module," Impact of Demographic Change on Industry Structure in Australia, Preliminary Working Paper OP-03, Industries Assistance Commission, Melbourne, June, 1976, Appendix I.

Some additional scripts are employed later in the present paper. These are explained as they are used.

similar to those described in section IV (a) (above) with respect to the other final demand columns from the data tables. We denote the typical element of these vectors

$I^{p}_{(is)}$ = the total input, at basic values, of type i from source s to GFCE of category p, where p = 1 (private) or 2 (public) .

Note that

$$I^{p}_{(is)} = \sum_{j} X^{(2p)}_{(is)j} ,$$

where

$X^{(2p)}_{(is)j}$ = the input, at basic values, of i from source s going to capital formation of category p in industry j .

Construction of matrix B (Figure 2) entails distributing the vectors showing inputs from domestic production to private and public capital formation (I^1_1 and I^2_1) back along rows to the columns of the investing industries. The typical element of matrix B - denoted $X^{(2)}_{(i1)j}$ - shows the input, at basic value, from domestic production of industry i to capital formation in industry j. In making these distributions a capital stock matrix was employed based on the capital coefficients matrix used in the Monash project.[1] The typical element - denoted K_{ij} - of the capital stock matrix is an estimate of the amount of input of type i (domestically produced and imported) embodied in the capital stock of industry j. The required distributions for the domestic investment

1. See H. D. Evans, B. Moore and G. Horgan, "The Structure of the Australian Capital Stock and Depreciation," (Mimeo), Monash Tariff Study 1967/68.

matrix (B in Figure 2) were then made according to the following formula

$$X^{(2)}_{(i1)j} = \frac{\alpha_j . I^1_{(i1)} . K_{ij}}{\sum_j K_{ij} . \alpha_j} + \frac{(1 - \alpha_j) . I^2_{(i1)} K_{ij}}{\sum_j K_{ij} \ (1 - \alpha_j)} ,$$

where

α_j = the proportion of private investment in the total investment made by industry j ;

i.e.

$$\alpha_j = \sum_s \sum_i X^{(2,1)}_{(is)j} \Big/ \sum_p \sum_s \sum_i X^{(2,p)}_{(is)j} .$$

The matrix G (Figure 2) was constructed in a strictly analagous way by distribution of the vectors (I^1_2 and I^2_2) showing imported inputs to private and public capital formation. The relevant formula for the construction of the cells ($X^{(2)}_{(i2)j}$) of the G matrix is

$$X^{(2)}_{(i2)j} = \frac{\alpha_j \ I^1_{(i2)} \ K_{ij}}{\sum_j K_{ij} \ \alpha_j} + \frac{(1 - \alpha_j) \ I^2_{(i2)} \ K_{ij}}{\sum_j K_{ij} \ (1 - \alpha_j)} .$$

For most I-O industries, $\alpha_j = 1$, implying that j is a purely private sector industry, or $\alpha_j = 0$, implying that industry j is entirely in the public sector. Some industries, health and education for example, have important elements of public and private sector investment. Since the α_j's do not vary with i, the procedures employed in the construction of the investment matrices implicitly assume that the structures of the base year capital stocks in the public sector and the private sector of any "mixed" industry are similar. For most such industries this seems a reasonable assumption. The input mix of a public hospital or school is probably broadly similar to that of a private hospital or school. Note however that these procedures do not constrain the investments into the private and public sectors of an industry to be of uniform input structures. These structures will depend upon the patterns of inputs into the I^1 and I^2 vectors.

One problem arises in the implementation of the procedures. It is the case that, for some i and s, $(\alpha_j K_{ij})$ (or $(1 - \alpha_j) K_{ij}$) is equal to zero for all j, but $I^1_{(is)}$ (or $I^2_{(is)}$) is not equal to zero. In such cases the problem arises of to which industries the investment shown in the i^{th} row of the relevant GFCE column should be allocated. This problem appears to reflect some inconsistency between the data used in the compilation of the investment vectors and that used in constructing the capital matrix. For most industries in which the problem arises the arbitrary procedure is adopted of allocating the entries in the investment columns back along the relevant rows in proportion to the intermediate flows in the equivalent rows of the intermediate usage quadrant of the I-O tables. The problem arises also in the mark-up industries. The entries in the investment columns in the mark-up rows in the basic value tables show the mark-up paid on inputs to capital formation. It appears that the capital matrix excludes all such mark-up. As explained in section IV (c) (below) ORANI employs the assumption that percentage mark-ups on flows to capital formation are the same for all purchasers. On this basis, matrices of mark-up flows to capital formation can be constructed (L_1 - L_6 and Q_1 - Q_6 in Figure 2). The sums of entries in these show the total amount of mark-up of each type paid on sales to GFCE. These totals can be checked against the corresponding elements of the GFCE vectors.

(c) <u>Margins</u>.

ORANI requires product prices which are relevant as signals to the producers of those products (basic values) and prices which are relevant to the users of products (purchasers' prices). For each good there are two basic value prices in ORANI : $P_{(i1)}$, the basic price of domestically produced i , and $P_{(i2)}$, the c.i.f. duty paid price of imported i. The module assumes that percentage margins on commodity i are invariant with respect to its source so that the difference between basic prices is also reflected in the purchasers' prices of each good.

Models based solely on basic values I-O tables and ignoring the importance of margins in the determination of purchasers' prices will mis-estimate the effects of price changes on users' behaviour. For example, consider an exogenous change in the model which increases the basic price of a product by 50% (say), an increase in a tariff for example. The resulting increase in the prices of that product to its users will however be less than 50% if the margins on its sales do not vary. On the other hand, an increase in the price of some input to margins, an increase in transport costs for example, will change both the relative basic value prices of commodities and their relative purchasers' prices. The change in relative basic value prices will depend upon the relative shares of industries' costs which are accounted for by transport on inputs. The change in relative purchasers' prices will depend upon shares of transport in margins on the sale of commodities as well as on the changes in basic values. Where substitution is allowed in the model, that is between different sources of the same good in intermediate demand and investment, and between different commodities as well in other final demand categories, it is important to account accurately for changes in relative purchasers' prices. ORANI therefore allows for margins associated with each commodity flow to be accounted for separately. The margins matrices (K - T in Figure 2), or aggregates from them, are therefore required.

Basic value prices are most obviously important in the solution of the ORANI module via their role in the determination of the rental rate on capital in each industry. For given costs of intermediate inputs and primary inputs other than capital, the rental rate on capital in any industry can be thought of, at least in the short run when the capital in each industry is regarded as fixed, as determined as a residual between the basic price of the product and unit costs (excluding capital costs). In turn the rental rates on capital in domestic industries are important variables in the determination of the allocation of aggregate investment expenditure (generated exogenously to the ORANI module) between industries.

Corresponding to each basic price of each product the module allows a separate purchasers' price for each potential user group. For each product there are potentially 214 categories of purchaser, i.e., 105 intermediate users, 105 investing industries and 4 categories of final demand other than investment. Thus in ORANI each good i has potentially 428 separate purchasers' prices denoted

$$P^{(k)}_{(is)j} = \text{the price of } i \text{ from source } s \text{ to purchaser } j \text{ for use } k .$$

Purchasers' prices are crucial in the determination of solutions in ORANI. Changes in relative purchasers' prices motivate substitution between products or sources of their supply. The purchasers' prices of inputs fix the costs of domestic output and capital formation.

As explained above, the differences between the basic price of a commodity and its purchasers' prices are explained by mark-ups and commodity taxes. The Australian 1962/63, 105 industry, I-O tables have six industries which provide inputs to mark-up and a single category of indirectly allocated commodity taxes (P.3). The mark-up industries are :

wholesale trade (F1)
retail trade (F2)
transport and storage (G1)
communication (H1)
other insurance (I2)
entertainment and hotels (L1) .

Use of a single, average purchasers' price for each product would imply an assumption that margins of each type are spread evenly over the sales of any product and do not vary with the user - that is the percentage margin on basic value is assumed to be constant. It is clear, however, that this is not the case so that a model which ignores the possibility of the price of a product varying between users is likely to mis-estimate the effects of various exogenous changes.

Differences in the margin on the sales from any industry to various users can arise for two reasons. Firstly, the industry groups of the 1962/63 I-O tables do not typically produce single homogenous products. The product mix within sales from an industry group to different users might well vary. When the different products which are included in the sales of the industry group attract different tax rates, involve different handling and transport procedures or are purchased through different trade channels, then the margins on sales of different bundles of these commodities to different users are likely to vary. For example, the industry group "fertilizers and industrial chemicals n.e.c." (C31) includes superphosphate which attracts subsidy as well as other industrial chemicals which attract no subsidy at all. Consequently the tax element in sales from this industry to agricultural users, but not to industrial users, is characteristically negative. To spread this subsidy element evenly over all users of the output from the industry (as would be required in a single purchasers' price) would overstate the increase in costs to manufacturing industry which would be caused by abolition of the superphosphate bounty but understate the increase in costs which its abolition would generate in the rural sector.

Even when the industry group does not involve this sort of product heterogeneity, differences in margins between users can still arise. Tax rates often discriminate between users of a given product. For example, primary producers are not liable to sales tax on various implements (chain-saws, etc.) although the same items are subject to sales tax when sold to personal consumption. Similarly, most products attract retail trade mark-up only when sold to personal consumption. An increase in the costs of retailing (say, because of a rise in wage rates) will then characteristically increase the price of commodities to personal consumption but leave their prices to other users unchanged. Use of a single average purchasers' price would implicitly spread retail margins incurred in the sale of a product over all its purchasers. The model would then tend to underestimate the reduction in the quantity of the product demanded by final consumers following an increase in retailing costs. Correspondingly, the effects of the increase in retailing costs on the intermediate and investment demand for the product would be overestimated.

ORANI describes the relationship between basic prices and purchasers' prices with equations of the following form :

(1) $$p^{(k)}_{(is)j} = m^{(k)}_{(is)j} \begin{bmatrix} p_1 \\ p_2 \end{bmatrix} + n^{(k)}_{(is)j} \; t^{(k)}_{(is)j}$$

for

$i = 1, \ldots, G$: the number of products ;

$s = 1$ (domestic production), 2 (imports) ;

$j = 1, \ldots, G$: the number of industrial users ;

$k = 1$ (current inputs), 2 (capital inputs) .

(2) $$p^{(k)}_{(is)} = m^{(k)}_{(is)} \begin{bmatrix} p_1 \\ p_2 \end{bmatrix} + n^{(k)}_{(is)} \; t^{(k)}_{(is)}$$

for

$i = 1, \ldots, G$;

$s = 1, 2$;

$k = 3$ (current consumption) ;

4 (exports) ;

5 (other final demands - government, inventories) ;

where

p_1 = a $G \times 1$ vector of percentage changes in basic prices of domestic outputs ;

p_2 = a $G \times 1$ vector of percentage changes in import prices (c.i.f. + duty) ;

$m^{(k)}_{(is)j}$ = a $1 \times 2G$ vector showing the shares in the purchasers' price of product i from source s going to use j for purpose k which is accounted for by the basic price of product i from source s and by inputs from the various mark-up industries , (for k = 1, 2) ;

continued ...

$m^{(k)}_{(is)}$ = a 1 × 2G vector showing the shares in the purchasers' price of product i from source s going to the final demand category k which is accounted for by the basic price of i and by inputs from the mark-up industries , (for k = 3 - 5) .

Similarly,

$n^{(k)}_{(is)j}$ (k = 1, 2) and $n^{(k)}_{(is)}$ (k = 3 - 5) are the shares in the relevant purchasers' prices which are accounted for by commodity taxes ;

$t^{(k)}_{(is)j}$ (k = 1, 2) and $t^{(k)}_{(is)}$ (k = 3 - 5) are the percentage changes in the relevant tax rates ; and

$p^{(k)}_{(is)j}$ (k = 1, 2) and $p^{(k)}_{(is)}$ (k = 3 - 5) are the corresponding percentage changes in the purchasers' prices .

Note that $p^{(4)}_{(i1)}$ is to be interpreted as the percentage change in the f.o.b. price of exports of type i .

Equations (1) and (2) assume that there is no mark-up on sales from the mark-up industries as inputs to mark-ups on other products. This allows us to use the basic values of output from the mark-up industries to indicate the amount paid for inputs to mark-ups. An implication of this is, of course, that all users of (say) transport as a margin input pay the same price for a unit of transport services. On the other hand, our formulation would allow mark-ups to be charged on sales by the mark-up industries for purposes other than as mark-up inputs.

Having decided on the general approach to be taken, we are left with the problem of how to estimate the various "shares" required as data in equations of the form of (1) and (2). As has been indicated above, it is assumed that the margin on flows of any domestically produced commodity is the same as the margin on the flows of imported supplies of the same commodity. In Figure 2 then the margin flows in (say) any pair of (K.,P.) matrices are related to each other in exactly the same proportions as the corresponding basic value flows in matrices (A.,F.). Analagous relationships hold for the pairs (L.,Q.), (M.,R.), (N.,S.), (O.,T.) with the corresponding basic value flow matrices (B.,G.), (C.,H.), (D.,I.),(E.,J.).

A second assumption adopted is that the margin on the sale of any commodity to a category (private or public) of capital formation does not vary with the purchasing industry.

These two simplifications allow the matrices K. - T. (Figure 2), which are required for the computation of the $m^{(k)}_{(is)j}$, $n^{(k)}_{(is)j}$, etc., to be estimated from matrices of the form illustrated in Figure 3. $Z^{(1)}_{(i.)j}$ (n) is the value of mark-up of type n associated with the sale of good i (domestically produced <u>plus</u> imported) to industry j as an intermediate input. $Z^{(2p)}_{(i.)}$ (n) is the value of margin of type n on the sale of i as an input to capital formation of category p (private or public). $Z^{(k)}_{(i.)}$ (n) is the margin of type n on the sale of i to final demand category k. Matrices K_n and P_n in Figure 2 can be produced by splitting the inter-industry quadrant of Figure 3 in the same proportions as matrices A and F (Figure 2). An analagous procedure is

__Figure 3__ : __Format for Margins Matrices, Z(n)__

	Intermediate usage	Final Demand					
	1 . . . . . . j 105	Capital formation (2, 1)	(2, 2)	(3)	(4)	(5)	
1 . . . . . . i 105	. . . . . . $Z^{(1)}_{(i.)}(n)$	$Z^{(2,1)}_{(i.)}(n)$	$Z^{(2,2)}_{(i.)}(n)$	$Z^{(3)}_{(i.)}(n)$	$Z^{(4)}_{(i.)}(n)$	$Z^{(5)}_{(i.)}(n)$	$\sum_j Z^{(1)}_{(i.)j}(n) + \sum_{p=1}^{2} Z^{(2,p)}_{(i.)}(n) + \sum_{k=3}^{5} Z^{(k)}_{(i.)}(n)$
	$\sum_i Z^{(1)}_{(i.)j}(n)$	$\sum_i Z^{(2,1)}_{(i.)}(n)$	$\sum_i Z^{(2,2)}_{(i.)}(n)$	$\sum_i Z^{(3)}_{(i.)}(n)$	$\sum_i Z^{(4)}_{(i.)}(n)$	$\sum_i Z^{(5)}_{(i.)}(n)$	

employed to split the final demand columns to produce matrices $M_n - O_n$ and $R_n - T_n$ (Figure 2). The capital formation columns ((2,1) and (2,2)) in Figure 3 must similarly be split into vectors of margins on inputs of domestic and imported source. These vectors can then be converted into the matrices L_n and Q_n (Figure 2) by allocation of the totals along the rows in proportion to the entries in the corresponding basic value flow matrices, B and G in Figure 2.

The Z(n) matrices can be estimated from data tables I & III. We attempt to build seven such matrices - one for each type of mark-up input and one for commodity taxes. The general approach is to attempt to estimate the cells of each matrix, in some cases individually and in others in blocks by the application of various assumptions. Once the cells have been estimated the whole matrix is forced to be consistent with required row and column totals, which can readily be deduced from the I-O tables. The application of the RAS method for adjusting I-O tables is required at this point. These general principles will be applied in detail in Appendix B to each of the seven required matrices.

From the Z(n) matrices the vectors $m^{(k)}_{(is)j}$ and $m^{(k)}_{(is)}$ and the ratios $n^{(k)}_{(is)j}$ and $n^{(k)}_{(is)}$ can be computed. The form of these parameters is illustrated in Table C. Only seven of the 2G components of each vector may be non-zero. For the i^{th} good there is an entry in either the i^{th} column (for domestically produced i) or the $(G + i)^{th}$ column (for imported i). This entry shows the proportion in the relevant purchasers' price of i which is accounted for by the basic value of a unit of product i. There may also be non-zero entries in the columns n = 1 ...... n = 6 which represent the shares of mark-up inputs from the six mark-up industries in the relevant purchasers' price of product i.

Table C : Parameters for Purchasers' Price Equations

Column numbers: $1, \; i, \; n=1, \; n=6, \; G+i, \; 2G$

$$m^{(k)}_{(i1)j} = \left(0, \ldots, 0, \frac{X^{(k)}_{(i1)j}}{\tilde{X}^{(k)}_{(i1)j}}, 0, \ldots, 0, \frac{Z^{(k)}_{(i1)j}(1)}{\tilde{X}^{(k)}_{(i1)j}}, \ldots, \frac{Z^{(k)}_{(i1)j}(6)}{\tilde{X}^{(k)}_{(i1)j}}, 0, \ldots\ldots, 0\right)$$

$$m^{(k)}_{(i2)j} = \left(0, \ldots\ldots, 0, \frac{Z^{(k)}_{(i2)}(1)}{\tilde{X}^{(k)}_{(i2)j}}, \ldots, \frac{Z^{(k)}_{(i2)j}(6)}{\tilde{X}^{(k)}_{(i2)j}}, 0, \ldots, 0, \frac{X^{(k)}_{(i2)j}}{\tilde{X}^{(k)}_{(i2)j}}, 0, \ldots, 0\right)$$

$$m^{(k)}_{(i1)} = \left(0, \ldots, 0, \frac{X^{(k)}_{(i1)}}{\tilde{X}^{(k)}_{(i1)}}, 0, \ldots, 0, \frac{Z^{(k)}_{(i1)}(1)}{\tilde{X}^{(k)}_{(i1)}}, \ldots, \frac{Z^{(k)}_{(i1)}(6)}{\tilde{X}^{(k)}_{(i1)}}, 0, \ldots\ldots, 0\right)$$

$$m^{(k)}_{(i2)} = \left(0, \ldots\ldots, 0, \frac{Z^{(k)}_{(i2)}(1)}{\tilde{X}^{(k)}_{(i2)}}, \ldots, \frac{Z^{(k)}_{(i2)}(6)}{\tilde{X}^{(k)}_{(i2)}}, 0, \ldots, 0, \frac{X^{(k)}_{(i2)}}{\tilde{X}^{(k)}_{(i2)}}, 0, \ldots, 0\right)$$

$$n^{(k)}_{(is)j} = \frac{Z^{(k)}_{(is)j}(7)}{\tilde{X}^{(k)}_{(is)j}}$$

$$n^{(k)}_{(is)} = \frac{Z^{(k)}_{(is)}(7)}{\tilde{X}^{(k)}_{(is)}} \, .$$

N.B. The $\tilde{X}$ are the purchasers' price values of the indicated flows.

(d) Primary Inputs

The treatment of primary inputs in the ORANI data base is compared with the corresponding treatment in the data tables in Table B (above). The major differences concern the split which is made in the ORANI data base of the "Gross operating surplus" category from the data tables and the disaggregation of the "wages, salaries and supplements" vector from the data tables into a wages matrix.

The procedure employed in splitting the GOS category from the data tables into its separate components in ORANI are described in detail by Vern Caddy and David Vincent.[1] The GOS category in the data tables includes returns to fixed capital, working capital, land and some self-employed labour. Returns to owner-operator labour are especially important in the rural sector. Returns to such labour were imputed and the implied amounts transferred from GOS to the labour income (wages, salaries and supplements) category of primary inputs. Similarly, rents on land were imputed and deducted from GOS to be included in a separate "land" category of primary inputs in the ORANI data base (matrix W in Figure 2). After these adjustments have been made, what remains in GOS are returns to fixed capital and returns to working capital.

ORANI requires a separate category of returns to fixed capital (matrix V in Figure 2). The rental rates on fixed capital in each industry are important determinants of the inter-industry allocation of investment expenditure. Estimates were made of the relative values of fixed and working capital in each of the I-O industries and the remainder of the GOS category

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1. V. Caddy and D. Vincent, Unpublished research memorandum, August, 1976.

was split in these proportions. Estimated returns to working capital are included in the "other costs" category in the ORANI data base (matrix X in Figure 2).

ORANI does not assume that labour is homogeneous. The labour force is disaggregated into the following nine occupational categories :

1. Professional white collar
2. Skilled white collar
3. Semi- and unskilled white collar
4. Skilled blue collar, metal and electrical
5. Skilled blue collar, building
6. Skilled blue collar, other
7. Semi- and unskilled blue collar
8. Rural
9. Armed services[1] .

Using these categories an employment matrix (industry by occupation) was constructed by allocation of the labour force from the 1971 population census into the industry groups of the 1962/63 I-O tables. Together with estimates of occupation specific wage rates (assumed constant across industries) this employment matrix can be used to generate a wage matrix of the form of matrix U in Figure 2. The column totals of this matrix should then correspond to the "wages, salaries and supplements" row of the data tables after the latter has been adjusted to account for imputed wages transferred from the GOS row.

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1. Further details of this categorisation are given in Appendix 1 of Ashok H. Tulpulê and M. K. McIntosh, "BACHUROO - An Economic-Demographic Module for Australia," Impact of Demographic Change on Industry Structure in Australia, Working Paper No. B-02, Industries Assistance Commission, Melbourne, April, 1976.

The employment matrix was used to construct a matrix showing the shares of the wage bill in each industry accounted for by each occupation group.[1] These shares are required in ORANI in order that the effects of changes in occupation specific wage rates on the costs of production in each industry and on the occupational demand for labour may be traced.

It is to be noted that the ORANI data base (and the data tables) does not allow for primary inputs to be employed directly in capital formation. The use of these inputs is accounted for indirectly via inputs to industries which supply inputs to capital formation, mainly the construction industries.

V. CONCLUSION

I-O tables contain more information than is immediately apparent. This paper has attempted to show how a knowledge of the conventions of I-O accounting can allow enough information to be deduced from published I-O data to form an I-O data base for a general equilibrium model of the Australian economy which distinguishes between domestically produced and imported commodity flows and accounts fully for purchasers' as well as producers' prices.

The solution methods employed in the ORANI module are structured so as to depend for the required I-O parameters only on an input of data in the form of Figure 2. The substitution of a more recent data base than the 1962/63 I-O tables used in the prototype version of ORANI will just require reformulation of the new I-O tables into the form of Figure 2 which can then be fed immediately into the solution program.

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1. Details of the construction of the wage bill matrix are contained in J. Sutton, Unpublished research memorandum, August, 1976.

APPENDIX A

Revision of the Treatment of Competing Intermediate Imports in the 1962/63 I-O Tables

1. Tables with indirect allocation of competing imports (Tables I & III)

   (a) Add row P6B to row P6C. [1]

   (b) Split row P7A+B into two separate rows, P7A and P7B, according to the formula

$$X_{(P7B,j)} = X_{(P7A+B,j)} \cdot \frac{X_{(P6B,j)}}{X_{(P6A,j)} + X_{(P6B,j)}} \; .$$ [2]

This assumes that the average ad valorem rate of duty on complementary imports (shown in P6A) is the same as that on competing intermediate imports (shown in P6B).

   (c) Add row P7B to row P7C.

These operations remove competing intermediate imports (plus duty) from the "Australian production" sub-total (T2). Row T2 must therefore correspondingly be reduced :

$$X^{*}_{(T2,j)} = X_{(T2,j)} - X_{(P6B,j)} - X_{(P7B,j)} \; .$$

2. Tables with direct allocation of competing imports (Table II)

   (a) Split row P6B+C using the row P6B from Table I :

$$\bar{X}_{(P6C,j)} = \bar{X}_{(P6B+C,j)} - X_{(P6B,j)} \; .$$

(b) Split row P7B+C using the estimate of P7B obtained from Table I :

$$\bar{X}_{(P7C,j)} = \bar{X}_{(P7B+C,j)} - X_{(P7B,j)} .$$

(c) Add rows P6B and P7B giving P_{6B+7B} = competing intermediate imports plus duty .

(d) Reduce the row for each industry by an estimate of that industry's resales of competing intermediate imports :

$$\bar{X}^*_{ij} = \bar{X}_{ij} \left[1 - \frac{\bar{X}_{(P6B + 7B,i)}}{\bar{X}_{(T3,i)}} \right] .$$

This assumes that all users of good i consume domestically produced i and competing intermediate imports of i in the same proportions.

(e) Replace the original row P6B+7B with a vector of the amounts taken out of the industry rows in step (d) above :

$$\bar{X}^*_{(P6B+7B,j)} = \sum_i (\bar{X}_{ij} - \bar{X}^*_{ij}) .$$

This replaces a vector of competing intermediate imports allocated as intermediate inputs with a vector of the same imports allocated directly to their eventual users.

N.B. The total supply aggregate in the direct allocation table will be reduced by the amount of aggregate intermediate imports.

Footnotes

1. The row names used are those of the 1962/63 I-O tables. See CBCS, op. cit..

continued ...

Footnotes continued ...

2. Symbols used are as follows :

X_{ij} = an element of an indirect allocation I-O table ;

$\bar{X}_{ij}$ = an element of a direct allocation I-O table .

An asterisk superscript indicates an adjusted element.

APPENDIX B

Details of Construction of Margins Matrices

This appendix contains details of how the principles outlined in the paper (see especially section IV (c)) were applied to estimate margins matrices from the 1962/63 I-O tables. These matrices were required for a "prototype" run of the ORANI module and were therefore prepared hurriedly, and using a minimum of information from outside the I-O tables. The results were not always entirely satisfactory. This is true especially of the tax matrix where the presence of negative elements and row and column totals presents severe problems for the use of RAS type procedures. Estimation could have been considerably improved with the use of more exogenous information. Time did not allow this for the prototype. The Phase 1 version of ORANI will in any case employ 1968/69 I-O data for which margins matrices will be supplied directly by the Australian Bureau of Statistics.

1. Aggregate mark-up

Table B1 shows mark-up, by mark-up industry, on aggregate sales to intermediate usage and to each category of final demand in the 1962/63 I-O tables. The table was computed from the basic values I-O table and Table E of the 1962/63 I-O accounts. Purchases from the mark-up industries shown in the basic values I-O table (Table I) comprise purchases for mark-up on inputs to the purchaser plus "other service" purchases. The "other service" purchases are shown separately in Table E of the I-O accounts so that the mark-up element in the purchases shown in the basic values table can be isolated by the obvious subtraction.

Table B1 : Mark-up by Mark-up Industry to Intermediate Usage and Final Demand, 1962/63 I-O Tables, $m

Purchaser / Mark-up Industry	Intermediate Usage	Final Demand					
		Q1	Q2	Q3	Q4	Q5	Q6
F1	621.4	203.3	-	128.3	12.4	2.2	90.3
F2	48.2	1376.9	-	40.0	0.4	-	0.2
G1	588.0	132.1	-	60.0	8.2	1.7	104.0
H1	2.8	0.3	-	0.4	0.1	-	0.5
I2	7.1	0.6	-	1.0	0.2	-	1.3
L1	4.3	227.9	-	-	-	-	-

2. Margins on non-competing imports and sales by final buyers

The 1962/63 I-O tables include some margins on non-competing imports and sales by final buyers. These margins are included in the purchases from the mark-up industries and commodity tax row shown in both the basic values and the purchasers' price tables. Before these purchases can be used as column and row totals for margins matrices of the form of Figure 3, they should be purged of margins on non-competing imports and sales by final buyers.

The aggregate amount of margins involved can be estimated from the identity :

Total purchases from margins		Margins on domestic flows and competing imports		"Other service" purchases		Margins on non-competing imports and sales by final buyer
\$6305.8m.[1]	≡	\$4460.7m.[2]	+	\$1755.0m.[3]	+	(90.1m.)[4]

The \$90.1m. aggregate was split among margin types as follows. The estimate from Table E of the 1962/63 I-O accounts of taxes on the relevant transactions (= \$18.9m.) was accepted and the remainder (= \$71.1m.) split among mark-up industries in proportion to their contributions to mark-up in total. The consequent estimates were deducted proportionately from the individual elements of the required row and column totals of the margins matrices.

3. <u>The wholesale mark-up matrix</u>[5]

The required sum of the elements of the matrix (= total wholesale mark-up on domestic and competing import flows) was derived from Table D of the 1962/63 I-O accounts after adjustment had been made for an estimate of mark-up on non-competing imports and sales by final buyers. (See section 2 above.) That is :

$$\sum_i U_i = \sum_j V_j = \$1057.9\text{m.}[6] - \$22.1\text{m.}[7] = \$1035.8\text{m.}$$

Row and column totals for the matrix were estimated as :

$$U_i = \tilde{X}_{88,i} \times \frac{1035.8}{\sum_i \tilde{X}_{88,i}} \qquad i = 1, \ldots, 105 \; ;$$

$$V_j = X_{88,j} \times \frac{1035.8}{\sum_j X_{88,j}} \qquad j = 1, \ldots, 111 \; .$$

An initial estimate of the wholesale matrix ($W^{est.}$) was made by proportional allocation of the row totals along the row, i.e.,

$$(W^{est.})_{ij} = U_i \times \frac{X_{ij}}{\sum_j X_{ij}} \qquad \begin{array}{l} i = 1, \ldots, 105 \\ j = 1, \ldots, 111 \end{array}$$ [8]

A final estimate of the required wholesale mark-up matrix was obtained by the application of RAS to $W^{est.}$, U and V.

4. Retail mark-up matrix

Most retail mark-up is in respect of sales to personal consumption. There are small, but significant, mark-ups on sales to intermediate usage (48.2m.) and private gross fixed capital formation ($40m.)[9] Most of the retail margin on sales to intermediate usage is accounted for by sales to industry F3.[10] Since both F3 and Q3 make large purchases from industry C54,[11] which in turn pays a large amount of retail margins in respect of its sales,[12] most of the retail margin on sales to F3 and Q3 was allocated initially to sales from industry C54. Some minor allocations were made to the rows C38 and C61. The retail margin on sales to personal consumption ($1376m.)[13] was initially allocated to selling industries in proportion to the purchases of retailing as margins on sales made by the industries.[14]

Column and row totals for the retail matrix were obtained from Table I and Table III respectively after adjustment for other service purchases and mark-up on non-competing imports and sales by final buyers, i.e.,

$$\sum_i U_i = \sum_j V_j = \$1435.3\text{ m.}$$

$$U_i = X_{89,i} \cdot \frac{1435.3}{\sum_i \tilde{X}_{89,i}} \qquad i = 1, \ldots, 105$$

$$V_j = X_{89,j} \cdot \frac{1435.3}{\sum_{j=1}^{105} X_{89,j}} \qquad j = 1, \ldots, 111 \quad \neq 106$$

$$V_{106} = (X_{89,106} - 54.0^{15}) \cdot \frac{1435.3}{\sum_{j=1}^{111} X_{89,j}} \quad .$$

That part of the row totals not yet provisionally allocated was allocated along the rows of the provisionally estimated retail matrix in proportion to the elements of Table I. The final estimate of the retail matrix was obtained by the application of RAS to the initial estimate, U and V.

5. Transport and storage mark-up matrix

The required sum of the matrix (i.e., total transport and storage mark-up on flows of domestic output and competing imports) was derived from Table D of the 1962/63 I-O tables after adjustment for mark-up on on-competing imports and sales by final buyers, i.e.,

$$\sum_i U_i = \sum_j V_j = \$875.4\text{m.}$$

The large purchase ($102.2m.) from transport and storage made by industry N1[16] can be identified as an "other service" purchase since there is no margin on the sales of this industry.

Required row and column totals for the matrix were computed from the purchases of transport and storage shown in Table III and Table I, together with the inforamtion given in the G1 row of Table B1 (above), i.e.,

$$U_i = \tilde{X}_{91,i} \cdot \frac{875.4}{\sum_{i=1}^{104} \tilde{X}_{91,i}} \qquad i = 1, \ldots, 104$$

$$= 0 \qquad i = 105$$

$$V_j = X_{91,j} \cdot \frac{588.0}{\sum_{j=1}^{104} X_{91,j}} \qquad j = 1, \ldots, 104$$

$$= 0 \qquad j = 105, 107$$

$$= \$132.1\text{ m.} \qquad j = 106$$

$$= \$60\text{ m.} \qquad j = 108$$

$$= \$8.2\text{ m.} \qquad j = 109$$

$$= \$1.7\text{ m.} \qquad j = 110$$

$$= \$104.0\text{ m.} \qquad j = 111 .$$

An initial estimate of the matrix $(T^{est.})$ was made by allocation of U, i.e.,

$$(T^{est.})_{ij} = U_i \cdot \frac{X_{ij}}{\sum_{j=1}^{111} X_{ij}} .$$

The final estimate was produced by application of RAS to $T^{est.}$, U and V.

6. Communication

The purchase of communication mode by industry N1 ($223.7m.)[17] was identified as an "other service" purchase. Row and column totals for the matrix were derived from row H1 in Table III and Table I combined with the information from the H1 row of Table B1, i.e.,

$$\begin{aligned} U_i &= X_{92,i} && i = 1, \ldots, 104 \\ &= 0 && i = 105 \end{aligned}$$

$$\begin{aligned} V_j &= X_{92,j} && j = 1, \ldots, 111 \\ & && \neq 105, 106, 109 \\ &= 0 && j = 105 \\ &= (X_{92,j} - 82.2) && j = 106 \\ &= (X_{92,j} - 96.6) && j = 109 . \end{aligned}$$

An initial estimate of the matrix was derived by allocation of the row totals in the usual way and a final estimate obtained by applying RAS to the initial estimate, U and V.

7. Other insurance

Once again industry N1 accounts for all the "other service" purchases ($122.1m.)[18] from the "other insurance" industry for intermediate usage. Row and column totals for the matrix can then be derived in the usual way, i.e.,

$$U_i = \tilde{X}_{94,i} \qquad i = 1, \ldots, 104$$
$$= 0 \qquad i = 105$$

$$V_j = X_{94,j} \qquad j = 1, \ldots, 104, 107, \ldots, 111$$
$$= 0 \qquad j = 105$$
$$= (X_{94,j} - 54.3) \qquad j = 106 .$$

The row totals were then allocated as before to produce a base matrix which was forced to agree with U and V by use of RAS. The product is the final estimate of the "other insurance" margins matrix.

8. Entertainment and hotels

The mark-up on sales of tobacco and alcohol in hotels and licensed clubs is shown in the 1962/63 I-O tables as an output of the "entertainment and hotels" industry. Mark-up of this category then is paid only in respect of the sales of the industries C11, C12 and C13. All other rows of the relevant mark-up matrix consist entirely of zeros.

The row totals for the matrix were derived from Table III as usual, i.e.,

$$U_i = \tilde{X}_{102,i} \qquad i = 24 - 6 .$$

The column totals were derived from Table I, noting that industries 91 and 105 make "other service" purchases from the "entertainment and hotels" industry, i.e.,

$$V_j = X_{102,j} \qquad j = 1, \ldots, 90, 92, \ldots, 104, 106, \ldots, 111$$

$$= X_{102,j} - 1.8 \qquad j = 91$$

$$= X_{102,j} - 74.6 \qquad j = 105 \;.$$

Table B1 reveals that most mark-up of this type ($227.9 m. out of a total of $232.2m.) is paid on sales to personal consumption. This amount was allocated to the relevant rows of the Q1 column in proportion to the value of purchases in the relevant industries from the "entertainment and hotels" industry, i.e.,

$$Z_{(i,106)}^{19} = \$227.9\text{m.}\ \frac{\tilde{X}_{102,i}}{\Sigma\,\tilde{X}_{102,i}} \qquad i = 24 - 26 \;.$$

The row totals, net of amounts already allocated to personal consumption, were then allocated to the remainder of the matrix in the usual way and RAS was then applied to produce a final estimate consistent with U and V.

9. Commodity taxes less subsidies

Attempts to produce a "tax less subsidies" matrix by methods similar to those employed for the mark-up matrices described above proved quite unsatisfactory. The proportionality assumption often employed in allocating mark-up in I-O tables may be less appropriate in the case of these taxes and the presence of negative elements (subsidies) severely hinders the use of RAS type procedures. In the prototype run of ORANI, taxes will always be assumed constant which greatly reduces the importance of the tax matrix in solutions to the module. As has been indicated previously, future versions of the module will employ data based on the 1968/69 I-O tables for which a comprehensive tax matrix will be available.

Row totals for the intermediate sector and the entire final demand quadrant of the matrix for the prototype run were derived directly from Table E of the 1962/63 I-O accounts. Column totals for the intermediate sector were derived from Table I and adjusted proportionately so that they were consistent in total with the row totals, i.e.,

$$V_j = X_{109,j} \cdot \frac{\sum_i U_i}{\sum_j X_{109,j}} \qquad \begin{array}{l} i = 1, \ldots, 105 \\ j = 1, \ldots, 105 \end{array} .$$

A preliminary estimate of the intermediate sector of the matrix was made by allocation of row totals in proportion to the basic value of flows in the corresponding cells of Table I with the following exceptions. All the subsidy shown on sales from industry A5 was allocated to sales to industry C2. Subsidy on the output of industry B4 was allocated entirely to sales to industry B2. Subsidy on sales of industry C31 was allocated only to industries A1 - A7.

A modified version of the RAS procedure which allows for the presence of negative elements was employed to force the preliminary estimate to be consistent with its row and column totals. The modified RAS is described in the next section.

10. The modified RAS procedure

This section describes a method of mechanically adjusting a matrix containing negative elements and/or required row and/or column totals in order to allow RAS to work.

(1) Given

	$(m \times n)$ A	$(m \times 1)$ U
$(1 \times n)$	V	

(2) Compute A^{+} = the + ve elements of A

A^{-} = the - ve elements of A

(3) Compute

$$A^{N} = A - 2A^{-}$$

$$U^{N} = U - 2A^{-}_{(i.)}$$ [20]

$$V^{N} = V - 2A^{-}_{(.j)}$$

(4) If U^{N} and $V^{N} > 0$, go to 7

(5) If $\exists\ U^{N}_{i}$ or $V^{N}_{j} < 0$

compute

$$A^{N} = A^{N} - A^{-}$$

$$U^{N} = U^{N} - A^{-}_{(i.)}$$

$$V^{N} = V^{N} - A^{-}_{(.j)}$$

(6) Go to 3

(7) RAS A^N to U^N and V^N yielding A^R

(8) Compute

$$A^* = A^R + m A^-$$

$$U^*(=U) = U^N + m A^-_{(i.)}$$

$$V^*(=V) = V^N + m A^-_{(.j)}$$

where $m = 2 +$ the number of times step 4 is used .

A^* is the required matrix .

Footnotes

1. From Table I the corresponding figure from the purchasers' price Table III is $6393m. The difference is partly explained by tax on sales from industry L1 ($54.2m.) and G1 ($13.1m.). $19.9m. remains unexplained.

2. This is the sum of the total margins matrix obtained by subtraction of Table I from Table III. Elements of the matrix obtained by this subtraction represent the total margin on the relevant flow except for the rows corresponding to the mark-up industries. In these rows, the elements represent the differences between the mark-up from that row paid on the purchaser's inputs and the mark-up paid in respect of the purchaser's sales. These differences are of no particular interest and are replaced in the total margins matrix with estimates of the margins on sales from the mark-up industries. These are confined to the taxes on the sales of industries L1 and G1 referred to in footnote 1.

3. From Table D in the 1962/63 I-O accounts.

4. Calculated as a residual. Note that this does not agree with the estimate given in Table E of the 1962/63 I-O accounts. We preferred to use the estimate given here and relied on Table E only for information on commodity taxes less subsidies.

5. Notation employed in the remainder of this appendix is as follows :

   U = vector of required row totals for margins matrix

   V = vector of required column totals for margins matrix

   X_{ij} = an element of the basic values I-O table with indirect allocation of competing imports (Table I)

   $\tilde{X}_{ij}$ = an element of the purchasers' prices I-O table (Table III).

6. From Table D.

7. Adjustment.

8. The column and row number employed refer to the columns or rows of the 1962/63 105 × 105 I-O tables with the column T4 extracted so that column Q1 = column 106 etc.

9. See Table B1.

10. $32.1m. - see cell (F2, F3) of Table I.

11. See cells (C54, F3) and (C54, Q3) in Table I.

12. See cell (F2, C54) in Table III.

13. See Table B1.

14. Obtained from row F2 in Table III.

15. "Other service" sales of retailing to personal consumption - see Table E of the 1962/63 I-O accounts.

16. See cell (G1, N1) of Table III.

17. See cell (H1, N1) in Table III.

18. See cell (I2, N2) in Table III.

19. Z_{ij} is the general notation employed for an element of a margins matrix.

20. $A^{-}_{(i.)}$ and $A^{-}_{(.j)}$ denote, respectively, the vectors of row and column totals of the matrix A^{-}.