INPUT-OUTPUT MODELS FOR PROJECTING & PLANNING THE ECONOMY

by

B. P. PHILPOTT and B. J. ROSS

STUDIES IN THE STRUCTURAL DEVELOPMENT OF THE NEW ZEALAND ECONOMY: No. 1

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of the New Zealand Economy No. 1

Agricultural Economics Research Unit Publication No. 41
THE AGRICULTURAL ECONOMICS RESEARCH UNIT

The Unit was established in 1962 at Lincoln College with an annual grant from the Department of Scientific and Industrial Research. This general grant has been supplemented by grants from the Wool Research Organisation, the Nuffield Foundation and the New Zealand Forest Service for specific research projects.

The Unit has on hand a long-term programme of research in the fields of agricultural marketing and agricultural production, resource economics, and the relationship between agriculture and the general economy. The results of these research studies will be published as Unit reports from time to time as projects are completed. In addition, it is intended to produce other bulletins which may range from discussion papers outlining proposed studies to reprints of papers published or delivered elsewhere. All these publications will be available at a small charge. For list of publications see inside back cover.

Director
Professor B. P. Philpott, M.Com., M.A.(Leeds), A.R.A.N.Z.

Senior Research Economist
R. W. M. Johnson, M.Agr.Sc., B.Litt.(Oxon.)

Research Economists
T. W. Francis, B.A.

Assistant Research Economists

UNIVERSITY LECTURING STAFF ASSOCIATED WITH THE UNIT'S RESEARCH PROJECTS:

J. D. Stewart, M.A., Ph.D. (Reading)
Professor of Farm Management

Senior Lecturer in Rural Education

Senior Lecturer in Economics

Lecturer in Farm Management

R. G. Cant, M.A., Ph.D. (Malaya)
Lecturer in Geography, Canterbury

Assistant Lecturer in Economics
The central theme of the research work of the Agricultural Economics Research Unit, is concerned with the place of agriculture in the future structure of the New Zealand economy. With this theme, the Unit's broad programme of research in the fields of agricultural production and marketing economics is closely integrated.

To analyse the future place of agriculture in the economy (especially in New Zealand conditions), it is necessary to take account of the close inter-relationships with other sectors and of the future development of those sectors. We have therefore chosen to approach the problem by developing interindustry models embracing the whole economy and to use these to formulate projections of the economy in 1975 under alternative assumptions about agricultural growth.

The research work in this field has been proceeding for some time now and a large mass of results has accumulated and is being prepared for publication during 1968 in a series under the general heading of "Studies in the Structural Development of the New Zealand Economy". The present paper is an introduction to this series and sets out, in broad terms, the methodology adopted; the detailed steps involved in building up a quantitative analysis of the intersectoral relationships involving the primary sector; and a coherent projection of the economy in 1975 which can be used to assist in decisions relating to economic policy and economic planning with respect to the structure of the economy.

In the last section we give a list of the further papers to be issued in the series during 1968 and show how they bear on our central problem.
Research work similar to that reported here has recently been started at the N.Z. Institute of Economic Research. As this develops it will be logical for a co-operative specialisation of effort to develop between the two institutions and arrangements towards this end have already been effected. The Research Unit will develop in greater detail matters relating to the primary sector and work in the Unit has already started on the production of a set of disaggregated interindustry accounts for this sector.

We should like to acknowledge the help we have received from graduate students at Lincoln, with whom this research has frequently been discussed in seminars. A valuable discussion was also held with Colin Gillion of the N.Z. Institute of Economic Research, and we are also indebted to the officers of the New Zealand Department of Statistics for the help they have given us.

Lincoln College,
February 1968

B.P. Philpott
I. INTRODUCTION

This paper has been written to introduce a series of reports forthcoming over the next year embodying the results of research we have been conducting for some time on the structure of the New Zealand economy.

Perhaps we should first define what we mean by "structure" and explain why we think it is an important subject for investigation by economists. We mean by "structure" the relative importance in the economy of different economic activities and variables; the proportions of the labour force employed in different industries, the proportions of the national income earned by different sectors of the economy, and similar variables. One of the most significant aspects of the structure of the New Zealand economy, and one in which we are particularly interested, is the relative importance of the exporting industries compared with the industries involved in the production of import substitutes. Since the major proportion of our exports comes from primary production, this aspect of the economy's structure is really a matter of the place of primary production in the New Zealand economy.

We are interested not so much in the structure of the economy as it is at present - though this provides a useful starting point to our work - but in the form it might have in years to come. As economists we are most interested in exploring the implications of the "best" structure for the economy, but it should be remembered that what constitutes the best may vary according to individual points of view. In our opinion the optimum economic structure is that in which the resources of the country are so allocated between sectors that the highest level of net national product per head is
achieved, consistent with the maintenance of overseas balance of payments equilibrium, full employment and a reasonable growth in incomes per head. In other words, we are concerned with projections of the economy into the future, and particularly with those projections which appear to satisfy the objectives set out above.

Such detailed quantitative analysis of the future structure of the economy is very important, if only because of the countless arguments as to the relative parts primary production and manufacturing industry have to play in the economic growth of the nation. In many cases these arguments are quite sterile, since what is really important is to ensure that there is encouragement of rapid growth in economically efficient industries, regardless of the particular sector of the economy in which they happen to lie.

Be that as it may, the fact is that a number of arguments, or in many cases impressions, about the need to change the structure of the New Zealand economy have led to final expression in economic policies such as import control, which have had, and will continue to have, profound effects on the nature of our economy and the achievement of our economic objectives.

It is most important that the validity of these policies be examined critically and quantitatively, and such an examination will be one of the products of the research which we have been conducting. As the results of our research programme are published, it should quickly become obvious whether current policies are likely to push the economy in the right direction.

Our general purpose in this introductory report is to accent questions of methodology such as:-

- the correct way to think about the problem of the best structure for the economy in the future;
- the most appropriate way of quantifying the problem;
- what information we need to quantify the problem and how this information should be put together to yield valid answers to our questions.
These matters will receive detailed attention in the further reports which will follow in this series, our aim here being only to give an introductory bird's-eye view of the whole question.

In the next section we present and discuss a simple condensed picture of the New Zealand economy in 1964/65 in the form of a set of inter-industry tables, the nature of which is then discussed.

This picture of the economy allows us to discuss New Zealand's structural problem in rather more detail in Section III, and in particular it helps to illustrate how we should think about the optimum economic structure.

After an example giving an outline projection of the New Zealand economy in 1975 in Section V, we conclude in the last section with a list of the further relationships and data required to turn such an outline into something more realistic and useful. Subsequent reports in a series under the general heading of "Studies in the Structural Development of the New Zealand Economy" will contain the results of research aimed at refining our inter-industry models to the stage where they will be useful tools in the hands of policy makers.
II. THE STRUCTURE OF THE NEW ZEALAND ECONOMY IN 1965

The best way of looking at the structure of the economy is by means of a table of interindustry transactions or an input output table. In Table 1 we present a condensed three-sector version of such an interindustry table for 1965.1

In an interindustry table the economy is divided into industries or sectors according to the type of output produced or input used. The transactions of each sector are presented in a row and a column, the row showing the disposal of the sector's output while the column indicates the sources of all the inputs used by the sector.

In Table 1, for the purposes of illustration, we have grouped the industries of New Zealand into three sectors, viz, primary, secondary and tertiary, the content of which is as follows:

Primary  - Farming, Forestry and Logging, Hunting & Fishing, Mining and Primary Produce Processing (freezing works and dairy companies)

Secondary - All Manufacturing industries not engaged in the processing of meat and dairy products, Building and Construction.

1 The figures given in this table have been condensed from a 15 sector table for 1964/65 to be published together with details on sources and methods in the next report in this series "New Zealand Interindustry Relationships in 1964/65". A much more detailed 110 sector table has been recently published by the Government Statistician for the year 1959/60. See Interindustry Study of the New Zealand Economy 1959/60, Department of Statistics, Wellington.
Tertiary - Electricity & Gas production, Transport & Communication, Wholesale and Retail Trade, Banking and insurance, services and ownership of property.

In addition to rows and columns for each productive sector, there are rows recording the payments for the primary factors of production employed - wages and salaries, other value added (which includes profits and interest), depreciation (i.e. an allowance for the consumption of capital) and imports - and the amount of indirect tax paid and subsidies received since our measurements are at market prices; and there are columns for the payments made by the final buyers of the goods and services produced (consumption by households, Government current expenditure, exports, the purchase of capital goods, and changes in stocks. The capital formation column records the value of capital goods, such as buildings and machinery, produced by each sector, but it does not show which sector has bought them. Taken together, the columns recording the purchases by final buyers show the total final demand for the products of each sector.

Thus each column shows in total the sources of all the inputs (including those purchased from other industries called intermediate purchases) used by each sector in producing its output over the course of the year. And the rows show the total disposal of the output of each sector divided into the sales to each other sector and the sales to consumers, government, exports etc.

1 Using the sector numbers as given in the Government Statistician's 110 sector Table (Inter-Industry Study of the New Zealand Economy 1959/60, op.cit.) the aggregations are:
- Primary - Sectors 1-6, 8 and 9
- Secondary - Sectors 7, 10-97
- Tertiary - Sectors 98-110
### TABLE 1 - Current Inter-Industry Transactions 1964-65

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Total Intermediate Sales</th>
<th>Household</th>
<th>Government</th>
<th>Purchases</th>
<th>Exports</th>
<th>Stock Changes</th>
<th>Fixed Capital Formation</th>
<th>Total Final Demand</th>
<th>Total Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary</strong></td>
<td>779</td>
<td>109</td>
<td>40</td>
<td>928</td>
<td>218</td>
<td>16</td>
<td>642</td>
<td>40</td>
<td>7</td>
<td>674</td>
<td>923</td>
<td>1851</td>
</tr>
<tr>
<td><strong>Secondary</strong></td>
<td>150</td>
<td>524</td>
<td>246</td>
<td>920</td>
<td>658</td>
<td>78</td>
<td>49</td>
<td>18</td>
<td>658</td>
<td>78</td>
<td>1477</td>
<td>2397</td>
</tr>
<tr>
<td><strong>Tertiary</strong></td>
<td>156</td>
<td>318</td>
<td>474</td>
<td>948</td>
<td>1205</td>
<td>308</td>
<td>118</td>
<td>26</td>
<td>97</td>
<td>65</td>
<td>1754</td>
<td>2702</td>
</tr>
<tr>
<td><strong>Total Inter-</strong></td>
<td>1085</td>
<td>951</td>
<td>760</td>
<td>2796</td>
<td>2081</td>
<td>402</td>
<td>809</td>
<td>84</td>
<td>778</td>
<td>4154</td>
<td>6950</td>
<td></td>
</tr>
<tr>
<td><strong>mediate</strong></td>
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</tr>
<tr>
<td><strong>Purchases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wages &amp;</strong></td>
<td>201</td>
<td>622</td>
<td>965</td>
<td>1788</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1788</td>
</tr>
<tr>
<td><strong>Salaries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Value</strong></td>
<td>432</td>
<td>309</td>
<td>636</td>
<td>1377</td>
<td>-</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>1393</td>
</tr>
<tr>
<td><strong>Added</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Indirect</strong></td>
<td>30</td>
<td>111</td>
<td>137</td>
<td>278</td>
<td>52</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>62</td>
<td>340</td>
</tr>
<tr>
<td><strong>Tax</strong></td>
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</tr>
<tr>
<td><strong>Subsidies</strong></td>
<td>-23</td>
<td>-12</td>
<td>-3</td>
<td>-38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-38</td>
</tr>
<tr>
<td><strong>Imports</strong></td>
<td>51</td>
<td>349</td>
<td>55</td>
<td>455</td>
<td>151</td>
<td>37</td>
<td>-</td>
<td>-</td>
<td>149</td>
<td>-</td>
<td>337</td>
<td>792</td>
</tr>
<tr>
<td><strong>Depr'n.</strong></td>
<td>75</td>
<td>68</td>
<td>151</td>
<td>294</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>294</td>
</tr>
<tr>
<td><strong>Total Prim-</strong></td>
<td>766</td>
<td>1447</td>
<td>1941</td>
<td>4154</td>
<td>203</td>
<td>57</td>
<td>1</td>
<td>-</td>
<td>154</td>
<td>-</td>
<td>415</td>
<td>4569</td>
</tr>
<tr>
<td><strong>ary Inputs</strong></td>
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<td></td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>1851</td>
<td>2398</td>
<td>2701</td>
<td>6950</td>
<td>2284</td>
<td>459</td>
<td>810</td>
<td>84</td>
<td>932</td>
<td>-</td>
<td>4569</td>
<td>11519</td>
</tr>
<tr>
<td><strong>Labour Force</strong></td>
<td></td>
<td></td>
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<tr>
<td>'000</td>
<td>161.7</td>
<td>316.7</td>
<td>489.1</td>
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<tr>
<td><strong>Est.Real</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Capital in</strong></td>
<td>4300</td>
<td>1800</td>
<td>5800</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td><strong>'64-65</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Prices($mn)</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Though it is not necessary for the normal use of an input output table, we have included at the foot of the table our estimates of the value in 1964/65 prices of the real capital employed in each sector and the labour force engaged.

The table thus gives a complete picture of the current-account flows of goods and services in the economy divided into the payments for use of primary inputs or factors of production; the sales of goods and services to the final purchasers; and the sales and purchases (or interindustry transactions) between each sector.

For example in Table 1, the column for the Primary Sector presents the following information. In 1964/65 this sector used a labour force of 161,700 and employed real capital, the replacement value of which, in 1964/65 prices, was $4,300 mn.

In the process of producing its output the sector paid $201 mn. for the labour employed; paid $51 mn., for imports; allowed $75 mn. for depreciation on the capital employed; and earned, as a residual, profits and interest equal to $432 mn.

The items in the upper part of the column indicate that to produce its output the sector purchased goods and services from other sectors amounting to $779 mn. from primary industry, 2

1 By real capital we mean capital valued at its replacement cost in 1964/65 rather than in current balance sheet values which represent historical cost.

2 Purchases and sales by primary industry to itself result largely from the amalgamation of individual industries into this sector. Thus farmers producing store stock sell these products to those producing fat stock and the whole farming industry sells to the primary produce processing industry. A similar situation applies to the secondary and tertiary sectors, and accounts for the quite considerable amount of intra-sector sales and purchases. These could quite easily have been netted out of the table but are left in to give the greatest possible amount of information.
$150 mn. from the secondary sector and $156 mn. from tertiary sector.

The column for the Primary Sector thus gives a complete statement of the purchases made by the sector in order to produce its output, or, alternatively, it can be regarded as a statement showing the disposal by way of current account payments of its current account receipts. ¹

Similarly, the row entries for the Primary Sector show the sales of the sector. Reading along the row $779 mn. was sold to itself, $109 mn. to the secondary sector and $40 mn. to the tertiary sector. Consumers bought $218 mn. of its output; $16 mn. was sold to the Government; $642 mn. was exported; $7 mn. was sold "to capital", i.e. to persons and firms who were adding to their stock of physical productive assets and $40 mn. worth of primary products were added to stocks held in the country.

The total of the row represents the value of total output from the sector and, since profits are included in the input column for the sector, it necessarily equals the total value of inputs, i.e. the column total. The situation is complicated slightly by the fact that prices paid by final customers for some goods are increased by indirect taxes, while the prices of others are reduced by subsidies. Allowance is made for these prices effects by including indirect taxes and subsidies in primary inputs. Total outputs and total inputs are thus increased or reduced by the same amount and equality between them is preserved.

¹ To give a complete picture of the sectors' disposal of funds both on current and capital account, would require a "flow of funds table" showing in detail the disposition of the profits and depreciation allowances as between consumption spending and acquisition of financial or physical assets.
Not all the goods and services bought by final customers are produced or processed within the economy, and the lower right-hand quadrant of the table records direct imports from abroad by Households of $151 mn., by Government of $37 mn., and of finished capital goods of $149 mn.

The totals of the particular rows, which show payments to factors of production (or primary inputs), make up the gross national income or gross national product at factor cost, and when account is taken of indirect taxes and subsidies, gross national product at market prices is obtained. The national product estimates are built up as follows:

<table>
<thead>
<tr>
<th></th>
<th>$mn.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages and Salaries</td>
<td>1788</td>
</tr>
<tr>
<td>Other Value Added (rents, interest and profits)</td>
<td>1393</td>
</tr>
<tr>
<td>Depreciation</td>
<td>294</td>
</tr>
<tr>
<td><strong>Gross National Income and Product</strong></td>
<td></td>
</tr>
<tr>
<td>at Factor Cost</td>
<td>3475</td>
</tr>
<tr>
<td>Indirect Taxes</td>
<td>340</td>
</tr>
<tr>
<td>Subsidies</td>
<td>-38</td>
</tr>
<tr>
<td><strong>Gross National Income and Product</strong></td>
<td></td>
</tr>
<tr>
<td>at Market Prices</td>
<td>3777</td>
</tr>
</tbody>
</table>

Similarly the totals of the columns showing final demand make up the national expenditure which in 1964-65, as estimated in our table\(^1\) totalled $3,777 mn.,\(^2\) divided into:

\(^1\) Estimates made from our table, and from the Statistics Dept., table for 1959-60, exceed the official estimates of national income and expenditure owing to different estimates of some components, notably the rental value of owner-occupied houses and depreciation.

\(^2\) National expenditure at $3,777 mn. is equal, as a social accounting identity, to national income given above. An alternative and possibly more enlightening social accounting identity is:

\[
\begin{align*}
\text{Gross National Product} & = 3777 \\
+ \text{Imports} & = 792 \\
i.e. \text{Total Supplies of Goods & Services} & = 4569 \\
= \text{Gross Domestic Expenditure} & = 3759 \\
+ \text{Exports} & = 810 \\
i.e. \text{Total Expenditure on Goods & Services} & = 4569
\end{align*}
\]
The total payments to factors of production in each sector represent the contribution of that sector to gross national income or product. Subtraction of depreciation gives the net contribution. Thus factor payments measure the importance of the sector to the economy, and division by the number of persons employed gives the product per head or labour productivity of the sector.

**Capital Account Transactions**

The interindustry table, as so far described, is solely concerned with current account transactions involving the sale and purchase of goods and services to be used within the time period covered by the table (usually a year), together with the sale of capital goods which form part of the current output of the industries which produce them. The purchases of these capital goods are not, however, shown by sector but are aggregated into the one column designated gross capital formation. Additional information is therefore required to indicate which industries purchased the capital goods produced and sold over the year, and this additional information is provided by a second table giving "Interindustry Transactions on Capital Account". The relevant figures for the three sector summary of the New Zealand economy in 1964/65 are given in Table 2.

The Capital Account table is similar in construction to the Current Account table and shows across the rows the disposal, by sectors, of the output of capital goods produced by each sector. The right hand column of the capital table

<table>
<thead>
<tr>
<th></th>
<th>$mn.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Expenditure</td>
<td>2284</td>
</tr>
<tr>
<td>Government Current Expenditure</td>
<td>459</td>
</tr>
<tr>
<td>Gross Capital Formation</td>
<td>1016</td>
</tr>
<tr>
<td>Exports less Imports</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total - Gross National Expenditure</strong></td>
<td>3777</td>
</tr>
</tbody>
</table>
showing the total output of capital goods by each sector, is identical to the column showing the sale of capital goods (gross capital formation) in the current interindustry table.

### TABLE 2  Capital Account Transactions 1964-65

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>6.4</td>
<td>-</td>
<td>.4</td>
<td>7</td>
</tr>
<tr>
<td>Secondary</td>
<td>84.7</td>
<td>86.7</td>
<td>503.0</td>
<td>674</td>
</tr>
<tr>
<td>Tertiary</td>
<td>25.4</td>
<td>26.4</td>
<td>45.0</td>
<td>97</td>
</tr>
<tr>
<td>Indirect Tax</td>
<td>.6</td>
<td>1.4</td>
<td>3.0</td>
<td>5</td>
</tr>
<tr>
<td>Imports</td>
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<td>41.4</td>
<td>85.6</td>
<td>149</td>
</tr>
<tr>
<td>Total</td>
<td>139.5</td>
<td>155.9</td>
<td>637.0</td>
<td>932</td>
</tr>
</tbody>
</table>

**Input-Output Coefficients**

The two tables so far described give a detailed picture of the economy's production and structure, and for this alone they are useful and interesting, but our main concern is to examine the effects of changes in output and consumption, and this requires further information in the form of input-output coefficients. These coefficients show the value of each input (both primary inputs and purchases from other sectors) required per unit of output of each sector. They are calculated quite simply from the current transactions table, by dividing each entry in each column, i.e. the inputs, by the total output for the relevant column.

The set of Input-Output Coefficients for 1964-65 is shown in Table 3.
In order to produce its output, each sector has to purchase inputs from other sectors, and Table 3 shows the relative importance of these purchases. For example, in the production of $1's worth of output the primary sector purchases goods or services to the value of $0.420854 from itself, $0.081037 from the secondary sector, $0.084279 from the tertiary sector and $0.413830's worth of primary inputs.

If these coefficients are assumed to remain constant for different levels of output and for different time periods, they can be used to estimate the effect on all sectors of a change in the output of one sector. In practice they are unlikely to remain unchanged and this assumption will be discussed in the last section of this report and will be the subject of further examination in a subsequent report.

**Direct and Indirect Demands**

Because of the interdependence of sectors in the economy as shown by the input-output coefficients, a change in the final demand for the output of one sector leads, in addition to a direct increase in the output of that sector, to indirect increases in the output of all other sectors upon which it is dependent for inputs.
For example it can be shown\(^1\) that if the final demand for the output of the primary sector were to rise by say 50\(^2\) from $923 mn. to $1385 mn., increases in output of the following magnitude would be required from each of the three sectors:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Original Output</th>
<th>Output following 50% increase in Final Demand</th>
<th>Increase in Output for Primary Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>1851</td>
<td>2659</td>
<td>+ 808</td>
</tr>
<tr>
<td>Secondary</td>
<td>2397</td>
<td>2491</td>
<td>+ 94</td>
</tr>
<tr>
<td>Tertiary</td>
<td>2702</td>
<td>2800</td>
<td>+ 98</td>
</tr>
</tbody>
</table>

From this table we see that the planned increase of $462 mn. in final demand for the products of one sector (50% rise in final demand for primary sector output) has led to an increase of $808 mn. in the output of that sector and $94 mn. and $98 mn. from the secondary and tertiary sectors respectively, a total of $1000 mn. The increased output, over and above that directly resulting from the change in final demand of $462 mn., is called the indirect output and, in this instance, amounts to $538 mn., i.e. $1000 mn. - $462 mn.\(^3\)

\(^1\) The detailed calculations and method will appear in the second report in this series.

\(^2\) This is roughly equivalent to a rise of 4 per cent per annum compounded over 10 years - i.e. the agricultural growth target of the Agricultural Development Conference.

\(^3\) It should be noted that the resulting increase in total output, both direct and indirect, is far greater than the increase in national income because double counting is involved in the estimation of gross outputs. In fact, the increase in national income is exactly equal to the increase in final demand.
The nature and magnitude of these indirect demands springs from the interdependence of the sectors, and the cumulative chain reaction or feed-back effect which is set up throughout the economy when there is a change in the requirements of output from any one sector. These indirect effects can be measured and analysed precisely by further sets of mathematical relationships but these will be explored in subsequent reports. Our purpose here is simply to point out their importance in the context of analysing changes in economic structure to which we turn in the next section.
III. THE OPTIMUM ECONOMIC STRUCTURE IN 1965

Given the statistical picture of the economy inherent in interindustry tables and input-output coefficients, we may now proceed to ask questions about the best, or optimum structure of the economy. In this section we discuss such questions in relation to the year 1965, reserving for the next section the more important question of the future. Our concern throughout is not to give precise quantitative conclusions as to what is the optimum structure (since this forms the content of subsequent reports); but rather to discuss briefly the correct way of thinking about the question, particularly in the interindustry content.

Looking back on 1965 we can take as given the labour force and stock of capital in that year, together with the amount of resources available for investment, from domestic saving and overseas borrowing. As stated earlier, we consider the optimum economic structure to be that in which these resources are so allocated between sectors that the highest level of net national product per head is achieved, consistent with the maintenance of overseas balance of payments equilibrium, full employment and a reasonable growth in incomes per head.

In the full-scale examination of this matter which will occupy us in later reports, the question of the optimum structure is concerned with the relative place in the economy of each of the many sectors into which it can be divided, or indeed of each industry or sub-sector. But at the simplified three sector level, which we are using here for purposes of exposition, we have chosen to restrict the discussion to an examination of the relative places in the economy of the primary and secondary sectors. These two sectors represent alternative and competing methods of increasing real income per head. They are alternative methods because, in general, local manufacturing represents a method of providing goods which could otherwise be obtained as imports, paid for by primary exports. They are competing methods because clearly resources used in one sector cannot be used in another.
We can use the interindustry table presented earlier as a means of thinking about the optimum structure by regarding the table as a type of national budget. A well run business firm has a budget, setting out the disposition of its labour force and capital assets, which it can then use to enquire whether sales and profit can be increased by switching men and machines from one department to another or from producing one product to another, while still remaining solvent. An interindustry table, thought of as a national budget, can be used in a similar way to ask whether real national income would be increased if there were a rearrangement of resources as between sectors, while still ensuring that all resources are fully employed and that there is national solvency, i.e. overseas balance of payments equilibrium.

For example, we could ask what would be the effect on the structure of the economy and on the level of real national income per head, if say $100 million of real capital employed in the secondary sector in 1965 were instead to be transferred to the primary sector or vice versa? Of course such a question is by its very nature unrealistic, since capital now invested in one sector is specific in form and it could not be immediately transmuted into a form suitable for employment in another. Such a transfer would take many years. A similar argument applies to labour specifically trained for employment in one sector.

However, we can rephrase our question more realistically by asking what would have happened if $100 million of real capital invested in one sector in the last decade had instead been invested in another sector. For the purposes of argument only, we ask the question with respect to $100 million invested in the primary sector instead of the secondary sector.

Using the interindustry table we could carry out a set of calculations as to the effect on output and the economic structure in 1965, i.e. comparing what might have been with what is.¹

¹ An alternative approach to this question is discussed in B.P. Philpott's "Economic Policy and the Best Use of our Resources", Canterbury Chamber of Commerce Economic Bulletin No.419, 1959. Here the approach ignores the interindustry relationships and thus, while it is simpler, is less comprehensive and less meaningful.
The following would be the steps involved:

(i) The output of the secondary sector would be lower by an amount indicated by its capital-output coefficient multiplied by $100 million.

(ii) The use of the $100 million of capital switched from secondary sector would have led to a rise in primary sector output by an amount indicated by the output capital coefficient in that sector multiplied by $100 million.

(iii) The secondary labour force would be lower by an amount equal to the output labour coefficient in that sector multiplied by the fall in output as in (i) above.

(iv) Some proportion of the labour force not employed in sector industry, as in (iii) above, would instead have been used in the primary sector, the amount being indicated by the output-labour coefficient in the primary sector multiplied by the change in output from (ii) above.

(v) Exports of primary sector products would be higher by an amount equal to the increased output in this sector. Imports of raw materials for secondary sector would have fallen by an amount indicated by the output-import coefficient in the secondary sector, and imports of finished goods for consumption, equal in value, would have risen.

(vi) As discussed on page 12 of Section II, we would also have to take account, over and above the foregoing direct effects, of a number of indirect effects for the analysis of which we would require to use the input-output coefficients. These indirect effects would lead to further changes in the levels of output, exports, imports, employment etc.
(vii) The final overall effect on national income of the imaginary changed economic structure could then be calculated and compared with that achieved under the existing structure. The major change in the imaginary structure would be a greater flow directly into the hands of consumers of imported finished goods and a smaller flow of imported raw materials via the secondary sector. Whether or not the new flow of goods would be larger or smaller than the old would depend, not only on the calculations listed above, but also on the price at which imported finished goods can be purchased from the proceeds of the extra exports compared with the price at which they are produced by local manufacturers. To ensure that our calculations do lead to results in real and not money terms, it would be necessary to value the fall in secondary output at comparable import prices.

The change in real national income would show up in two ways. Firstly it would show as an increase or decrease in the gross outputs of sectors. Since the total amount of labour is unchanged, the value added, or net income per head, would increase (without anything further having to be allowed for capital since this too is unchanged). Secondly, it would show in an increase or decrease in the totals of the final expenditure columns of the table - consumption plus Investment plus Government Expenditure which together equal national expenditure and therefore national product.

(viii) Next, account must be taken of the full employment and balance of payments constraints. The total labour requirements of the expanded primary sector plus the indirect labour effects (mentioned in (iv) above), may be greater or smaller than the labour not now employed in the secondary sector. In any case it is unlikely to be exactly equal to it and our condition of full employment (neither unemployment nor labour shortages) is unlikely to be satisfied. Similarly it is possible that the imaginary structure, after all effects, direct and indirect, have been taken into account, would yield an overseas balance of payments deficit which again is
inconsistent with our conditions for an optimum. Whatever increases in per capita real income are yielded by the changed structure, it cannot be regarded as feasible, let alone optimum, if it does not ensure an overseas balance of payments equilibrium and full employment of labour.

This simply means that in such cases we would have to measure the effect of alternative types of structural change by "juggling around" or using "cut and thrust" methods to see if a changed structure can be found which does produce higher real income and equilibrium in the balance of payments and the labour market. A more sophisticated approach, which we shall adopt, is to use mathematical programming in which these and other restraints are imposed on the solution. A description of these methods, and the results to which they lead, will form the subject of a further report in this series.

In the foregoing discussion of the analysis of changes in economic structure using the interindustry approach, we have stressed that the criterion to be adopted in deciding whether a change would have been desirable is whether or not it would have raised real income per head subject to the maintenance of equilibrium in overseas balance of payments and to the maintenance of full employment.

Too often, the popular arguments used in support of structural changes (usually in favour of increased development of manufacturing industry), turn out to be fallacious because they use the wrong criteria.

Thus the "import saving" argument in favour of increased local manufacturing, adopts the requirements of the overseas balance of payments as a criterion (instead of real income),

1 A fuller, and more thorough-going critical discussion of the popular arguments in connection with structural change will be found in B.P. Philpott "Productivity, Planning and the Price Mechanism in New Zealand Manufacturing Industry", A.E.R.U. Publication No. 36.
whereas in the exposition above, the balance of payments is a restraint. It is easy to see from the interindustry model that in analysing the effects of a new industry, allowance must first be made for the capital and labour it requires and what this capital and labour produce or contribute to national income compared with other uses; and, probably most important, what indirect effects on other industries and on the level of imports accrue as a result of the structural change. These indirect effects can, as we have shown, be very substantial and if they are ignored there is a danger that the direct savings in imports which a new industry makes is almost cancelled out by the indirect increases in imports and that, in addition, the real income of the nation has been reduced so that the whole operation has had a deleterious effect.

A similar case can be made against another, frequently used, argument for industrialisation, viz, the provision of employment. Here again there is a danger that indirect demands for labour are ignored but, above all, that the basic criterion - the effect on per capita real national income - is ignored to the country's detriment.

This is not to say that there are not good economic arguments for industrialisation in New Zealand. But they do not necessarily include the arguments given above.

There are however two important further arguments which have not been allowed for in our discussion and which are worthy of separate treatment since they bear on the whole question of the methodology of input-output models - in particular on the assumption of simple linear relationships between inputs and outputs. This may not apply because of diminishing or increasing returns.

In the first place there may be diminishing returns to capital and labour employed in primary industry - or expressed in another way, increasing requirements of capital and/or labour per unit of output. Or again, secondary industry may be subject to increasing returns, i.e. falling requirements of labour and capital per unit of output. Allowance for these conditions (if they exist) in our analysis could lead to a different conclusion about the optimum economic structure.
Secondly, there is a similar question of diminishing returns in exporting due to lower prices caused by increased primary exports. Again allowance for this (if it exists) would lead to a different final answer.

These two matters will be raised again in the last section of this paper.

This discussion of the imaginary optimum economic structure in 1964/65 is of course, as we pointed out, purely academic, and has been used for expository purposes only. Even if it were found that a higher level of real income could have been achieved with a radical change in economic structure involving considerable reallocation of the fixed supplies of labour and capital available, nothing much can be done about it since bygones are bygones.

Much more relevance and importance attaches to the analysis of the future, in which we are not so much concerned with the allocation of the present level of resources, but with the allocation of the annual flow of new resources of labour and capital from savings, available over the decade ahead.

We therefore turn, in the next section, to the question of the optimum economic structure in 1975.
IV. THE OPTIMUM ECONOMIC STRUCTURE IN 1975

In this section we are concerned with the question of using an interindustry table or national business budget to answer questions about the future structure of the economy. There are a number of increasingly complex ways of going about this - here we deal, for purposes of exposition, with the simplest method.

In this case we take, as a starting assumption, a growth target for the New Zealand economy of 4 per cent per annum compound in consumption and Government expenditure combined. And we then use the 1965 interindustry table and coefficients to answer the following questions:

(1) What would the New Zealand economy look like in 1975 if this growth target were attained, and patterns of consumption unchanged?

(2) Is the 1975 projection feasible?

(3) Is the 1975 projection optimal?

(4) How sensitive is the projected structure to changes in our basic assumptions?

(5) What policies are required to attain the optimal structure?

(1) The Projection of the 1975 Structure

Our first step is to provide a projection, for 1975, of the structure of the economy, assuming consumption and government expenditure grow at 4 per cent per annum, and that we have roughly the same balance of economic activities as at present. The steps in this procedure (which are illustrated by an example in the next section) are as follows:
(a) We take the 1965 interindustry accounts as a starting point and recalculate the figures in the columns in final demand section for consumption and government expenditure, assuming each grows for 10 years at 4 per cent per annum.\footnote{i.e. at this stage, we assume the proportions of government and consumption expenditure on each sector's product remains the same as in 1975.}

(b) The new 1975 levels of final demand, calculated in (a), immediately imply new levels of output required directly from each sector, and indirectly from each sector, via the input-output coefficients.

(c) The new levels of demand as in (a) and output calculated in (b), require new levels of imports which can be calculated via the 1965 import coefficients.

(d) The new levels of imports require, for their payment, new levels of exports which in turn, via the interindustry table, impose further direct and indirect requirements of output from each sector.

(e) The new levels of output in each sector, springing from (a) to (d) above, require new levels of capital in each sector and therefore a new level of annual gross investment in 1975 if this stock of capital is to be growing at the rate required. In addition allowance must be made for the gross investment required to replace those assets in the 1965 stock of capital which will fall due for replacement around 1975.

These new requirements for capital imply a set of different figures in the final demand column for gross investment and again, via the set of input output coefficients, new levels of output in each sector.
At this stage we must return to step (c) and work through the process again, and yet again, in a series of iterations which finally converge to an equilibrium solution which must contain the following elements:

(i) The value of exports plus foreign borrowing must equal the value of imports required to pass directly into consumption and indirectly to satisfy sector demands.

(ii) The stock of capital must be sufficient to produce the output required for the new higher level of consumption and government expenditure.

(iii) The level of gross investment must be sufficient to increase the stock of capital over the year 1975 by sufficient to provide a further 4 per cent increase in consumption in 1976, and also to replace capital installed in earlier years and now due for replacement in 1975.

(iv) The level of sector outputs as determined by the interindustry table and input-output coefficients must be sufficient to satisfy (i) and (iii) above.

As a result of these calculations we finish up with a new table with new entries in all the final demand columns (all springing from the original increases in the consumption and government expenditure column), with new figures in all other columns of the table and therefore a picture of the changed structure of the economy compared with 1965.

An example of a provisional projection using this approach is given in the next section.

The next question we must ask is:

(2) Is the Projected 1975 Structure Feasible?

By this we mean:
(a) Can we sell the new required level of exports, at 1965 prices, or will the very effect of trying to sell more, simply force down the price and so, if anything, either increase the export volume required or increase the amount of overseas borrowing needed? The answer to this requires research on export price projections which we will mention again later.

(b) Is the level of income achieved in 1975 sufficient to provide the savings required for the projected rate of gross investment in that year?

(c) Is the labour force required (calculated simply by applying the 1965 labour coefficients to the new 1975 levels of sector outputs) more or less than that which is likely to be available with the present projected population and labour force growth rates?

Our third question is:-

(3) Is the Projected 1975 Structure an Optimal One?

Or can it be improved in any way? Again, as in the previous section where we examined the 1964/65 structure, we assume that the criterion of an optimum structure is maximum real income per capita - again subject to the restrictions of:

(a) Overseas Balance of Payments Equilibrium.

(b) Full Employment of Labour.

In addition we have a third restriction resulting from the fact that we are now dealing with the picture of a growing economy rather than with a picture at one point in time like 1964/65:

(c) The voluntary savings, given the level of income achieved, must equal the level of annual investment required in 1975.
To investigate whether the projected 1975 structure is optimal, in the sense denoted above, requires again, manipulation of the model by "cut and thrust methods" to see if any projections, based on alternative growth patterns, yield higher projected real income per capita in 1975 than the one we have adopted. For example we may choose to ask what would the projection of the New Zealand economy in 1975 look like, if, instead of assuming a continuation of the 1965 structure over the next decade\(^1\) (as we have implicitly assumed in the previous discussion, and in the example in the next section), we assume a radical change in the structure of the economy with static levels of primary production and exports and a greatly expanded manufactured export sector?

Again, as with the static case previously discussed, the most efficient method of investigating the nature of an optimum structure in 1975 is by the use of mathematical programming methods; but whatever methods are used the important thing is to establish what is the optimal structure and then by conscious policy changes, to try to move the economy towards it.

(4) **How Sensitive is the 1975 Optimum Projection to the Assumptions on which it is Based?**

The projection of future optimum economic developments is only as good as the validity of the assumptions on which it is based. In the first place there is the question of the validity of using the 1965 interindustry table and input-output coefficients as a base for projections into the future. Furthermore, the optimum structure of the economy in 1975 will depend very much on what we assume about the future of New Zealand's agricultural terms of trade. There are, apart from these, a host of other explicit and implicit assumptions, and the nature of the optimum structure

\(^1\) This is the assumption which has been made in the formulation of recent development plans for New Zealand as stated in the various reports of the "Agricultural Development Conference".
of the economy will be particularly sensitive to changes in some of these assumptions but not in others. An important task therefore is to examine the effects on the optimum structure of changes in the assumptions, i.e. its sensitivity to such changes.

It may be for example that some assumptions, e.g. the stability of the 1965 input-output coefficients throughout the next decade, can be amended quite substantially without this markedly changing the nature of the 1975 optimum structure; while other assumptions, such as for example changes in the terms of trade, turn out to be quite critical in changing the optimum from one particular type of structure to another.

The results of such a sensitivity analysis, are likely to suggest those types of data and those particular assumptions on which intensive research is required to ensure the utmost accuracy and those for which it is possible to be rather more cavalier in one's approach without, in the event, affecting substantially the nature of the optimum solution being sought.

(5) **Projections, Planning & Policy**

The detailed examination of the optimal structure of the economy in the future, along the lines outlined above, is a fundamental and basic exercise in the development of a national indicative economic plan. Such a plan is not a forecast of the economy in the future, but a blueprint of what the economy could look like in the decade ahead - a national budget setting out what is feasible, consistent and optimal for the structure of the economy, given our present state of knowledge. Economic policies can then be formulated to shift the economy in the direction indicated as desirable by such a blueprint. Undoubtedly such planning blueprints, and policies based on them, will need continual amendment and revision as the future unfolds itself, revealing the need for fresh assumptions and providing opportunities for the use of more up-to-date and accurate data. Such revisions do not vitiate the usefulness of national economic plans any more than the continual revision of business budgets and business policies vitiate the need for and usefulness of business planning.
It is not our purpose to discuss here the particular types of economic policies which can be used to shift the structure of the economy towards the indicated optimum. But whether these policies take the form of direct administrative intervention and control such as is implied by import licensing; or the use of a flat tariff and subsidy as adjuncts to the price mechanism; or whether other types of policy are used, continual reference to the inter-industry model is essential to decide, on the one hand, the sorts of import substitute industries which should be granted protection by import control; or on the other hand the appropriate level of the flat tariff on imports.
V. AN EXAMPLE PROJECTION OF THE NEW ZEALAND ECONOMY IN 1975

In this section we give an example, based on the simple three sector table presented earlier, of an outline projection of the structure of the New Zealand economy in 1975. No attempt is made to explore the optimum structure of the economy. Nor are we concerned with trying to forecast the structure of the economy. Our aim is simply to present a picture of what the economy would look like in 1975, if, over the previous decade, it had been growing at 4 per cent per annum and was continuing to grow at that rate.

For ease of exposition, we have chosen to express the 4 per cent growth rate as applicable to the total of household Consumption plus Government current expenditure, rather than to gross national product as such. Moreover, we have assumed that no attempt is made to change the present structure of the economy so that most of the increased exports are assumed to come, as at present, from the primary sector, or more precisely we have assumed that for every $100 of increased exports the "mix" of primary, secondary and tertiary exports is the same as in the base year 1964/65.

Even though our example is presented for expository purposes only, the assumptions do correspond very broadly to those underlying the Agricultural Development Conference's target of 4 per cent growth in the economy1 and the results ought to give some indication of the implications for the rest of the economy of the increased growth rate of agricultural production.

In Table 5 we repeat the 1964/65 Three Sector Inter-industry Table and then follow through arithmetically the calculations required in the projection process which have already been described on pages 22-24 of Section IV.

1 Though it should be noted that the Agricultural Development Conference target was for 4 per cent growth in gross national product, while here it is the sum of consumption and government current expenditure.
<table>
<thead>
<tr>
<th>$mn</th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Total Intermediate Sales</th>
<th>Total Hsehld Exports</th>
<th>Total Exports</th>
<th>Stock Changes</th>
<th>Capital Formation</th>
<th>Total Final Buyers</th>
<th>Total Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>779</td>
<td>109</td>
<td>40</td>
<td>928</td>
<td>234</td>
<td>642</td>
<td>40</td>
<td>7</td>
<td>923</td>
<td>1851</td>
</tr>
<tr>
<td>Secondary</td>
<td>150</td>
<td>524</td>
<td>246</td>
<td>920</td>
<td>736</td>
<td>49</td>
<td>18</td>
<td>674</td>
<td>1477</td>
<td>2397</td>
</tr>
<tr>
<td>Tertiary</td>
<td>156</td>
<td>318</td>
<td>474</td>
<td>948</td>
<td>1513</td>
<td>118</td>
<td>26</td>
<td>97</td>
<td>1754</td>
<td>2702</td>
</tr>
<tr>
<td>Total Intermediate</td>
<td>1085</td>
<td>951</td>
<td>760</td>
<td>2796</td>
<td>2483</td>
<td>809</td>
<td>84</td>
<td>778</td>
<td>4154</td>
<td>6950</td>
</tr>
<tr>
<td>Inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>51</td>
<td>349</td>
<td>55</td>
<td>455</td>
<td>188</td>
<td>-</td>
<td>-</td>
<td>149</td>
<td>337</td>
<td>792</td>
</tr>
<tr>
<td>Other Primary Inputs</td>
<td>715</td>
<td>1098</td>
<td>1886</td>
<td>3699</td>
<td>72</td>
<td>1</td>
<td>-</td>
<td>5</td>
<td>78</td>
<td>3777</td>
</tr>
<tr>
<td>Total Primary Inputs</td>
<td>766</td>
<td>1447</td>
<td>1941</td>
<td>4154</td>
<td>260</td>
<td>1</td>
<td>-</td>
<td>154</td>
<td>415</td>
<td>4569</td>
</tr>
<tr>
<td>Total Inputs</td>
<td>1851</td>
<td>2398</td>
<td>2701</td>
<td>6950</td>
<td>2743</td>
<td>810</td>
<td>84</td>
<td>932</td>
<td>4569</td>
<td>11519</td>
</tr>
<tr>
<td>Labour Force, '000</td>
<td>161.7</td>
<td>316.7</td>
<td>489.1</td>
<td>967.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If Household and Government consumption expenditure grows at a compound rate of 4 per cent over a period of ten years, and the pattern of consumption is unchanged, then in the last year, 1975, the consumption expenditure on the products of each sector will be:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Consumption Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$346.0 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$1,089.5 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$2,239.6 mn.</td>
</tr>
</tbody>
</table>

These consumption expenditures are added to the original values of Exports, Stock Changes and Capital Formation, giving a new level of Final Demand. The new Final Demand requires greater Total Output from each sector, the new totals being:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Total Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$2,324.4 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$2,842.4 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$3,715.1 mn.</td>
</tr>
</tbody>
</table>

In order to produce these higher levels of Total Output, each sector requires more capital than it had before. Multiplying the increase in output required from each sector by the appropriate capital/output ratio gives us the amount of extra capital needed by each sector. If we assume that the extra capital is built up in ten equally sized annual increments, then the net investment required by each sector in 1975 is:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Net Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$110.0 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$33.4 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$217.5 mn.</td>
</tr>
</tbody>
</table>

In addition to increasing the capital stock in each sector, it is necessary to maintain the capital already in place in 1965 and that which has been added over the 1965/75 period. Consequently the total investment required in each sector in 1975 has to take account of depreciation in the sector as well as the need for extra capital. The gross investment apparently required by each sector in 1975 is:
Thus the total investment required by the economy is $799.3 mn. which differs from the amount allowed for in the first estimate of capital formation in 1975, and Final Demand has to be changed accordingly. Production of the capital required, as calculated above, would involve each sector in the production of the following amounts of capital:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$229.0 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$114.8 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$455.5 mn.</td>
</tr>
</tbody>
</table>

The increased output from each sector required to satisfy Household and Government requirements also necessitates an increase in imports, and if we require balance of payments equilibrium, then exports must be increased. The new levels of Final Demand and Total Output calculated earlier, involve the following imports:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$10.8 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$562.5 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$93.3 mn.</td>
</tr>
<tr>
<td>Final Demand</td>
<td>$406.8 mn.</td>
</tr>
<tr>
<td>Total</td>
<td>$960.1 mn.</td>
</tr>
</tbody>
</table>

If balance of payments equilibrium is to be preserved, and if each sector produces the same proportion of total exports as before, then exports in 1975 will be:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$761.0 mn.</td>
</tr>
<tr>
<td>Secondary</td>
<td>$58.1 mn.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>$139.9 mn.*</td>
</tr>
<tr>
<td>Total</td>
<td>$959.0 mn.</td>
</tr>
</tbody>
</table>

* Indirect Taxes, applied at the same rate as in 1964-65, would raise the value of exports by $1.1 mn. to the required level of $960.1 mn.
We now have new estimates of Capital Formation and Exports for 1975. If these estimates are substituted in the appropriate columns of Final Demand, new estimates of total Final Demand are obtained, and these imply new levels of Total Output.

Again, we now need more capital and imports, and it is necessary to go through the whole process once more. Each time the process is repeated the requirements and production of capital and exports come closer to each other, until eventually an equilibrium situation is reached in which annual capital requirements are matched by annual capital formation, and exports equal import requirements. This equilibrium situation is shown in Table 6.

This table then shows a picture of the economy in 1974/75 if it had enjoyed and was still enjoying a growth rate of 4 per cent, given all the simplifying assumptions which have been employed as mentioned before.

We are not entitled, nor is it intended, at this juncture, to draw any conclusions from the results but it is pertinent to point out one very important implication of the calculations as they stand. This is the very high total labour requirement\(^1\) in the economy - 160,000 more persons required in 1975/75 than would be available from the normal growth in the labour force plus 10,000 per annum immigration. The labour force increase in the primary sector is very small indeed but the expansion of this sector (as the major export earner under the assumption employed) has led to a large increase in the indirect requirements for labour in other sectors linked with the primary sector via the set of input-output relationships. This suggests that it is unwise, when judging the effect on employment of any one sector's output, to look solely at the labour force in that sector and points up the error

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\(^1\) The 1974/75 labour force figures in each sector as given at the foot of the table have been calculated by applying the 1965 output-labour coefficients to the 1975 levels of output.
### TABLE 6 - Current Inter-Industry Transactions 1974-75

<table>
<thead>
<tr>
<th>$mn</th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Total Intermediate</th>
<th>Hsehld &amp; Govt. Consumpt-</th>
<th>Exports</th>
<th>Stock Changes</th>
<th>Capital Formation</th>
<th>Total Final Buyers</th>
<th>Total Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>987.0</td>
<td>132.4</td>
<td>55.5</td>
<td>1174.9</td>
<td>346.0</td>
<td>773.3</td>
<td>40.0</td>
<td>11.0</td>
<td>1170.3</td>
<td>2345.2</td>
</tr>
<tr>
<td>Secondary</td>
<td>190.0</td>
<td>636.3</td>
<td>341.1</td>
<td>1167.4</td>
<td>1089.5</td>
<td>59.0</td>
<td>18.0</td>
<td>577.9</td>
<td>1744.4</td>
<td>2911.8</td>
</tr>
<tr>
<td>Tertiary</td>
<td>197.7</td>
<td>386.1</td>
<td>657.2</td>
<td>1241.0</td>
<td>2239.6</td>
<td>142.2</td>
<td>26.0</td>
<td>96.4</td>
<td>2504.2</td>
<td>3745.2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>1374.7</td>
<td>1154.8</td>
<td>1053.8</td>
<td>3583.3</td>
<td>3675.1</td>
<td>974.5</td>
<td>84.0</td>
<td>685.3</td>
<td>5418.9</td>
<td>9002.2</td>
</tr>
<tr>
<td>Imports</td>
<td>64.6</td>
<td>423.8</td>
<td>76.3</td>
<td>564.7</td>
<td>278.3</td>
<td>-</td>
<td>-</td>
<td>132.7</td>
<td>411.0</td>
<td>975.7</td>
</tr>
<tr>
<td>Other Primary Inputs</td>
<td>905.9</td>
<td>1333.2</td>
<td>2615.1</td>
<td>4854.2</td>
<td>106.6</td>
<td>1.2</td>
<td>-</td>
<td>4.3</td>
<td>112.1</td>
<td>4966.3</td>
</tr>
<tr>
<td>Total Primary Inputs</td>
<td>970.5</td>
<td>1757.0</td>
<td>2691.4</td>
<td>5418.9</td>
<td>384.9</td>
<td>1.2</td>
<td>-</td>
<td>137.0</td>
<td>523.1</td>
<td>5942.0</td>
</tr>
<tr>
<td>Total Inputs</td>
<td>2345.2</td>
<td>2911.8</td>
<td>3745.2</td>
<td>9002.2</td>
<td>4060.0</td>
<td>975.7</td>
<td>84.0</td>
<td>822.3</td>
<td>5942.0</td>
<td>13944.2</td>
</tr>
<tr>
<td>Labour Force '000</td>
<td>204.9</td>
<td>384.6</td>
<td>678.2</td>
<td>1267.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
in the policy of stimulating secondary industry in New Zealand in order "to ensure full employment".

However, many refinements are necessary before taking this or anything else as a firm conclusion. Some of these refinements have already been mentioned, e.g. allowing for changes in the input output coefficients; allowing for changes in the future terms of trade etc.; in the case of the sectoral labour requirements mentioned above, we ought to allow for rising labour productivity (or falling labour/output coefficients) in each sector.

The nature of these and other refinements is discussed in the next and last section of this paper.
VI NECESSARY REFINEMENTS - A PROGRAMME OF WORK AND PUBLICATION

The outline projection in the previous section was given as an example only. Before we can present a reasonably reliable projection model of the New Zealand economy, a number of refinements are necessary. These are given below.

In most cases the necessary research is well advanced or has been completed and awaits publication and therefore we have arranged these refinements or qualifications under the heading of the relevant Research Unit publication which will appear during the coming year in a series under the general heading of "Studies in the Structure of the New Zealand Economy".

1. A Fifteen-Sector Social Accounting Matrix for 1965

In this publication we will present the data for a fifteen-sector model of the economy since the three-sector aggregation we have used in this paper is too highly aggregated for reliability.

2. The Value and Structure of Fixed Capital in New Zealand in 1965

The figures we used for capital in each sector, in the outline projection above were provisional estimates and more reliable figures for fifteen sectors will be presented. Of salient importance for projections are our estimates of the future dates at which capital assets will fall due for replacement, i.e. the age structure of capital. Such information is needed to estimate that part of gross investment in 1975 required to replace depreciated assets.

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1 Indeed a fifteen-sector model is itself hardly large enough and we have already under way research for further disaggregation of the primary sectors into special types of agricultural and other primary production, and of the manufacturing sector into three or four main types.
3. Incremental Sectoral Capital-Output and Labour-Output Relationships and Technical Change

We have referred before to the fact that the labour and capital requirements per unit of output in different sectors in 1965 may not necessarily apply in the future. There may be increasing requirements due to diminishing returns or falling requirements due to economies of scale. To allow for this we are measuring, sector by sector, the historical relationships between change in output and changes in labour and capital employed, and also the effect of technical change. These relationships (or production functions) are then extrapolated and used to formulate more realistic labour-capital-output relationships for 1975.1


This publication and the problem it discusses are similar in nature to No. 3. In this case we wish to allow for changes which we think might occur in the input-output coefficients between 1965 and 1975 rather than assuming (as we did in the outline projection above), that the 1965 set of coefficients is stable over time. Again our method is to measure the changes which have occurred in these coefficients in the past (by comparing interindustry studies at two different points in time) and to assume they will continue at the same rate in the future.

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1 Some preliminary results in this area have already been published in the following A.E.R.U. Papers:

No. 29 "Aspects of Productivity & Economic Growth in New Zealand," B.P. Philpott
No. 30 "Estimates of Farm Income and Productivity in New Zealand," B.P. Philpott et al.
No. 36 "Productivity Planning & The Price Mechanism in New Zealand Manufacturing Industry," B.P. Philpott
5. **Internal Demand Relationships and Projections 1950-75**

In this publication we take account of the need to allow for and use a different sectoral mix in consumer demand in 1975 compared with that which applied in 1965 (and which we used in the outline projection model). Econometric analysis of historical data has been used to evaluate consumers' income and price elasticities of demand for the products of each of the fifteen sectors and the income elasticities so derived are used, in conjunction with the planned or target growth in real per capita income, to project the structure of consumption in 1975.2

The planned rate of growth of government current expenditure has already been the subject of investigation and publication by N.Z. Treasury and can be used for our 1975 level of Government demand.

6. **External Demand Relationships and Export Projections for 1975**

Along with the problem of diminishing returns in production, the problem of diminishing returns in overseas marketing was specifically raised earlier - a target growth rate of 4 per cent per annum in the volume of agriculture may not, because

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1 Preliminary results in this field are contained in R.H. Court "Some Projections of Retail Consumption in New Zealand", A.E.R.U. Publication No. 37.

2 Ideally our projection model ought also to take account of price elasticities and projected changes in price (instead of allowing solely for income elasticities). The introduction of relationships for internal price formation is quite feasible but enormously complicated and better left for a revised version at a future date.
of the effect in reducing export prices, yield 4 per cent per annum more in export receipts. Therefore account must be taken of the relationship between prices received and the volume of traditional exports placed on the world market, and the formulation, in the light of these relationships, of export projections (in money terms) for 1975. The publication mentioned above will discuss this matter. This is probably the most difficult and most uncertain part of our whole exercise.

Not only is it necessary to measure the historical dependence of New Zealand's export prices on a number of world-wide variables such as world real income, prices and supplies of competing products etc., - in itself a difficult enough task - but the future development of these variables has to be forecast.

These difficulties and uncertainties, great as they are, have not however daunted investigators in other countries from formulating export market projections for future years. Even apart from their importance to the present projection model, such export projections are important in their own right and a lot of effort in the last few years has been devoted in the Agricultural Economics Research Unit, to measuring the economic relationships which are strategically

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1 See for example the series of long run demand and supply projections published as the result of research commissioned by the U.S. Department of Agriculture - especially the study for Australian exports by Professor F.H. Gruen of Monash University, "Long Term Projections of Agricultural Supply & Demand Australia 1965-80", Melbourne, Department of Economics, Monash University 1967.

important in our export markets, and using these to formulate export projections.\footnote{See for example:}  

Under the heading given above we shall shortly bring all this work together, giving a set of export demand projections to be used in the context of the present model and, in particular, setting out what we consider to be the prices at which we can sell 4 per cent more primary exports each year. 

The difficulty and uncertainty necessarily surrounding the formulation of export projections, gives added point to the suggestion made on page 26 that great importance attaches, not so much to the final projection thrown up by our interindustry model, but to the sensitivity of the answers to changes in data or in coefficients. The importance of formulating export projections lies not so much in establishing clear-cut forecasts as to what is thought is going to happen, but to indicate what, to the best of our knowledge, is likely to happen, and then to measure how sensitive is our overall-economy projection to small changes in the export forecast used.
7. The New Zealand Economy in 1975

This publication will present a projection (similar to the outline given in Section V above), i.e. assuming that the present structure of the economy continues in the future with continued reliance on primary exports, but incorporating all the refinements mentioned in publications 1 to 6 above. As a result of these refinements the results may be somewhat different from the example given in Section IV.

8. Some Further Refinements

While the aim of the present report is to describe and put in context the research work up to and including the presentation of economy projections for 1975, there still remains a host of further matters to be investigated consistent with our discussion in Section IV. These include:

(i) The optimal structure of the economy in 1975 - alternatives to present policies.

(ii) The sensitivity of optimal structural policies to changes in data and coefficients.

(iii) The measurement and allowance for costs of protection inherent in import control.

(iv) The analysis of and allowance for internal price formation in an interindustry context.

(v) The analysis of the path or process by which the economy moves from the present structure to the future structure and the extent to which this process itself renders the optimal structure more difficult to attain.

On these matters some research has already been started but its completion and publication are well beyond our present horizon.
PUBLICATIONS

1964

2. The New Agricultural Economics Research Unit, B. P. Philpott
3. Indicative Planning for the Poultry Industry in New Zealand, J. T. Ward
4. The International Sugar Situation and New Zealand’s Sugar Policy, A. R. Frampton
5. Economic Implication of Increased Agricultural Production, B. P. Philpott
6. Profitability of Irrigation in Mid-Canterbury, J. D. Stewart and D. A. R. Haslam
7. Programming a Canterbury Mixed Farm, J. D. Stewart and P. Nuttall
8. Economic Implications of Increased Wool Production, B. P. Philpott
9. Investment Analysis for Farm Improvement, J. T. Ward

11. Factors Affecting Demand for Wool Textiles in New Zealand, B. P. Philpott
12. The Degree of Protection accorded by Import Licensing to New Zealand Manufacturing Industry, P. Hampton
13. Fluctuations in Wool Prices, 1870-1963, B. P. Philpott
15. The Problem of Scheduling Sales of New Zealand Butter on the United Kingdom Market, Robert Townsley
17. Breeding Flock Composition in Relation to Economic Criteria, R. J. Townsley and W. Schroder
18. Trends in Production, Trade and Consumption of Wool and Wool Textiles, B. P. Philpott and D. M. Beggs
19. Standardisation of Farm Accounts for Managerial Analysis, J. W. B. Guise
20. The Use of Linear Programming in Least-cost Feed Compounding, N. W. Taylor
21. The Maximisation of Revenue from New Zealand Sales of Butter on the United Kingdom Market—A Dynamic Programming Problem, B. J. Ross (Reprint)
23. An Analysis of the Retail Demand for Meat in the United Kingdom, B. P. Philpott and M. J. Matheson

1965

25. Strategic and Tactical Planning in International Marketing Policies, B. P. Philpott (Reprint)

27. An Economic Analysis of Large-scale Land Development for Agriculture and Forestry, J. T. Ward and E. D. Parkes
29. Aspects of Productivity and Economic Growth in New Zealand 1920-64, B. P. Philpott
31. The Regional Pattern of the Demand for Meat In the United Kingdom, Mary J. Matheson and B. P. Philpott (Published 1967.)
32. Long-Run Swings in Wool Prices, B. P. Philpott (In preparation)
33. The Economics of Hill Country Development, J. S. Holden (Reprint)
34. Report on a Survey of Farm Labour in Patangata County, Hawke’s Bay 1965-6, D. McClatchey
36. Productivity, Planning and the Price Mechanism in the New Zealand Manufacturing Industry, B. P. Philpott
37. Some Projections of Retail Consumption in New Zealand, B. H. Court
38. The Nature and Extent of the Farm Labour Shortage in Cheviot County, Canterbury, J. L. Morris and R. G. Cant

1967

40. High Country Development on Molesworth, R. W. M. Johnson
41. Input-Output Models for Projecting and Planning the Economy, B. P. Philpott and B. J. Ross
43. Survey of Christchurch Consumer Attitudes to Meat, C. A. Yandle
44. Fertiliser and Production on a sample of Intensive Sheep Farms in Southland 1953-64, R. C. Jensen and A. C. Lewis
47. The Impact of Falling Prices on Taranaki Hill-Country Development, R. W. M Johnson
49. Inter-Industry Structure of the New Zealand Economy, 1967-5, B. J. Ross and B. P. Philpott

OUT OF PRINT: Numbers 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 17, 21, 22, 25, 33 and 34.

While stocks last, single copies of the publications listed above are available to interested individuals, institutions and firms, on application.