

AGRICULTURAL
ECONOMICS
RESEARCH UNIT



Lincoln College

ASPECTS OF PRODUCTIVITY AND ECONOMIC
GROWTH IN NEW ZEALAND

1926 - 1964

BY

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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 publications will be available to the public on request.

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P R E F A C E

This discussion paper was originally given as a speech to the Wellington Branch of the Economic Society of Australia and New Zealand in November 1964, under the title, "Explorations in Productivity Analysis". The aim was to bring together all the available data bearing on long term productivity growth in New Zealand; to explore it and see what could be discovered; and to stimulate discussion. This is still the aim in publishing, a somewhat modified version of the paper, at this time.

One of the major problems in trying to measure pre-war trends in productivity, is the lack of adequate statistics. I have tried to remedy some of these deficiencies with my own estimates, including a provisional estimate of the growth in real capital in New Zealand. No one is more aware than I am of the frail formulations on which some of these estimates are based and the tentative nature, therefore, of some of the conclusions reached. The hope is that they can be improved by discussion and criticism.

Many of the results given here spring from one of the Unit's research projects on agricultural productivity and I must acknowledge the immense help I have received from members of my staff, especially Mary Matheson, Robin Court and Christopher Yandle.

B. P. Philpott

Lincoln College
May 1966

I. INTRODUCTION

Our purpose in this paper is to survey present knowledge with respect to long term changes in productivity in New Zealand, especially in so far as this is related to economic growth.

All the data at present available, for both post- and pre-war periods, bearing on this question, have been gathered together and, in some cases, new estimates have been made, with the aim of exploring the data to see what can be discovered about long term growth trends in New Zealand. As it happens, quite a lot can be discovered, or at any rate we can discern the outline of some new vistas, in spite of the great gaps and deficiencies in the available data and in the new estimates presented.

In the following sections we discuss, first of all, the meaning of productivity and indicate two approaches to its measurement - the first involving the measurement of trends in total national product per worker, and the second the measurement of productivity changes in each sector.

In Section III, pre- and post-war trends in national income and product per worker are discussed. In Section IV the sectoral productivity growth rates are measured and then combined into a weighted average for the whole economy, giving, as expected, much the same result as in Section III.

The respective contributions of growth in capital and efficiency as the basic determinants of productivity growth are measured in Section V and the results are used in Section VI to measure future capital requirements which, it appears, are likely to increase quite markedly.

The paper concludes in Section VII with a brief discussion of policies required to increase efficiency in the New Zealand economy, as one way of reducing these large capital requirements, while still sustaining high rates of growth.

II. THE MEANING AND MEASUREMENT OF PRODUCTIVITY

The meaning and measurement of productivity is best approached from a breakdown of the economy into its component sectors and an analysis of the net product of each sector.

Such a breakdown for the year 1954/55 and for 1936, is given in Table 1. The 1954/55 figures are mainly from the Sector Accounts. The 1936 figures are estimates derived as described in an appendix to this paper. The net product of each sector is calculated as the gross value of output less the payments to other sectors (including imports) for goods and services used in production. The residual net product represents the amount available to reward the factors of production - land, labour and capital - employed in the industry. The net product of a sector thus represents that sector's contribution to the national product.

Net product, divided by the number of persons employed, gives the labour productivity in the sector. (It is important to remember, however, that it could equally well be divided by the capital employed, or land utilised, to give capital productivity or land-productivity. Indeed, the only true measure of productivity, though it is rarely used, is the ratio of output to all inputs used.)

Growth in real per capita national product is, of course, the result of the separate rates of real productivity growth in each sector, together with the changes in the relative size of each sector. In Section IV, the sectoral contributions to aggregate productivity will be measured in these terms.

There is an alternative measure of productivity which stresses the spending, rather than the producing aspect, of the economy. The net product, or national income, of the economy, is used in various ways, usually summarised under the broad aggregates: consumption, investment and public current expenditure which, in total, give national expenditure. Other things equal, changes in national expenditure in real terms (i.e. corrected for price changes), will be the same as changes in the real product of the economy. But other things are rarely equal - in particular allowance has to be made for changes in the overseas terms of trade which, when

TABLE 1 NET PRODUCT AND LABOUR FORCE BY SECTORS

| | 1954/55 | | | | | 1936 | | | |
|---|--------------------|----------------------------------|----------------------|----------------------------------|---------------------------------|--|----------------------------------|----------------------|----------------------------------|
| | Net Product £mn | Percent- age of Total % | Labour Force '000 | Percent- age of Total % | Net Product per Head £ | Est. Net Product Current Prices £mn. | Percent- age of Total % | Labour Force '000 | Percent- age of Total % |
| <u>I. PRIMARY</u> | | | | | | | | | |
| 1. Farming | 172.7 | 20.7 | 135.5 | 16.9 | 1274.5 | | 150.8 | 23.4 | |
| 2. Forestry & Logging | 6.3 | 0.7 | 4.7 | 0.6 | 1340.4 | | 10.3 | 1.6 | |
| 3. Hunting & Fishing | 2.9 | 0.3 | 4.3 | 0.5 | 674.4 | | 2.5 | 0.4 | |
| 4. Mining | 8.0 | 1.0 | 5.8 | 0.7 | 1379.3 | | 11.4 | 1.8 | |
| <u>Total Primary</u> | 189.9 | 22.7 | 150.3 | 18.7 | 1263.5 | 62 | 36.5 | 175.0 | 27.2 |
| <u>II. SECONDARY</u> | | | | | | | | | |
| 5. Manufacturing (Prim. Prod. Proc.) | 20.6 | 2.5 | 19.5 | 2.4 | 1056.4 | | 25.6 | 4.0 | |
| 6. Manufacturing (Other) | 160.3 | 19.2 | 179.4 | 22.4 | 893.5 | | 79.8 | 12.4 | |
| 7. Bldg & Constr. | 60.8 | 7.3 | 69.2 | 8.6 | 878.6 | | 46.4 | 7.2 | |
| 8. Public Utilities | 14.7 | 1.8 | 11.8 | 1.5 | 1245.8 | | 5.5 | 0.9 | |
| <u>Total Secondary</u> | 256.4 | 30.7 | 279.9 | 34.9 | 916.0 | 45 | 26.5 | 157.3 | 24.4 |
| <u>III. TERTIARY</u> | | | | | | | | | |
| 9. Transport & Communication | 69.8 | 8.4 | 77.8 | 9.7 | 897.2 | | 62.2 | 9.7 | |
| 10. Wholesale & Retail Trade | 138.8 | 16.6 | 103.9 | 13.0 | 1335.9 | |) 102.4 | 15.9 | |
| 11. Banking & Ins. | 31.3 | 3.7 | 29.3 | 3.7 | 1068.3 | | | | |
| 12. Services | 94.8 | 11.3 | 160.7 | 20.0 | 589.9 | | 147.4 | 22.9 | |
| 13. Other | 54.3 | 6.5 | . | . | . | | | | |
| <u>Total Tertiary</u> | 389.0 | 46.6 | 371.7 | 46.4 | 1046.5 | 63 | 37.0 | 312.0 | 48.4 |
| <u>TOTAL</u> | 835.3 | 100.0 | 801.9 | 100.0 | 1041.6 | 170 | 100.0 | 644.3 | 100.0 |

Sources: See Appendix I.

they occur, change the quantity of imports which can be purchased from exports and therefore change the real expenditures possible from any given level of national product.

Trends in aggregate productivity, measured by real expenditures per head, are discussed in the next section.

III. AGGREGATE REAL EXPENDITURE AND PRODUCTIVITY

Our method here is to deflate the components of national expenditure by appropriate price indices to give real expenditure or real income of the nation. The growth rates in real gross national income for the pre-war period and for some selected post-war periods are shown in the first line of Table 2. When divided by population growth, we derive, as in line 3, the growth rate in real gross income per head, or standards of living.

Growth in real income is determined, partly by growth in productivity, but also by the amounts which have been paid abroad as income to overseas owned factors of production, and by the losses or gains secured as the result of changes in the terms of trade. The growth in these two items is shown in lines four and five of Table 1, and when appropriate allowance is made for them, we secure the growth rate in real product as in line six and in labour productivity as in line eight.

The sources used for these calculations are given in Appendix II. It should be noted that the data available for the pre-war calculations are not nearly as reliable as for the post-war years and the pre-war rates of growth must be regarded as broad indications only.

For the period 1954/55-1962/63 (the last column of the table) the relation between the figures is as follows:

The growth in total real income of 3.0 per cent per annum resulted from a 3.6 per cent growth in real product, less 0.6 per cent "loss" each year, due to falling terms of trade and rising amounts of income paid abroad.¹ In addition population rose faster than the labour force and the net effect of all these factors was that while there was an increase of 1.8 per cent per annum in productivity (that is, in goods and services produced per unit of the labour force each year), only about 0.8 per cent more could be consumed

¹ The effect on income of growth rates in factor income paid abroad and in terms of trade must be calculated after allowing for the proportion these occupy in total national product. These proportions are about .02 and .03 respectively.

TABLE 2 GROWTH RATES IN THE NEW ZEALAND ECONOMY

Annual Average Compound Interest Rates of Growth

| | <u>Pre-war Period</u> | <u>Post-war Period</u> | | |
|---|---------------------------------|---------------------------------|------------------|------------------|
| | <u>1928-1939</u> ^(a) | <u>1948-1964</u> ^(b) | <u>1950-1960</u> | <u>1955-1963</u> |
| 1. Total Real Gross National Income in '54/55 Prices | 3.8 | 3.6 | 3.1 | 3.0 |
| 2. Population | 1.0 | 2.2 | 2.2 | 2.2 |
| 3. Real Gross National Income Per Head of Population | 2.7 | 1.4 | 0.9 | 0.8 |
| 4. Terms of Trade | 0.1 | 1.2 | 0.6 | -2.0 |
| 5. Real Factor Income Paid Abroad | 0.9 | 4.2 | 2.2 | 11.1 |
| 6. Total Real Gross Product in '54/55 Prices | 3.6 | 3.3 | 3.4 | 3.6 |
| 7. Labour Force | 1.4 | 1.7 | 1.7 | 1.8 |
| 8. Real Product per Person Employed | 2.2 | 1.6 | 1.6 | 1.8 |

(a) Average of three years ending 1927/28 and 1938/39 respectively.

(b) " " " " " 1947/48 and 1963/64 "

Sources: See Appendix II.

per head of population each year.

Two further points thrown up by this table should be noted. Firstly, we should note the very rapid growth in recent years in real income paid abroad, reflecting largely the growth in overseas investment in New Zealand. Secondly, productivity and real income growth have, it appears, both been lower in the post-war period than pre-war, in spite of the retarding effect of the pre-war depression and declining terms of trade. Part of the reason for this startling difference in performance post-war, compared with pre-war, will emerge after we examine, in the next section, the sector contributions to productivity.

IV. PRODUCTIVITY CHANGES BY SECTORS

In this section we turn to the measurement of productivity by the first method described before, in which the matter is looked at from the viewpoint of the total product of the economy and of its component sectors, rather than on the basis of aggregate income or expenditure, as in the previous section.

In Table 3, we summarise what is known about growth in productivity (net product per person employed) in the major sectors of the New Zealand economy. The figures are given for three different post-war periods, and for a pre-war period. Again, it is necessary to warn against too great a reliance on the pre-war figures, due to inadequacies in the available data for this period. The sources of data and methods used in compiling these figures are given in Appendix III.

These sector productivity rates are then combined into a weighted average for the whole economy, using as weights the sector's proportionate contribution to national net product as shown in the first and last columns for pre-war and post-war respectively. This average figure for the whole economy is given at the foot of the table, where there is also shown, for comparison, the productivity growth rate we derived in section III. As expected, there is broad agreement between the two measures and again we find evidence of a lower rate of post-war (1946-64) productivity growth compared with pre-war. A heartening feature is, of course, that the rate seemed to be rising in the later years of the post-war era and may now be closer to the figure of approximately 2 per cent, characteristic of the pre-war era.

Returning however to the whole post-war period, one of the reasons for this slower post-war overall productivity growth rate is apparent from Table 3. This is, that the sector with the highest productivity growth rate, viz, agriculture, now contributes a much smaller proportion of national product (22.7 per cent post-war for primary industry, compared with 36.5 per cent pre-war); and the low productivity-growth sector, viz, tertiary production, has risen markedly in importance. In fact, if the post-war productivity growth rates, in each sector, were reweighted by the pre-war proportions of national product, the overall

TABLE 3

PRODUCTIVITY GROWTH IN SECTORS OF THE NEW ZEALAND ECONOMY

(Figures given are compound percentage rates of growth per annum in net product per person employed)

| | PRE-WAR | | POST-WAR | | | Sector's Ppn. of Net Product '54/55 |
|---|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-------------------------------------|
| | Sector's Ppn. of Net Product 1936 | 1926-39 Productivity Growth Rate | 1946-64 Productivity Growth Rate | 1950-60 Productivity Growth Rate | 1955-63 Productivity Growth Rate | |
| I. PRIMARY | | | | | | |
| 1. Farming | . | . | 3.5 | 2.9 | 4.5 | 20.7 |
| 2. Forestry & Logging | . | . |) | . |) | 0.7 |
| 3. Hunting & Fishing | . | . |) 2.0 | . |) 3.3 | 0.3 |
| 4. Mining | . | . |) | . |) | 1.0 |
| <u>Total Primary</u> | 36.5 | 3.6 | 3.4 | 2.9 | 4.4 | 22.7 |
| II. SECONDARY | | | | | | |
| 5. Manufacturing (Prim. Prod. Proc.) | 4.7 | 2.7 |) 2.4 | 2.6 | 2.7 | 21.7 |
| 6. Other Manufacturing | 16.5 | 1.1 |) | | | |
| 7. Bldg & Construction | 3.5 | 3.0 | 1.7 | 2.1 | 1.7 | 7.3 |
| 8. Public Utilities | 1.8 | 1.1 | 3.0 | 4.0 | 6.0 | 1.8 |
| <u>Total Secondary</u> | 26.5 | 1.5 | 2.3 | 2.6 | 2.6 | 30.8 |
| III. TERTIARY | | | | | | |
| 9. Transp. & Comm. |) | 1.0 | 1.7 | 2.0 |) | 8.4 |
| 10. W/S. & Retail Trade |) 37 |) 1.0 |) |) |) 0.7 | 16.6 |
| 11. Banking & Insurance |) |) |) 0.4 |) 0.5 |) | 3.7 |
| 12. Services |) | 0.5 |) |) |) | 17.8 |
| <u>Total Tertiary</u> | 37 | 1.0 | 0.6 | 0.8 | 0.7 | 46.5 |
| TOTAL AVERAGE PRODUCTIVITY RATE FOR WHOLE ECONOMY | | 2.1 | 1.7 | 1.8 | 1.9 | |
| GROWTH RATE IN AGGREGATE REAL PRODUCT PER PERSON AS IN TABLE 2 | | 2.2 | 1.6 | 1.6 | 1.8 | |

Sources: See Appendix III.

average rate would be 2.3 per cent compared with 1.7 per cent achieved for the whole post-war period. This is a measure of the effect of changes in sector proportions.

It is perhaps inevitable that, as an economy grows, and a greater proportion of its activity is devoted to tertiary production, where productivity growth rates are low, the overall national productivity rate will decline. This might possibly explain the very high productivity rates secured by lower income countries like Japan, where tertiary production is probably a smaller proportion of national product compared with higher income countries like the United Kingdom.

Nevertheless, as Table 3 shows there is clear evidence of consistently higher productivity growth rates for the primary sector in general and agriculture in particular, compared with most other sectors, any increase in the relative size of the primary sector will therefore contribute to an increase in the aggregate national productivity rate.

Possibly it is significant that the rise in aggregate productivity noted in the last five years or so in New Zealand, has coincided with renewed interest in the need for increased agricultural production and the introduction of economic policies towards this end.¹

¹ A consideration of agriculture's declining proportionate contribution to national product, may also provide an answer to the question as to why we now need to raise gross agricultural production to around 4 per cent per annum to secure 4 per cent growth in total real income, when pre-war we were able to secure nearly 4 per cent total real income growth with only about a 2.6 per cent increase in total agricultural production.

V. THE DETERMINANTS OF PRODUCTIVITY GROWTH
- CAPITAL AND EFFICIENCY

Changes in productivity can be attributed to two factors of which the first is the growth in stock of capital per worker and the second, called, for want of a better name, "efficiency", includes the effect of such factors as technical progress, improvements in managerial skill, more intensive labour effort, and possibly most important of all, increasing returns to scale.

To sort out and measure the relative effect of capital and efficiency on productivity requires, amongst other things, a measure of the growth in capital per worker. There are, however, no official estimates of New Zealand's capital stock and in order to secure an approximate measure of capital growth, some new provisional estimates of real capital for the years 1929-64, have been made, using methods described in Appendix IV.¹

In Table 4 are given (for the beginning and ending years of the pre-war period and for the last nine years of the post-war period), the estimates of real capital which, together with the figures of aggregate real product, provide estimates of the average and marginal capital output ratio. Of importance in this context is the marked rise in the marginal capital output in the period 1955-64 compared with the pre-war period, confirming suggestions, made by other authors², that there has been a marked rise in capital requirements per unit of output in New Zealand.

¹ These provisional estimates are for the total stock of capital only. Estimates of capital growth in each sector are currently being made at the Agricultural Economics Research Unit and, when complete, these sector estimates will undoubtedly indicate the need for amendment of the provisional total series used here.

² In particular C.A. Blyth in "Economic Growth 1950-1960", N.Z. Institute of Economic Research, Research Paper No.1.

The last two lines of the table give the rates of growth of real capital per worker and net product per worker (the latter as given in Table 3).

TABLE 4 REAL CAPITAL AND CAPITAL OUTPUT RATIOS IN
NEW ZEALAND

| | <u>Pre-War</u> | | <u>Post-War</u> | |
|--|------------------------------|------------------------------|------------------------------|------------------------------|
| | <u>Av. of 3 Years Ending</u> | <u>Av. of 3 Years Ending</u> | <u>Av. of 3 Years Ending</u> | <u>Av. of 3 Years Ending</u> |
| | <u>1928</u> | <u>1939</u> | <u>1955</u> | <u>1964</u> |
| Aggregate Net Real Capital (£m '54/55 Prices) | 1543 | 1801 | 2602 | 3722 |
| Aggregate Real Product (£m '54/55 Prices) | 318 | 470 | 935 | 1244 |
| Average Capital/Output Ratio | 4.8 | 3.8 | 2.8 | 3.0 |
| Marginal Capital/Output Ratio | 1.6 | | 3.6 | |
| Rates of Growth of: | | | | |
| Real Capital per Worker | 0.1% p.a. | | 2.8% p.a. | |
| Real Product per Worker | 2.2% p.a. | | 1.9% p.a. | |

These figures can be used to sort out the relative effects of capital and efficiency in raising productivity. The method used is that proposed by Robert Solow¹ and the results indicate that, in the nine years 1955-64, of the

¹ R.M. Solow "Technical Change in the Aggregate Production Function", Review of Economics and Statistics, August 1957. Solow shows that the growth in productivity due to efficiency is equal to the growth in output per head, less the growth in capital per head, multiplied by capital's share in total product.

1.9 per cent per annum increase in product per worker, about 1.1 per cent was due to increased capital per worker and about 0.8 per cent due to increased efficiency.¹ This is rather lower than the contribution of efficiency found in other countries, particularly the United States, where more than one half of increased labour productivity can be attributed to this factor.

But it is also much lower than the estimated figure for the pre-war period in which the growth in capital per worker was virtually non-existent and therefore nearly all the 2.2 per cent increase in productivity must be attributed to increased efficiency.

Even allowing for the approximate nature of our pre-war data, it is fairly clear that, by comparison with pre-war, the post-war growth of aggregate productivity in New Zealand has depended very much more on capital growth and has benefited far less from all the factors which we have chosen to group under the heading of efficiency.

Some possible reasons for this decline in efficiency can be suggested:

(i) The cosier and less competitive business climate post-war, due to import controls and continuous inflation, has possibly reduced managerial efficiency.

(ii) Similar effects on labour efficiency have probably resulted from post-war over-full employment.

¹ The contribution of primary and secondary industry to the 0.8 per cent increase in aggregate efficiency were probably about equal, and, in each case, somewhere about one half of the productivity changes in each of these sectors, with no increase in efficiency in the tertiary sector. The estimate for manufacturing was made by Dr C.A. Blyth in "Strategic Factors in New Zealand's Economic Growth 1965 to 1975", N.Z.E.R. Research Paper No. 8 and the estimate for primary industry was made by the present author and will be published in a forthcoming AERU Publication, "Productivity and Technical Progress in New Zealand Agriculture".

- (iii) There has been, post-war, a far greater tendency towards rapid obsolescence of equipment and the urge to judge re-equipment on technical rather than economic grounds. Pre-war, industrial capital equipment was probably used much more intensively with shift work, etc.

Without further research, however, these must remain as suggestions only.

VI. CAPITAL REQUIREMENTS FOR ECONOMIC GROWTH

The foregoing analysis of the factors contributing to productivity change, can now be used to make some tentative estimates of the growth in capital required, to achieve any desired target rate of growth in gross national product. A reasonable assumption would be a target rate of growth for the economy, over the next decade, of 4.5 per cent per annum, which, with population in future rising at about 2.2 per cent, would provide increasing income per head of 2.3 per cent.

Our calculation of capital requirements proceeds as follows:

- | | | |
|-------|---|-------------|
| (i) | Required rate of growth in total product | = 4.5% p.a. |
| (ii) | Prospective growth in labour force | = 2.1% p.a. |
| (iii) | Therefore required growth in output per worker | = 2.4% p.a. |
| (iv) | Assume that efficiency can be raised from the 1955-64 rate of 0.8% p.a. to a rate of | 1.0% p.a. |
| (v) | We therefore require, from increasing Capital per worker, an increase in product per worker of | 1.4% p.a. |
| (vi) | With a production elasticity for capital of 0.4 this will require an increase in capital per head of | 3.5% p.a. |
| (vii) | And therefore an increase in total capital of 5.6% p.a. compared with the actual increase in total capital in the period 1955-64 of | 4.6% p.a. |

To secure a sustained growth rate, in the next decade, of 4.5% p.a. will therefore require (even after allowing for an increase in the rate of efficiency growth), a marked increase in the rate of capital formation, compared with the rate in the last nine years.

These increased capital requirements are more easily appreciated when expressed in terms of annual gross investment required as a percentage of gross national product.

This has stood at around 22.5 per cent for the last decade. To secure a growth in the real capital stock of 5.6 per cent, annual investment, and therefore savings, will have to rise to about 24 per cent of gross national product and continue rising by about 0.2 per cent each year.

To increase savings at such a rate is indeed a demanding assignment and, if for no other reason, justifies the closest possible look at economic policies which ensure that the best possible uses are made of capital, and which ensure the highest possible level in the efficiency growth rate because any increase in this rate allows a reduction in capital requirements for any given rate of growth in output.

To this question we turn in the next, and concluding, section.

VII. POLICIES TO INCREASE EFFICIENCY

We conclude this paper by simply listing some of the things which can be done to ensure that there is optimal allocation of capital and maintain a high rate of efficiency (bearing in mind all the various factors which this term covers).

- (i) Continued accent on increasing output growth in primary industry, which is the high productivity-growth-rate sector, even if this means reducing the size of the import-substitution sector.
- (ii) Abolition of import control to provide a more competitive climate, which rewards managerial efficiency and penalises inefficiency.
- (iii) Use of a flat rate tariff on imports (including imports of capital goods). This would ensure that only economic import saving industries were set up and would also ensure that imported capital is not used wastefully but is "fully employed".
- (iv) More careful economic appraisal, including cost benefit studies, of all new proposals (including steel mills), which involve directly and indirectly large amounts of capital.
- (v) More training for management, using new tools of managerial economics and operations research.
- (vi) More accent on research of an applied and developmental nature, and on extension methods to spread to industry new ideas springing from research, in the way which has been so successful in agriculture.

Each one of these developments can have the effect of raising efficiency and so reducing capital requirements and in so far as it does this, it not only reduces the required annual investment (including government investment, much of which is financed from taxation), but it also eases some of the pressure on the overseas balance of payments, at any rate as long as the major proportion of our capital equipment comes from overseas.

A P P E N D I X I

Notes on sources for Table 1

1954/55 figures are from "The Interindustry Study of the New Zealand Economy", Department of Statistics.

1936 figures for agriculture are derived from Philpott & Stewart, "Capital Income and Output in Agriculture 1922-1956", Economic Record, August 1958.

Other primary - from estimate of proportion of value added in gross output.

Manufacturing Utilities Building - Value added from N.Z. Year Book.

Tertiary - estimated as a residual from national income estimates minus above estimates of net product in other sectors.

A P P E N D I X II

Notes on Table 2

Post-war - all data are from Statistics Department Reports.

Pre-war - Gross National Product: the basic series used was aggregate gross national income 1933-39, as given in Report of Monetary Commission 1956. This was extended back to 1925/26 by using the official volume of production indices.

- Overseas Trade items: from N.Z. Year Book and League of Nations Balance of Payments Year Book (for invisibles).

- Labour Force: interpolations of census figures.

A P P E N D I X III

Notes on sources for Table 3

Post-war - 1950-1960: from Blyth & Hamer "Output Employment and Productivity Growth in N.Z. Manufacturing Industries", N.Z.E.R. Research Paper No. 4.

- 1954/55-1962/63: from Statistics Department's new Indexes of Production and Productivity for each sector, divided by sectoral labour force estimates.

- 1946-64: Old official Volume of Production Index linked with Blyth & Hamer and new Production Index as above.

Pre-war - Primary: The productivity rate used is that found for farming in unpublished research A.E.R.U. Also see Philpott & Stewart "Capital Income and Output in New Zealand Agriculture, 1922-56", Economic Record August 1958.

- Manufacturing (Processing): Old Statistics Department Volume of Production divided by reported manufacturing labour force.

- Other Manufacturing: As for Primary Produce Processing.

- Building: Deflated Value of total Building and Construction divided by Labour Force. Figures from N.Z. Year Books.

- Utilities: Old volume of production index for power and water, divided by reported labour force.

- Transport and Communications:

Transport: Ton miles of freight and passenger miles divided by transport labour force, as reported in N.Z. Year Books. This calculation indicates a zero rise in productivity over the period.

Communications: Weighted average of letters posted, telegrams, phones in operation, divided by labour force. Results indicate a rise in productivity of 2% per annum.

- Wholesale & Retail Trade: Real Value of total N.Z. output divided by labour force (interpolated from Censuses), indicates rise of about 2% per annum. Banking and Insurance assumed zero rise in productivity - giving weighted average for Trade plus Banking of 1.0% p.a.

- Services: Arbitrarily assumed rise of 0.5% p.a.

A P P E N D I X I V

Notes on sources for Table 4

The estimate of total national real net capital was built up by the perpetual inventory method.

Gross Investment figures are from A.D. Brownlie, unpublished thesis "Capital Formation in New Zealand" (University of Auckland) for 1926-38 and from official statistics 1938-64. Gross investment was deflated by an index of capital goods, prices and depreciation allowed at 5% on each year's starting value of net capital, to secure net investment.

Starting Value for the net capital stock figures was 1925/26.

For this year the 1927 Year Book (page 771) reports the results of a survey of national public and private wealth which, with appropriate adjustments to eliminate double counting financial assets, government debt and unimproved value of land, gives value of wealth at £540 million. A check on this figure is provided by an analysis of value of physical assets in existence in 1926 from Government balance sheets, factory production statistics, census of houses, yielded the figure of £527 million as value of capital. These figures are in historical costs and were converted into 1926 prices by adjusting upwards the value of each type of asset, by the same proportion as was found necessary in independent studies of real capital in a group of ten industries, using perpetual inventory methods, with starting date 1900. The average factor was 3.0. This gave replacement value of capital in 1926 prices and adjustment to 1954/55 prices was effected by use of the index of price of capital goods.

The 1926 starting value was then split into two sections, value of farm improvements, for which a separate series was already available from work of Philpott & Stewart, and other assets to which the perpetual inventory analysis, using gross investment figures described above, was applied.

The results are:

Value of Net Capital in 1954/55 Prices in 1925/26

| | |
|-------------------|------------------|
| Farm Improvements | £279 m. |
| Other Assets | £ <u>1221</u> m. |
| Total | £ <u>1500</u> m. |

The figures for the beginning of 1964/65 are:

| | |
|-------------------|------------------|
| Farm Improvements | £845 m. |
| Other Assets | £ <u>3162</u> m. |
| Total Capital | £ <u>4007</u> m. |