PROJECT ON ECONOMIC PLANNING

Victoria University of Wellington

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ECONOMIC ASPECTS OF THE COMMISSION FOR THE FUTURE'S SCENARIOS OF 2010

By: Bryan Philpott,
Adolf Stroombergen,
and Stephen Burnell.

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I. INTRODUCTION

For some time now the Research Project on Economic Planning has been developing and using modelling techniques to evaluate the detailed economic implications of the contexts or scenarios for 2010 being explored by the Commission for the Future. The purpose of this paper is to present our results to date.[1]

The C.F.F. scenarios, of course, embrace many aspects of the New Zealand scene in 2010, other than the purely economic characteristics. Nevertheless, our attention is in the main confined to those economic aspects,though in one or two cases in has been possible to include non-economic considerations where such can be made subject to economic calculus.

Our quantification of the scenarios is therefore aimed at providing an economic evaluation of each scenario by answering questions such as:

- What would be the pattern of exports and imports?
- What would be the pattern of employment by sectors and what level of unemployment would prevail?
- What would the economy look like under each scenario?
- What standard of living would be provided by the economy?

and so on.

It will be noticed that the questions asked are all in the subjunctive mood - "what would, not what will, the economy look like?" In no sense of the word therefore, are our results forecasts of the future. They are simply explorations of a set of assumptions and goals which make up the C.F.F. scenarios and they are explorations made in the light of what we at present know about the complex structure and interrelationships of the New Zealand economy as it is revealed in 1981.

Highly conditional as such explorations of the future are, they are nevertheless useful both to throw up possible inconsistencies in the qualitative scenarios but, more important, to establish trade-offs between economic and non-economic goals. Thus, one of the C.F.F. scenarios stresses conservation of non-renewable resources, minimum pollution and environmental destruction and it is useful to establish what is the reduction in living standards which has to be paid as a price or a trade-off for the achievement of such a goal.

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[1] *The research on which this paper is based is funded by a continuing grant to the Project on Economic Planning by the Commission for the Future whose assistance in this regard is gratefully acknowledged.*

The plan of the paper is as follows:

Section II gives a brief description of the four CFF scenarious which, in due course, we are going to explore;

Section III sets out a very simple general aggregate economic framework leading to the definition and understanding of some basic economic terminology which is used later. This section is more specifically written for non-economists to assist in their understanding the key ingredients in the structure of our economy and as a lead in to the idea of an economic model.

Section IV discusses the concept of an economic model thought of as a long run structural budget of the economy.

SECTION V gives more precise detail of the relationships and constraints in the EMILY model to be used for the present purposes.

SECTION VI looks at the way the four different scenarios have led to the introduction of different assumptions and constraints into the EMILY model.

SECTION VII gives and discusses the quantitative results from EMILY for each of the four scenarios.

SECTION VIII concludes the paper with some caveats about the model and the results and lists the further agenda of work to be carried out in the future, especially in regard to pollution, education, research and development expenditure and the impact of the microprocessor.

II. The Scenarios In Brief

Full details of the scenarios for year 2010 are given in earlier publications by the Commission.[1]

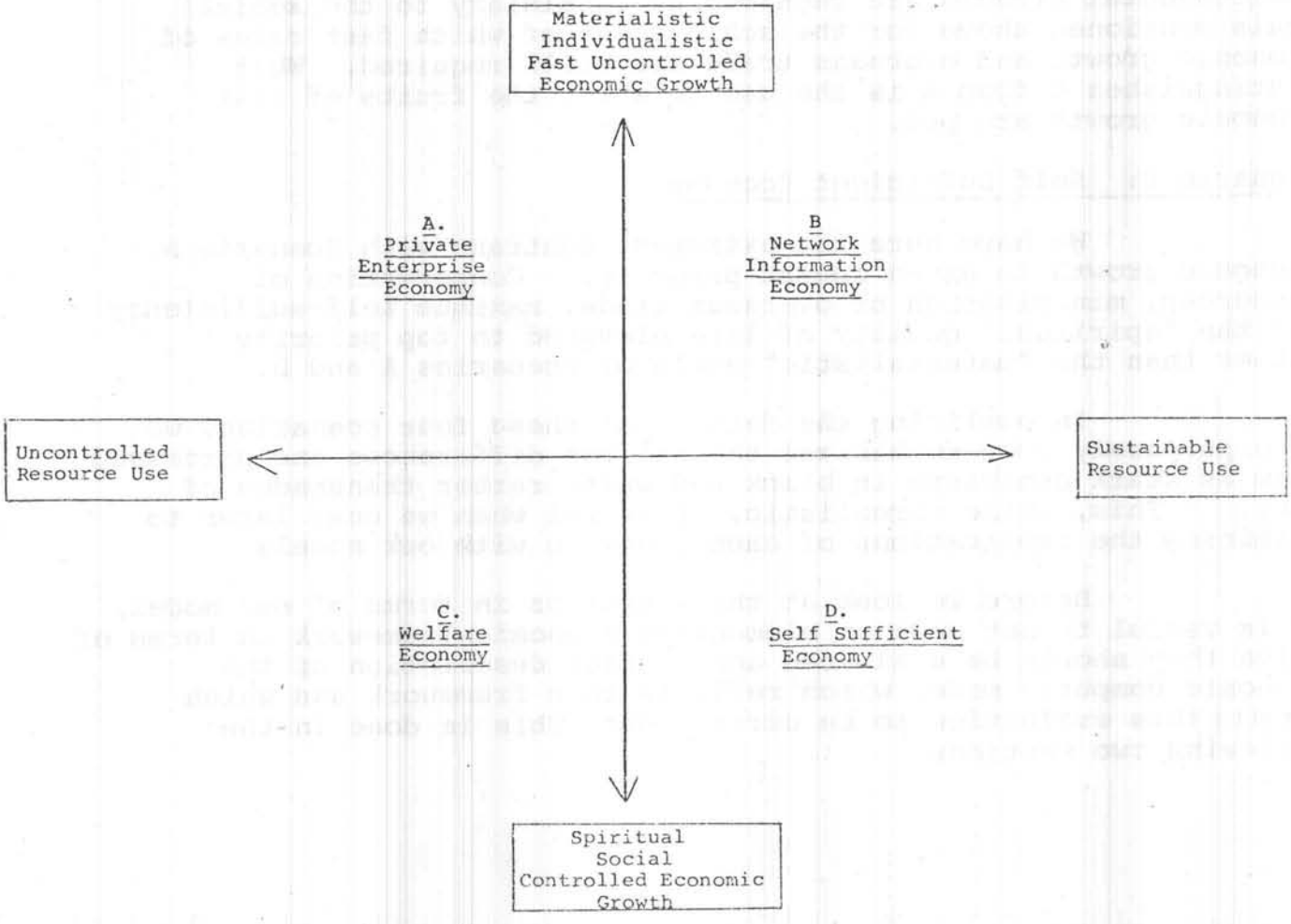
Here we present a brief condensed picture in which we highlight the aspects which relate to the modelling procedure used to explore them.

The four scenarios fall logically into a classification scheme which distinguishes them from each other according to the accent placed on:

a) The goal of fast rates of economic growth to raise standards of living in an individualistic, materialistic society versus growth controlled or monitored to ensure achievement of social goals; welfare, full employment, the "good life" etc. in a co-operative society.

b) Attitudes towards the use of non-renewable resources and the effect on the environment ranging from complete unconcern on the one hand to complete sustainability of resources and minimum environmental effects on the other.

These two distinguishing features (taking account of mutually exclusive combinations) lead to four different scenarios which can be shown in the following four-way diagram in which we have attached names to the scenarios to assist recognition later on when we deal with them in model form:



Confining ourselves only to the economic aspects, the main characteristics of these four scenarios are as follows:

Scenario A: Private Enterprise Economy

In this economy, maximum rates of economic growth are to be achieved by any means available but likely to be based on maximum throughput of resources; maximum accent on overseas trade, and on the use of capital intensive (rather than labour intensive) technology; and minimum concern on government expenditure social goals such as full employment, health, education, etc. Sustainability of resources and environmental effects are not regarded as important and borrowing overseas to sustain large overseas balance of payments deficits does not occasion great concern if such is necessary for fast economic growth.

Scenario B: Network Information Economy

Fast rates of economic growth in a materialistic, individualistic setting are still the goal but somewhat tempered if this is at the expense of the environment and the using up of resources. To achieve this, accent is laid on rapid introduction and use of new microprocessor technology, with consumption and exports oriented more towards those products and areas which minimise the use of resources.

Scenario C: Welfare Economy

Social and collective values now start to assume pre-eminence over individualism and in this scenario top priority is assigned to the achievement of full employment and the collective provision of high levels of social welfare. Resource use and environmental effects are regarded as subsidiary to the social goals mentioned above for the achievement of which fast rates of economic growth and overseas trade are still required. What distinguishes C from A is the use to which the fruits of fast economic growth are put.

Scenario D: Self Sufficient Economy

We have here the extremest contrast with Scenario A. Economic growth is given lowest priority. Conservation of resources, minimisation of overseas trade, maximum self-sufficiency and the "spiritual" quality of life elevated to top priority rather than the "materialistic" goals of Scenarios A and B.

In outlining the details of these four scenarios, we have purposely over-emphasized the salient differences and portrayed them as stark contrasts in black and white rather thanshades of grey. This, while unrealistic, is useful when we come later to examining the implications of each scenario with our models.

Before we look at the scenarios in terms of our model, it is useful to set down an elementary economic framework in terms of which they should be evaluated and a brief description of the economic computer model which reflects this framework and which permits this evaluation to be carried out. This is done in the following two sections.

III. The Economic Framework

The barest essential of an economy, any economy, which need to be understood in order to follow the subsequent discussion of modelling are best comprehended in terms of the flow diagram given below

In this diagram the economy is portrayed in the box in the centre as a productive machine producing the national product. For this to take place the machine requires inputs shown mainly at the foot of the diagram and from the machine emerge outputs or products shown at the top of the diagram and which, when appropriately arranged, make up the national product or gnp as it is usually called. The owners or providers of the inputs, i.e, owners of capital national resources and the providers of labour receive incomes (making up the national income in the form of wages and profits) and these incomes are spent on the various types of products which emerge.

The inputs can be classified into labour (L); national resources (N) consisting of land minerals, marine resources, etc., and capital (K), i.e. the stock of buildings, machines and other productive investments not directly useful in their own right but because of the productive services they provide. Additional to these three classically designated inputs or factors of production, the economic machine also needs imports (M) of raw materials and finished consumer and capital goods of a type which it is more economic or efficient to purchase from overseas than to produce in New Zealand.

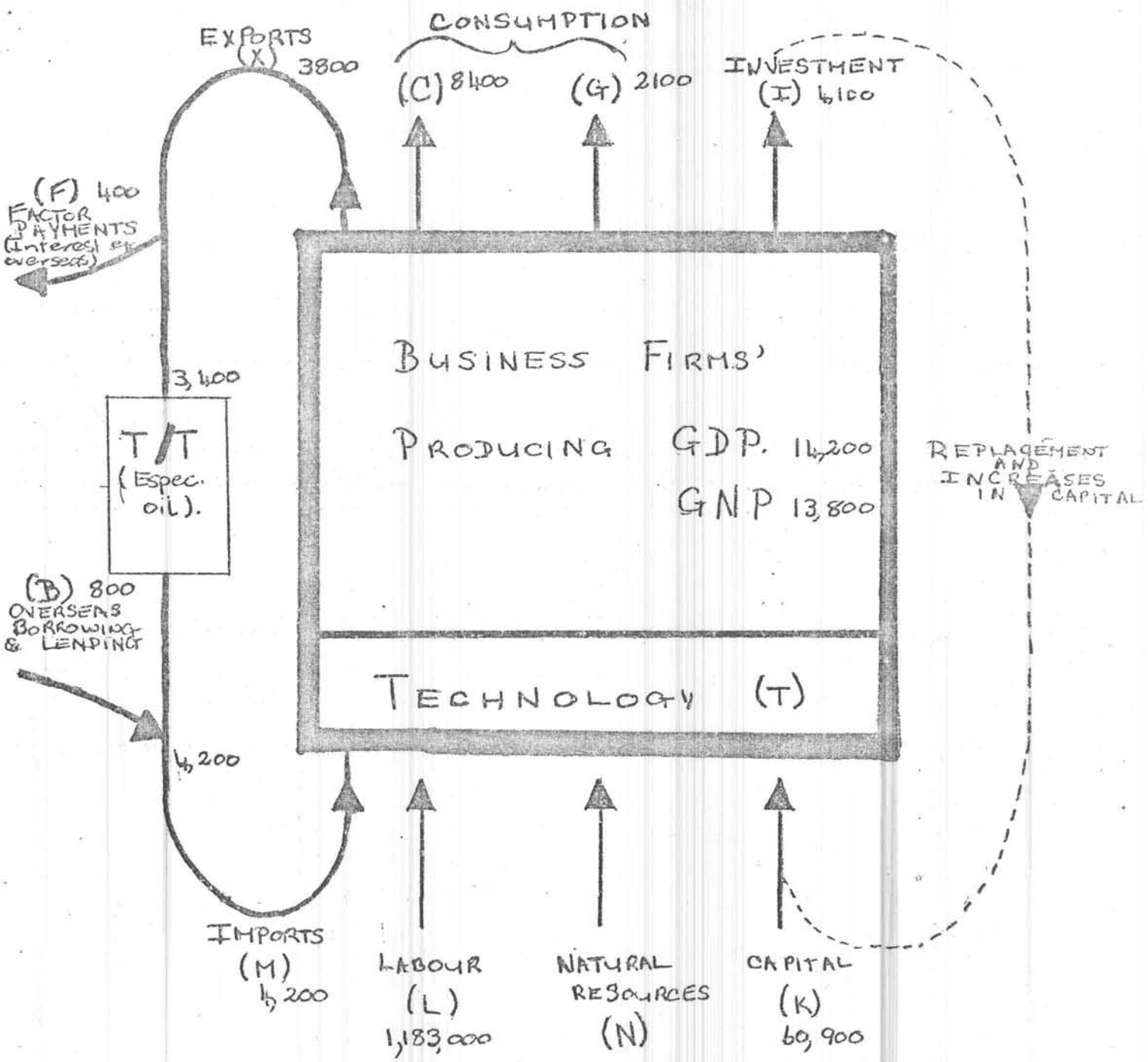
The economic machine transforms the inputs into outputs in a way, and to an extent, which depends - as the diagram shows - on the level of technology (T) available - the current stock of knowledge in science, engineering, management, etc.

The outputs or product of the economic machine consist of various goods and services usually in the aggregate, classified according to their purpose.

Firstly, there are new capital goods produced making up the flow of Investment (I). These are required to replace the worn out capital goods, i.e. Depreciation (D) but, also, to add to or extend the stock of capital to assist in increasing production even further in the future.

Secondly, there are products on which via the Government the community spends part of its income collectively from taxation and denoted as Government expenditure (G).

THE ECONOMIC FRAMEWORK.



(Apart from Labour all values are in $ million and rounded, figures relating to 1976/77).

Thirdly, there are Exports (X) which, as the flow shows, are sent abroad and converted into Imports (M) [to an extent dependent on the Overseas Terms of Trade (T/T)] which are required as inputs into the productive machine.

Finally, we have the flow of consumer goods, i.e. Private Consumption (C), the provision of which in many ways we can regard as the ultimate goal of the economy since it is these which, in the aggregate, make up the standard of living of the community.

One or two additional flows must be mentioned.

To the extent that imports and exports do not exactly balance and they rarely do, then the difference (X - M) defined as an overseas balance of payments deficit or surplus (B) requires financing either by borrowing from overseas to meet the deficit or lending overseas to dispose of the surplus.

Such borrowing or lending, i.e. overseas investment involves the payment (or receipt) of interest for as long as the liability or asset exists. As a reflection of past borrowing by New Zealand, the overseas commitment by way of interest on debts and profits on overseas capital invested in New Zealand is substantial and the total amount is denoted as Factor Payments Abroad (F). It represents an additional amount out of export income which must be provided before expenditure on imports can occur. And it represents part of the product of the economy which is not available to the domestic citizenry (since it accrues overseas) to spend on consumption or investment or government expenditure.

When we calculate the total production of the economy without allowing for these factor payments abroad (F) we denote the calculation as Gross Domestic Product, GDP. When allowing for factor payments abroad, we denote the result as Gross National Product (GNP). Thus we can say: GNP = GDP - F. Equally, the overseas Balance of Payments Deficit (B) or Overseas Borrowing = X - M - F.

The 1976/77 Economic Structure

The figures given in the previous diagram and the accompanying text relating to 1976/77 were approximate and rounded to the nearest $100 m. We give below the actual 1976/77 data in the form in which it is, in due course, used in the EMILY model for which the base year or starting point is in fact 1976/77.

National Product Aggregates
1976/77

Private Consumption (C)	8,393
Government Consumption (G)	2,067
Gross Fixed Investment (I)	3,427
Inventory Investment (S)	665
Gross Domestic Expenditure (GDE)	14,552
Exports of Goods & Services (X)	3,830
Less Imports of Goods & Services (M)	4,248
(X - M)	-418
Gross Domestic Product	14,134
Factor Payments Abroad (F)	438
Balance of Payments (B)	-856
Gross National Product	13,696

During the course of 1976/77 the total expenditure (GDE) of the nation was $14,552 m. Some of the products on which expenditure occurred were imports (M) and cannot therefore be counted as part of New Zealand product. Equally, some of the products were exports (X) bought be people overseas and therefore must be added to expenditure. Consequently, as shown, Gross Domestic Product (GDP) equals Gross Domestic Expenditure (GDE) plus Exports (X) minus Imports (M).

Part of New Zealand's GDP was however, not available for use in New Zealand but had to be paid abroad mainly by way of interest, dividends, etc. on overseas debt and overseas capital invested in New Zealand. These factor payments (F) must be deducted from production GDP to give the amount available to New Zealanders, i.e. Gross National Product (GNP).

The overall overseas balance of payments (B) equalling X - (M + F), represents the amount which must be borrowed abroad to maintain the level of overseas reserves.

Growth and Movement Over Time

The above simple picture and the numbers included in it, relate to one point in time, i.e. it is a static picture. To consider similar pictures for 2010, we need to take account of dynamics, of the movement of the economy over time between now and 2010 and the way in which it is in fact moving in the year 2010.

Our picture of the economy will display change and growth over time as a result of a number of factors of which a preliminary list would include:

(i) The growth of the labour force (L);

(ii) The rate at which non-renewable natural resources (N) are used up;

(iii) The rate of increase in the capital stock which itself will depend on the level of investment each year and that in turn depends on the disposition of expenditure between private and public consumption (C + G) on the one hand and Investment (I) from saving on the other;

(iv) The rate of growth of new technology (T) usually described as Technical Progress;

(v) The rate of growth of Exports (X);

(vi) Changes in the Terms of Trade (T/T) and the growth in imports (M) which are thereby provided;

(vii) The level of overseas deficit and therefore overseas borrowing (B) which is thought desirable and feasible in terms of its future financing.

Given the growth rates of each of these magnitudes and the quantitative relationships between them, it is possible mathematically to calculate the steady state growth rate in GNP and C which will emerge over the decades ahead.

It is useful at this point to mention that economic growth can be measured in a number of alternative ways in terms of total GDP or total GNP or total consumption or total consumption plus government expenditure, etc. Alternatively and probably of greater importance, growth should be measured in terms of any of these magnitudes expressed on a per capita basis. There is no particular virtue in aspiring to high levels of economic activity for its own sake as compared with aspiring to high levels of income or product or consumption per head of population.

The 2010 Economic Structure

The aggregate picture of the economy which emerges for the year 2010 or round about that time (since we should not make the pretence of spurious accuracy) will depend on the resources available at that time, on how they are used, and on the particular scenario which applies.

The resources available depend, in some cases and to some extent on outside events and, in other cases, on the growth pattern over the next three decades.

Thus the labour force (L) in 2010 is regraded as being determined by non-economic considerations. The terms of trade, especially insofar as these reflect changes in oil prices, are largely determined by factors external to New Zealand.

But the level of national resources available depends very much on the rate of exploitation which has occurred over the next three decades and on the rate of exploitation regarded as permissible in 2010. And the stock of capital in 2010 will depend on the rate of growth of investment over the preceding thirty years. So, too, will the level of factor payments abroad (F) depend on the amount of overseas borrowing which has been conducted over the period.

Technology (T) in 2010 will depend on new techniques developed here and abroad and on the extent to which it is thought useful and desirable for these to be adopted and indeed encouraged.

However, whatever the causal factors at work, and in the last resort the level of resources available will determine for 2010, the picture of the economy and the potential level of GNP and its disposition in various ways. These in turn will depend largely on which of the alternative scenarios is preferred.

Thus, in terms of our diagrammatic analysis, each scenario implies strategic chorus between:

(i) Private and public consumption.

(ii) Consumption and investment.

(iii) High exports and imports and low exports plus import substitution.

(iv) High or low overseas borrowing.

(v) Greater or smaller use of non-renewable natural resources.

(vi) Full use of available labour or toleration of substantial unemployment.

(vii) Greater or smaller uptake of new technology.

Multisectoral Choices in 2010

In addition to the above choices there are a number of others implicit in the scenarios which follow from the fact that the economy is not a single sector one but is made up of a large number of sectors each selling goods and services to each other, each making different products with different input requirements and different contributions to exports.

Thus, the choices outlined above apply to each of the sectors included in our analysis - 26 of them - as we shall see when we turn to modelling. It is now not only a question, for example, of the level of exports and/or imports but the particular

and appropriate sectoral mix of exports, more or less agricultural products or manufacturing or whatever and, similarly, there are choices as to where investment ought to occur, what sorts of goods would enter into consumption, what sort of labour/capital mix should be adopted in each sector and so on.

Lastly, to take account of environmental influences, allowance needs to be made for the fact that effects on the environment differ vastly as between different sectors and different sectoral structures of the economy.

To sort out all these intersectoral questions especially in the context of the four scenarios for 2010 requires much more than the simple, highly aggregated diagram with which we started this section. It requires a fully specified, computable, economic model of the economy to the description of which we now turn.

IV. Modelling The Scenarios

What is an Economic Model?

An economic model in the present context can be thought of as a long term or structural budget or plan of the economy of exactly the same sort as any firm would (or should) use in exploring or making decisions about its future operations. The picture of the economy, and the relationships which it encompasses, which we discussed in the previous section, represents a very simple and highly aggregated model of the economy. In our model essentially the same relationships as were portrayed there are included, except that the whole economy is broken down or disaggregated into 26 producing sectors to each one of which these relationships apply and between which there are also flows of goods and services that need to be taken into account.

Thus, using our model, we can produce a structural budget of the economy, in the future, showing for each sector:

- The disposition and use of labour, capital and natural resources;
- The exports provided;
- The imports used;
- The amount of import substitution done;
- The uptake of new technology, etc;

and finally:

- The overall economic outcome, in terms of some criterion, of which the most likely one is the standard of living or consumption per capita yielded by the economy.

To do this in the disaggregated sectoral model just as with the simple aggregated picture of Section III requires a knowledge of the quantitative relationships applicable to each sector; of the balance or consistency constraints which must apply; and, finally, requires some sort of optimisation routine.

Relationships

Greater detail on the relationships which need to be incorporated in the budget is given later in this paper. Broadly speaking however, we need to know:

- What are the capital, labour, and natural resource requirements in each sector, per unit of output;
- What are the goods and services required by each sector from each other sector per unit of output (the inter-industry relationship);

- What are the imports required in each sector per unit of its output;

- What goods and services are required from each sector to satisfy requirements for Private Consumption, Government Consumption and Investment.

Consistency Constraints

Whatever sort of budget is produced for the economy in terms of disposition of resources in and level of product from each sector, certain overall balance or consistency constraints must be satisfied. These include:

- Overall use of product for consumption, investment, export, etc. cannot exceed the production of products, i.e. Supply = Demand for Product.

- Overall use of capital, labour and natural resources cannot exceed the availability of these factors, i.e. Supply = Demand for Factors.

- Overall requirements for foreign exchange for imports (M) and factor payments abroad (F) cannot exceed the foreign exchange provided by exports (X) plus overseas borrowing (B).

- If the economy is to continue its growth, the level of investment in each sector must be adequate to expand the capital stock at a rate determined by the overall economy-wide growth rate of GDP.

The "Best" or Optimal Budget

Economic models leading to structural budgets of the economy can be used to simply explore what the economy would look like if things proceeded, especially the disposition of resources, along a path replicating the present situation and incorporating the present relationships.

But, clearly, the aim of structural budgeting, no less for the economy than for the simple firm, is to explore the implications of alternative budgets of which there are a countless number, as many in fact as we choose to generate from changes in assumptions, etc.

We could, for instance, use our model to throw up the budget which results from say:

- A shift of capital, labour and natural resources from one sector to another;

- A change in the sectoral mix of exports - more agricultural products and less manufacturing than normal;

- A change in the sectoral mix of goods entering consumption ;
- A change inthe level of government consumption relative to private consumption;
- An increase in the population or labour force from natural increase or immigration.

Further than this, we might wish to explore the implications of the budget which results from changes in the basic production relationships such as:

- Changes in each sector in the amount of labour and/or capital used in production, i.e. changes in the capital labour ratio;
- Changes in each sector in the imports required with compensating provision by each sector of higher cost import substitutes;
- Changes in the overseas terms of trade for each type of export;
- New intersectoral relationships as the result of new products, new sectors, new activities, thus, for example, the introduction of microprocessor technology; the introduction of pollution abatement activities; and the establishment of substantial effort involved in retraining of redundant labour, and the imparting of needed skills, or in scientific research and development aimed at speeding up the rate of technical progress.

To carry out all the necessary calculations for each one of a myriad alternative budgets embracing the above types of changes and to select from them the best or optimal budget, would be a daunting if not impossible task.

Happily, a computer routine known as Linear Programming is available which not only performs this task efficiently and expeditiously but which also ensures that no violation occurs to the consistency constraints mentioned before. To use this routine, indeed to use any routine in which we seek to establish the best or optimal budget, we need to decide what it is we are endeavouring to optimise, i.e. we need some optimisation criterion.

Optimisation Criterion

Usually, in our model, this is set as Maximise Private Consumption subject to all the relationships and consistency constraints. But any criterion wished can be chosen provided there is appropriate rearrangement of the constraints. Thus, if we wished, and in fact have done, we could:

- Maximise employment subject, inter alia, to some minimum level of consumption or gdp;
- Minimise the import of energy subject, inter alia, to some level of consumption or gdp;
- Minimise exports subject, inter alia, to some level of consumption or gdp,

and so on.

The modelling of the four alternative scenarios discussed in Section II is, largely speaking, a matter of varying in the basic model, either the optimisation criterion or the mix and levels of the constraints, or both. Thus, in scenario A, we allow very high levels of export constraints from each sector; in scenario C we maximise employment; in scenario B we introduce a microprocessor sector; in scenario D we minimise pollution and environmental destruction and so on.

The EMILY Model

The particular economic linear programming model we use for producing our quantitative scenarios or budgets is known as EMILY. It consists of a 26 sectoral break-up of the economy, is an outcrop of the VICTORIA model, and is fully described in earlier papers.[1] A detailed treatment of the model and the particular constraint pattern adopted is given in an Appendix to this paper.

Some discussion on the ingredients of the EMILY model now follows with particular reference to the three main requirements we have already mentioned, viz:

- Relationships
- Consistency Constraints
- Optimisation Criteria

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[1] *In particular, in Bryan Philpott and Adolf Stroombergen "Modelling the End of the Millennium With EMILY", PEP Internal Paper No. 89, April 1980.*

Reference should also be made to Bryan Philpott, Adolf Stroombergen and Richard Wallace - "The Equation Structure of the Victoria Model", PEP Internal Paper No. 93, Aug. 1980.

V. Basic Relationships and Constraints In EMILY

The following brief description of the basic relationships and constraints in the basic EMILY model relates, of course, to the situation at the time of writing and is subject to considerable amendment even over the year ahead. The development, amendment and improvement of EMILY and, indeed, of all economic models is a continuous never-ending process reflecting, in the main, the experience we gain as we proceed and the accumulation of new banks of statistical data available for use.

Basic Relationships

These concern mainly:

- Interindustry input-output relationships;
- Labour, Capital and Natural Resources used per unit of sectoral output;
- Import-output relationships;
- Government and private consumption mix.

They are all based on the Statistics Department's 1976/77 Input-Output Table encompassing 26 sectors and full quantitative details are given in earlier papers[2] but a summary table of the base year relationships is given in an appendix table in this paper. By and large the sectoral coverage and data are the same as for the current versions of the VICTORIA model.

Technical change rates of the labour augmenting type are assumed for 1976/77 to 2010 at individual sectoral rates which reflect recent experience and which for the economy as a whole, average out at 0.6% p.a. The implication of these rates is that labour and capital requirements fall each year in each sector by an amount which, for the economy as a whole in terms of gdp, represents a reduction of 0.6%.

Alternatives and Changes in Relationships

To allow the model to choose the optimum mixture of factors, labour and capital, in the production process; and to permit choices on whether to import goods or produce them where feasible and economic at home, alternative activities must be allowed to the basic 1976/77 relationships listed above.

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[2] *Adolf Stroombergen - "Description ad Data Base For 1985 Version of the VICTORIA Model", PEP Internal Paper No. 86, January 1980.*

Alternative Factor Output Ratios are introduced such that production can proceed in 2010 with up to either 30 percent or 60 percent more capital per unit of output than in the base year with a proportionate reduction in labour used; and, also, up to either 30 percent or 60 per cent more labour with proportionate reduction in capital use. These alternatives are denoted as "capital intensive" and "labour intensive" production modes respectively.

In simulating this process of capital labour substitution, special attention has been paid to the type of labour, i.e. skilled or unskilled which is being used or displaced in the substitution process. (A special note on this matter follows below).

Import substitution or encouragement is permitted as departures from the basic import-output relationship up to a level representing 70% of the potential maximum of such substitution in each sector. Cost penalties (and bonuses) attached to such substitution (and encouragement) are set at 30%, this being roughly the average rate of nominal protection in New Zealand. This, then, represents roughly the additional resource cost involved in producing in New Zealand goods and services which are otherwise imported, or the bonus in terms of resources which accrues to us in importing goods which were otherwise produced in New Zealand.

Fuller details of these relationships can be found in the papers referred to in earlier footnotes.

Basic Constraints

As indicated earlier, a number of constraints are varied and new ones added according to the particular scenario under examination. Here, we give the basic values of the constraints. Variations will be dealt with later when we turn to the scenarios. The following constraints are, of course, all additional to those basic consistency constraints which we mentioned in Section IV, i.e. supply demand balances for goods, capital and labour, foreign exchange, etc. as well as growth in investment.

The Labour Force in 2010

This is set at 1,821,000 persons calculated by interpolating the Labour Department's predictions for 2006 and 2011 - low immigration variant. The result is a growth rate of 1.3 percent per annum from 1976/77.

The split up of the labour force in 2010 as between skilled and unskilled persons is discussed in a special note below on this question.

Government Expenditure

Government Social Investment Expenditure $765 m. (in 1976/77 prices) and Consumption $3,973m. both representing a growth rate of 2% p.a. for 1980.

New Housing Expenditure $620.4m is calculated as an extrapolation of the Statistics Department's housing forecasts (to 1988) at the same rate as population growth.

Terms of Trade are assumed to remain at 1976/77 level unless mentioned otherwise.

Balance of Payments is set at zero implying, in our model, (which does not treat of overseas factor payments) that net overseas borrowing equals overseas factor payments.

Growth of Capital Stock and Net Investment

The growth of the capital stock over the 33-year period is assumed to be 3% p.a. (including in this allowance for government social capital $22,046 million and houses $28,803 million). The total capital stock of the economy in 2010 is $167,556 m. in 1976/77 prices.

The task of the model is then to allocate this together with labour, imports, etc. etc.) amongst sectors in such a way as to maximise consumption but subject to the constraint that new investment must occur in each sector at a rate equal to 3% of the capital allocated. In this way, we simulate via our model an economy in 2010 which is growing at around 3%.

Export Maxima

These constraints which are varied from scenario to scenario are set to reflect what is though to be either the maximum of the particular export product which can be produced, say for biological reasons in the case of agriculture, but, of far more importance, the maximum which it is thought could be sold overseas at unchanged terms of trade. The variations in them in each scenario are a reflection of the pre-set desirable export mix which characterises each scenario.

The four sets of upper level export constraints relating to each of the four scenarios are given in the following table together with the per annum percentage growth rates of each main group of exports from 1976/77 to 2010.

The main variations are in the growth rates of agriculture, forestry, manufacturing and services exports each of which admit of a high, medium, or low level and in various combinations according to the flavour of the scenario. These particular combinations for each scenario are shown in greater detail in the next section.

EMILY EXPORT CONSTRAINTS BY EXPORT GROUP AND C.F.F. SCENARIOS

	BASE YEAR 1976/77			A.		GROWTH RATE	B		GROWTH RATE	C		GROWTH RATE	D.		GROWTH RATE
AGRICULTURE															
Agriculture / Horticulture	80.2			172.1			122.1			401.3			110.2		
Dairy	429.0			429.0			429.0			429.0			429.0		
Meat	757.0			1624.6			1150.2			2694.2			1039.9		
Wood	650.0			1395.0			987.8			2318.4			893.0		
Food, Beverages & Tob.	280.0			600.9			425.4			996.5			384.7		
TOTAL		2196.2			4221.6	(2.0)		3114.5	(1.1)		6834.4	(3.5)		2856.8	(0.8)
FISHING															
TOTAL		26.0			130.1	(5.0)		50.2	(2.0)		50.2	(2.0)		50.2	(2.0)
FORESTRY															
Forestry	39.5			147.6			52.7			57.0			56.0		
Wood	40.4			439.4			77.7			125.7			77.7		
Paper	157.9			1717.4			303.5			491.4			303.5		
TOTAL		237.8			2304.4	(7.1)		437.9	(1.9)		674.1	(3.2)		437.2	(1.9)
MANUFACTURING															
Textiles	112.7			1776.3			350.7			350.7			135.2		
Chemicals	35.6			561.1			110.7			110.7			42.7		
Non-Metallic	10.3			162.3			32.0			32.0			12.4		
Base Metals	131.2			2067.9			498.4			498.4			157.4		
Metal Products	114.5			1804.7			356.3			356.3			137.4		
Other	12.5			197.0			38.9			38.9			15.0		
TOTAL		416.8			6569.3	(8.7)		1687.0	(4.3)		1687.0	(4.3)		500.1	(0.6)
SERVICES															
TOTAL		737.6	(0.0)		734.6	(0.0)		5045.6	(6.0)		5045.6	(6.0)		734.6	(0.0)
OTHER															
Mining	14.0			70.0			26.9			26.9			16.8		
Energy	37.3			405.7			116.1			116.1			44.8		
Re-Export	161.1			161.1			161.1			161.1			161.1		
TOTAL		212.4			636.8	(3.4)		304.1	(1.1)		304.1	(1.1)		222.7	(0.1)
TOTAL		3826.8			14599.8	(4.1)		10639.3	(3.1)		14595.4	(4.1)		4785.6	(0.7)

Skilled Versus Unskilled Labour

The labour force used in EMILY and the labour coefficients reflecting the labour requirements in each sector, have been divided into skilled and unskilled categories. The work we have done in this area is so far preliminary only and will be extended and intensified over the coming year, but an analysis of the 1971 and 1976 censuses has provided us with a preliminary view of labour requirements and availability divided in this way. The basic census data and our analysis of it are to be published in a forthcoming PEP Internal Paper.[3]

The resulting coefficients giving skilled and unskilled labour requirements in the base year are given in the table in Appendix I. These refer to the base year and the use of existing (or X) production modes, i.e. degree of capital and labour intensity which, if desired, the model may use in 2010 after allowing for rates of technical change between 1977 and 2010.

We need also to allow for the possibility of the model using in 2010, alternative production modes which stress either greater degrees of capital intensity (denoted later by k' and K") or labour intensity (L' L") as explained before.

In calculating the labour coefficients for these alternatives we assumed that in any departure from the X activity, the ratio of skilled to unskilled labour increases.

The ratio of skilled to unskilled labour available in 2010 is assumed at this stage of our work to be unchanged as compared with the base year. However, and to repeat this assumption and all the routines mentioned above are preliminary only and subject to substantial amendment resulting from further research at present under way.

Optimisation Criterion

The foregoing sections have described the basic empirical relationships which are embodied in EMILY and the constraints to which, in the light of these relationships, the optimisation process is subject. It remains to say what is to be optimised.

At this stage, we have been concerned mainly to maximise the level of private consumption provided by the economy in 2010. As such, private consumption has been taken as a measure of the standard of living achieved - with a given level of labour force it is of course identical with maximising consumption per capita.

As mentioned earlier, other optimisation criteria could easily be introduced such for example as maximising exports, maximising employment, minimising imported energy use and so on but exploration of these criteria has yet to occur.

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[3] *Richard Wallace, Stephen Burnell and Peter Lawson: "Educational and Occupational Classification of the Sectoral Labour Force 1971 and 1976", PEP Internal Paper 100 (forthcoming).*

One important, but rather moot, point needs to be mentioned about optimisation. In much scenario modelling overseas the procedure has been to as it were "force in" to the model the particular features which are embodied in the scenario. Thus, in scenario C which inter alia emphasises agricultural production, the procedure under such an approach would be to force the economy to produce and export agricultural products at a very high level and observe the result. Our procedure has been different. We have in effect said, under Scenario C:

> "You may if you wish produce and export agricultural products at a higher level because we have raised the upper level export constraint for agricultural products to a high level. But you should only do this if in fact it gives us a better result than any other export mix or structural policy you may decide on".

It is, of course, not impossible for us to "force in" to the model anything we wish (by using equality constraints) and, in due course, we shall do so but, for the present, the results presented below are produced in the context of the optimisation philosophy described above.

VI. Particular Constraints For Each Scenario

To explore quantitatively with EMILY the four scenarios outlined in Section II, we have varied, as far as possible, the level and mix of various constraints and relationships to reflect the spirit of each scenario.

The table below gives the detail of these specifications for each of the four scenarios A, B, C and D. The alternative specifications relate to:

- Different levels and mixtures of the upper level export constraints ranging from high manufacturing and forestry in A through high agriculture in C and very low levels of all exports in D.

- Different permissible levels of overseas borrowing ranging from a high level in A through to a surplus (to pay accumulated interest or part borrowing) without further borrowing, in D.

- Different levels of required Government Expenditure to reflect varying accent on welfare, etc.

- Different types of permissible Production mode allowed ranging from accent on capital intensity in A through to labour intensity in C and D.

- Different permissible import stance ranging from accent on free trade and therefore import encouragement in A to accent only on import substitution in B, C and D.

- Amendments to reflect the accent on microprocessors in scenario B by reducing the use of transport in private consumption by 25% and increasing the use of computer terminals, increasing the import content of investment in the communications sector, and reducing the availability of liquid fuels by about one-third. At this stage, we have not yet made allowance for the development of domestic substitutes.

  The detail of these changes is given in the Appendix II.

SCENARIO CONSTRAINTS

		A	B	C	D
CONSTRAINTS ON EXPORTS GROWTH.	Agr	medium	low	high	very low
	For	high	low	low	low
	Mfg	high	medium / low	medium / low	very low
	Serv	no growth	high	high	no growth
BALANCE of PAY.		5% GDP (≈1500)	0	0	400
GOVT. EXPENDITURE		low	medium	high	low
TECHNICAL CHANGE		general	labour	augmenting	bias
PRODUCTION MODE					
- ALLOWED		k' k"	All	L' L"	X L'
- CHOSEN		k'	k'	L'	L'
IMPORT STATUS					
- ALLOWED		E / X	S	X / S	X / S
- CHOSEN		E	S	X	S
MISCELLANEOUS		Lower liquid fuel availability. Lower personal transport use. More use of computer terminals. Higher import content in communications sector.			

Definitions

Capital intensity - k', greater capital intensity - k"

Labour intensity - L', greater labour intensity - L"

import substitution - S

existing import status - X

freer trade - E

In the light of these particular amendments to the general level of constraints and relationships dealt with in the previous section, we now proceed to use EMILY to produce long run optimal structural budgets of the economy giving the highest level of private consumption which can be achieved subject to all the constraints imposed in each different scenario.

The results are given in the next section.

RUN RESULTS

		A		B		C		D		C	
		Run 100	Growth % p.a	Run 100	Growth % p.a	Run 100	Growth % p.a	Run 100	Growth % p.a	Run 101	Growth % p.a
Consumption Private	8393	26161	(3.51)	19234	(2.54)	15463	(1.87	11820	(1.04)	21662	(2.91)
Government	2067	2870		3973		4669		2870		4669	
Gross Investment (excl. stocks)	3247	3005	(2.77)	4059	(0.68)	3364	(0.11)	2954	(-0.29)	6647	(2.19)
Imports Consumption		3599		2646		2127		1100		2980	
Total	4248	13750		7442		7048		4405		9060	
Exports Agricultural	1916	3824		2196		3868		2857		5904	
Fishing + Hunting	26	50		50		50		50		26	
Forestry	30	147		57		57		56		57	
Wood products	40	2157		381		617		381		617	
Manufacturing	868	4754		1590		1427		500		1427	
Services	738	738		2956		738		738		738	
Other	212	581		212		291		223		291	
Total	3830	12251	(3.59)	7442	(2.03)	7048	(1.87)	4805	(0.69)	9060	(2.64)
Gross Domestic Product	14134	36697	(2.93)	28195	(2.11)	24301	(1.64)	18632	(0.84)	34031	(2.70)
Ratios I/GDP	24.2%	21.8%		14.4%		13.8%		15.9%		19.5%	
M/GDP	30.1%	37.5%		26.4%		29.0%		23.6%		26.6%	
Employment = Skilled	1183.0	728.4	(0.66)	728.4	(1.32)	728.4	(1.32)	661.7	(0.30)	728.4	(1.32)
Unskilled		741.7		1092.6		1092.6		646.3		1092.6	
Unemployment = Skilled	47.0	0.0		0.0		0.0		66.7		0.0	
Unskilled		350.9		0.0		0.0		446.3		0.0	
Predominant Tecnology status		K'		K'		L'		L'		K'	
Predominant Import status		E, X		S		X		S		S/X	

VII. Quantitative Results For Each Scenario

These are given in the table below where the main macromagnitudes are given for each of th four scenarios A to D. The basic runs are numbered 100. In addition, there is for scenario C a variant numbered C101 on which we comment further below.

We note again that these results represent the models attempt (by shuffling around resources) to secure the highest level of private consumption in 2010, given the resources made available and within the constraints, especially as to types and levels of export set out in the previous section.

A General View

As we move progressively from.scenario A through to the self sufficient economy in scenario D, we note the decline in consumption and gdp achieved - in fact, in D, consumption and gdp growth does not ever match the growth in labour force.

However, the level of unemployment does not match the pattern of gdp growth. Unemployment of unskilled labour is high in A and of skilled and unskilled labour high in D.

Each scenario displays differences in other variables, exports investment, imports, etc. and these are now discussed in turn.

Differences in Production Mode

To a large extent these reflect the production mode forced into the model as in scenarios A, C and D. In scenario B where all production modes were permitted, the model chose K' - a moderate degree of capital intensity.

Differences in Investment

These can be gauged from the growth rates of investment and from the investment/gdp ratios given two-thirds way down the table. Scenario A is a very high investment economy (which accounts for its high performance in gdp per head). Its high investment level is facilitated by the large amount of overseas borrowing which this scenario permits.

Investment, of course, also depends on the model's choice as to production mode (and vice versa). The accent on capital intensity in scenario A reinforces the tendency to high investment. Equally in C and D, the accent on labour intensity, and in D the grave shortage of foreign exchange due to low export constraint levels, all conspire to encourage lower investment levels. Investment in B is also low largely because of the tough energy use constraint we have imposed on it.

Differences in Trade Status

Again, as with the production mode, the model's choice as between import encouragement and freer trade on the one hand and import substitution and protection on the other, is limited by the constricted range of alternatives offered to it.

In scenario B, import substitution was forced into the model and in D, from the choice of existing trade status or import substitution it unequivocally chose the latter because of its scarcity of foreign exchange earnings from exports. In scenario A with high levels of exports, the free trade option was chosen.

Differences in Exports

To gauge effectively what is happening in regard to exports, we need to compare the figures given with the upper level export constraints presented in the previous section.

The only scenario in which all export constraints are "used up" is D where the levels are so low as to make it imperative that every export opportunity be exploited. As far as A, B and C are concerned, total exports come nowhere near the total potential available. This follows the very important implication that there is no use exporting just for exports sake - that there are, in all scenarios depending on the constellation of resources available and economic structures posited, optimal levels of exports required if one is to secure optimal levels of private consumption.

Looking at scenarios A, B and C, we note that:

- Forestry exports are in all cases up to the constraint level;
- Manufacturing exports are not far behind;
- Services and agricultural exports are consistently below and sometimes well below their constraint levels.

Not too much should be read into these apparent orders of priority. They will, undoubtedly, change when in future work we allow for possible changes in the overseas terms of trade and permissible production modes, levels of investment, etc. Indeed, the above priorities will be immediately amended when we move (in a moment) to Run C101.

Differences in Employment and Unemployment

A high level of unskilled unemployment emerges in scenario A largely because of the accent on capital intensity, the particularly low level of unskilled labour requirements of the sectoral production mix chosen, and because of the low level of government expenditure. Unemployment is avoided in B and C because government expenditure runs at high levels and, also, in C, because of the labour intensive production mode which has been forced into the model. The strait jacket into which the self-sufficient economy D is forced leads to unemployment of both categories of labour in spite of the model opting for labour intensity in production.

A Variant on Scenario C

In C100 we forced the model to adopt a labour intensive production mode as a means of achieving full employment which goal is pre-eminent in scenario C. It has achieved this but at the expense of a quite low level and rate of consumption and gdp growth. Run C101 shown on the table was undertaken to test whether we could still get full employment plus a faster growth of consumption by allowing the model to choose its own production mode.

This it did. The optimising routine switched production to capital intensity and the trade status a little away from import substitution.

With the ability now available to utilise greater amount of capital, there is immediately a substantial rise in agricultural exports nearly up to constraint, agricultural production being a very high capital user. The result is a very respectable rise in consumption and gdp growth towards the sort of levels turned out by scenario A.

Consumption Achieved

Differences in private consumption achievable, reflect not only the economic structure which is developed given the general constraints imposed, but also the specific amount of government consumption which the model is enjoined to provide.

Thus, part of the very high consumption level of A is achieved because government consumption is set so low as compared with C where the opposite applies. Consumption levels in B come third in the order of achievement and in D a very low outcome emerges. In fact at 1.04% p.a. growth in consumption matched by a 1.3% growth in labour force (and much the same in population) the level of consumption per head or standard of living as conventionally measured, actually declines in scenario D. Of course, this is the standard of living as conventionally defined in terms of goods and services which currently make up the consumption pattern of our economy. It takes no account at this stage of changes in consumption patterns consonant with the "spiritual" emphasis of scenario D let alone the non-economic ingredients in the web of human satisfactions such as the quality of life, protection of the environment, greater degree of leisure and the chance to "do ones own thing".

Nevertheless, given the restricted type of measurement used, the result does give an indication in the form of a trade off, of the amount of conventional consumption which needs to be sacrificed to achieve these non-economic goals.

VIII. CAVEATS, CONCLUSION AND FURTHER WORK

It cannot be too strongly emphasized once again, not only that the foregoing results are not predictions but explorations, but also that as such they are only a beginning of the exploration process and presented mainly to show the sort of pictures that emerge from our model. There are countless variations which are currently being investigated - changes in assumptions, constraint levels, parameters - such as terms of trade, consumption mixtures and so on.

Furthermore, our model so far, takes no account of the important constraints of a non-economic nature or of special structural changes in the economy which need special investigation.

Many of the non-economic constraints are qualitative in nature and as such cannot be included in our model. These are the matters to which close attention is being devoted by the Secretariat of the Commission for the Future to whose work the present research must be regarded as complementary.

Some non-economic or quasi-economic values can be modelled and our current modelling research is well advanced in directions which involve including in our model four new sectors embracing:

- Microprocessor technology and all its ramifications for further exploration of scenario B (The Network Information Economy).
- Expenditure on Education and its impact on the level of skill in the labour force.
- Expenditure on Research and Development and its impact on the rate of technical change in each sector.

These important additions to our model are again likely to lead to some amendment to the general pictures portrayed in the results given above and represent therefore a further reason for regarding them, at this stage, with considerable reservation and in the spirit in which they are presented.

APPENDICES

APPENDIX I

Basic Factor Output Relationships in EMILY.

APPENDIX II.

The detailed structure of the EMILY Model.

APPENDIX I. BASIC FACTOR OUTPUT RELATIONSHIPS IN EMILY

Sectors	Skilled labour-output ratios	Unskilled labour-output ratios	Capital-output ratios	Depreciation-output ratios	Import-output ratios	Rate of technical change % per annum w.r.t.	
						labour	capital
1. Agriculture	.0129	.0129	2.140	.0456	.0543	2.0	1.0
2. Fishing	.0185	.0186	0.539	.0403	.0697	2.6	1.3
3. Forestry	.0033	.0072	0.265	.0104	.0486	3.4	1.7
4. Mining	.0045	.0105	2.66	.1252	.0427	0.5	0.0
5. Food	.0051	.0129	0.512	.0274	.0657	0.74	0.37
6. Textiles	.0090	.0249	0.429	.0223	.1601	1.5	0.75
7. Wood	.0028	.0077	0.052	.0027	.0459	4.0	2.0
8. Paper	.0029	.0054	0.078	.0051	.0629	4.0	2.0
9. Chemicals	.0032	.0060	0.273	.0157	.2961	2.8	1.4
10. Non Metallic	.0087	.0200	0.850	.0530	.0565	0.5	0.0
11. Base Metals	.0037	.0084	0.788	.0524	.1604	0.5	0.0
12. Fab. Metals	.0031	.0069	0.037	.0018	.1979	4.0	2.0
13. Other Mfg.	.0049	.0117	0.045	.0020	.1728	4.0	2.0
14. Water	.0043	.0116	9.88	.0506	.0460	0.5	0.0
15. Construction	.0063	.0077	0.148	.0120	.0577	2.32	1.16
16. Trade	.0104	.0210	1.99	.0477	.0405	0.5	0.0
17. Transport	.0088	.0200	1.398	.0768	.1101	1.44	0.72
18. Communications	.0254	.0431	1.948	.0626	.0159	1.0	0.50
19. Insurance	.0236	.0135	2.419	.0579	.0133	0.5	0.0
20. Own Dwelling					.0214		
21. Govt. Services	.0447	.0358			.0579	0.5	0.0
22. Private Services	.0255	.0205	1.554	.0375	.1219	0.5	0.0
23. Coal & Nat. gas	.0100	.0232	1.47	.0548	.0257	0.5	0.0
24. Petrol	.00025	.00045	0.25	.0065	.5403	0.5	0.0
25. Electricity	.0031	.0033	0.549	.0083	.0224	4.0	2.0
26. Gas	.0056	.0059	0.131	.0069	.0883	4.0	2.0

(All Output Values in $m. 1976/77 Prices. Labour in '000 Persons)

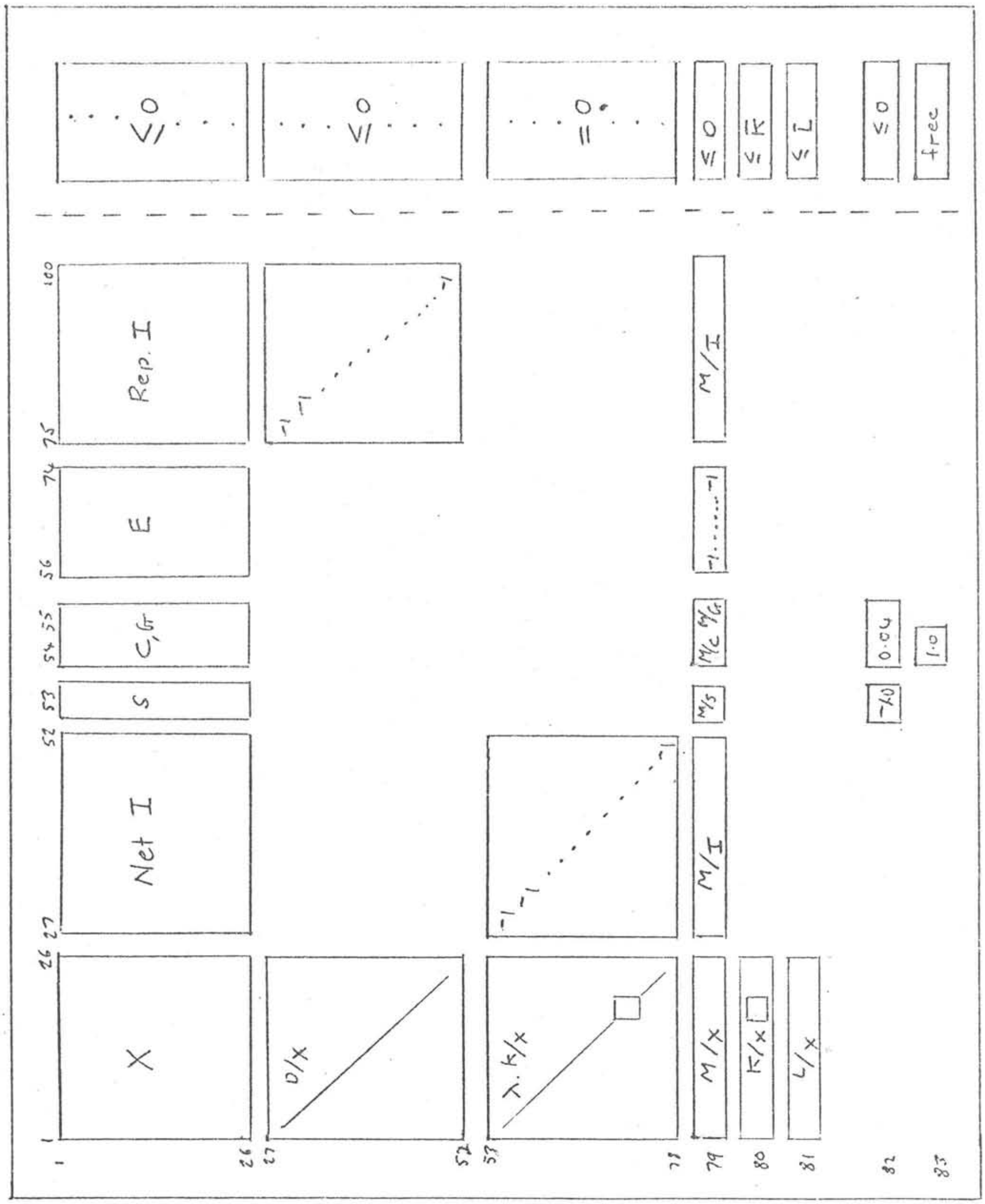
APPENDIX II

THE DETAILED STRUCTURE OF THE EMILY MODEL

In the EMILY model the aim is to maximise the level of private consumption subject to a number of constraints including a predetermined level of government consumption and social investment, and a predetermined level of housebuilding; and the usual economic constraints relating to labour supply, overseas balance of payments equilibrium, maximum investment and savings levels, and market potentials for various types of exports.

In achieving this optimum level of consumption the model has available to it, in establishing the optimal sectoral allocation of the stock of capital and of the available supplies of labour, a number of alternative methods of production and economic structures including choice between various degrees of capital and labour intensity, varying degrees of accent on exports of various types and/or varying degrees of import substitution of various types.

SCHEMATIC DIAGRAM OF EMILY 2010 MODEL



KEY TO DIAGRAM

X - Matrix of input-output coefficients

Net I - " " " " for net investment .

Rep I - " " " " " replacement " .

S - Vector of stocks

C - Vector for private consumption

G - Vector for government consumption

E - Matrix of input-output coefficients for export

$D/_X$ - Diagonal matrix of depreciation (D) - output (X) coefficient

$\lambda.K/_X$ - Diagonal matrix of capital (K) - output (X) coefficients multiplied by the net investment - capital ratio (λ).

$M/_X$ - Row vector of import (M) - output (X) ratios.

$L/_X$ - Row vector of labour (L) - output (X) ratios.

The model's construction can be illustrated in the diagram above which shows the main blocks of numbers and relationships involved. A key to the symbols used in the diagram is given on the page following it.

The numbers along the top represent numbers of columns. As there are 26 producing sectors in the model, the numbers are in groups of 26 for production (X), net investment (I) and replacement investment (Rep I). In the case of exports (E) there are only 19 columns as 7 of the producing sectors do not export.

The numbers down the side represent rows again tending to be in groups of 26. They relate to the various constraints to which the model is subject.

The details of these constraint rows are as follows:

(i) Rows 1-26 — ensure that total output is at least equal to the amount required for intermediate input (cols. 1-26), net investment (cols. 27-52), stocks (col. 53), consumption (cols. 54-55), exports (cols. 56-74), and replacement investment (cols. 75-100).

(ii) Rows 27-52 — ensure that replacement investment in each sector is sufficient to satisfy depreciation requirements.

(iii) Rows 53-78: — ensure that net investment in each sector is equal to the same proportion (λ) of the capital stock in that sector. Note that there is no such relationship in "Housing" and "Government Services" sectors since net investment here is exogenously stipulated. For the present model λ is set at 0.03, i.e. net investment in all sectors proceeds at the rate of 3 percent of the capital stock optimally allocated to that sector. This implies an equiproportional expansion in capital used in all sectors in the economy at that rate.

(iv) Row 79: — ensures that total import requirements do not exceed revenue from exports plus some allowable balance of payments deficit or surplus, in this case zero.

(v) Row 80: — ensures that the sum of the sectoral capital stocks in each sector is not greater than the total available, $\overline{K}$ where in this case $\overline{K}$ = \$167556m.

(vi) Row 81: — ensures that no more labour is used than is available ($\overline{L}$), where $\overline{L}$ = 1821.1 ('000).

(vii) Row 82: — ensures that stock accumulation occurs at a rate at least equal to 4% of total consumption.

(viii) Row 83: — represents the objective function, which in this case is private consumption, the level of which it is the model's purpose to maximise.

P.E.P. PUBLICATIONS

OCCASIONAL PAPERS

No.	Author	Title
25	B.P. Philpott & V.C. Elley:	*The Victoria Planning Model - A New Version Incorporating Alternative Capital-Labour Ratios and Import Sunstitution.*
27	N.D. Tho:	*A Pilot Three-Sector Model with Prices.*
28	N.D. Tho:	*Sectoral Trends in Labour Productivity 1965/6 to 1973/4.*
29	V.C. Elley:	*Effective Protection in Selected New Zealand Manufacturing Industries in 1972/73.*
30	B.P. Philpott & N.D. Tho:	*Sectoral Trends in Gross Output, Factor Input, and Labour Productivity 1954/55 - 1974/75.*
31	Colin Campbell:	*Capacity Capital Formation in New Zealand Manufacturing Industries 1952-1973.*
32	Colin Campbell:	*The Stock of Fixed Capital in New Zealand Manufacturing Industries 1950/51 - 1972/73.*
33	B.P. Philpott & D.T. Nguyen:	*Exploring the Economy in the Eighties*, June 1977.
34	L.T.A. Nguyen & B.P. Philpott:	*Exploring 1990 with the Victoria Model*, June 1977.
35	L.T. Evans:	*Duality Between Production, Profit and Cost Functions: Real Value Added*, July 1978.
36	Colin Campbell:	*Trends in Productivity of New Zealand's Manufacturing Industries - 1951/52 - 1972/73.* October 1978.
37	Richard Wallace, A. and B. Philpott	*A Prototype Three-Sector New Zealand Groth Model*, Feb.1980.
38	Bryan Philpott & Adolf Stroombergen	*Modelling the End of the Millennium with Emily*, June, 1980.
39	Adolf Stroombergen & Bryan Philpott	*Optimal Economic Structure with Uncertainty as to Export Volume Achievement*, August 1980.
40	A. Stroombergen & B.P. Philpott	*Julianne - A New Zealand General Equilibrium Model Stressing International Trade*, August 1980.
41	B.P. Philpott & A. Stroombergen	*Unemployment and Structural Change*, August 1980.
42	Bryan Philpott, Richard Wallace & Adolf Stroombergen	*The Equation Structure of the Victoria Model*, Sept., 1980.
43	Richard Wallace & Bryan Philpott	*JOANNA - A Johansen Type General Equilibrium Model for New Zealand*, November 1980.
44	Bryan Philpott & Richard Wallace	*Policies for Raising Employment - An Application of the Short Run Joanna Model*, January 1981.

DISCUSSION PAPERS

9	B.P. Philpott & N.D. Tho:	*An Analysis of Real Import Ratios by Economic End Use*, December 1975.
10	B.P. Philpott & N.D. Tho:	*An Input-Output Analysis of Structural Import Demand in New Zealand*, January, 1976.
11	B.P. Philpott:	*Economic Planning and the Shape of Things to Come*, Feb. 1976.
12	B.P. Philpott:	*A Productivity /Subsidy Tax to Raise Production and Stabilise Income by Agriculture*, May 1976.
13	B.P. Philpott:	*Structural Economic Policy in New Zealand*, April 1976.
14	B.P. Philpott:	*The Role of Government in Maximising Future Economic Growth*, July, 1978.
15	B.P. Philpott:	*Aspects of a New Agricultural Policy*, October 1978.
16	B.P. Philpott :	*The Administration of the Economy - A Fresh Look at Economic Planning*, April 1979.
17	K. Lowen & B.P. Philpott:	*Interfacing Industry Level and Economy-wide Models for Planning - An Example From Forestry*, March 1980.
18	B.P. Philpott:	*Appropriate Economic Policy for New Zealand*,July 1980.
19	B.P. Philpott:	*Economic Policy for the Eighties*, September 1980.
20	Richard Wallace & Bryan Philpott	*Price Determination in New Zealand Manufacturing Industry*, November 1980.
21	Andrew Philpott & Wyndham Draper	*Demand Elasticities From the Household Expenditure Survey*, January 1981.