A PROGRAMMING APPROACH TO REGIONAL ECONOMIC PLANNING: AN APPLICATION TO THE NEWFOUNDLAND ECONOMY

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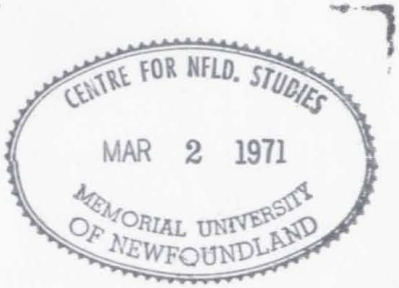
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A PROGRAMMING APPROACH TO REGIONAL ECONOMIC PLANNING: AN APPLICATION TO THE NEWFOUNDLAND ECONOMY

by

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ABSTRACT

The aim of this study is to present and apply a programming model to the Newfoundland economy through which the efficient allocation of scarce factor inputs can be determined. In addition the possible results that the elimination of resource misallocation would have on the level of Provincial income and on the rate of growth of the economy within the next five years are explored.

The model used to achieve this aim is based on a combination of linear programming and input-output analysis. This allows general equilibrium and structural interdependence to be taken into account so that efficient and optimum resource allocation can be achieved for the economy as a whole.

Chapter I briefly examines the crucial variables in the Newfoundland economy which reveal that resource misallocation has taken place to some extent.

In Chapter II the theoretical aspects of resource allocation are discussed. The conclusion is that to prevent resource misallocation co-ordinated investment is required, that is, planning.

The general activity model is presented in Chapter III and two empirical models used in planning regional economic development are criticized. The planning model and methodology used in this study is then discussed.

In Chapter IV the planning model is applied to the Newfoundland economy. An optimum solution for each period of the planning period is obtained and briefly discussed.

Chapter V gives the main conclusions of the study. These are:

1) Relatively high rates of growth are possible in Newfoundland of up to a maximum of 15% per annum.

2) Labour, although relatively abundant in the initial periods, becomes the operative constraint quite early in the planning period.

3) With efficient allocation of resources the gap between Newfoundland and Canadian per capita income would close quite rapidly.

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Dimitri Ypsilanti

CHAPTER I

INTRODUCTION

> "A slow sort of a country," said the Queen. "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that."
>
> Lewis Carroll,
> Through the Looking Glass

To a less than casual observer, the contemporary economic scene of Newfoundland is exciting. For there is an evolving situation in which the long history of hesitant industrialization has at last taken a definite turn, and some signs of economic development are unmistakable in what has been a classic example of a static economy.

The Gross Provincial Product of Newfoundland has grown in real terms at an annual average rate of 6.5 per cent between 1952 and 1968, which is one per cent higher than the national average in the corresponding period. Per capita income would probably exceed $1,500 in 1970, which is still lower than the Canadian average. This is an impressive improvement compared to the $500 per year that the people of Newfoundland enjoyed only two and a half decades ago. The rate of capital formation, perhaps the most important economic aggregate in a growing economy, averaged close to a twelve per cent increase per year since 1952.

The task of inducing growth in a static economy is invariably more difficult and costly than the task of maintaining expansion in a growing economy. Actually, the twelve per cent annual average increase in the rate of capital formation was accomplished by the Province and its people by increasing the rate of investment from 23.4 per cent to 43.5 per cent of Gross Provincial Product between 1951 and 1968. Needless to say, one seldom sees such a high investment rate in a mature economy, and for that matter, even in a growing economy. The annual 6.5 per cent gain in Gross Provincial Product no longer seems high, when viewed as a rate of return to such a high investment ratio. Neither has this high rate of investment been effective in reducing the unemployment rate in the economy which, as shown in Table I-1, has remained consistently high during the entire period of investment expansion.

At the initial stage of development, a lower than average capital productivity is to some extent unavoidable. In the case of Newfoundland, the low productivity of capital and continued existence of a high unemployment rate can be explained by the large expenditure on infrastructure development which has taken place. Thus, of the total investment in the period 1967 to 1969, thirty seven percent of that was spent on infrastructure construction projects (roads, highways, harbour facilities, power projects, etc.).

TABLE I - 1

GROSS PROVINCIAL PRODUCT, INVESTMENT & EMPLOYMENT FOR NEWFOUNDLAND
1951 - 1968

YEAR	$MN	CHANGE	INVESTMENT[2] $MN	CHANGE	INVESTMENT AS A % OF GPP	EMPLOYMENT[3] '000	RATE OF UNEMPLOYMENT[4]
1951	281.6	---	66.1	---	23.4	94	7.8
1952	310.0	10.0	96.9	46.5	31.2	94	6.9
1953	340.1	9.7	91.3	-5.7	26.8	96	5.8
1954	363.2	6.7	82.8	-9.3	22.7	94	6.0
1955	388.5	6.9	99.6	20.2	25.6	97	6.7
1956	424.0	9.1	103.8	4.2	24.4	100	6.5
1957	431.1	1.6	107.7	3.7	24.9	98	10.1
1958	412.5	-4.3	111.4	3.4	27.0	88	18.5
1959	437.1	5.9	112.4	0.8	25.7	89	19.8
1960	464.6	6.2	148.4	32.0	31.9	91	18.0
1961	508.0	9.3	184.0	23.9	36.2	91	20.4
1962	548.6	7.9	258.9	40.7	47.1	97	11.9
1963	595.3	8.3	229.5	-11.3	38.6	108	15.1
1964	651.5	9.6	222.3	-3.1	34.1	112	10.3
1965	711.8	9.2	215.1	-3.2	30.2	119	11.3
1966	770.3	8.2	314.8	46.3	40.8	127	11.4
1967	788.9	2.4	323.7	2.8	41.0	130	12.0
1968	819.6	3.8	357.2	10.3	43.5	130	14.5
1952-68 Average Annual increase		6.5		11.89	31.9		12.0

NOTE: 1. GPP and Investment are in constant 1961 dollars

SOURCE: 1. Economics & Statistics Division, Dept. of Finance Government of Newfoundland & Labrador
2. Dept. of Trade & Commerce, Ottawa, Private and Public Investment in Canada
3. DBS, The Labor Force, Catalogue No. 71-001
4. ibid

Manufacturing and commercial construction accounted for three and four per cent of total construction. Infrastructure by itself creates only a small amount of permanent employment, and if unutilized by other sectors of the economy, it will represent a loss.

In Newfoundland large investment in infrastructure did very little to transform the economy, and modern industry in the province today is not more significant as a source of employment and income than it was in 1951, or perhaps even earlier. The economy is still static in terms of industrial development.

The unemployment problem in the Province has also been affected significantly by extensive mechanization in the logging industry as well as in handling cargo in the harbour. Between 1960 and 1969, mechanization has replaced over 9,500 loggers and longshoremen.[1] The closure of the Bell Island iron mine and of several U.S. Armed Forces bases also resulted in the unemployment of 5,600 workers[2] vitiating many of the effects of increased investment expenditure. Thus, despite new investments which created employment for 50,000 workers, unemployment kept rising as a result of mechanization, closures, etc.

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[1] Economics and Statistics Division, Department of Finance, Government of Newfoundland Labrador.

[2] Ibid.

Indeed, the net increase in employment between 1960 and 1969 was only 32,000.[3] Net migration of 19,000 during this period prevented the unemployment rate in the Province from rising still higher.[4]

There is undoubtedly a great need for social infrastructure development in underdeveloped economies, but the rationale put forward for Social Overhead Capital expenditure is that it attracts industry and that it is a prerequisite for industrial development. The igniting effect Social Overhead Capital investment is expected to have on private industry is, however, largely a matter of faith and hope. Faith and hope being impervious to economic calculus, the possibility of wasteful mistakes always exists.

Actually, one of the major characteristics of an underdeveloped economy is the continued existence of excess capacity. Underutilization can give rise to excess capacity in one form or another - whether unemployed, underemployed, or seasonally unemployed resources. In the case of Newfoundland, there is considerable evidence that the problem of excess capacity is prevalent, not only in social overhead capital, but in most of the key industrial sectors. There is excess capacity in transportation (ocean, ferry and train), in port facilities and shipyards, fishing and fish processing, and in the overcrowded service sector.

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[3] Ibid.

[4] Ibid.

To some extent, the problem of excess or idle capacity is unavoidable when an economy is undergoing a radical structural change; but, the fact that much of the existing resources are less than ideally employed means than an economy which reallocates its resources more efficiently has an additional source of growth compared to an economy that does not exploit its existing resources as efficiently.

In this study, we attempt to explore the possible results that the elimination of resource misallocation would have on the level of Provincial income and on the rate of growth of the economy within the next five years. Our findings will show that an optimum investment plan that reallocates resources among the present industries, without change in their production techniques, would improve the rate of growth of the economy between five and ten per cent for the next five years.

The primary aim of this investigation is to formulate an optimum industrial structure for the Newfoundland economy which will permit the optimum utilization of existing resources. The ultimate practical purpose is to aid the formulation of the future economic development of the Province. During research no lack of theoretical models in this field was found, but empirical application was sadly lacking. To reconcile the theory with what we had in mind, a model was constructed, based on the limited number of empirical studies.

CHAPTER II

THEORETICAL ASPECTS OF RESOURCE ALLOCATION

Before describing our model and empirical findings, some theoretical aspects of the problem are discussed here in order to clarify a number of ideas recurring throughout the study.

The aim of economic development is to increase real per capita income. Income can be shown as a simple function:

$Y = f(K, L)$ where K is capital and L is labour.

It follows from this equation that income will depend on two identifiable, but interdependent processes. An increase in income can come about through increased availability of capital and labour, and/or through a more rational use of existing factor inputs. These processes are interdependent in the sense that the outputs of period 't' become inputs for period 't+1'; if factor inputs are optimally combined and used efficiently, this will maximize the output level in 't' thereby increasing the potential supply of inputs for 't+1'.

By efficiency in resource use, we do not mean full utilization of all resources, but an optimal use of resources on hand to produce maximum output. According to this definition, the often repeated argument for labor-intensive

techniques in a capital poor country does not necessarily hold true. Even if it were possible to find techniques which will employ all the labour with a given amount of capital, such labour-intensive techniques may very well prove to be so inefficient that output per unit of capital, as well as output per unit of labour, is lower than with more capital intensive methods.

Theoretically, at least, there are three possible ways of adjusting to changing factor supplies:

(1) If there exists more than one available technique of production for industry during any single period, the factor proportions actually used in industry can be adjusted to the changing factor endowment by switching to the technique which utilizes more of the relatively abundant factor. Adjustment in this manner is, however, quite limited. The existing capital equipment in the economy is to some degree fixed, and the necessary adjustment has to take place mostly in new industries.

Not all new industries will have choices in production technique. Some production processes, such as petroleum refining, actually come very close to having fixed technical coefficients. Even for those industries whose technical coefficients are more flexible, the adoption of particular methods of production already used in other regions or other countries without looking for alternative

techniques more suited to the factor endowment of the economy, can have the same effect as if the coefficients were technologically fixed.

(2) Adjustment to changing factor supplies is also possible via changes in the composition of demand. Suppose that there is only one technique available for the production of each product, then adjustment to changing factor supplies is not possible through changing production techniques. Production processes used to produce different commodities are, however, not identical; some commodities would use different amounts of capital and labour. If surplus labour exists, the demand for commodities produced by more labour-intensive methods could be encouraged at the expense of capital-intensive goods. New investments would go into the sectors of the economy requiring relatively more labour in their production process, and adjustment to given factor supplies is thereby aided. Adjustment in this manner, however, does not constitute a real solution to the problem. Gross National (Provincial) Product, which we want to increase is not an amorphous mass; it is a complex of specified goods and services would should reflect the specific set of products consumers demand. Economic development is an expansion in the production of goods and services demanded in desired proportions. To the extent that a given composition of demand reflects the consumers' preferences, it can not be arbitrarily changed.

(3) Changing the output composition provides the third and most sensible alternative. If an economy has access to foreign markets, production activities are no longer constrained by the composition of domestic demand. Since the world market is much larger and more diversified than the domestic, and since most of the products consumed domestically could be imported, the economy is completely free to adjust its scale and composition of domestic outputs to meet the changing factor supply situations. If the economy has a surplus labour problem, it can produce more labour-intensive commodities to be sold abroad and the proceeds used to finance imports of capital-intensive commodities to satisfy domestic demand.

Of course, in a capitalistic economy, adjustments to changing factor situations are constantly taking place through competitive forces in the market. If the price of labour is cheap compared to capital, there is an inducement for production managers to substitute capital-intenstive for labour-intensive techniques in order to reduce production costs. To the extent that the price of a product reflects the cost of production, the price of capital-intensive commodities will be relatively higher than that of labour-intensive goods. Consumers would demand more of the latter group of commodities. New investment would tend to move into the sectors of the economy requiring relatively

more labour in their production processes. International trade facilitates this process of adjustment by encouraging imports of capital intensive commodities in exchange for labour-intesive commodities.

In reality, the market is, at best, a decidedly inaccurate gauge of social costs and utilities; and, the case for some sort of economic planning in resource allocation rests more strongly on this "inaccuracy" than on the "inadequacy" of the market. This inaccuracy, of course, causes a misallocation of resources in the economy; moreover, the problem of resource misallocation tends to be more serious in an underdeveloped than in a highly industrialized economy. A brief and cursory review of the current literature on the subject gives the following list of reasons, which is by no means exhaustive:

(1) The dualistic nature of an underdeveloped economy means that there are often underutilized resources embedded in the "subsistence" sector, which the ordinary market mechanism fails to reflect, and consequently, fails to set into motion.

(2) The money cost of labour is usually higher than its real or opportunity cost. Wage rates which reflect the real cost of labour or its productivity may very well be insufficient for survival and may fall below legal or conventional minimum rates. Since the real or opportunity cost of labour in a labour surplus economy may be close to

zero, the contribution made by the sub-marginal labour force could be substantial, if it were utilized.

(3) Individual economic decisions based upon market information alone would lead to nonoptimal allocation of resources because of the "externalities" of the market. And, to the extent that the externalities are caused by "lumpiness" of capital and indivisibility of demand, the problem of externality would be greater and more serious in underdeveloped economies.

(4) Complementarity of industires raises another problem. With a smaller industrial base and more or less stationary investment, an underdeveloped economy cannot sufficiently exploit the external economies arising from complementarity.

Under these conditions, a conscious and deliberate economic policy designed to "influence" the amount and composition of investment in the economy is almost mandatory. Underdeveloped economies can ill afford the costs of erroneous investment decisions. Furthermore, individual private investment decisions are hard to make and often prove to be unattractive unless several investment decisions are undertaken simulateneously or conjointly (eg. an industrial complex). It is, of course, not true that government is better than private entrepreneurs at judging the profitability of particular private investment projects.

It is true that government is better able to judge the total effect of various individual investment programs and their impact upon the economy in terms of real economic costs and benefits.

In general, efficient allocation of scarce factor inputs requires overall planning since the piecemeal nature of investment in the market system neglects the structural input-output linkages existing between the producing activities in the economy. Every investment has an indirect effect which the private investor does not consider since his objective is to maximize private and not 'social' profit. These indirect effects may be beneficial in creating additional employment opportunities in other activities, or they may be a cost to the economy by increasing its imports. Neglect of sectoral complementarity also means than the external economies or diseconomies resulting from a given investment are not considered. A diseconomy created by an investment will reduce the net benefit of that investment to the economy as a whole. If the investment creates economies for another sector the potential capability of that sector and for the economy as a whole is expanded and should be taken advantage of.

With co-ordinated investment the real cost of supplying a given demand is decreased since individual decisions are based on a given market structure, whereas the aim of co-ordinated investment is to change this

market structure by a simulataneous expansion of effective demand. Production bottlenecks are also eliminated and the advantages of economies of scale can be realized. For this process of simultaneous and complementary expansion to be successful there must be a co-ordinated decision making process and control over resource allocation.

The approach to planning economic development suggested in the following discussion is one which takes into account structural interdependence, as well as ensuring efficient allocation of scarce factor inputs. These criteria are taken into account by activity analysis. A modified version of the general activity analysis model, shown in the following chapter, will be applied to the Newfoundland economy. The purpose of applying this model is not to plan the Newfoundland economy as such, but rather to determine the potential rate of growth which could result from existing factor inputs if these inputs were efficiently allocated. Therefore the increased availabilities of factor inputs from sources external to the economy are ignored.

CHAPTER III

THE PLANNING MODEL AND METHODOLOGY

The mathematical model used here is essentially a generalization of the Leontief general equilibrium inter-industry model. The model, however, explicitly introduces alternative activities for each 'industry', while the choice between activities and their output levels depends on some specified objective function which is to be maximized or minimized. The model therefore permits mathematical programming.

Generally the type of normative solution desired requires the following set of linear equations:

$$\text{Commodities:} \quad X_j - E_j + M_j - \sum_{j=1}^{n} a_{ij} \geq Y_j$$

$$\text{Capital:} \quad \sum_{j=1}^{n} k_j X_j + \sum_{j=1}^{n} k_j E_j \leq \bar{K}$$

$$\text{Labour:} \quad \sum_{j=1}^{n} w_j X_j + \sum_{j=1}^{n} w_j E_j \leq \bar{L}$$

$$\text{'Foreign Exchange':} \quad \sum_{j=1}^{n} m_j M_j - \sum_{j=1}^{n} e_j E_j + \sum_{j=1}^{n} g_j X_j \leq \bar{D}$$

where K, L and D are fixed and represent respectively capital, labour, and the allowable import deficit. A desired export surplus may also be specified.

Each row vector in the model shown above represents an equation. The set of activities in the model allows a choice to be made between alternative ways of supplying domestic Final Demand. The output of each domestic producing activity is shown by a positive coefficient (+1.0). The use of commodity inputs is shown by a negative coefficient, a_{ij}, where the amount of commodity 'i' used in sector 'j' is $a_{ij}X_j$. The output of exporting activities is shown by a negative coefficient, (-1.0), since exports of activity E_j decrease domestic availabilities of X_j. However, each unit of exports adds a positive amount e_jE_j to 'foreign exchange'. The import activities have a positive coefficient, (+1.0), since imports add to domestic supply, but they reduce 'foreign exchange' by m_jM_j.

Given a set of activities and a set of restrictions in the form of resource availabilities and demand coefficients, we have to choose an objective function which we wish to maximize or minimize. The objective function $Z = c_1X_1 + c_2X_2 + \ldots + c_nX_n$ is a function of the activity levels. Starting from an initial extreme position where the value of an activity $X_j = 0$, $(j = 1, \ldots, n)$ we can, given the objective function, find a combination of the different activities which will maximize (minimize) the value of Z subject to resource supplies and to $X_j \geq 0$ $(j = 1, \ldots, n)$. The value of Z and the levels of the different activities are both optimum for that programme and unique to it.

The different activities (column vectors) represent domestic production, (X_j), exports, (E_j), and imports, (M_j). Since production for exports requires the same commodity and factor inputs as domestic production there is no need to have separate input coefficients for the exporting activities. The domestic producing activities use direct commodity inputs, (a_{ij}), direct factor inputs in the form of capital, (k_j), and labour, (w_j), as well as direct use of 'foreign exchange', (g_j), or noncompetitive imports. Imports use no direct factor inputs but deplete 'foreign exchange', while export activities add to 'foreign exchange' depleting domestic supply. The right-hand restriction or requirements vector, (Y_j), shows commodity requirements, that is, Final Demand and total factor availabilities. The commodity requirements can be specified in terms of totals or simply as coefficients of Final Demand. In activity analysis form these equations are as follows:

		PRODUCTION ACTIVITIES									REQUIREMENTS VECTOR	
**	COMMODITIES	X_1	E_1	M_1	X_2	E_2	M_2	X_3	E_3	M_3		Y_i
1.	X_1	$+1.0$	-1.0	$+1.0$	$-a_{12}$	0	0	$-a_{13}$	0	0	$\geq$	Y_1
2.	X_2	$-a_{21}$	0	0	$+1.0$	-1.0	$+1.0$	$-a_{23}$	0	0	$\geq$	Y_2
3.	X_3	$-a_{31}$	0	0	$-a_{32}$	0	0	$+1.0$	-1.0	$+1.0$	$\geq$	Y_3
4.	FOREIGN EXCHANGE	$-g_1$	$+e_1$	$-m_1$	$-g_2$	$+e_2$	$-m_2$	$-g_3$	$+e_3$	$-m_3$	$\leq$	$\bar{D}$
5.	LABOUR	$-w$	0	0	$-w$	0	0	$-w$	0	0	$\leq$	$\bar{L}$
6.	CAPITAL	$-k$	0	0	$-k$	0	0	$-k$	0	0	$\leq$	$\bar{K}$
7.	OBJECTIVE FUNCTION	$+C_1X_1$	0	0	$+C_2X_2$	0	0	$+C_3X_3$	0	0	$=$	Z

** EQUATION NO.

Thus, three components need to be specified in activity analysis - an objective, a choice of activities and a set of restrictions. Without choices and limited resources a programming problem does not exist. Given these components, an optimum solution can be obtained. 'Optimum', as used here is similar to the concept of a Pareto-optimum. That is, given the pattern of final demand, given production functions for the different activities, as well as prices for imports and exports, there is a certain level of final demand which is not only feasible in that it satisfies a certain set of constraints, but is such that no other structure can improve the level of final demand.

It is not the output level of any particular activity as such which is of interest, but the combination of output levels of the different activities which give an efficient set such that, if any activity's output is changed, the set will become inefficient. This efficient set is dependent on the structure of demand, technology and factor supplies. Changes in any of these will require a new efficient set to be calculated.

Some progress has been made by two pioneering works in the past which actually used this model for planning purposes. These are the Chenery and Kretschmer model[5]

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[5] Chenery, H.B. and Kretschmer, K.S., Resource Allocation for Economic Development, ECONOMETRICA, Vol. 24, Oct. 1956, No. 4, pp. 365-399.

applied to Southern Italy, and the model by Spiegelman, Baum, and Talbert,[6] applied to a region in central Kentucky. Hereafter, the latter will be referred to as the Kentucky model.

In the Chenery and Kretschmer model the goal was to reduce the regional economic disparity existing between Northern and Southern Italy. Final Demand targets for each commodity were set "on the basis of an assumed increase in regional income of about 75% over a 13-year period"[7]. The object of the programme was then to choose the structure of production for the terminal year in which "given final demand will be producible in the target year with a minimum total investment and without exceeding the specified resources available."[8]

One built-in rigidity in the Chenery and Kretschmer model is that, while the model permits each industry to adjust its output level, this output level is not allowed to be adjusted downward at any time. Chenery and Kretschmer are interested in "increases in production above existing capacity levels..."[9] for all existing industires. As such, they are only concerned in determing whether the net increase

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[6] Spiegelman, R.G.; Baum, E.L.; and Talbert, L.E., Application of Activity Analysis to Regional Development Planning, U.S. Dept. of Agriculture, Technical Bulletin 1339, Washington, D.C. 1965

[7] Chenery and Kretschmer, op. cit. p. 389.

[8] Ibid., p. 376

[9] Ibid., p. 373, emphasis in original

in final demand (that is the difference between final demand in the base year and final demand in the target year) should be met from imports or increases in domestic supply. This means that no activity is allowed to decrease its output level below that which existed in the base year, although by the terminal year its proportionate ratio in the economy may have declined. If industries are not allowed to decline scarce factor inputs cannot be released from the less efficient activities for use in the more productive and expanding activities. Therefore the object of this model is not to determine the overall efficient industrial structure, but to determine efficient sources of supply to satisify the target final demand.

In this model only two positions are known -- that in the base year and in the terminal year -- so that it has to be assumed that the overall rate of growth is averaged out evenly between these two points in time, although this assumption is not made explicit by the authors. Such an assumption is expedient. The fulfillment of targets in this model depends on the availabilities of external capital. Provided sufficient capital is forthcoming the target may be met at any time during the 13-year planning period.

The Kentucky model also ignores the solutions for intermediate years. The objective of this model was to determine "the amount of outside financing needed to meet

the increase in income and consumption adopted as targets for the development plan."[10]

Unlike the Chenery and Kretschmer model which was only concerned in determining the minimum amount of capital required to finance the desired net increase in final demand over the entire planning period, the Kentucky model focuses its attention on "...only the 10th year (the terminal year) of the development programme, and the capital requirements are for that year, and not for the entire 10 years."[11] Therefore the assumption made here is that the target will be reached in the last year of the development plan, and that the growth rates in intervening years are all identical and the same as the rate established in the terminal year. The total investment requirement for the entire planning period is thus calculated by the use of a constant capital-output ratio. Needless to say, this approach is as crude as that used by Chenery and Kretschmer.

The Kentucky model, however, has a far greater range of choices in selecting the types and the magnitudes of different activities. The number of discrete types of activities contained in the model is considerably increased by addition of so-called 'conversion activities'. Through these conversion activities some industries are allowed to

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[10] Spiegelman, Baum and Talbert, op. cit. p. iv.

[11] Ibid., p. 16.

switch their production techniques (eg. from labour-intensive to more capital-intensive techniques). The model also allows the economy to 'convert' some of its unskilled labour into skilled labour at a certain cost.

The difference between the two models is then more of a technical nature rather than one of substance. Both models deal with the dynamic economic problem of optimal investment. They are both interested in the change in the economic system over time, rather than in the status of the economic system at any given moment of time; but both define the change in terms of a once-over change rather than in terms of a continuous or a sequential change. This makes the analysis one of 'comparative statics' rather than a truly dynamic one. In order to make the analysis dynamic would require specification not only of the total change over a long period, but specification of the annual changes and the sequence in which these annual changes have to take in order to accomplish the total change.

Both models prefer to minimize costs rather than to maximize income. Spiegelman, in his paper to the Regional Science Association, explains why minimization is preferable to maximization. According to him,

> "Besides its advantage in providing more realistic pricing for domestic resources, foreign exchange minimization has the advantage of permitting a

> more meaningful expression of constraints than is possible by the income maximization formulation."[12]

These alleged advantages of the minimization problem, however, do not stand up to closer scrutiny.

Spiegelman's first contention is that realistic resource pricing is only possible under a minimization scheme. If income maximization were adopted as an objective function, there must be a specification of consumption as right-hand targets (in coefficient form) and of domestic resources as constraints. But,

> "because of market imperfections, market prices often do not represent the true scarcity of commodities; thus a commodity which is monopolistically priced will have "too high" a value added and receive too high a weight... Since the objective function is specified in market prices, this inconsistency is not readily resolved."[13]

On the other hand, he maintains, a cost minimization model avoids such problems because it can specify the consumption targets in terms of the physical amounts of each commodity demanded and because it uses exogenously determined resource prices.

Yet a perplexing question remains; what makes it judicious to use exogenously determined resource prices and, at the same time, deny the use of exogenously

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[12] Spiegelman, R.G., Activity Analysis in Regional Development Planning, Regional Science Association, Papers, Vol. 17, 1966, p. 147.

[13] Ibid., p. 145.

determined market prices for consumption goods? The fact that the regional economy is part of a large national economy denies any regional control over input prices or for that matter output prices. So it is irrelevant whether we express the commodity in terms of value or in physical units. Its monetary value can of course, be determined endogenously or exogenously; again this is irrelevant to the argument. The monopoly problem remains no matter how the right-hand side targets or constraints are specified. The problem is contained in the structural matrix itself, and not in the definition of the objective function.

Whether minimizing is more meaningful than maximizing is again subject to dispute, and largely a matter of value judgement. To Spiegelman income maximization is less meaningful because:

> "Constraints on mobile resources, such as labour and capital, are not as meaningful in planning for an open regional economy as in planning for a closed national economy. By implication, a development plan expects to alter the present spatial distribution of resources. However, one can not determine ex ante the new distribution without essentially prejudging the solution to the programme. It appears more consistent with good planning technique to establish targets for income and consumption, leaving the mobile resources free to move in or out the planning region as required."[14]

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[14] Ibid., p. 147.

This appears sensible and proper, especially if the programme is for a national agency not overduly concerned with regional boundaries. A regional development plan is, however, concerned with the economic welfare of those people who live in that particular region and who will remain to do so regardless of the reason.

Mobility of resources is, of course, more free between regions than it is between nations. But, if resources were completely mobile between regions, regional economic problems would not exist. On the other hand, if spatial reallocation of resources is the basic issue, inter-regional planning is desired, since reallocation could not be handled by a regional programme. Furthermore, in regional planning it is not only necessary but desirable to take the indigenous population (and labour resource) as a constraint. This must be so even for the minimization models because it is essential to know the number of people who will be allowed to stay in or leave a region if we wish to specify the consumption targets in physical quantities, for example, the amount of beef or the number of houses required.

No theoretical model can be perfect. The assumptions involved will always remain assumptions; but if these are made more realistic a better model can be

obtained. The decision taken here to use an income maximization model, instead of a cost minimization model, is based upon the following assumptions:

(1) Although the danger of resource misallocation due to monopolistic elements in the economy is real enough, it is considerably less within a region which is part of a larger national market. A regional monopoly or localized monopoly is highly unlikely when the region is not allowed to establish trade barriers.

(2) It is assumed that the proper goal for a regional model is to raise the general level of economic welfare for the entire population of that region.

(3) It is assumed far more practical to programme an optimal plan of action to maximize income with whatever resources that region can and expects to command rather than to determine the minimum amount of resources required to produce a pre-determined level of income. Moreover, it is highly unlikely that the amount of resources available will coincide with the amount desirable. This means that unless the balance is made up by some benefactor, the programme solution

derived through the cost minimization method will lose its raison d'etre.

(4) It is assumed that the annual supply of capital for a region can be estimated one year in advance. Further, it is assumed that the amount of capital forthcoming is related to the current level of economic activity and the rate of economic growth in the region.

THE NEWFOUNDLAND MODEL

Since we are concerned here with determining the potential (rathern than a target rate of growth) of the Newfoundland economy, no specific consumption targets are set except that the general level of consumption should be maximized in each and every year of the planning period. The plan covers a period of five years from 1969 to 1975. This requires six consecutive programmes. Each programme represents a year, and all time lags are assumed to be uniform and take one year. All main data specifications for the model are arranged in the following order:

(1) Final Demand

(2) Production functions

(3) Capital

(4) Labour

(5) 'Foreign Exchange'

Mathematical Notations

In what follows we use the following mathematical notations:

Activity Levels

X_j^t = level of production activity 'j' at time 't' (production of commodity 'j'), (j = 1, ..., n)

E_j^t = level of export activity 'j' at time 't' (export of commodity 'j'), (j = 1, ..., n)

M_j^t = level of import activity 'j' at time 't' (import of commodity 'j') (j = 1, ..., n)

Input Coefficients

a_{ij} = input of commodity 'i', (-), per unit of output of activity 'j'

w_j = input of labour, (-), per unit of output of activity 'j'

d_j = capital consumption, (-) per unit of output of activity 'j', (replacement value of capital consumed by activity 'j')

m_i = import price per unit of commodity 'i' (-)

g_j = export price per unit of commodity 'i' (+)

c_i = final demand for commodity 'i' per unit of total final demand, (-)

Resource Restrictions

$\bar{L}_t$ = Maximum available supply of labour at time 't'

$\bar{R}_t$ = Maximum allowable consumption of capital stock K at time 't', ($R_t = rK_t - 1$ where r is the depreciation rate and K^t the capital stock)

$\bar{D}_t$ = Maximum allowable deficit (surplus) on the balance of trade at time 't'.

The basic matrix for the Newfoundland activity analysis model is included in the following pages. The upper and lower bounds for the domestic producing activities are not shown since their values change for each year. The equations are in the form of equalities as a result of allowing the Final Demand coefficient vector to act as slack variables for the commodity row vectors.

Final Demand

Final Demand is a column vector for which the ratios of commodity requirements per unit of total final demand have been specified. These ratios are shown in the activity analysis matrix.

Thus final demand, Y, is $Y = \Sigma c_i$, $(i = 1, \ldots, m)$ where $a_{ij}X_i + M_i - E_i \geq C_i$, $(X_j \geq 0, M_i \geq 0, E_i \geq 0)$. Y has been chosen to be maximized. Final demand is also a composite item consisting of personal consumption, investment, and the public sector. The public sector includes Federal Government, Provincial and Municipal Government, Education and Hospitals. Investment includes both public and private investment. The ratio between consumption, C, investment, I, and Government, G, is assumed to remain fixed throughout the planning period. These ratios are 0.6023 for C, 0.1517 for G, and 0.2457 for I.

TABLE III-1

NEWFOUNDLAND ACTIVITY ANALYSIS MODEL

TABLE III-1

NO.	INDUSTRIAL SECTOR	AGRICULTURE	FORESTRY	SHELL FISH	OTHER FISH	METAL MINING	NON-METAL MINING	MEAT PRODUCTS	DAIRY PRODUCTS
1	AGRICULTURE	+ .9881973	- .0006629	0	0	0	0	- .5164552	- .0521092
2	FORESTRY	0	+ .8587731	0	0	0	0	0	0
3	SHELL FISH	0	0	+1.0000000	0	0	0		
4	OTHER FISH	0	0	0	+1.0000000	0	0	0	0
5	METAL MINING	0	0	0	0	+1.0000000	0	0	0
6	NON METAL MINING	- .0122638	0	- .0003109	- .0239043	0	+1.0000000	0	0
7	MEAT PRODUCTS	0	0	0	0	0	0	+ .9550477	0
8	DAIRY PRODUCTS	0	0	0	0	0	0	0	+ .8486132
9	SHELL FISH PRODUCTS	0	0	0	0	0	0	0	0
10	OTHER FISH PRODUCTS	0	0	+ .0349786	- .0085665	0	0	0	0
11	FRUIT & VEGETABLES	0	0	0	0	0	0	0	0
12	FEED & FLOUR	- .2463830	0	0	0	0	0	0	0
13	BAKERIES	0	0	0	0	0	0	0	0
14	MISCELLANEOUS FOODS	0	0	0	0	0	0	- .0004091	- .0261999
15	SOFT DRINKS	0	0	0	0	0	0	0	0
16	BREWERIES	0	0	0	0	0	0	0	0
17	SHOES	0	0	0	0	0	0	0	0
18	LEATHER PRODUCTS	0	- .0000171		0	0	0	0	0
19	CORDAGE & CANVAS	- .0043338	- .0002782	- .0186552	- .0638086	0	0	- .0066054	0
20	CLOTHING	0	0	0	0	0	0	0	0
21	SAWMILLS & SASH	- .0009220	0	- .0540614	- .0067360	- .0041349	- .0062277	0	0
22	MISCELLANEOUS WOOD	0	0	0	- .0139559	0	0	0	0
23	FURNITURE	0	- .0003641	0	0	0	0	0	0
24	PULP & PAPER	0	0	0	0	- .0003604	0	- .0022213	0
25	PAPER PRODUCTS	- .0038727	0	0	0	0	- .0128293	- .0165429	- .0663926
26	PRINTING	0	0	0	0	- .0006074	- .0004903	- .0075407	0
27	IRON FOUNDRIES	0	0	0	0	- .0060283	- .0000490	0	0
28	MISCELLANEOUS METALS	0	0	0	0	- .0046260	- .0679285	0	0
29	WIRE PRODUCTS	- .0132781	- .0089688	- .0295375	- .0204401	- .0052158	- .0029054	0	0
30	MACHINERY	- .0186262	- .0247286	- .1036533	- .0231081	- .1135391	- .0070184	- .0269480	- .0282345
31	BOATS & SHIPS	0	0	0	- .0246851	0	0	0	0
32	CEMENT PRODUCTS	0	0	0	0	0	0	0	0
33	NON-METALLIC MINERAL PRODUCTS	- .0047026	0	0	0	- .0003864	0	0	0
34	PETROLEUM	- .0174275	- .0188375	- .0536727	- .0520382	- .0381200	- .0318679	- .0135616	- .0169407
35	PAINT & VARNISH	0	0	- .0013991	- .0003827	0	0	0	0
36	SOAP PRODUCTS	0	0	0	0	- .0007798	- .0004781	0	0
37	MISCELLANEOUS MANUFACTURING	0	0	- .0005441	- .0072765	0	0	0	- .0050655
38	RESIDENTIAL CONSTRUCTION	0	0	0	0	0	0	0	0
39	NON-RESIDENTIAL CONSTRUCTION	- .0092209	- .0085531	- .0027205	- .0045511	- .0264121	- .0055166	- .0030396	- .0027819
40	TRANSPORTATION	- .0344862	- .0065746	- .0441119	- .0248535	- .0580219	- .0246411	- .0482843	- .0528981
41	UTILITIES	- .0047948	- .0110263	- .0019432	- .0040421	- .0017568	- .0016304	- .0027473	- .0022421
42	ELECTRICAL POWER	- .0074689	- .0003641	0	0	- .0671166	- .0277120	- .0074823	- .0129131
43	SERVICES	- .1157223	- .0402375	- .0962299	- .0434486	- .0344485	- .0294160	- .0407433	- .0466282
44	FOREIGN EXCHANGE	- .0325498	- .0028544	- .0122813	- .0051291	- .0664772	- .0067481	- .0033319	- .0423102
45	LABOUR	- .0419552	- .1300494	- .4166352	- .6460478	- .0391218	- .0378198	- .0169521	- .0784753
46	CAPITAL	- .0497929	- .0655640	- .1146521	- .0416459	- .0693920	- .0787657	- .0056701	- .0250788

TABLE III-1 Cont

SHELL FISH PRODUCTS	OTHER FISH PRODUCTS	FRUIT AND VEGETABLES	FEED AND FLOUR	BAKERIES	MISCELLANEOUS FOODS	SOFT DRINKS	BREWERII
0	0	- .4939024	- .0884119	- .0021184	- .0004383	0	0
0	0	0	0	0	0	0	0
- .6004554	0	0	0	0	0	0	0
0	- .4541401	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	- .0009370	0	0	- .0006733	- .0016522	- .0000930	0
0	0	0	0	- .0104443	0	0	0
0	0	0	0	- .0058133	- .0018208	0	0
+1.000000	0	0	0	0	0	0	0
0	+1.0000000	0	0	0	0	0	0
0	- .0111494	+1.0000000	0	- .0030216	0	0	0
0	0	0	+1.0000000	0	0	0	0
0	0	0	0	+ .9977502	0	0	0
0	0	0	0	- .0725523	+ .9980443	- .0760666	- .00038
0	0	0	0	0	0	+ .9853334	0
0	0	0	0	0	0	0	+1.00000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	- .0011159	0	- .0456827	0	0	0	0
0	0	0	0	0	0	0	0
- .0018218	- .0046930	0	0	0	0	- .0019777	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0001012	- .0022948	0	- .0048242	- .0159293	- .0389803	0	0
- .0255819	- .0236189	- .0047154	- .0019690	- .0415804	- .0398907	0	- .04043
- .0019736	- .0038945	- .0060975	- .0029536	- .0008867	- .0038103	0	- .00988
0	0	0	0	0	0	0	0
- .0106528	- .0002166	- .0060975	- .0004922	0	0	0	0
0	- .0001183	0	0	0	- .0001011	0	0
- .0151821	- .0175705	0	- .0096485	- .0106250	- .0086323	- .0206222	- .01571
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0018724	- .0102702	0	- .0089593	- .0150425	- .0057323	- .0131777	- .01267
0	0	0	0	0	0	0	0
0	0	0	0	0	0	- .0164666	- .00286
- .0010121	- .0024233	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0025303	- .0165503	0	- .0069902	- .0045160	- .0045859	- .0040444	- .00787
- .0396508	- .0396075	- .0284552	- .0611401	- .0493480	- .0498381	- .0391333	- .02045
- .0070849	- .0079350	0	- .0073840	- .0050251	- .0050916	- .0076443	- .00587
- .0116396	- .0075572	- .0040650	- .0184109	- .0064374	- .0024952	- .0037333	- .01090
- .0227224	- .0372394	- .0752031	- .0560202	- .0640455	- .1068922	- .1127774	- .05070
- .0022773	- .0021084	- .0243902	- .4961110	- .2298255	- .4383935	- .1215555	- .10046
- .0693319	- .0946167	- .0406504	- .0246135	- .0558347	- .0347315	- .0408880	- .04839
- .0202429	- .0251908	- .0182926	- .0499163	- .0282293	- .0162193	- .0326444	- .02939

TABLE III-1 Cont.

CORDAGE AND CANVAS	CLOTHING	SAWMILLS AND SASH	MISCELLANEOUS WOOD	FURNITURE	PULP AND PAPER	PAPER PRODUCTS	PRINTING
0	0	0	0	0	0	0	0
0	0	- .3311150	- .1479922	0	- .2691243	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	- .0011716	0	0
0	- .0667979	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
+ .9850499	0	0	0	0	0	- .0012419	- .0001508
0	+1.0000000	0	0	0	0	0	0
- .0049833	0	+ .8954232	- .1033031	- .0172848	0	- .0001241	0
0	0	- .0001629	+1.0000000	0	0	0	0
0	0	0	0	+ .9989197	0	0	0
- .0033222	- .0009186	0	0	- .0018005	+ .9861144	0	- .0736532
- .0016611	- .0097112	- .0023088	0	- .0079222	0	+1.0000000	- .0000754
- .0016611	- .0009186	0	0	0	- .0002002	- .0014903	+ .9728011
0	0	0	- .0006476	- .0007202	- .0004031	0	- .0015836
- .0265780	- .0066929	0	0	0	- .0010238	0	0
0	0	- .0004346	- .0037240	- .0021606	- .0124506	- .0075757	0
0	0	- .0351215	- .0471178	0	- .0063731	- .1060606	- .0066614
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	- .0094488	- .0179274	- .0506800	- .0090025	- .0360847	- .0060854	- .0094014
0	0	- .0013309	0	- .0241267	0	0	0
0	0	0	- .0484132	- .0064818	0	0	- .0004776
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0249169	0	- .0108379	- .0003238	0	- .0003372	- .0007451	- .0014328
- .0431893	- .0712598	- .0638055	- .1131800	- .0248469	- .0297626	- .0576254	- .0141273
- .0016611	- .0036745	- .0145864	- .0045336	- .0054015	- .0023944	- .0011177	- .0092002
0	- .0148293	- .0134456	- .0255829	- .0162045	- .0376501	- .0045951	- .0100047
- .0415280	- .0902885	- .1242154	- .0935878	- .0536549	- .0326903	- .0350221	- .0353432
- .4800664	- .3204724	- .0931142	- .0014572	- .1955347	- .0296578	- .6307749	- .0680978
- .0332225	- .1417322	- .0651908	- .0825777	- .1404393	- .0399076	- .0322901	- .1136220
- .0049833	- .0115485	- .0330300	- .0144106	- .0129636	- .0335921	0	- .0089741

TABLE III-1 Cont.

WIRE PRODUCTS	MACHINERY	BOATS AND SHIPS	CEMENT PRODUCTS	NON-METALLIC MINERAL PRODUCTS	PETROLEUM	PAINT AND VARNISH	S PRO
0	0	0	0	0	0	0	0
0	0	- .0055833	0	- .0000648	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	- .0049215	- .0733522	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	- .0008652	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	- .0161622	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	- .0703872	- .0199658	0	0	0
- .0183968	0	0	0	- .0006056	0	- .0077694	0
0	0	0	0	0	- .0000772	- .0115962	0
0	- .0478779	- .0255656	0	0	0	0	0
- .0091984	- .0117752	0	0	- .0011464	- .0021629	0	0
+1.0000000	0	0	0	0	0	0	0
0	+1.0000000	0	- .0167146	- .0047589	0	- .0084652	-
0	0	+ .9761975	0	0	0	0	0
0	0	0	+1.0000000	- .1494083	0	0	0
0	0	0	0	+ .9966039	0	0	0
- .0013140	- .0040645	- .0117543	- .1216918	- .0171753	+ .9741223	- .0049863	-
0	0	- .0088157	0	0	0	+1.0000000	0
0	0	0	0	0	0	- .0002319	+1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0091984	- .0032875	- .0916838	- .0220076	- .0056674	- .0003991	- .0077114	-
- .0551905	- .0595337	- .0546576	- .0215897	- .1120292	- .0507893	- .0375137	-
- .0065702	- .0079497	- .0026446	- .0045500	- .0020549	- .0004377	- .0044644	-
- .0105124	- .0053197	- .0038201	- .0414151	- .0081117	- .0148314	- .0040586	-
- .0591325	- .1085471	- .0646486	- .0487044	- .0794090	- .0615141	- .0768247	-
- .5243101	- .1205020	- .0910960	- .0030179	- .0027688	- .7407078	- .3721806	-
- .0657030	- .1028093	- .1498677	- .0770730	- .0646780	- .0254918	- .0730561	-
- .0183968	- .0440525	- .2033401	- .1937970	- .0339613	- .0051497	- .0123499	-

TABLE III-1 Cont.

NON-RESIDENTIAL CONSTRUCTION	TRANS-PORTATION	UTILITIES	ELECTRICAL POWER	SERVICES	E_1	E_2	
- .0003079	0	0	0	- .0000124	-1.0000000	0	0
0	0	0	0	0	0	-1.0000000	0
0	0	0	0	0	0	0	-1.00
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
- .0189957	- .0002596	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	- .0002932	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	- .0000293	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	- .0000043	0	0	0
- .0002768	- .0002218	- .0005[illegible]04	0	- .0001869	0	0	0
0	0	- .0005[illegible]72	0	- .0004013	0	0	0
- .0512740	- .0000772	0	0	- .0006788	0	0	0
- .0044427	0	0	0	0	0	0	0
- .0001176	- .0000818	0	0	- .0048447	0	0	0
- .0003321	- .0003011	0	0	- .0003669	0	0	0
- .0011369	- .0001655	0	0	- .0009380	0	0	0
0	- .0002042	- .0071[illegible]94	- .002952	- .0076126	0	0	0
- .0151343	- .0013172	0	- .0[illegible]00656	- .0000806	0	0	0
- .0314353	- .0030852	- .0063[illegible]48	- .0[illegible]49215	0	0	0	0
- .0092120	- .0007862	- .0007[illegible]77	- .0[illegible]00328	- .0003559	0	0	0
- .0236793	- .0000739	- .0064[illegible]60	- .0[illegible]4860	- .0112811	0	0	0
0	- .0308710	0	0	0	0	0	0
- .0035098	0	0	0	0	0	0	0
- .0768660	0	0	0	- .0000989	0	0	0
0	- .0562663	- .0000[illegible]37	- .0[illegible]98397	- .0058484	0	0	0
- .0016456	- .0014264	- .0001[illegible]73	- .0[illegible]00369	- .0001854	0	0	0
- .0006117	- .0003724	- .0000[illegible]74	0	- .0006612	0	0	0
0	- .0002148	0	0	- .0007906	0	0	0
0	0	0	0	- .0384884	0	0	0
+ .9995848	- .0104426	- .0353[illegible]99	- .[illegible]45807	- .0072325	0	0	0
- .0765934	+ .9746541	- .0574[illegible]96	- .0[illegible]98298	- .0529975	0	0	0
- .0012179	- .0054431	+ .9782[illegible]79	- .0[illegible]23253	- .0201741	0	0	0
- .0006020	- .0027647	- .0148[illegible]92	+1.0[illegible]00000	- .0046516	0	0	0
- .1397082	- .1700077	- .0465[illegible]30	- .0[illegible]6098	+ .9052381	0	0	0
- .1295531	- .0296498	- .0471[illegible]58	- .0[illegible]9393	- .0524418	+1.0000000	+1.0000000	+1.000
- .0682117	- .0816837	- .1610[illegible]22	- .0[illegible]9839	- .1007252	0	0	0
- .0465849	- .1130178	- .0997[illegible]42	- .2[illegible]0897	- .0766976	0	0	0

TABLE [illegible] cont.

E[illegible]	E_{9}	E_{10}	E_{12}	E_{13}	E_{14}	
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
-1.0000[illegible]00	0	0	0	0	0	[illegible]
0	0	0	0	0	0	[illegible]
0	0	0	0	0	0	[illegible]
0	-1.0000000	0	0	0	0	[illegible]
0	0	-1.0000000	0	0	0	[illegible]
0	0	0	0	0	0	[illegible]
0	0	0	-1.0000000	0	0	[illegible]
0	0	0	0	-1.0000000	0	[illegible]
0	0	0	0	0	-1.0000000	[illegible]
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	-
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
+1.00000[illegible]00	+1.0000000	+1.0000000	+1.0000000	+1.0000000	+1.0000000	
0	0	0	0	0	0	
0	0	0	0	0	0	

TABLE III-1 Cont.

E_{22}	E_{24}	E_{25}	E_{26}	E_{27}	E_{28}	E
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
-1.0000000	0	0	0	0	0	0
0	0	0	0	0	0	0
0	-1.0000000	0	0	0	0	0
0	0	-1.0000000	0	0	0	0
0	0	0	-1.0000000	0	0	0
0	0	0	0	-1.0000000	0	0
0	0	0	0	0	-1.0000000	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	-1.0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
+1.0000000	+1.0000000	+1.0000000	+1.0000000	+1.0000000	+1.0000000	+1.
0	0	0	0	0	0	0
0	0	0	0	0	0	0

TABLE III-1 Cont.

E_{36}	E_{37}	M_1	M_2	M_3	M_4	M
0	0	+1.0000000	0	0	0	0
0	0	0	+1.0000000	0	0	0
0	0	0	0	+1.0000000	0	0
0	0	0	0	0	+1.0000000	0
0	0	0	0	0	0	0
0	0	0	0	0	0	+1.000
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
-1.0000000	0	0	0	0	0	0
0	-1.0000000	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
+1.0000000	+1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.000
0	0	0	0	0	0	0
0	0	0	0	0	0	0

TABLE III-1 Cont.

M_{10}	M_{11}	M_{12}	M_{13}	M_{14}	M_{15}	M_{16}	M_{17}
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
+1.0000000	0	0	0	0	0	0	0
0	+1.0000000	0	0	0	0	0	0
0	0	+1.0000000	0	0	0	0	0
0	0	0	+1.0000000	0	0	0	0
0	0	0	0	+1.0000000	0	0	0
0	0	0	0	0	+1.0000000	0	0
0	0	0	0	0	0	+1.0000000	0
0	0	0	0	0	0	0	+1.0000000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

TABLE III-1 Cont.

M_{20}	M_{21}	M_{22}	M_{23}	M_{24}	M_{25}	M_{26}	M_{27}
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
+1.0000000	0	0	0	0	0	0	0
0	+1.0000000	0	0	0	0	0	0
0	0	+1.0000000	0	0	0	0	0
0	0	0	+1.0000000	0	0	0	0
0	0	0	0	+1.0000000	0	0	0
0	0	0	0	0	+1.0000000	0	0
0	0	0	0	0	0	+1.0000000	0
0	0	0	0	0	0	0	+1.0000000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.00000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

TABLE III-1 Cont.

M_{30}	M_{31}	M_{32}	M_{33}	M_{34}	M_{35}
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
+1.0000000	0	0	0	0	0
0	+1.0000000	0	0	0	0
0	0	+1.0000000	0	0	0
0	0	0	+1.0000000	0	0
0	0	0	0	+1.0000000	0
0	0	0	0	0	+1.0000000
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000	-1.0000000
0	0	0	0	0	0
0	0	0	0	0	0

By maximizing final demand, Y, we would be maximizing the Gross Provincial Product if exports and imports are balanced. Since a component of Y is personal consumption, personal income is implicitly maximized. Although the pattern of consumption is assumed to remain unchanged until 1975, the consumption coefficients could be changed without disturbing previous solutions.

Maximizing the investment component of final demand involves maximizing net addition to capital stock for the following year. New investment is in the form of non-residential construction, machinery, and boats and ships. These capital goods are not used in the same production period but enter production in the following period.

The output of the Public Sector is nonproductive and disappear after use being analogous to final consumption goods. The rate of growth of employment in the public service will be determined by the rate of growth of final demand.

Production Functions

The programming model consists of 43 domestic good-producing activities. Each sector has one domestic producing activity where a sector can be identified as a row vector for commodity X_i.

The production functions for the domestic producing activities were based on the input-output technical coefficient matrix for Newfoundland in 1965. The structural matrix existing at that time is however updated by the integration of new industrial activities. The adjusted coefficients are for activities[15] Pulp and Paper (24), Wire Products (29), Non-Metallic Mineral Products (33), and Petroleum (34). Activities (29) and (33) were adjusted from the base period (1969) to take into account an Aluminium Cable Plant (added to 29), a new Phosphorous Plant and a Magnesium Hydroxide Plant (both added to 33) which had come into production since 1965. Added to the Pulp and Paper activity is a Linerboard Mill and the coefficients in the Petroleum activity are adjusted to take into account a new Petroleum refinery. Both these new industries are scheduled to go into production in 1973, and therefore the adjustment appears in the 1973 programme. The inputs for these new industries were obtained from an impact study made for the Area Development Agency.[16]

All commodity inputs, a_{ij}, or input coefficients have a negative sign in the matrix. Thus the output of activity X_j producing commodity k consists of a column vector

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[15] The figure in brackets refers to the sector number in the activity analysis matrix.

[16] Hurwitz, N., Cho, Y.R., and Weisser, M. Area Development Agency Impact Study in Newfoundland and Labrador, Institute of Social and Economic Research, Memorial University of Newfoundland, St. John's, Nfld., 1969.

$$
\begin{matrix}
 & & -a_{1i} & & \\
 & & -a_{2j} & & \\
1-a_{11} & \cdots & 1-a_{kj} & \cdots & -a_{1n} \\
 & & -a_{nj} & &
\end{matrix}
$$

where $1 - a_{kj} = X_j$, with '$1-a_{kj}$' representing the net output of activity X_j determined by treating the use of its own output, a_{kj}, as an output. All inputs have the property $a_{ij} \geq 0$ and $\sum_{j=1}^{N} a_{ij} \geq 1$, and all activities have property $X_j \geq 0$. Constant returns to scale to individual industries are assumed throughout. This does not exclude the possibility of external economies if all industries followed a co-ordinated investment plan.

Each of the domestic producing activities are allowed to change their output level by a maximum of 20% within a year. That is, output cannot increase or decrease by more than 20% in any one year period. The activities with no constraints are transportation, construction (residential, and non-residential), utilities, electric power, and services. These activities require no constraints because we assume the commodities they produce cannot be exported or imported and therefore their output level is determined by the level of final demand and by the levels of the producing activities.

The reason for this 20% upper and lower bound on the output of the producing activities is threefold. Firstly, some form of capacity constraint has to be included, since it is impossible for any activity to have unlimited output expansion in any one year period. The choice of 20% was arbitrary, but it was thought that anything exceeding this figure would entail too much strain on the capacity adjustment of individual industries affected. Secondly, the inherent tendency of linear programming is to seek extreme solutions unless constrained. Thus it was found on a test programme that without any constraints on the level of domestic producing activities, the agriculture activity tends to replace most of the existing industrial activities. Such an extreme solution is, of course, impossible and unrealistic. Thirdly, there are no frictions in linear programming. Adjustments are instantaneous. In reality this is not the case and this 20% constraint prevents any activity increasing or decreasing at too fast a rate, thereby helping to reduce excessive instability in the process of development. In the Chenery and Kretschmer model discussed previously the programme was constrained firstly by assuming that the capacity of activities in the base year would not decline, and secondly by making the price of exports decrease with the increase in exports, thereby making it unprofitable to specialize completely in any one export activity.

Capital

The discussion on capital is concerned with the production of capital and the use of capital. These two aspects have to be differentiated. Unlike labour, which in the model is treated as simply a row vector (that is, a selling activity), capital appears as both a producing as well as a selling activity. Complications arise because, although initially restricted, capital can create itself. Therefore without proper specification of time-lags in the production of capital goods, the economy can re-generate itself endlessly and explosively.

A macro version of the capital formation process used in the model is as follows:

Assume the required capital stock to be in proportion to gross income, the factor of proportionality being the capital coefficient b, then

$K_t = bY_t$, where K_t is the total value of physical capital stock

Y is the Gross Provincial Product

t is the base period

But K_t can also stand for a list of physical units as well as a single value: it represents a heterogeneous complex of capital items used by different industries in the economy. Since it is our contention that a reallocation of existing capital stock will improve economic efficiency,

the capital coefficient, b, is determined by the given pattern of capital utilization existing in the economy at time 't'. New investment in the economy will change the composition of K_t and will give the economy a new capital coefficient, b_{t+1}. This new coefficient is a result of the change in capital utilization which takes place during period 't'. The equation for period two will become

$$K_{t+1} = b_{t+1} Y_{t+1}$$

and new investment

$$I_t^{new} = K_{t+1} - K_t.$$

Assuming a closed economy for the sake of determining a potential rate of growth, equilibrium requires the sum of consumption (C) and gross investment demand (I) for final output to equal Gross Provincial Product:

$$Y_t = C_t + I_t$$

Here, I_t is gross investment which includes both new and replacement investment,

$$I_t = I_t^{new} + I_t^{rep.}$$

The size of replacement investment, $I^{rep.}$, is determined by the depreciation charges accrued through the period, and is itself a function of the average useful life of total physical capital stock. Denoting R_t as depreciation

or capital consumption in period t, the relationship stands as follows:

$$I_t^{rep.} = R_t$$

$$R_t = rK_{t-1}$$ where r is a fixed depreciation rate

In this model the capital goods producing activities are Non-Residential Construction, Machinery, and Boat-and-Ship-Building. The last activity was included because of the large part played by the fisheries sector in the Newfoundland economy and the importance of this activity to the fisheries. The Residential Construction activity adds to capital stock, but this capital (houses) can be considered as non-productive or terminal. The capital goods activities produce for new investment demands, and undertake repair and maintenance works on the existing capital stock used by other producing activities in the economy.

No capital stock values for the Newfoundland economy as a whole, nor for any of its individual industires are available. We do, however, know the rate of capital consumption per unit of output, d_j, by each activity. We assumed, therefore, that total R_t was equal to the total capital consumption which took place in 1969, which was determined by using d_j, ($j = 1, \ldots, n$), on the known output levels in 1969. From Final Demand

for this period I_t was found. Given r,[17] R_t and I_t, R_{t+1} for 1970 was determined.

Given an initial stock of capital goods, K_t, with constant productivity, this level of capital goods must be available over time. If this were not the case production would eventually decline with capital consumption. The diminised size of capital stock would not be able to sustain production at the level which existed in the initial period. Therefore, to ensure an increase in production the increase in gross investment must be greater than the consumption of capital in any period.

New investment takes place in the economy in the form of new and different durable goods. Also the depreciated producers' goods will be replaced by new and different ones. The technological efficiency difference between the new and old capital goods may be substantial. But, again we abstract technological changes in order to determine the net improvement in the rate of growth due to changes in the structure - the pattern of deployment - of the existing capital stock.

Within a given period, the extent to which we can modify the structure of existing capital stock is limited and equals R - the capital consumption allowance

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[17] 'r' is a composite of depreciation rates for the different capital goods. These rates are 10% for Machinery and Boat-and-Ship-Building, and 5% for Non-Residential Construction.

or depreciation for that period. This R increases with increasing capital stock. Suppose at the beginning of period t capital stock is K_t, and the capital consumption allowance is R_t for that period. Therefore, by the end of the period capital stock will have decreased and will be equal to $K_t - R_t$. But investment takes place and adds to the capital stock so that at the beginning of period 2, capital stock is now: $K_{t+1} = K_t - R_t + I_t$. Since both new and old capital goods are subject for depreciation, the capital consumption allowance for period 2 will be $R_{t+1} = R_t + rI_t$, and thus the capital stock available at the end of period 2 will be $K_{t+1} = K_t - R_t + rI_t + I_t - rI_t$. If I_t is greater than R_t, K_{t+1} will be greater than K_t.

I_{t+1} is necessarily bigger than R_t because the fact that R_t is positive means that there is room for re-allocating capital resources and changing the existing capital structure. Y_{t+1} which determines I_{t+1} increases when structural change in the capital stock improves the capital coefficient, b. In our model, the capital coefficient, b, will not remain constant unless the existing capital structure happens to be an optimal one.

In our model Final Demand is being maximized in each period. Because a component of Final Demand is investment, investment is implicitly maximized and larger than R_t. Part of this new investment is added to the

previous period's capital consumption allowance at a ratio of 10% for Machinery and Boat-and-Ship-Building, and 5% for Non-Residential Construction.[18]

LABOUR

The labour requirements per unit of output shown in the activity analysis model, (Table III-1), are assumed to remain fixed over time and are measured in man year units. Labour is treated as homogeneous and there is no conversion activity which could transform unskilled labour into skilled labour or into a certain type of skilled labour. Skilled labour therefore does not constitute a bottleneck.

The definition of the labour force is that used by the Dominion Bureau of Statistics;[19] that is, that portion of the population 14 years of age and over, who, during the reference week, were employed or actively seeking employment. However employment figures do not include part-time or seasonally employed. The labour force is assumed to increase annually at a constant rate of 2.1% throughout the planning period. This rate of growth is equivalent to the annual average rate of growth of the labour force in Newfoundland since 1950.

The assumption that the labour force (L_t) is determined exogeneously and grows at a constant rate means that the current participation rate will remain constant

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[18] A similar assumption on the depreciation rate is made in the Kentucky model. See Spiegelman, Baum and Talbert, op. cit., p. 14.

[19] D.B.S., The Labour Force, Catalogue No. 71-001.

even though this rate is lower than the Canadian average. Normally the participation rate is expected to increase as full employment is approached and the wage rate tends to increase.

The annual labour supply, L_t, is then given and fixed and $L_t \leq \sum_{j=1}^{N} w_j x_j + w_j Y$, that is, labour used by the producing activities and by final demand cannot exceed the given supply of labour. The fixity of the labour coefficients will mean that demand for labour will tend to be overestimated since no allowance is made for labour productivity changes, nor for internal economies of scale within the activity itself. If qualitative changes in the labour force were allowed to take place in the model output levels would be adjusted upwards.

Foreign Exchange

The balance equation for foreign exchange is $\sum_{j=1}^{n} g_j X_j + \sum_{i=1}^{n} m_j M_j - \sum_{i=1}^{n} e_j E_j = 0$. No surplus or deficit in the balance of trade is allowed. This restriction means that the rate of growth in final demand is slowed down considerably. If a deficit in the balance of trade is allowed over a period, the rate of growth of final demand can be much higher although the actual level of the Gross Provincial Product will be less than that of Final Demand. An import deficit could have been allowed since it is relatively easier for a region to go into

debt for longer periods than a nation. A region also receives grants, statutory or otherwise from the national government which enable it to offset somewhat the deficit in the required balance of trade. These factors were not taken into account since were are concerned with determining the potential rate of growth of the economy when it relies on its own existing factor inputs.

The function of exports in the model is simply to purchase imports. No separate estimate has been made of export demand, and exports are constrained on the supply side only. The level of imports depends on the level of domestic supply which in turn depends partially on the level of final demand and export requirements. The rate of growth in final demand and in the level of exports are of course dependent on the supply of resources.

The cost of exports is in terms of factor use, that is, the direct and indirect use of labour and capital used to produce the export goods. Since total exports and total imports have to be balanced, the cost of imports is simply the amount of labour and capital used to produce the total exports.

As mentioned previously each activity has a 20% upper and lower bound on output for each period. This means a complete import substitution of a commodity is impossible if more than 50% of that commodity was imported in the initial period. For the same reason in sectors

where imports are replacing domestic production as the source of supply the domestic production activity would not disappear within the five year period. For some domestic output there is little or no domestic final demand; the surplus output of these activities will have to be exported since no provision is made for inventory accumulation.

Most of the domestic producing activities use foreign exchange to purchase non-competitive imports, where non-competitive imports are defined as any commodity used in domestic production or demanded for final consumption which is not produced in the Atlantic Region. These imports are assumed to be non-substitutable and the ratios for non-competitive imports remain fixed.

METHODS OF SOLUTION

This section is intended to give an indication of how the optimum solutions for the various programmes are obtained and how activities are chosen to be included in the basis. A better idea of this process will be obtained when the results of the six programmes are discussed in the following chapter.

The simplex method used to solve the programme gives a step by step revision of a feasible solution until an optimum solution is obtained. At the start a basic feasible soltuion has to be obtained. In many activity analysis programmes this can be found quite easily by

making all activities zero and giving the slack or disposal activities a positive value. In our case activities have a minimum lower bound which must be attained. The initial basic feasible solution will only be obtained when all activities have reached their lower bound values. But since final demand has a fixed ratio of coefficients which must be satisfied simultaneously, the lower bound of an activity may be such that it forces another activity to take on a value higher than its lower bound.

This requires the determination of relative factor scarcities between capital, labour, and foreign exchange. However, with no deficit allowed, 'foreign exchange' is not free but has to be produced. Therefore the scarcity of 'foreign exchange' will depend on the relative scarcity of the other two resources. The factor intensities of the different activities are unchanged through time, but the absolute level of the different resources used are changing and therefore their relative value will be changing.

The factor intensity of an activity will determine its profitability. An activity is profitable if the value of its output is greater than the cost of its inputs. The cost of factor inputs, or the price of factor inputs, is measured in terms of opportunity cost - that is, the value of output which would be lost given a unit decrease in the amount of the resource available. The opportunity cost of

a resource is its marginal product. Input and output proportions for each activity are, however, fixed, so that we cannot vary factor input proportions to determine the most efficient combination of factors for an individual activity. But for the economy as a whole factor proportions can be varied by changing the combination of different activity levels. In this manner a factor's marginal productivity for the economy as a whole can be determined.

With some labour resources unutilized, labour would have a zero price, that is, it has no opportunity cost. In this case there would be a tendency to choose labour intensive activities. Once a level of full employment is reached labour is scarce and has a positive value attached to it. With full employment the rate of growth of the economy will be constrained by the rate of growth of the labour force, which is assumed to be exogenously determined. This rate of growth of the economy will be similar to the natural rate of growth as defined by the Harrod-Domar model.[20]

However, in an open economy the rate of growth of the economy will not be restricted by the rate of growth of the labour force since imports are labour substituting. Thus adjustments will be made to decrease

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[20] See Hahn, F.H., and Matthews, R.C.O., The Theory of Economic Growth: A Survey, The Economic Journal, December, 1964, Vol. LXXIV, pp. 779-902,

labour intensive activities and increase imports in these activities. This will mean that exports have to be made to ensure a balance of trade as required by the model. The export activities which are the least labour intensive will be chosen. But this process will only take place if the labour displaced by imports is greater than that used by the exporting activities. Only after these adjustments have been made in the structure of production will the full effects of labour scarcity come into play.

When capital is the scarcer factor input it will be the capital intensive commodities which are imported, and the labour intensive goods will be exported. As the ratios existing between the two factor inputs change through time, capital-labour or labour-capital substitution will take place, depending on the relative abundance of the different factor inputs.

Six consecutive programmes were made in order to consider changes through time, but the model cannot be considered truly dynamic. The end result of one period will inevitably influence the succeeding period's results, but there is no feedback. Only a one way and direct connection exists between two adjacent periods. In that computations are undertaken for consecutive periods there is an indirect connection between the base period and the results of the terminal period. This process of sequential change is similar to that of period analysis.

The rate of growth of final demand in the model is dependent to the extent that the economy can generate additional capital inputs for use in the following period. This depends on the efficient allocation of scarce factor inputs within the period. It will also depend to the extent that the economy can substitute imports for capital and labour. The optimum solution obtained for each programme is unique, given resource specifications and given the minimum and maximum boundary constraints imposed on each activity. If these constraints were altered the optimum would also change. It follows that no optimum can be considered in isolation and without taking into account the technological coefficients the technological linkages existing between activities, factor availabilities, and capacity constraints.

CHAPTER IV

SOLUTIONS TO COMPUTER RUNS

Six solutions were obtained - one for each year of the planning period. Only significant points in the solutions will be discussed since for all programmes the process of choice and method of obtaining solutions is essentially the same. The solution for 1970 will be dealt with in rather more detail.

Programmes were solved through the use of the simplex method. The print-out for the computer programme used is shown in Appendix II.

The matrix used was composed of 120 rows and 185 columns. These columns consisted of 43 domestic producing activities, 27 export activities, 36 import activities, 77 slack activities for the resource constraints (foreign exchange, labour, and capital), and the upper and lower bounds imposed on 36 of the domestic producing activities. In addition there was a column for Final Demand coefficients and a restriction column. The rows consisted of 43 commodities, 3 resource rows while the remaining rows account for the upper and lower bounds for the domestic production activities. The programme required all the memory core of the IBM 360/42 computer, each solution taking on the average 3 hours and 20 minutes.

Each year's solution is only meaningful and can be properly evaluated only when compared to the solutions for the previous years and to the base period. To facilitate comparison of the six solutions with each other and with the base period, 'skyline' charts have been drawn for each of the planning periods. A 'skyline' chart shows the structure and level of production, exports and imports of the economy which are needed to maintain its level of consumption and investment. The horizontal scale represents the total supply for the economy in terms of dollars and is obtained by adding total competitive imports to total domestic output. The width of each of the 43 sectors to the total supply of the whole economy. The vertical scale, on the other hand, shows the percentage supply for a sector which is contributed by domestic production and by imports as well as the percentage of domestic production which is exported.

For each of the trading sectors, exports and imports have been taken as a percentage of total supply. The amount that a sector exports has been shown by a cross-hatched block added above the 100% level since exports are a surplus over and above the needs of a local economy. Imports are shown by a cross-hatched block below the 100% line because imports form a part of total supply.

The heavy black line shows the structure or a 'skyline' picture of the economic structure. By comparing these 'skyline' charts, structural changes occuring throughout the planning period can be seen. A jagged 'skyline' means that the economic structure lacks complete interdependence between resource based industries and the manufacturing industries, as well as between the manufacturing industries themselves. In an industrialized or developed economy the 'skyline' would therefore tend to be more even, reflecting a greater degree of interdependence existing among the producing activities.

The Solution for 1970

The output, imports, exports and employment for each activity in the base year, 1969, is shown in Table IV-1, and the comparable figures for 1970 in Table IV-2. The 'skyline' charts for both years are shown in Charts I and II. The data in Table IV-1 has, as mentioned in the previous chapter, been obtained partly from published data and partly from projections. The export figures are fairly accurate and were obtained from Government sources.[21] The import figures are less accurate since they were estimated by using the output-import ratios existing in 1965.

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[21] Economic & Statistics Division, Department of Finance, Government of Newfoundland and Labrador.

TABLE IV - 1

OPTIMUM INDUSTRIAL STRUCTURE FOR 1969

INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1. Agriculture	$ 15,442,000.00	$ 4,879,907.00	$ ------	613
2. Forestry	30,000,000.00	1,463,601.00	------	3,692
3. Shell Fish	2,540,300.00	911,448.00	------	1,020
4. Other Fish	25,800,725.00	1,121,423.00	------	13,633
5. Metal Mining	303,090,000.00	------	303,090,000.00	6,200
6. Non-Metal Mining	20,573,829.00	------	14,328,381.00	736
7. Meat Products	1,500,496.00	15,210,927.00	------	24
8. Dairy Products	2,112,467.00	17,453,633.00	------	157
9. Shell Fish Products	5,613,504.00	------	4,506,025.00	368
10. Other Fish Products	57,386,489.00	------	48,427,888.00	5,138
11. Fruit and Vegetables	43,152.00	23,534,963.00	------	2
12. Feed and Flour	890,896.00	2,723,243.00	------	21
13. Bakeries	6,467,000.00	2,312,494.00	------	342
14. Miscellaneous Foods	2,601,203.00	8,881,308.00	------	85
15. Soft Drinks	5,404,891.00	18,092.00		221
16. Breweries	5,655,002.00	2,506,824.00	------	259
17. Shoes	220,508.00	2,843,848.00	------	32
18. Leather Products	102,358.00	191,313.00	------	11
19. Cordage and Canvas	52,801.00	2,427,315.00	------	2
20. Clothing	668,369.00	31,416,066.00	------	90
21. Sawmills and Sash	3,773,537.00	18,025,408.00	------	246
22. Miscellaneous Wood	495.367.00	1,101,528.00	------	39
23. Furniture	236,000.00	8,081.604.00	------	31
24. Pulp and Paper	82,900,000.00	------	78,467,581.00	3,131
25. Paper Products	706,261.00	2,745,865.00	------	22
26. Printing	3,489,291.00	4,489,035.00	------	375
27. Iron Foundries	457,331.00	5,042,975.00	------	62
28. Miscellaneous Metals	3,629,369.00	6,053,231.00	------	156
29. Wire Products	2,916,747.00	3,784,798.00	------	29
30. Machinery	1,467,431.00	90,481,873.00	------	143
31. Boats and Ships	298,485.00	18,704,062.00	------	42
32. Cement Products	1,660,605.00	------	------	121
33. Non-Metallic Mineral Products	37,722,037.00	------	18,935,851.00	358
34. Petroleum	11,807,713.00	32,118,393.00	------	301
35. Paint and Varnish	1,512,777.00	1,977,136.00	------	105
36. Soap Products	460,140.00	2,364,663.00	------	24
37. Miscellaneous Manufacturing	550,570.00	906,624.00	------	52
38. Residential Construction	49,800,000.00	------	------	2,741
39. Non-res. Construction	175,805,900.00	------	------	9,675
40. Transportation	120,572,200.00	------	------	9,321
41. Utilities	17,565,800.00	------	------	2,678
42. Electric Power	36,504,665.00	------	------	1,209
43. Services	327,519,000.00	------	------	31,221
Public Sector				20,019
TOTAL	$1,368,017,216.00	$313,773,600.00	$467,755,726.00	114,747

TABLE IV - 2

OPTIMUM INDUSTRIAL STRUCTURE FOR 1970

	INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1.	Agriculture	$ 18,505,712.00	$ 3,384,141.00	$	734
2.	Forestry	35,998,416.00	------	1,041,989.00	4,430
3.	Shell Fish	2,032,117.00	2,279,654.00	------	815
4.	Other Fish	30,949,616.00	2,576,380.00	------	16,353
5.	Metal Mining	302,400,260.00	------	302,400,260.00	6,185
6.	Non-Metal Mining	24,687,552.00	------	15,145,088.00	883
7.	Meat Products	1,800,495.00	16,571,816.00	------	28
8.	Dairy Products	2,534,850.00	18,887,296.00		188
9.	Shell Fish Products	6,736,009.00	------	5,513,774.00	441
10.	Other Fish Products	67,661,088.00	------	64,386,000.00	6,058
11.	Fruit and Vegetables	51,781.00	18,776,960.00	------	2
12.	Feed and Flour	712,705.00	3,846,706.00	------	16
13.	Bakeries	7,760,218.00	1,935,115.00	------	410
14.	Miscellaneous Foods	3,121,335.00	9,365,584.00	------	102
15.	Soft Drinks	5,973,427.00	------	------	244
16.	Breweries	6,785,845.00	2,220,969.00	------	310
17.	Shoes	264,602.00	3,117,056.00	------	38
18.	Leather Products	122,822.00	200,972.00	------	12
19.	Cordage and Canvas	63,360.00	2,499,492.00	------	2
20.	Clothing	802,029.00	34,586,128.00	------	107
21.	Sawmills and Sash	3,018,732.00	20,513,696.00	------	196
22.	Miscellaneous Wood	594,426.00	1,028,323.00	------	46
23.	Furniture	283,190.00	8,665,258.00	------	37
24.	Pulp and Paper	99,378,752.00	------	94,808,816.00	3,753
25.	Paper Products	847,500.00	2,995,558.00	------	25
26.	Printing	4,186,995.00	4,247,753.00	------	450
27.	Iron Foundries	548,783.00	5,440,245.00	------	74
28.	Miscellaneous Metals	4,355,068.00	6,410,342.00	------	187
29.	Wire Products	3,499,927.00	3,540,725.00	------	34
30.	Machinery	1,760,818.00	105,086,610.00	------	171
31.	Boats and Ships	238,781.00	19,270,032.00	------	33
32.	Cement Products	1,328,398.00	385,652.00	------	96
33.	Non-Metallic Mineral Products	55,708,960.00	------	31,789,760.00	523
34.	Petroleum	14,169,007.00	33,414,320.00	------	361
35.	Paint and Varnish	1,815,229.00	1,748,860.00	------	125
36.	Soap Products	552,156.00	2,558,893.00	------	28
37.	Miscellaneous Manufacturing	660,670.00	938,614.00	------	62
38.	Residential Construction	55,820,576.00	------	------	3,072
39.	Non-res. Construction	195,795,420.00	------	------	10,775
40.	Transportation	128,842,740.00	------	------	9,960
41.	Utilities	19,530,832.00	------	------	2,977
42.	Electric Power	47,036,336.00	------	------	1,358
43.	Services	364,702,980.00	------	------	34,765
	Public Sector				22,396
	T O T A L	$1,517,640,515.00	$335,554,536.00	$517,085,687.00	128,887

The unemployment rate in 1969 was high, standing at 22.1%. This figure is slightly higher than the published data since we have taken seasonally employed and part-time workers as partially unemployed. Total capital consumption allowance, or R, for this period was $97.7 million and was increased to $107.5 million in 1970.

For the 1970 programme output levels were not allowed to vary more than 20% above or below the 1969 domestic output levels. This restriction applied only to the sectors in which imports and exports were allowed. The only activity for which this restriction was relaxed was for the Non-Metallic Mineral Products activity. This activity was allowed to increase by over 45%, but to decrease by only 20%. The reason for allowing this activity to increase output to this extent is due to the inclusion of two new industries in this activity, namely the new Phosphorous plant and the Magnesium Hydroxide plant. By 1969 these two industries had not yet attained full capacity output. The relaxation of the bound allowed the attainment of full capacity by the end of 1970.

In 1970 the total labour availability was 2.1% greater than that for 1969, but the capital consumption allowance was 10% greater. However no deficit in the balance of trade was allowed to occur. With these

CHART I

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1969

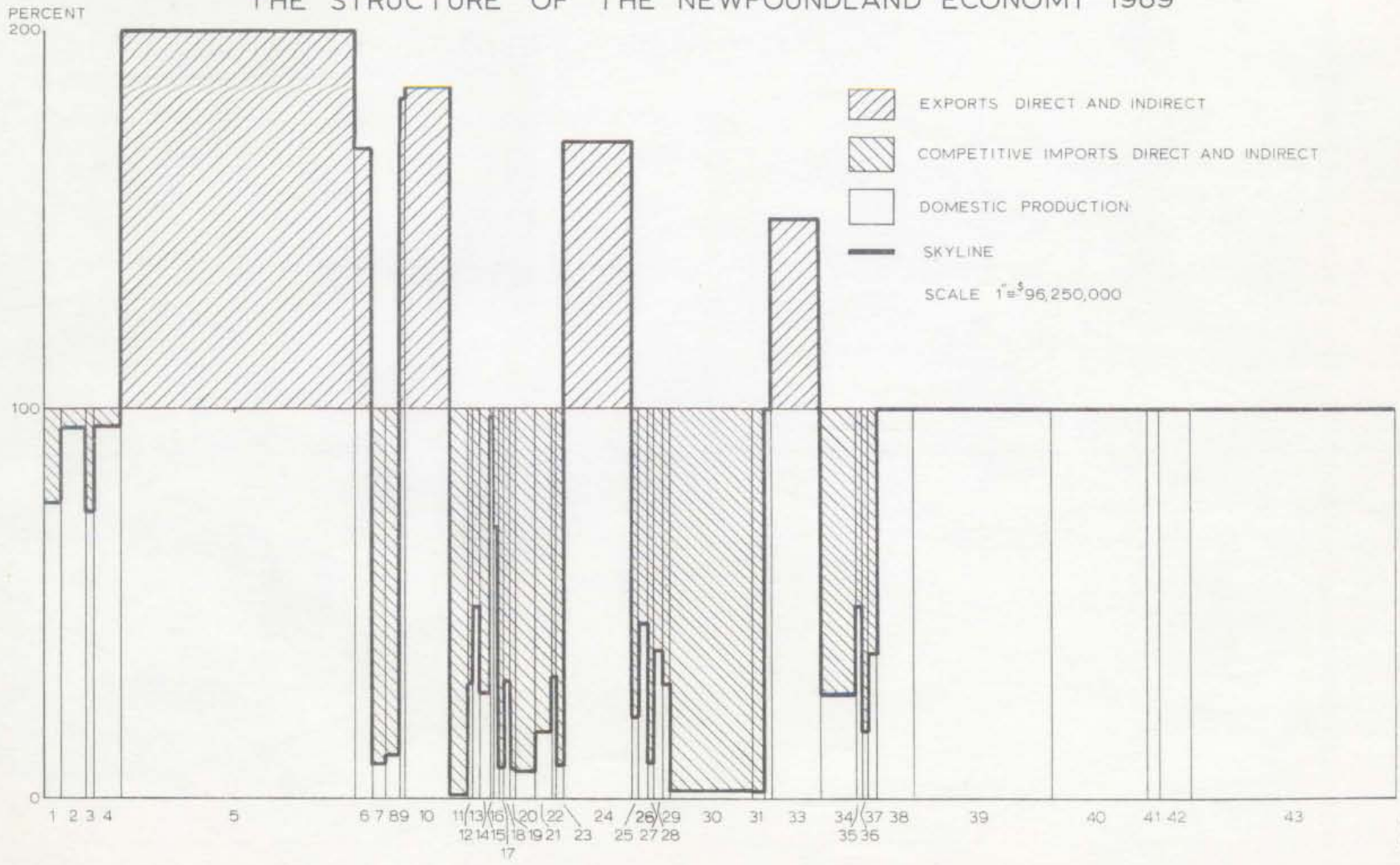
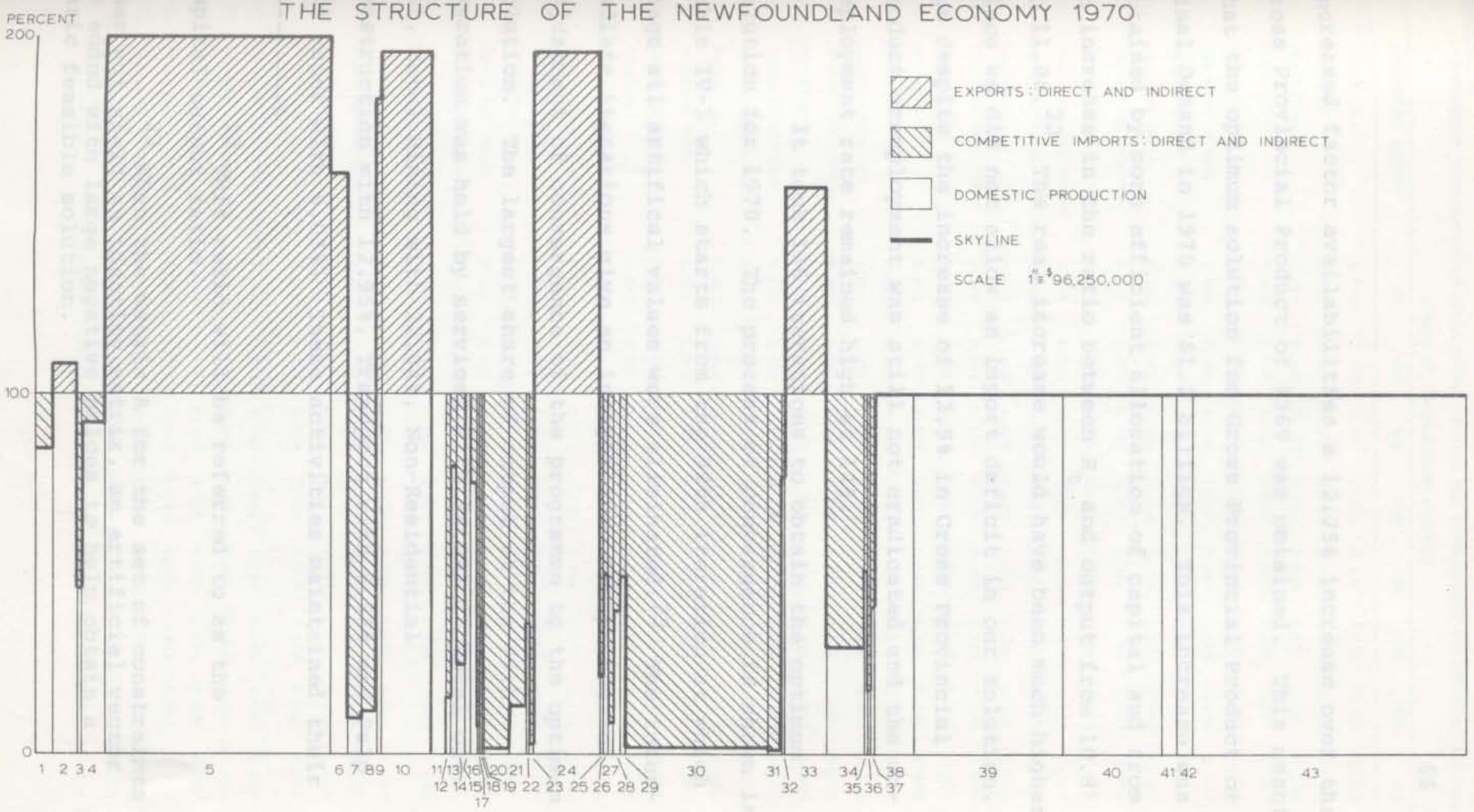


CHART II

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1970



increased factor availabilities a 12.25% increase over the Gross Provincial Product of 1969 was obtained. This meant that the optimum solution for Gross Provincial Product or Final Demand in 1970 was $1.2 billion. This increase was obtained by more efficient allocation of capital and from an increase in the ratio between R_t and output from 10.8 to 11.08.[22] The real increase would have been much higher since we did not allow an import deficit in our solution. But despite the increase of 12.5% in Gross Provincial Product unemployment was still not eradicated and the unemployment rate remained high at 14%.

It took 136 iterations to obtain the optimum solution for 1970. The process of convergence is shown in Table IV-3 which starts from the 99th iteration at which stage all artifical values were eliminated.[23] The intermediate iterations give an insight into the process of adjustment of convergence of the programme to the optimum solution. The largest share of output at the 99th iteration was held by services with 24.08% of total output, Metal Mining with 22.04%, Non-Residential Construction with 12.95%, Transport with 8.58% and Pulp and Paper with 6.03%. These activities maintained their

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[22] This ratio will be referred to as the capital output ratio.

[23] When the matrix A for the set of constraints does not yield an identity matrix, an artificial vector is added with large negative prices to help obtain a basic feasible solution.

TABLE IV - 3

PERCENTAGE DISTRIBUTION OF TOTAL OUTPUT IN 1970 FOR INTERMEDIATE AND OPTIMUM SOLUTIONS

		NUMBER OF INTERMEDIATE SOLUTION								
	INDUSTRIAL SECTOR	99	103	108	113	118	123	128	133	136
1.	Agriculture	1.120%	1.093	1.060	1.010	0.830	0.829	0.818	1.224	1.219
2.	Forestry	2.180	2.120	3.110	2.940	2.420	2.420	2.388	2.381	2.371
3.	Shell Fish	0.260	0.256	0.250	0.238	0.199	0.136	0.134	0.134	0.133
4.	Other Fish	1.870	1.820	1.780	2.530	2.080	2.080	2.053	2.047	2.039
5.	Metal Mining	22.040	21.490	20.960	19.850	24.130	24.080	22.148	21.631	19.920
6.	Non-Metal Mining	1.490	2.180	2.130	2.020	1.660	1.659	1.638	1.633	1.626
7.	Meat Products	0.109	0.106	0.103	0.098	0.080	0.080	0.119	0.119	0.118
8.	Dairy Products	0.153	0.149	0.146	0.138	0.113	0.113	0.168	0.167	0.167
9.	Shell Fish Products	0.408	0.398	0.388	0.367	0.302	0.301	0.297	0.297	0.443
10.	Other Fish Products	4.100	3.990	3.890	5.540	4.550	4.548	4.489	4.476	4.583
11.	Fruit and Vegetables	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003
12.	Feed and Flour	0.064	0.063	0.061	0.058	0.047	0.047	0.047	0.447	0.046
13.	Bakeries	0.470	0.458	0.447	0.423	0.348	0.347	0.514	0.513	0.511
14.	Miscellaneous Foods	0.189	0.184	0.179	0.170	0.140	0.139	0.138	0.206	0.205
15.	Soft Drinks	0.393	0.383	0.373	0.354	0.291	0.395	0.394	0.394	0.393
16.	Breweries	0.411	0.595	0.586	0.555	0.456	0.456	0.450	0.448	0.447
17.	Shoes	0.024	0.023	0.022	0.021	0.017	0.017	0.017	0.017	0.017
18.	Leather Products	0.007	0.007	0.007	0.006	0.005	0.008	0.008	0.008	0.008
19.	Cordage and Canvas	0.003	0.003	0.003	0.003	0.002	0.004	0.004	0.004	0.004
20.	Clothing	0.072	0.071	0.069	0.065	0.053	0.053	0.053	0.053	0.052
21.	Sawmills and Sash	0.270	0.267	0.260	0.274	0.203	0.202	0.200	0.199	0.198
22.	Miscellaneous Wood	0.036	0.035	0.034	0.032	0.026	0.026	0.039	0.039	0.039
23.	Furniture	0.017	0.016	0.016	0.015	0.019	0.019	0.018	0.018	0.018
24.	Pulp and Paper	6.020	5.870	5.720	5.420	4.450	4.453	6.594	6.575	6.548
25.	Paper Products	0.077	0.075	0.073	0.069	0.057	0.056	0.056	0.056	0.558
26.	Printing	0.253	0.371	0.362	0.342	0.281	0.281	0.277	0.277	0.275
27.	Iron Foundries	0.033	0.032	0.047	0.044	0.036	0.036	0.036	0.036	0.361
28.	Miscellaneous Metals	0.263	0.257	0.251	0.237	0.195	0.195	0.192	0.288	0.286
29.	Wire Products	0.212	0.206	0.201	0.191	0.157	0.156	0.154	0.231	0.230
30.	Machinery	0.106	0.104	0.152	0.144	0.118	0.118	0.116	0.116	0.116
31.	Boats and Ships	0.021	0.021	0.020	0.029	0.016	0.016	0.015	0.015	0.157
32.	Cement Products	0.120	0.117	0.114	0.163	0.089	0.089	0.088	0.087	0.087
33.	Non-Metallic Mineral Products	2.740	2.670	2.600	2.470	2.030	2.028	2.002	1.990	3.670
34.	Petroleum	0.858	0.837	0.816	0.773	0.635	0.635	0.626	0.624	0.933
35.	Paint and Varnish	0.110	0.107	0.106	0.099	0.081	0.122	0.120	0.120	0.119
36.	Soap Products	0.033	0.048	0.047	0.045	0.037	0.037	0.036	0.036	0.036
37.	Miscellaneous Manufacturing	0.040	0.039	0.038	0.036	0.029	0.029	0.029	0.043	0.043
38	Residential Construction	3.680	3.690	3.700	3.680	3.690	3.699	3.690	3.686	3.678
39.	Non-res Construction	12.950	12.980	13.010	12.950	13.080	13.084	13.000	12.960	12.900
40.	Transportation	8.580	8.570	8.550	8.520	8.660	8.679	8.606	8.590	8.489
41.	Utilities	1.280	1.280	1.290	1.300	1.290	1.293	1.291	1.292	1.286
42.	Electric Power	2.780	2.760	2.720	2.630	2.840	2.843	2.791	2.758	2.703
43.	Services	24.080	24.140	24.120	24.110	24.170	24.179	24.120	24.120	24.030
	Total Output $ Million	1,099.8	1,127.8	1,156.3	1,221.1	1,485.5	1,487.5	1,507.0	1,511.4	1,517.6

large shares of total output up to the final iteration when the optimum solution was obtained with the most significant change taking place in Metal Mining whose proportionate share decreased to 19.29% of total domestic output.

The share of most of the manufacturing activities as a percentage of total output remained relatively stable throughout. The main reason for this is that manufacturing as a percentage of total output is still relatively small; any changes that take place are not very noticeable. The percentage increase of a manufacturing activity may be large. In absolute terms this increase is small because initial level of manufacturing output is relatively small. In contrast the ititial levels of output of the service activities, Metal Mining, and the other activities mentioned above are large. Therefore, a relatively small change in their level of output will mean a significant percentage change in total output composition.

Between iteration 110 and 111 a sudden large drop in labour availabilities occurred as a result of a $2 million output increase in the Fishing (Other) Activity, an activity which employed a large direct use of labour. This large increase of output eliminated imports for the same activity and thus the increase in

output resulted from import substitution rather than from any increase in Final Demand. Further most of the input requirements for the Fishing activity (Boats-and-Ships, Wire Products, Machinery, and Cordage and Canvas) were supplied from imports. Although the output in the fishing activity increased this did not add much to the economy's total output, nor to an increase in capital consumption. Only non-trading activities such as Construction increased output slightly to satisfy input requirements for this activity.

However, in iteration 112 there was a large decline in labour availabilities (7,600) and a relatively larger decrease in capital availabilities than for the previous iteration. But the increase in this iteration was a result of increased demand rather from a process of substitution. Final Demand increased by approximately $35 million and total output by $40 million.[24] The large increase in labour usage resulted from the expansion of the Fish Products activity. This is a relatively labour intensive activity, and a large user of labour indirectly since most of its inputs originate from the fishing activities. The increased output of the Fish Products activity ($18 million) was used for exports so that

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[24] The ratio between total output and Final Demand remains relatively stable throughout all iterations varying from a low of 0.7852 to a high of 0.7911.

imports could be made to satisfy Final Demand. The increase in both the Primary Fishing and Fish Product activities led to an increase in the Tertiary activities to satisfy final demand. These resulted in a higher use of capital than in the previous iterations. In this iteration the Fish Products activity increased its share of total output from 3.87% to 5.21%.

The increase in output of these very labour intensive activities in the previous iterations shows us the process of choice through which activities are increased. Thus with capital only at $21 million by the start of the 110 iteration, an attempt is made to increase labour intensive activities to their full capacity levels, exporting the output of these activities and using the exports to import more capital intensive commodities. Since full capacity is attained in the Fish (Other) activity before it is reached in the Fish Products activity, fish had to be imported. Because of this the increase in output of the Fish Products activity in the following iteration is only slight.

The 114th iteration is significant because at this point all the available capital is exhausted. Between the 113th and 114th iterations, a number of industries expand output which increased total output by $270 million and Final Demand by $230 million.

The Metal Mining activity has no forward linkages because its output is directly exported. Its backward linkages also are small because its intermediate inputs account for only 34% of the value of total output. Neither is this activity very labour intensive. Although this activity has the same specified upper and lower bounds as other activities (i.e. 20% either way), the net difference between these two bounds is large, i.e., $1.25 million. Thus the large increase allowed an equivalent amount of imports to take place which could satisfy the increase in Final Demand. The large increase in Metal Mining also meant that its share of total output (which had been declining from 22% to 19.8% as a result of the increase in the Fish Products) now increased to 24%.

The sudden and large increase in output and the simultaneous decrease and elimination of capital, is a result of the simplex method which seeks extreme corner points thereby increasing the value of the objective function in a jagged rather than smooth manner. Thus after this iteration further adjustments are made and another corner point is sought at which the objective function can be further increased.

After capital has been eliminated futher adjustments were made for another 22 iterations. By decreasing an activity level and making more capital

available for other activities, the value of the objective function and total output could be increased respectively by $20 million and $30 million. These adjustments result in the share of mining as a percentage of total output being reduced from its extreme position of 24% to 19.9%. The adjustments, after the 114th iteration up to the 136th iteration, when the otpimum solution is obtained, take place mainly in the export activities, particularly in the Pulp and Paper activity and in the Non-Metallic Mineral Products activity whose output levels increased $33 million and $25 million respectively. The result of these adjustments meant that the Metal Mining activity fell to its original output level of 1969 where it remained until the optimum soltution was obtained.

The optimum structure showed an increase in all but five of the domestic producing activities with all other primary and manufacturing activities reaching their full allowable capacity limits, except the Soft Drinks activity. This latter activity has no intermediate use: its supply is a function of the level of Final Demand. The producing activities which declined were Shell Fish, Feed and Flour, Sawmills, Boats and Ships, and Cement.

The Shell Fish activity is directly labour intensive; with labour being the abundant factor it would be expected, at a first glance, that this activity would

be increased. But this would be neglecting its linkages with its direct commodity supplying activities and through these its indirect linkages with other activities. However, 10% of its inputs are in the form of machinery, and a further 5% comes from the Petroleum activity, and 5% from Sawmills. All these activities are relatively more capital intensive than the Shell Fish activity. The large input requirement of machinery (the Fish(Other) activity obtained only 2% of its inputs from the machinery sector) is a crucial factor making for the decline of the Shell Fish activity. With the scarcity of capital the output of the machinery activity can be used more profitably elsewhere than in the Shell Fish activity especially in producing exports which can be used to make capital-saving imports.

If the linkages of the Feed and Flour activity are traced it can be seen that it does not contribute directly to the value of Final Demand; the only intermediate demand for its product comes from the Agriculture activity. It also requires a relatively large amount of non-competitive imports. In this sense it uses capital indirectly since the non-competitive imports have to be paid for by exports. The Boat-and-Ships and the Cement activities are both large direct users of capital. The Boat and Ship activity is also a large direct user of construction and transportation - both capital-intensive

activities. The Cement activity which includes asphalt is large user of petroleum products. Petroleum requires a large amount of non-competitive imports and therefore exports to finance these imports. In addition it is a relatively large user of transportation and electric power, both of these activities being highly capital-intensive.

A comparison of the 'skyline' charts of 1969 and 1970 shows the changes which occured in the economic structure between these periods. Significant changes in the 'skyline' result firstly from the change in Forestry from an importing to an exporting sector, and secondly from an increase in imports in the Shell Fish activity which now contributes 52% of total supply for this commodity instead of 26% as in 1969. In addition Cement which previously was supplied wholely from domestic sources is imported in 1970, imports contributing 22% of total domestic requirements. Similarly Machinery's share in the total supply for the economy has increased from 5.5% to 9.7%. The final result for 1970 is that, although total output for most of the domestic producing activities increase, imports tended to increase simultaneously, and as a result the proportionate share of the various sectors in the economy changed only slightly.

The Solution for 1971

In 1971 labour availabilities increased by 2.1% equal to the exogenous rate of growth of the labour force. The increae in capital availabilities was however 15.08%, setting total availability at $123.7 million. This increase resulted from the large increase which took place in Final Demand in 1970. The optimum level for Final Demand for this year was $1.4 billion or an increase of 15.57% over the previous period. Employment also increased by 16.21%, thus decreasing the unemployment rate to 2.6%, an equivalent of 3,925 unemployed. The overall capital-output ratio also showed an increase from 11.08 in 1970 to 11.13 in 1971.

The optimum industrial structure and its 'skyline' chart are shown on the following two pages (Table IV-4 and Chart III). Even though it is only a small amount, labour remained as the abundant factor. Thus the process of change is similar to that occuring in 1970 with the same five activities showing a decline. Since in the 1971 solution the Non-Metallic Minderal Products activity had an upper bound of 20% reimposed, additional export earnings had to be obtained from another source. This source was the Metal Mining activity which showed an increase in output of 11.3%, and an equivalent increase in exports.

TABLE IV - 4

OPTIMUM INDUSTRIAL STRUCTURE FOR 1971

	INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1.	Agriculture	$22,206.048.00	$ 3,131,886.00	$ ------	881
2.	Forestry	43,196,288.00	------	4,051,583.00	5,316
3.	Shell Fish	1,625,598.00	3,536,425.00	------	652
4.	Other Fish	37,137,856.00	2,967,671.00	------	19,623
5.	Metal Mining	336,625,660.00	------	336,625,660.00	6,885
6.	Non-Metal Mining	29,623,456.00	------	18,386,704.00	1,060
7.	Meat Products	2,160,486.00	19,081,936.00	------	34
8.	Dairy Products	3,041,706.00	21,735,248.00	------	225
9.	Shell Fish Products	8,083,011.00	------	6,670,488.00	530
10.	Other Fish Products	81,190,560.00	------	77,421,072.00	7,270
11.	Fruit & Vegetables	62,136.00	21,732,912.00	------	2
12.	Feed & Flour	570,153.00	4,900,947.00	------	13
13.	Bakeries	9,312,076.00	1,893,658.00	------	492
14.	Miscellaneous Foods	3,745,459.00	10,714,104.00	------	123
15.	Soft Drinks	6,903,538.00	------	------	282
16.	Breweries	8,142,853.00	2,266,421.00	------	372
17.	Shoes	317,513.00	3,590,696.00	------	46
18.	Leather Products	147,379.00	226,859.00	------	15
19.	Cordage & Canvas	76,029.00	2,956,115.00	------	2
20.	Clothing	962,420.00	39,936,229.00	------	129
21.	Sawmills & Sash	2,414,884.00	24,594,800.00	------	157
22.	Miscellaneous Wood	713,296.00	1,179,678.00	------	55
23.	Furniture	339,817.00	10,001,686.00	------	45
24.	Pulp & Paper	119,251,570.00	------	113,912,190.00	4583
25.	Paper Products	1,016,984.00	3,559,114.00	------	31
26.	Printing	5,024,236.00	4,738,334.00	------	540
27.	Iron Foundries	658,525.00	6,186,733.00	------	88
28.	Miscellaneous Metals	5,225,890.00	7,226,927.00	------	224
29.	Wire Products	4,199,739.00	3,960,442.00	------	41
30.	Machinery	2,112,878.00	119,987,280.00	------	205
31.	Boats and Ships	191,017.00	22,373,072.00	------	27
32.	Cement Products	1,062,628.00	951,170.00	------	77
33.	Non-Metallic Mineral Products	66,848,224.00	------	39,003,120.00	628
34.	Petroleum	17,002,144.00	37,711,680.00	------	431
35.	Paint & Varnish	2,178,162.00	1,937,397.00	------	159
36.	Soap Products	662,574.00	2,925,479.00	------	34
37.	Miscellaneous Manufacturing	792,788.00	1,073,013.00	------	71
38.	Residential Construction	64,506,528.00	------		3,558
39.	Non-Residential Constr.	225,973,940.00	------	------	12,435
40.	Transportation	148,444,220.00	------	------	11,475
41.	Utilities	22,597,104.00	------	------	3,444
42.	Electric Power	46,859,120.00	------	------	1,551
43.	Services	421,335,550.00	------	------	40,164
	PUBLIC SECTOR				25,884
	T O T A L	$1,754,542,043.00	$387,077,912.00	$596,070,817.00	149,790

ECONOMY 1971

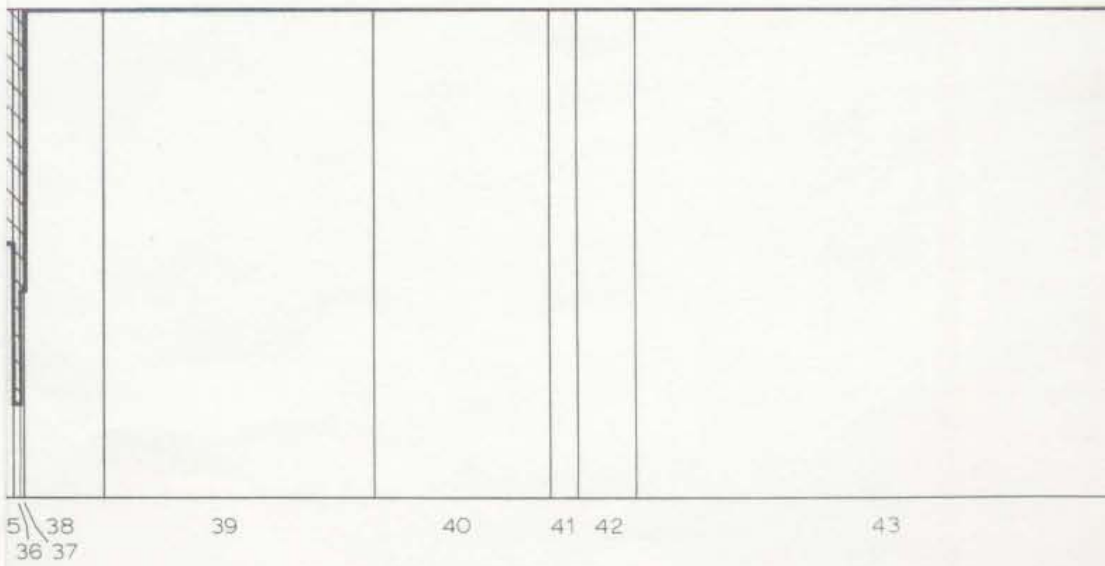
EXPORTS DIRECT AND INDIRECT

COMPETITIVE IMPORTS DIRECT AND INDIRECT

DOMESTIC PRODUCTION

SKYLINE

SCALE 1" ≡ $65,083,800



A decline in imports in the Agricultural sector and in the Bakeries sector by 7.4% and 2.1% respectively between 1970 and 1971 meant that the increase in the domestic producing activities in these sectors was only partly due to the increase in Final Demand and the inter-industry demand, and partly due to import substitution. Similarly in the Breweries sector there was a small net increase in imports (2.1%). The more than proportionate increase in domestic production meant that imports as a percentage of domestic supply declined from 24% to 21%. The further decline in the Shell Fish, Feed and Flour, Sawmill, Boats and Ships, and Cement activities showed that imports were rapidly displacing domestic production.

For the economy as a whole in 1971 the overall rate of increase of exports was slightly higher than the rate of increase of competitive imports. Since Non-competitive imports have to be paid for by exports, the relatively higher rate of growth of exports would indicate, that for the economy as a whole net import substitution took place.

The Solution for 1972

Final Demand for 1972 was $1.5 billion an increase of 11.38% over 1971. The capital consumption allowance increased by 15.09% as a result of the increase

in Gross Provincial Product in 1971. However, 2.3% of this capital was unutilized because all the labour force was utilized. The fact that a level of full employment had been reached, and with surplus capital available, reverses the process which occured in the previous two years since now labour has become the scarce resource. The capital-output ratio for this year also declined to 10.77. When we consider only the capital utilized this ratio becomes 11.03. Underlying the decline in this ratio is that the labour shortage is forcing capital to be used more intensively, thereby resulting in a fall in the capital-output ratio.

The solution for 1972 shows a decline in twenty of the domestic producing activities. Declining activities which had a very high direct labour intensity were the two Primary Fish producing and the Fish Processing activities. As a result of the decline in the Shell Fish Products activity and a decrease in exports by this activity there was a decrease in demand for Primary Shell Fish. Domestic output of this activity declined together with a 17% decline in imports of this commodity. This sector's share of the total supply of the economy declined as shown by the skyline chart. The decrease in the Primary Fish (Other) activity is largely a result of its labour intensity, as well as the decreased demand from the Fish Products activity.

Forestry became in 1972 a net importer, as a result of the decline in the Forestry producing activity. Forestry is itself labour intensive and the decline in domestic production released approximately 1,000 workers for use in other activities. Except for services, a labour intensive activity, the largest inputs for Forestry are Machinery and Petroleum - both of which declined. Although the output of Paper Products declined, there was not a large increase in imports of this commodity (2.7%). The Paper Products sector has a large amount of forward linkages. Many of these were connected with activities which declined thus resulting in a decrease in intermediate demand for Paper Products.

Despite the decrease in a large number of domestic producing activities a substantial amount of import substitution took place. For example, imports declined by 48.1% in Agriculture, by 30.58% in Bakeries, by 19.54% in Breweries, and in Cordage and Canvas by 15.04%. A decline in imports cannot always be interpreted as a process of import substitution. This decline can be attributed - especially in the case of industries supplying intermediate goods - to a decline in inter-industry demand. The latter decline, however, must be attributed either to substitution by imports for domestic production in some sectors, or to a decline in one of the exporting sectors.

The optimum industrial structure for 1972 is seen in Table IV-5. A comparison of the 'skyline' chart of this year (Chart IV) with that for the previous year shows the change in the Agriculture sector resulting from import substitution. Forestry again becomes a net importing sector as in 1969. The relative share of the exporting sectors of the total output also declined slightly as a result of increased output in the tertiary sectors.

The Solution for 1973

Coefficients for two domestic producing activities were changed at the start of the programme for 1973. These activities were Pulp and Paper, and Petroleum. The new coefficients are shown in Appendix I. The change was made to take into account the effect of a new Linerboard Mill on the west coast of Newfoundland and the new large Petroleum refinery scheduled to go into operation by the end of 1972 or early 1973. As a result of the entry of these two new industries both activities became highly capital intensive (their indirect capital intensity did not change however). The upper constraints of these activities were also relaxed to allow the new industries to attain full-capacity levels.

TABLE IV - 5

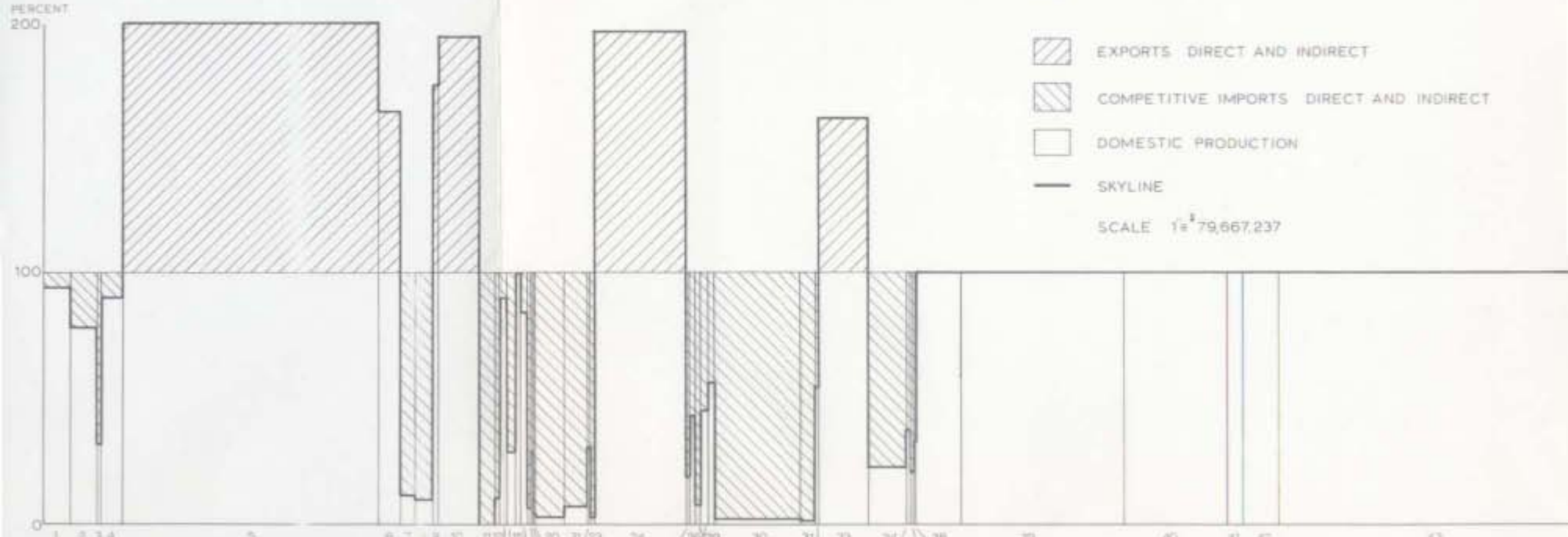
OPTIMUM INDUSTRIAL STRUCTURE FOR 1972

INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1. Agriculture	$ 26,645,536.00	$ 1,625,965.00	$ ------	1,058
2. Forestry	34,555,328.00	9,610,768.00	------	4,253
3. Shell Fish	1,300,384.00	2,925,982.00	------	522
4. Other Fish	29,708,496.00	3,389,511.00	------	15,698
5. Metal Mining	403,924,990.00	------	403,924,990.00	8,262
6. Non-Metal Mining	35,546,336.00	------	22,903,760.00	1,272
7. Meat Products	2,592,472.00	21,065,584.00	------	41
8. Dairy Products	2,433,259.00	25,025,888.00	------	180
9. Shell Fish Products	6,466,288.00	------	4,892,948.00	424
10. Other Fish Products	64,950,688.00	------	60,870,016.00	5,816
11. Fruit & Vegetables	74,556.00	23,920,176.00	------	2
12. Feed and Flour	684,168.00	5,880.947.00	------	15
13. Bakeries	11,174,267.00	1,309,284.00	------	590
14. Miscellaneous Foods	4,494,400.00	11,645,909.00	------	147
15. Soft Drinks	7,689,718.00	------	------	314
16. Breweries	9,771,237.00	1,823,396.00		447
17. Shoes	254,005.00	4,099,285.00	------	37
18. Leather Products	117,897.00	298,724.00	------	12
19. Cordage and Canvas	91,231.00	2,511,282.00	------	2
20. Clothing	769,904.00	44,785,344.00	------	103
21. Sawmills and Sash	1,931,804.00	27,946,592.00	------	125
22. Miscellaneous Wood	570,625.00	1,376,055.00	------	44
23. Furniture	271,846.00	11,237,158.00	------	36
24. Pulp and Paper	143,098,540.00	------	137,089,340.00	5,404
25. Paper Products	813,521.00	3,656,327.00	------	24
26. Printing	4,591,276.00	6,163,160.00	------	493
27. Iron Foundries	526,808,00	7,251,755.00	------	71
28. Miscellaneous Metals	6,270,870.00	7,889,280.00	------	269
29. Wire Products	5,039,509.00	3,989,788.00	------	50
30. Machinery	1,690,202.00	136,505,760.00	------	164
31. Boats and Ships	152,807.00	24,696,752.00	------	21
32. Cement Products	1,275,092.00	1,048,152.00	------	93
33. Non-Metallic Mineral Products	80,215,024.00	------	48,632,048.00	754
34. Petroleum	13,601,472.00	47,711,200.00	------	346
35. Paint and Varnish	1,742,421.00	2,828,903.00	------	120
36. Soap Products	795,073.00	3,212,845.00	------	41
37. Miscellaneous Manufacturing	634,220.00	1,288,992.00	------	60
38. Residential Construction	71,812,496.00	------	------	3,952
39. Non-Res. Construction	251,974,940.00	------	------	13,866
40. Transportation	165,520,450.00	------	------	12,795
41. Utilities	24,794,208.00	------	------	3.779
42. Electric Power	54,453,040.00	------	------	1,802
43. Services	468,274,940.00	------	------	44,638
Public Sector				28,831
TOTAL	$1,937,025,474.00	$446,720,764.00	$678,313,102.00	156,991

CHART IV

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1972



The solution for 1973 is also unique in that all factor resources were utilized; labour still remained the scarce factor since it was depleted before capital. Only after 38 additional iterations during which adjustments were made in domestic production, exports and imports, was it possible to eliminate all capital. The rate of growth in 1972 had resulted in an additional increase of capital of 14.7% for 1973, but this enabled a rate of increase of only 7.65% in Gross Provincial Product in 1973 in which year the GNP stands at $1.7 billion, and a capital-output ratio is of the order of 10.12.

Although the number of domestic producing activities which showed declines for 1973 was the same as for the previous year, these were not all the same activities. Significant activities which showed changes were Petroleum, Pulp and Paper, Dairy Products, Feed and Flour, Printing, Miscellaneous Metal, Cement, and Paint and Varnish.

The new upper constraint on the Petroleum activity allowed the attainment of full capacity for the new refinery added to this activity. This full capacity level was sufficiently high to allow the Petroleum activity to satisfy domestic requirements as well as export a significantly large amount of its

TABLE IV - 6

OPTIMUM INDUSTRIAL STRUCTURE FOR 1973

	INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1.	Agriculture	$ 31,973,008.00	$ ------	$ 1,345,625.00	1,270
2.	Forestry	27,642,800.00	20,064,384.00	------	3,402
3.	Shell Fish	1,040,247.00	2,435,859.00	------	417
4.	Other Fish	23,765,200.00	3,708,121.00	------	12,557
5.	Metal Mining	484,684,030.00	------	484,684,030.00	9,915
6.	Non-Metal Mining	42,653,984.00	------	28,613,088.00	1,527
7.	Meat Products	3,110,853.00	22,373,584.00	------	50
8.	Dairy Products	2,919,802.00	26,696,640.00	------	217
9.	Shell Fish Products	5,172,912.00	------	3,479,640.00	340
10.	Other Fish Products	51,958,896.00	------	47,646,896.00	4,653
11.	Fruit and Vegetables	89,461.00	25,546,176.00	------	4
12.	Feed and Flour	547,323.00	7,330.363.00	------	13
13.	Bakeries	13,408,887.00	33,706.00	------	709
14.	Miscellaneous Foods	5,393,158.00	12,092,711.00	------	177
15.	Soft Drinks	8,278,695.00	------	------	339
16.	Breweries	11,725,276.00	757,430.00	------	537
17.	Shoes	203,198.00	4,483,479.00	------	30
18.	Leather Products	94,310.00	354,044.00	------	10
19.	Cordage and Canvas	109,470.00	2,145,064.00	------	3
20.	Clothing	615,914.00	48,426,864.00	------	83
21.	Sawmills and Sash	1,545,357.00	30,642,928.00	------	101
22.	Miscellaneous Wood	456,488.00	1,528,540.00	------	36
23.	Furniture	217,469.00	12,156,592.00	------	29
24.	Pulp and Paper	128,516,140.00	------	124,123,580.00	3,664
25.	Paper Products	650,805.00	3,907,431.00	------	20
26.	Printing	5,509,370.00	6,024,798.00	------	593
27.	Iron Foundries	421,435.00	8,204,700.00	------	57
28.	Miscellaneous Metals	6,031,990.00	9,659,424.00	------	259
29.	Wire Products	6,047,229	2,841,346.00	------	60
30.	Machinery	1,352,070.00	151,923,330.00	------	132
31.	Boats and Ships	122,239.00	26,401,312.00	------	17
32.	Cement Products	1,020,052.00	1,620,749.00	------	75
33.	Non-Metallic Mineral Products	96,255,232.00	------	61,235,168.00	905
34.	Petroleum	10,880,993.00	63,370,192.00	------	30
35.	Paint and Varnish	2,090,796.00	2,816,978.00	------	145
36.	Soap Products	954,069.00	3,394,635.00	------	50
37.	Miscellaneous Manufacturing	507,365.00	1,457,067.00	------	48
38.	Residential Construction	77,212,160.00	------	------	4,249
39.	Non-Res. Construction	272,306,940.00	------	------	14,986
40.	Transportation	177,373,970.00	------	------	13,712
41.	Utilities	26,278,496.00	------	------	4,006
42.	Electric Power	62,198,192.00	------	------	2,059
43.	Services	501,535,230.00	------	------	47,809
	Public Sector				31,040
	T O T A L	$2,094,871,511.00	$502,398,441.00	$751,127,464.00	160,335

CHART V

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1973

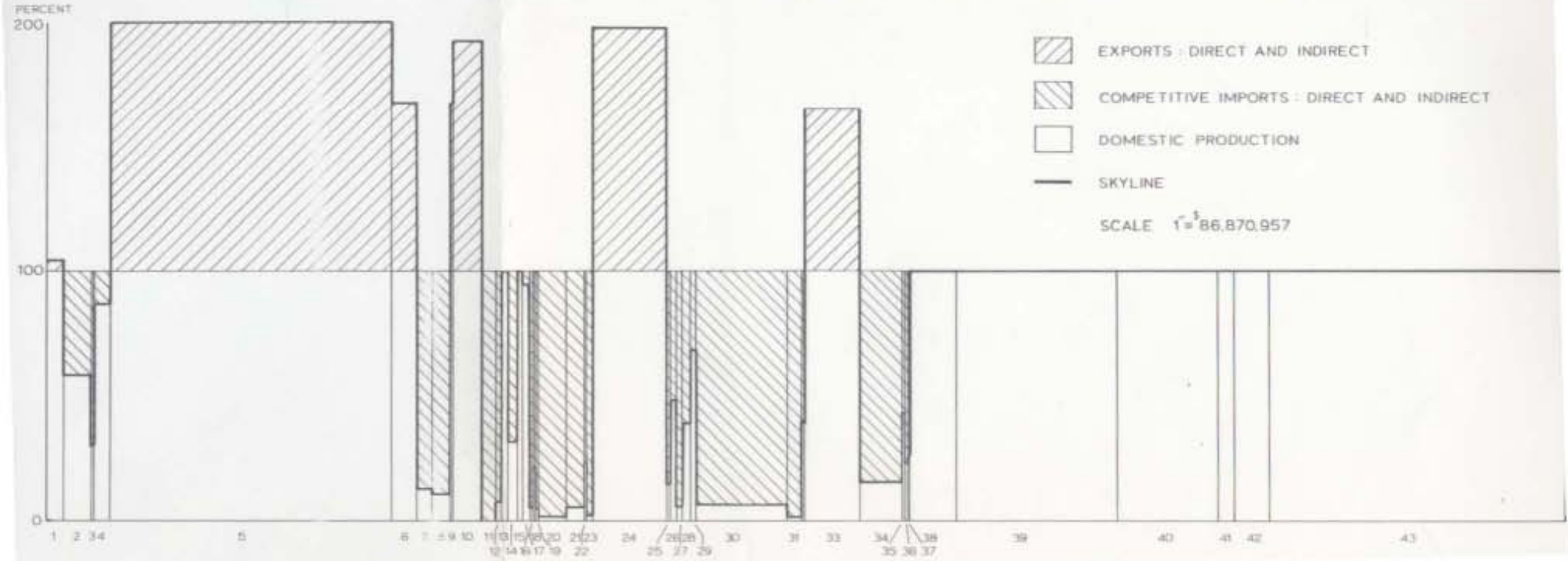
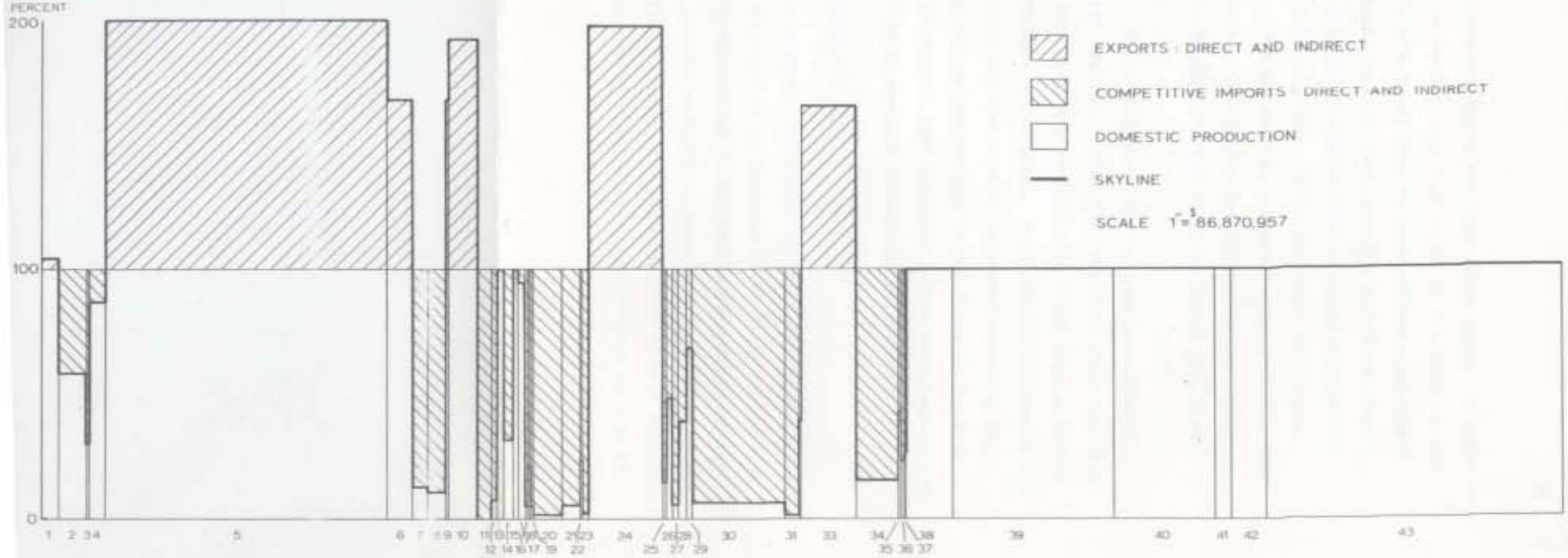


CHART V

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1973



taking place throughout the last three years. A large decline in imports also took place in the Bakeries and Breweries sectors so that in both imports contributed only a small part to total supply. A similar, but smaller decline in imports took place in Cordage and Canvas, Printing, Wire and in the Paint and Varnish sectors. Overall exports increased by only 10.7%. There was a decline in the Pulp and Paper activity and a continued decline in Fish Products (Shell and Other) exports.

Table IV-6 shows the optimum structure of production for 1973. From the 'skyline' chart for this period the relatively smaller role which imports played in the economy can be seen. Metal Mining's share in the total output for the economy increased by nearly 2%, compensating for the decline in the share of the Pulp and Paper sector. The 'skyline' became more uneven with the decline in domestic production of Forestry.

The Solution for 1974

Although the growth of Gross Provincial Product in 1973 resulted in an increase of 13.7% in capital for 1974, the shortage of labour became more acute so that 6.7% of capital remained unutilized. The rate of growth of GPP fell to 6.26% leavingitata level of $1.8 billion. The total capital-output ratio also dropped to 9.45 if

TABLE IV - 7

OPTIMUM INDUSTRIAL STRUCTURE FOR 1974

INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1. Agriculture	$ 25,577,040.00	$ 6,359,201.00	$	1,015
2. Forestry	22,112,864.00	16,066,251.00	------	2,722
3. Shell Fish	832,139.00	2,045,866.00	------	334
4. Other Fish	19,010,816.00	3,985,209.00	------	10,045
5. Metal Mining	581,595,900.00	------	581,595,900.00	11,897
6. Non-Metal Mining	38,016,272.00	------	22,478,288.00	1,361
7. Meat Products	2,488,585.00	24,507,104.00	------	40
8. Dairy Products	2,335,742.00	28,995,968.00	------	173
9. Shell Fish Products	4,138,227.00		2,338,368.00	272
10. Other Fish Products	41,565,584.00	------	37,047,040.00	3,722
11. Fruit and Vegetables	71,563.00	27,005,744.00	------	3
12. Feed and Flour	437,850.00	5,863,972.00	------	10
13. Bakeries	10,726,956.00	3,549,425.00	------	567
14. Miscellaneous Foods	4,314,423.00	13,821,257.00	------	142
15. Soft Drinks	6,622,832.00	2,142,389.00	------	271
16. Breweries	9,380,075.00	3,884,111.00	------	430
17. Shoes	162,553.00	4,817,554.00	------	24
18. Leather Products	75,442.00	400,852.00	------	8
19. Cordage and Canvas	87,750.00	1,837,729.00	------	3
20. Clothing	492,723.00	51,619,936.00	------	66
21. Sawmills and Sash	1,236,209.00	33,051,344.00	------	81
22. Miscellaneous Wood	365,180.00	1,662,479.00	------	29
23. Furniture	173,969.00	12,963,905.00	------	23
24. Pulp and Paper	102,811,180.00	------	98,368,864.00	2,931
25. Paper Products	520,634.00	3,437,026.00	------	16
26. Printing	4,407,376.00	7,719,031.00		474
27. Iron Foundries	337,139.00	9,198,229.00	------	46
28. Miscellaneous Metals	4,825,463.00	11,675,669.00	------	208
29. Wire Products	7,256,484.00	1,906,311.00	------	72
30. Machinery	1,081,575.00	168,104,640.00	------	105
31. Boats and Ships	97,785.00	27,969,616.00	------	14
32. Cement Products	816,028.00	2,176,725.00	------	60
33. Non-Metallic Mineral Products	115,503,390.00	------	76,990.720.00	1,086
34. Petroleum	8,704,654.00	68,323,744.00	------	24
35. Paint and Varnish	1,672,546.00	3,535,702.00	------	116
36. Soap Products	763,237.00	3,853,622.00	------	40
37. Miscellaneous Manufacturing	405,884.00	1,596,556.00	------	39
38. Residential Construction	81,980,880.00	------	------	4,511
39. Non-res. Construction	290,692,100.00	------	------	15,998
40. Transportation	189,709,710.00	------	------	14,665
41. Utilities	27,577,360.00	------	------	4,203
42. Electric Power	68,904,928.00	------	------	2,281
43. Services	531,237,890.00	------	------	50,640
Public Sector				32,983
T O T A L	$2,211,130,937.00	$554,077,167.00	$818,819,180.00	163,750

only capital utilized is taken into account, it would stand at 10.14.

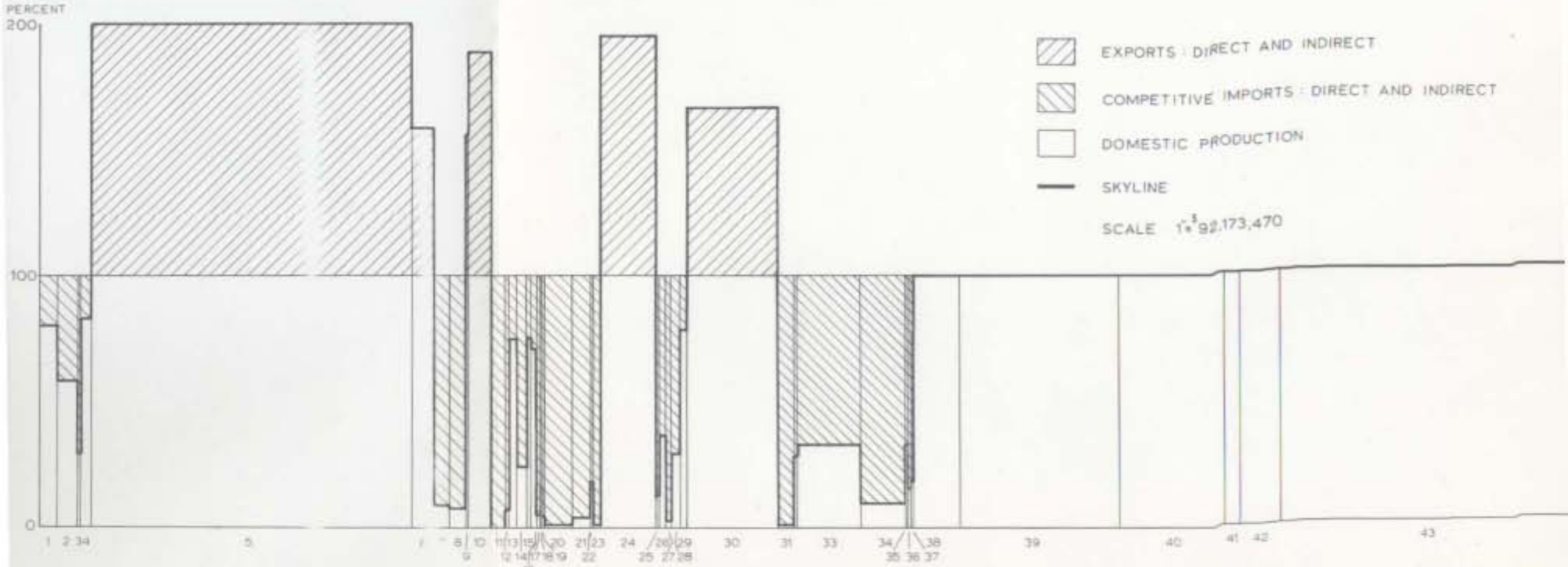
Except for these a decrease in output was experienced by all the primary producing and manufacturing activities. These were Metal Mining, Wire Products, and Non-Metallic Mineral Products. The decrease in output levels was matched by a large increase in imports in some activities, notably the Agriculture sector and Soft Drinks and Bakeries. There was a decline in imports compared to the previous year in the following sectors - Shell and Other Fish (which experienced a continuous decline in imports since 1972), Fruit,Feed and Flour, Cordage and Canvas, Paper Products, Wire Products and Paint and Varnish. Exports of Pulp and Paper as well as of Fish Products continued to decline. Significantly, exports declined in the Non-Metal Mining activity for the first time, but continued to increase in the Non-Metallic Mineral Products activity.

Although the labour shortage had been felt in the last two years it was only in 1974 that its full effects were felt. To supply labour for the tertiary and public sectors which increased with the increase in GPP and in the export activities which were required to finance imports, adjustments had to be made in virtually all activities to release labour. Thus even in the

CHART VI

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1974



Agriculture sector, which in the previous year had been a net exporter, net imports had to be made. With the decline in domestic output imports supplied nearly 25% of total demand for that sector.

The changes which occured in this period can be seen from Tables IV-7 and IV-6, as well as from the 'skyline' charts for 1973 and 1974. For many sectors the share of imports of the total output increased, with a decline taking place in exports for all sectors except Metal Mining and Non-Metallic Mineral Products.

The Solution for 1975

Even with the relatively low rate of increase that took place in the previous period, capital in 1975 increased by 12.8%, but with the continued labour shortage 12.99% of total capital remained unutilized. The rate of growth of GPP continued to fall thus showing an increase of only 5.34%. Final Demand was $1.8 billion. Taking all capital the capital-output ratio was 8.83 or 10.15 if only capital used is considered.

The change in 1975 remained similar to that of 1974 with all activities showing a decline except the large exporting activities, which increased at a rate of 10%. With the fall in intermediate demand imports of Cordage and Canvas, Paper and Wire Products

TABLE IV - 8

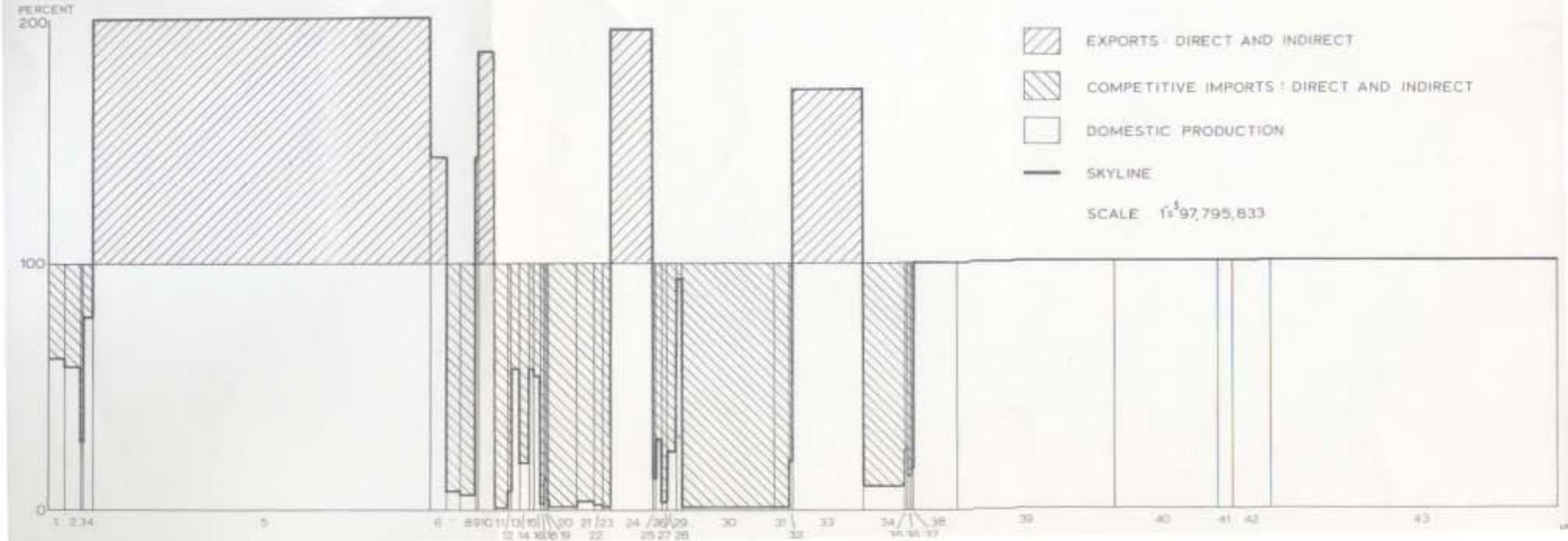
OPTIMUM INDUSTRIAL STRUCTURE FOR 1975

	INDUSTRIAL SECTOR	OUTPUT	IMPORTS	EXPORTS	EMPLOYMENT (MAN-YEARS)
1.	Agriculture	$ 20,460,320.00	$ 12,713,678.00	$ ------	812
2.	Forestry	17,688,992.00	12,868,044.00	------	2,177
3.	Shell Fish	665,703.00	1,736,389.00	------	267
4.	Other Fish	15,208,211.00	4,232,612.00	------	8,036
5.	Metal Mining	662,255,870.00	------	662,255,870.00	13,547
6.	Non-Metal Mining	30,411,584.00	------	13,114,307.00	1,089
7.	Meat Products	1,990,777.00	26,383,488.00	------	32
8.	Dairy Products	1,868,503.00	31,031,248.00	------	139
9.	Shell Fish Products	3,310,489.00	------	1,414,393.00	217
10.	Other Fish Products	33,251,104.00	------	28,538,656.00	2,977
11.	Fruit and Vegetables	57,246.00	28,341,744.00	------	2
12.	Feed and Flour	350,273.00	4,690,844.00	------	8
13.	Bakeries	8,581,451.00	6,452,172.00	------	453
14.	Miscellaneous Foods	3,451,446.00	15,310,153.00	------	113
15.	Soft Drinks	5,298,149.00	3,911,207.00	------	216
16.	Breweries	7,503,940.00	6,469,417.00	------	344
17.	Shoes	130,036.00	5,116,362.00	------	19
18.	Leather Products	60,352.00	441,308.00	------	6
19.	Cordage and Canvas	70,194.00	1,595,174.00	------	2
20.	Clothing	394,171.00	54,504,272.00	------	53
21.	Sawmills and Sash	988,950.00	35,158,784.00	------	65
22.	Miscellaneous Wood	292,136.00	17,805,550.00	------	23
23.	Furniture	139,169.00	13,691,713.00	------	19
24.	Pulp and Paper	82,247,152.00	------	77,729,632.00	2,345
25.	Paper Products	416,499.00	3,017,715.00	------	13
26.	Printing	3,525,810.00	9,143,765.00	------	379
27.	Iron Foundries	269,704.00	10,047,748.00	------	36
28.	Miscellaneous Metals	3,860,254.00	13,107,536.00	------	166
29.	Wire Products	8,707,576.00	705,027.00	------	87
30.	Machinery	865,246.00	182,004,460.00	------	84
31.	Boats and Ships	78,222.00	29,393,360.00	------	11
32.	Cement Products	652,813.00	2,736,256.00	------	48
33.	Non-Metallic Mineral Products	138,601,060.00	------	96,415,456.00	1,304
34.	Petroleum	6,963,615.00	72,537,856.00	------	20
35.	Paint and Varnish	1,337,950.00	4,142,646.00	------	93
36.	Soap Products	610,580.00	4,246,367.00	------	32
37.	Miscellaneous Manufacturing	324,699.00	1,718,988.00	------	31
38.	Residential Construction	86,305,488.00	------	------	4,749
39.	Non-res. Construction	307,193,860.00	------	------	16,905
40.	Transportation	200,598,800.00	------	------	15,507
41.	Utilities	28,769,456.00	------	------	4,386
42.	Electric Power	74,754,896.00	------	------	2,475
43.	Services	558,106,370.00	------	------	53,202
	Public Sector				34,748
	T O T A L	$2,318,637,422.00	$599,260,801.00	$879,468,314.00	167,237

CHART VII

SKYLINE CHART

THE STRUCTURE OF THE NEWFOUNDLAND ECONOMY 1975



were reduced. Imports in this period had taken a larger share of total supply for each sector as can be seen by comparing the 'skyline' chart for this year with those of other years. A noticeable change came in the Soft Drinks sector which only started importing in the previous year. Imports in 1974 and 1975 increased at a rapid rate for this sector.

The reduction in domestic producing activities meant that fewer Non-competitive imports were required. The overall rate of increase of exports was only 7.4% compared with a rate of increase of imports of 8.15%.

The Overall Change 1970 - 1975

Final Demand or Gross Provincial Product increased by some 74% between 1969 and 1975. This was equivalent to an annual average rate of increase of 9.7%. At the same time full employment was attained with labour becoming the relatively scarce resource. With Final Demand at $1.8 billion in 1975, and assuming a population growth consistent with the assumed rate of increase in the labour force of 2.1%, per capita income would have attained a level of $2,146 equivalent to a 51.66% increase over that of 1969.

Table IV-9 shows the level of Final Demand, capital and labour for each year of the planning period, and the percentage changes which took place between these

TABLE IV - 9

FINAL DEMAND, CAPITAL CONSUMPTION AND LABOR 1969 - 1975

YEAR	FINAL DEMAND	% CHANGE	CAPITAL CONSUMPTION ALLOWANCE	% CHANGE	LABOR	% CHANGE
1969	$1,061,581,359	----	$ 97,700,675	----	$147,373	----
1970	1,191,656,200	12.25	107,508,100	10.0	150,512	2.1
1971	1,377,206,500	15.57	123,664,221	15.0	153,717	2.1
1972	1,534,040,800	11.38	142,335,978	15.1	156,991	2.1
1973	1,651,528,700	7.65	163,134,050	14.6	160,335	2.1
1974	1,754,937,600	6.26	185,524,987	13.7	163,750	2.1
1975	1,848,767,200	5.34	209,317,911	12.8	167,237	2.1

years. As can be seen from the table the rate of increase in Final Demand began decreasing once the full effects of the labour shortage came into play. However, the rate of increase of capital was not declining as rapidly as Final Demand. With an increase in Final Demand in the terminal period, an increase in capital is assured for the following period. Therefore growth is assured after the terminal period.

The distribution of total output between the producing activities for each year is shown in Table IV-10. As can be seen the most notable changes took place in the Primary and Secondary Fishing activities, in Metal Mining, Wire Products, Non-Metallic Mineral Products and Petroleum. The share of Metal Mining increased significantly in the last three years of the planning period when labour became the main constraint. A substantial increase in imports had to be made in these periods as a substitute for labour. In addition to purchasing these imports, Metal Mining output had to increase to offset the decrease in exports by other activities, especially in the Fishing activities and Pulp and Paper.

The distribution of labour in the different sectors for each year in the planning period is shown in Table IV-11. The public sector, Services, and Metal Mining showed the largest increase in labour usage. In

the Fishing sectors, both primary and producing, labour use declined significantly. These sectors are very labour intensive, and as a result of labour shortages, these sectors had to decline so that labour could be utilized in more profitable activities.

The overall increase or decrease in output levels of the different activities between the base and the terminal year is shown by Table IV-12. The relatively large increases taking place in the main exporting activities are readily apparent. Most of the food producing sectors showed increased over the five year period (the exceptions being Fish Products, Dairy Products and Soft Drinks), while the wood producing and using activities showed on the whole declines in output levels. Large increases in output levels were apparent in the Wire Products and the Non-metallic Mineral Products activities. These activities had been adjusted in the initial period to take into account an Aluminium Cable Plant, a Phosphorous Plant, and a Magnesium Hydroxide Plant. However, both the Petroleum and the Pulp and Paper activity in which the coefficients had been adjusted in the intermediate year during the planning period, showed declines in their output levels. Of the sectors in which domestic output increased between 1969 and 1975 only two showed a total decrease in imports.

TABLE IV - 10

PERCENTAGE DISTRIBUTION OF TOTAL OUTPUT BY INDUSTRY 1969 TO 1975

	INDUSTRIAL SECTOR	1969	1970	1971	1972	1973	1974	1975
1.	Agriculture	1.128%	1.219	1.260	1.370	1.520	1.150	0.882
2.	Forestry	2.192	2.371	2.460	1.780	1.310	1.000	0.762
3.	Shell Fish	0.185	0.133	0.092	0.067	0.049	0.037	0.028
4.	Other Fish	1.885	2.039	2.110	1.530	1.130	0.850	0.655
5.	Metal Mining	22.155	19.920	19.180	20.850	23.130	26.300	28.560
6.	Non-Metal Mining	1.503	1.620	1.680	1.830	2.036	1.710	1.311
7.	Meat Products	0.109	0.770	0.123	0.133	0.148	0.112	0.085
8.	Dairy Products	0.154	0.760	0.173	0.125	0.139	0.105	0.080
9.	Shell Fish Products	0.410	0.440	0.460	0.333	0.246	0.187	0.143
10.	Other Fish Products	4.194	4.450	4.620	3.350	2.480	1.870	1.430
11.	Fruit and Vegetables	0.003	0.003	0.003	0.003	0.004	0.003	0.002
12.	Feed and Flour	0.065	0.046	0.032	0.035	0.026	0.190	0.015
13.	Bakeries	0.472	0.511	0.530	0.576	0.640	0.485	0.370
14.	Miscellaneous Foods	0.190	0.205	0.213	0.232	0.257	0.195	0.148
15.	Soft Drinks	0.395	0.393	0.393	0.396	0.395	0.299	0.228
16.	Breweries	0.413	0.447	0.464	0.504	0.559	0.424	0.323
17.	Shoes	0.016	0.077	0.018	0.013	0.009	0.007	0.005
18.	Leather Products	0.007	0.008	0.008	0.006	0.004	0.030	0.020
19.	Cordage and Canvas	0.003	0.004	0.004	0.004	0.005	0.003	0.003
20.	Clothing	0.048	0.520	0.054	0.039	0.029	0.022	0.017
21.	Sawmills and Sash	0.275	0.198	0.137	0.090	0.073	0.055	0.042
22.	Miscellaneous Wood	0.036	0.039	0.400	0.029	0.021	0.016	0.012
23.	Furniture	0.017	0.018	0.019	0.014	0.010	0.007	0.006
24.	Pulp and Paper	6.059	6.540	6.790	7.380	6.130	4.640	3.540
25.	Paper Products	0.051	0.055	0.057	0.041	0.031	0.230	0.017
26.	Printing	0.255	0.275	0.286	0.237	0.262	0.199	0.152
27.	Iron Foundries	0.033	0.036	0.037	0.027	0.020	0.015	0.011
28.	Miscellaneous Metals	0.265	0.286	0.297	0.323	0.287	0.218	0.166
29.	Wire Products	0.213	0.230	0.239	0.260	0.288	0.328	0.375
30.	Machinery	0.107	0.116	0.120	0.087	0.064	0.048	0.037
31.	Boats and Ships	0.021	0.015	0.010	0.007	0.005	0.004	0.003
32.	Cement Products	0.121	0.087	0.060	0.065	0.048	0.036	0.028
33.	Non-Metallic Mineral Products	2.757	3.670	3.810	4.140	4.590	5.220	5.970
34.	Petroleum	0.863	0.933	0.969	0.702	0.519	0.393	0.300
35.	Paint and Varnish	0.110	0.119	0.124	0.890	0.099	0.750	0.570
36.	Soap Products	0.033	0.360	0.037	0.041	0.045	0.034	0.026
37.	Miscellaneous Manufacturing	0.040	0.043	0.450	0.032	0.024	0.018	0.014
38.	Residential Construction	3.640	3.670	3.676	3.700	3.680	3.700	3.720
39.	Non-res. Construction	12.851	12.900	12.870	13.000	12.990	13.140	13.240
40.	Transportation	8.813	8.480	8.460	8.540	8.460	8.570	8.650
41.	Utilities	1.284	1.280	1.280	1.280	1.250	1.240	1.240
42.	Electric Power	2.668	2.700	2.670	2.810	2.960	3.110	3.220
43.	Services	23.941	24.030	24.010	24.170	23.940	24.020	24.070
	Total Output $ Million	1,368.0	1,517.6	1,754.5	1,937.0	2,094.8	2,211.1	2,318.6

PERCENTAGE DISTRIBUTION OF LABOR BY INDUSTRY - 1969 TO 1975

	INDUSTRIAL SECTOR	1969	1970	1971	1972	1973	1974	1975
1.	Agriculture	0.534	0.488	0.573	0.673	0.791	0.620	0.485
2.	Forestry	3.210	2.943	3.458	2.709	2.121	1.662	1.301
3.	Shell Fish	0.880	0.542	0.424	0.322	0.260	0.204	0.159
4.	Other Fish	11.880	10.865	12.766	9.999	7.832	6.134	4.805
5.	Metal Mining	5.403	4.109	4.479	5.263	6.183	7.265	8.100
6.	Non-Metal Mining	0.641	0.587	0.689	0.810	0.952	0.830	0.650
7.	Meat Products	0.021	0.019	0.022	0.026	0.031	0.240	0.019
8.	Dairy Products	0.136	0.125	0.146	0.115	0.135	0.105	0.082
9.	Shell Fish Products	0.320	0.293	0.345	0.270	0.211	0.165	0.129
10.	Other Fish Products	4.470	4.025	4.729	3.704	2.901	2.272	1.780
11.	Fruit and Vegetables	0.002	0.001	0.001	0.001	0.002	0.001	0.001
12.	Feed and Flour	0.018	0.011	0.008	0.010	0.007	0.006	0.004
13.	Bakeries	0.298	0.272	0.320	0.376	0.4410	0.3460	0.2710
14.	Miscellaneous Foods	0.074	0.068	0.080	0.094	0.110	0.086	0.067
15.	Soft Drinks	0.192	0.162	0.183	0.200	0.211	0.165	0.129
16.	Breweries	0.225	0.206	0.242	0.285	0.334	0.262	0.205
17.	Shoes	0.027	0.025	0.300	0.023	0.018	0.014	0.011
18.	Leather Products	0.009	0.008	0.010	0.007	0.006	0.004	0.003
19.	Cordage and Canvas	0.002	0.001	0.001	0.001	0.002	0.001	0.001
20.	Clothing	0.078	0.071	0.083	0.065	0.051	0.040	0.031
21.	Sawmills and Sash	0.214	0.130	0.102	0.080	0.062	0.049	0.038
22.	Miscellaneous Wood	0.033	0.030	0.036	0.028	0.022	0.017	0.031
23.	Furniture	0.027	0.024	0.029	0.023	0.018	0.014	0.011
24.	Pulp and Paper	2.720	2.493	2.930	3.440	2.280	1.780	1.402
25.	Paper Products	0.019	0.017	0.020	0.015	0.012	0.009	0.007
26.	Printing	0.326	0.299	0.351	0.314	0.369	0.289	0.226
27.	Iron Foundries	0.054	0.049	0.057	0.045	0.035	0.027	0.021
28.	Miscellaneous Metals	0.135	0.124	0.146	0.171	0.161	0.126	0.099
29.	Wire Products	0.025	0.023	0.027	0.031	0.037	0.044	0.051
30.	Machinery	0.124	0.113	0.133	0.104	0.082	0.064	0.050
31.	Boats and Ships	0.036	0.022	0.017	0.013	0.010	0.008	0.006
32.	Cement Products	0.105	0.064	0.050	0.059	0.046	0.036	0.028
33.	Non-Metallic Mineral Products	0.311	0.348	0.409	0.480	0.564	0.663	0.779
34.	Petroleum	0.262	0.239	0.281	0.220	0.018	0.014	0.010
35.	Paint and Varnish	0.091	0.083	0.097	0.076	0.090	0.070	0.055
36.	Soap Products	0.021	0.019	0.022	0.026	0.031	0.024	0.019
37.	Miscellaneous Manufacturing	0.045	0.041	0.048	0.038	0.030	0.023	0.018
38.	Residential Construction	2.388	2.041	2.309	2.517	2.650	2.755	2.840
39.	Non-res. Construction	8.431	7.159	8.090	8.832	9.346	9.769	10.108
40.	Transportation	8.120	6.617	7.465	8.150	8.552	8.956	9.272
41.	Utilities	2.330	1.977	2.240	2.400	2.490	2.567	2.622
42.	Electric Power	1.053	0.902	1.009	1.140	1.284	1.393	1.479
43.	Services	27.200	23.098	26.128	28.430	29.818	30.925	31.810
	Public Sector	17.400	14.880	16.838	18.360	19.359	20.142	.207
	Total Employed	114,747	128,887	149,790	156,991	160,335	163,750	167,237
	Total Labor Force	147,373	150,512	153,717	156,991	160,335	163,750	167,237
	Total Unemployed	32,626	21,624	3,926	-----	-----	-----	-----
	Unemployment Rate	22.13%	14.36%	2.55%	-----	-----	-----	-----

TABLE IV-12

PERCENTAGE CHANGE IN OUTPUT
BETWEEN 1969-1975

	INDUSTRIAL SECTOR		%		INDUSTRIAL SECTOR		%
1	AGRICULTURE	+	32.49	23	FURNITURE	-	41.03
2	FORESTRY	-	41.03	24	PULP AND PAPER	-	0.78
3	SHELL FISH	-	73.79	25	PAPER PRODUCTS	-	41.02
4	OTHER FISH	-	41.05	26	PRINTING	+	1.04
5	METAL MINING	+	118.50	27	IRON FOUNDRIES	-	41.02
6	NON-METAL MINING	+	47.81	28	MISCELLANEOUS METALS	+	6.36
7	MEAT PRODUCTS	+	32.67	29	WIRE PRODUCTS	+	198.50
8	DAIRY PRODUCTS	-	11.54	30	MACHINERY	-	41.03
9	SHELL FISH PRODUCTS	-	41.02	31	BOATS AND SHIPS	-	73.07
10	OTHER FISH PRODUCTS	-	42.05	32	CEMENT PRODUCTS	-	60.68
11	FRUIT AND VEGETABLES	+	32.66	33	NON-METALLIC MINERAL PRODUCTS	+	8246.41
12	FEED AND FLOUR	-	60.68	34	PETROLEUM	-	41.02
13	BAKERIES	+	32.69	35	PAINT AND VARNISH	-	11.55
14	MISCELLANEOUS FOODS	+	32.68	36	SOAP PRODUCTS	+	32.69
15	SOFT DRINKS	-	1.97	37	MISCELLANEOUS MANUFACTURING	-	41.02
16	BREWERIES	+	32.69	38	RESIDENTIAL CONSTRUCTION	+	73.30
17	SHOES	-	41.02	39	NON-RESIDENTIAL CONSTRUCTION	+	74.73
18	LEATHER PRODUCTS	-	41.03	40	TRANSPORTATION	+	66.37
19	CORDAGE AND CANVAS	+	32.94	41	UTILITIES	+	63.78
20	CLOTHING	-	41.02	42	ELECTRIC POWER	+	104.78
21	SAWMILLS AND SASH	-	73.79	43	SERVICES	+	70.40
22	MISCELLANEOUS WOOD	-	41.02				

These were Cordage and Canvas, and Wire Products. In the Paper products sector and Fruit and Vegetable sector imports increased between 1969 and 1975, but at a relatively low rate compared to other sectors. The only sectors which showed net increases in exports for the entire period were the Metal Mining, and Non-Metallic Mineral Products sectors. Pulp and Paper showed a small decrease in exports as a result of the relatively small decline in total output for the domestic producing activity.

Comparison of the 'skyline' charts for the base and terminal periods show changes in the structure of production for the economy, but these changes are far from drastic. This is a result of the constraints placed on the domestic producing activities which prevent extreme solutions and changes from taking place too rapidy. Even with these constraints there is a tendency to specialize in the exporting activities.

CHAPTER V

CONCLUSIONS

In order to relieve the unemployment problem, more investment is required. But it is platidudinous to say that investment is desirous. In order to obtain insights into the likely results of alternative investment outlays, government should elaborate distinctive investment criteria. But it is insufficient to say that such criteria are required without any specific prescription. Unfortunately, most of the studies on the Newfoundland economy stress the need for planning and the need for rational investment criteria to determine priorities, without specifying what the criteria should be or what the priorities are.

In formal programming procedures, as used in this study, these criteria are built into a model, and, as a result, priorities can be obtained from solutions. Priorities can be specified in terms of activities in which planned expansion should take place. The programming also provides analysis of industrial output composition and labour force requirements.

Formal programming procedures are, however, only a guide to development planning. The purpose of building a model is to isolate certain crucial variables which are

considered as determing factors in the system. Thus, assumptions have to be made made which to some degree extrapolate from the real world. All models are therefore, by nature, ideal.

The information obtained through the use of our model disclosed important but preliminary information of the potential rate of growth of the Newfoundland Gross Provincial Product. The Newfoundland economy appears to be capable of attaining a relatively high rate of growth if investment decisions were coordinated to give a better allocation of resources.

It would at this state be convenient to summarize the main solutions:

(1) Relatively high rates of growth are possible in Newfoundland of up to a maximum of 15% and an average of 9% per annum. These rates can be achieved by relying on endogenous supplies of factor inputs. If external supply of capital and labour were added the potential rate of growth would be much higher.

(2) Labour becomes the operative constraint quite early in the planning period. To prevent this requires substantial increased in labour productivity and in labour saving technological changes. In lieu of these changes, an increase in participation rates would be required.

(3) Per capita income increased at an annual average of just over 5%. By 1975 the per capita income attainable in Newfoundland would be 82% of the Canadian average compared to 66% in 1969.

(4) The changes shown in output levels of the different activities would obviously have different impacts on the individual regions within Newfoundland. For example, the large increase in Metal Mining output would have a substantial impact in Labrador. Changes which occured in Pulp and Paper output would be felt on the West Coast and in Central Newfoundland.

(5) In order of importance, the most profitable domestic producing activities are Non-Metallic Products (for export), Wire Products (for domestic use), Non-Metallic Mining (for export), Soap Products, Meat Products, and Agriculture (all for domestic use).

i) The Non-Metallic Mineral Products activity: The main commodity outputs of this activity are Phosphorous, Magnesium Hydroxide, Gypsum Products, Lime, Concrete and Concrete Products, and Stone Products. This is a key activity to the expansion process taking place over the five year period, and important not only as the source of inputs for the expanding construction sectors, but also in its export contributions. This activity has the

highest rate of increase of all the domestic producing activities, and exports during the five year period is shown to increase fourfold.

ii) Wire Products:
Commodity outputs for this activity are Aluminum Cable, Tools, Hardwood, Cutlery, Nuts, Bolts, etc. However, the main importance of this activity lies in the production of Aluminum Cable, an input for the expanding Electrical Power activity. The large expansion which took place in this activity was solely for domestic purposes.

iii) Non-Metallic Mining:
Output of this activity is chiefly Non-Metallic minerals, for example, Fluorspar, Asbestos, Pyrophillite, as well as Gypsum, Sand, Gravel, and Stone. This activity is important in supplying input requirements to the Non-Metallic Mineral Products activity, and for the exporting sector. Exports for this activity show a relative

decline in the last two years of the planning period. This is a result of the increased use of Non-Metallic mining output by the Non-Metallic Mineral Products activity.

iv) Soap Products:

The main commodity output for this activity are cleaning and washing compounds. The main users of this activity's output are Metal Mining, Breweries, Non-Residential Construction and Transportation. All these activities showed substantial increases throughout the five year period. Imports in the Soap Products sector were not, however, replaced by domestic production, but increased in step with domestic production.

v) Meat Products:

The output of this activity is fresh, frozen and cured meat, canned and processed meat, lard, and meat-by-products. The increase in income and therefore consumption over the five year period makes this a profitable activity to expand.

vi) Agriculture :

The output of agriculture consists mainly of livestock, poultry, eggs, potatoes, vegetables, and fruit. The expansion in this activity is highly desirable and domestic production should replace imports.

(6) The most unprofitable activities are Shell Fish, Sawmills and Sash, Boat and Shipbuilding.

i) Shell Fish:

This is a primary fishing activity. Its unprofitability results from its high direct capital intensity. Considerable technological changes would have to take place in this activity to make it profitable.

ii) Sawmills and Sash

Lumber, ties, laths, shingles, plywood and veneer are the chief commodity outputs of this activity. Although the output of this activity is important to the construction industry, domestic production, given the present technological structure of the Sawmill industry in Newfoundland, is not profitable and should not be encouraged in its present pattern.

iii) Boat-and-Shipbuilding: This is a relatively small activity providing repair services to Ships and constructing boats and ships for use in the Fishing industry. The firms engaged in this activity are all small and unable to take advantage of economies of scale. This is a result of the scattered operation of the fishing industry. Greater rationalization in the fishing industry would allow for larger and more profitable Boat-and-Shipbuilding firms to be established.

By the terminal period large import requirements are still necessary, and as a result, concentration on large export activities is still required. However, export specialization should be concentrated in activities which use relatively small amounts of scarce resources (e.g., Metal Mining) rather than in the factor intensive industries (e.g. Primary and Secondary Fishing).

The most pertinent conclusion of this study is, however, the value of continuous research. Activity analysis for regional planning provides a fruitful tool not available in other currently operational models. Activity analysis, as presented in this study, can be expanded to include:

A P P E N D I C E S

APPENDIX I

ADJUSTED COEFFICIENTS FOR 1973

INDUSTRIAL SECTOR	PULP AND PAPER	PETROLEUM
1. Agriculture	0	0
2. Forestry	-.3359086	0
3. Shell Fish	0	0
4. Other Fish	0	0
5. Metal Mining	0	0
6. Non-Metal Mining	-.0007654	0
7. Meat Products	0	0
8. Dairy Products	0	0
9. Shell Fish Products	0	0
10. Other Fish Products	0	0
11. Fruit and Vegetables	0	0
12. Feed and Flour	0	0
13. Bakeries	0	0
14. Miscellaneous Foods	0	0
15. Soft Drinks	0	0
16. Breweries	0	0
17. Shoes	0	0
18. Leather Products	0	0
19. Cordage and Canvas	0	0
20. Clothing	0	0
21. Sawmills and Sash	0	0
22. Miscellaneous Wood	0	0
23. Furniture	0	0
24. Pulp and Paper	+.9999289	0
25. Paper Products	0	0
26. Printing	-.0001307	-.0000043
27. Iron Foundries	-.0002633	0
28. Miscellaneous Metals	-.0006688	-.0001210
29. Wire Products	-.0081336	0
30. Machinery	-.0041633	0
31. Boats and Ships	0	0
32. Cement Products	0	0
33. Non-Metallic Mineral Products	0	0
34. Petroleum	-.0235731	+.9995516
35. Pain and Varnish	0	0
36. Soap Products	0	0
37. Miscellaneous Manufacturing	0	0
38. Residential Construction	0	-.0000223
39. Non-res. Construction	-.0002203	0
40. Transportation	-.0194431	-.0028428
41 Utilities	-.0015642	-.0000245
42. Electric Power	-.0457402	-.0068474
43. Services	-.0213558	-.0034431
Foreign Exchange	-.0193746	-.6701657
Labor	-.0285076	-.0027888
Capital	-.1151664	-.01919416

A P P E N D I X II

```
      DIMENSION A(120,186),CB(120),Z(186),CJ(186),COL(186),ROW(120),
     1 AINI(60)
      ITR=0
      READ 100,M,N
  100 FORMAT(2I3)
      DO 101 I=1,M
      READ 102,(A(I,J),J=1,N)
  102 FORMAT(F14.0,7F9.0,4(/8F9.0)/5F9.0,11F3.0,5(/26F3.0))
  101 CONTINUE
      READ 202,(CB(I),I=1,M)
  202 FORMAT(10E8.2)
      READ 102,(CJ(I),I=1,N)
      READ 103, (COL(I),I=1,N)
      READ 103, (ROW(I), I=1,M)
  103 FORMAT(20A4)
  900 DO 1 I=1,N
      Z(I)=0.
      DO 2 J=1,M
      Z(I)=Z(I)+CB(J)*A(J,I)
    2 CONTINUE
    1 Z(I)=Z(I)-CJ(I)
      DO 20 I=2,N
      IF(Z(I)) 21,20,20
   20 CONTINUE
      PRINT 23
   23 FORMAT(1H1,5X,'OPTIMUM SOLUTION OBTAINED'//)
   24 PRINT 420,ITR
  420 FORMAT(6X,'NO OF ITERATION =',I6//)
      PRINT 25, (ROW(I),A(I,1),I=1,M)
   25 FORMAT(6X,A4,' =',E16.8)
      PRINT 26,Z(1)
   26 FORMAT(//' MAXIMUM VALUE =',E16.8)
      DO 27 I=2,186,5
      I1=I+1
      I2=I+2
      I3=I+3
      I4=I+4
   28 FORMAT(1H1,6(6X,A4,8X))
      PRINT 28,COL(I),COL(I1),COL(I2),COL(I3),COL(I4)
      PRINT 707
  707 FORMAT(1H )
      PRINT 29,(A(J,I),A(J,I1),A(J,I2),A(J,I3),A(J,I4),J=1,M)
   29 FORMAT(1X,5E18.8)
   27 CONTINUE
      PRINT  111
  111 FORMAT(1H1)
      PRINT 29, (Z(I),I=2,N)
      CALL EXIT
   21 E=0.
      DO 30 I=2,N
      IF(Z(I)) 31,30,30
   31 IF(E-Z(I)) 30,30,32
   32 IC=I
      E=Z(I)
```

```
30 CONTINUE
   DO 40 I=1,M
   IF(A(I,IC)) 40,40,41
40 CONTINUE
   PRINT 693
93 FORMAT(1H1,6X,'UNBOUNDED SOLUTION '//)
   GO TO 24
41 E=1.00E+10
   DO 42 I=1,M
   IF(A(I,IC)) 42,42,43
43 E1= A(I,1)/A(I,IC)
   IF(E-E1) 42,42,44
44 E=E1
   IR=I
42 CONTINUE
   REWIND 8
   DO 50 J=1,N
   K=1
37 L=K+59
   IS=0
   DO 1850 I= K,L
   AT     =(A(I,J)*A(IR,IC)-A(I,IC)*A(IR,J))/A(IR,IC)
   IS=IS+1
   AINT(IS)=AT
50 CONTINUE
   WRITE (8) AINT
   IF(L-120) 444,50,444
44 K=L+1
   GO TO 1037
50 CONTINUE
   DO 60 I=1,N
   AT      =A(IR,I)/A(IR,IC)
   WRITE (8) AT
60 CONTINUE
   ROW(IR)=COL(IC)
   CB(IR)=CJ(IC)
   REWIND 8
   DO 193 J=1,N
   K=1
73 L=K+59
   IS=0
   READ (8) AINT
   DO 974 I=K,L
   IS=IS+1
   A(I,J)= AINT(IS)
74 CONTINUE
   IF (L-120) 373,193,373
73 K=L+1
   GO TO 973
93 CONTINUE
   DO 194  I=1,N
   READ (8) A(IR,I)
94 CONTINUE
   ITR =ITR+1
```

```
    IF (ITR-80) 900,222,222
222 IF (ITR-160) 800,800,801
800 PRINT 600
600 FORMAT(1H1,6X,'INTERMEDIATE SOLUTION'//)
    PRINT 420, ITR
    PRINT  25,(ROW(I),A(I,1),I=1,M)
    PRINT 26, Z(1)
    GO TO 900
801 IF(ITR-200) 900,900,1000
1000 PRINT 1001
1001 FORMAT(1H1,6X,'CONVERGENCE NOT OBTAINED',' ITERATION STOPPED'//)
    GO TO 24
    END
```

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