SHORT-RUN DETERMINATION

OF CANADA'S G.N.E.

THE SHORT-RUN DETERMINATION OF CANADA'S GROSS NATIONAL EXPENDITURE

By

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PREFACE

The purpose of this thesis is to construct a very simple econometric model to explain Canada's Gross National Expenditure (G.N.E.) during the post-World War II years, 1947-1962, and to indicate how this simple model may be used as a tool in the formulation of Canada's short-run economic policy.

In form this thesis is divided into five chapters. The first chapter gives a simple explanation of a general theory of the determination of G.N.E., while the second chapter analyses the historical behaviour of Canada's G.N.E. with a view to determining: (a) the main factors which were responsible for producing short-run changes in the level of this aggregate, and (b) whether there has been any stability in the pattern of these changes. This being done, the third chapter develops, on the basis of the background knowledge provided by Chapters I and II, an hypothesis concerning the short-run determination of Canada's G.N.E. The fourth chapter then presents the statistical estimates of the mathematical relationships derived from this hypothesis, and attempts to select that estimating equation which gives the best explanation of Canada's G.N.E. Lastly, Chapter V summarises Chapters I to IV and discusses in particular the use of the selected

estimating equation as a simple forecasting tool.

I wish to express my sincere gratitude to my supervisors, Professor R.W. Thompson and Dr. J. Johnson for the help, encouragement and inspiration which they gave me. I also thank Professor T.M. Brown of Queen's University for the very helpful comments which he made. Finally, I thank Mrs. Ruth Quibell for an excellent typing job.

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CHAPTER I

A GENERAL THEORY OF THE DETERMINATION OF GROSS NATIONAL EXPENDITURE

The ultimate aim of this thesis is to explain Canada's G.N.E. by equations of relationship, to measure the parameters of these equations, and to use the best of these equations for making predictions. But in order to achieve this three-fold aim it is necessary to explain why certain variables are thought to be important in determining G.N.E. and the role they are expected to play in determining this economic aggregate. This chapter therefore sets out a simple explanation of a general theory of the determination of G.N.E., which it is hoped will serve as a background to the analysis of the determination of Canada's G.N.E.

BASIC CONCEPTS OF THE DETERMINATION OF G.N.E.

A general explanation of the determination of G.N.E. may be conveniently given within the framework of the theory of national income determination. This theory which is primarily concerned with explaining the volume of goods and services produced by the nation - the market value of which is

given by the Gross National Product (G.N.P.)[1] - is in essence a theory of aggregate supply and demand.

It defines G.N.P. as equal in an ex post sense to (a) the Gross National Income (Y) accruing to the factors of production which produce the nation's output, and to (b) G.N.E. i.e. the total amount spent in acquiring this output. The theory then states that the equilibrium level of output is determined by the equality of ex ante aggregate demand and supply (i.e. by the equality of planned Y and G.N.E.). Hence changes in the nation's output arise as a result of a divergence between planned aggregate demand and planned aggregate supply, and consequently can be explained by changes in one or both of these aggregates.

In general, it is to be expected that both aggregate supply and aggregate demand simultaneously determine the nation's output, but in the short-run it is reasonable to assume that demand factors are the more relevant and important ones. Indeed, there is much to be said for making this assumption. Firstly, it simplifies the analysis of the short-run determination of Canada's G.N.E. Secondly, it has proved fruitful in other

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[1] This aggregate is described as gross because it does not make allowance for the depreciation of capital goods which are used in the process of production, and as national because it represents the productive contribution of nationals, together with the contribution of any property owned by them, whether this property is located at home or abroad.

studies of the Canadian economy,[2] and it is now the concensus that the main factor retarding Canada's growth and contributing to its increased unemployment in the post-war period is an insufficiency of aggregate demand. Thirdly, the historical tendency of prices and output to move together[3] implies the greater importance of demand factors, for if supply factors were the more important ones there would be an inverse relationship between prices and output.

In view of these considerations, and in view of the fact that supply factors are implicit in the theory to be explained anyway[4] it is thought best for the purpose of this thesis, viz., the determination of the short-run changes in Canada's output, to emphasise demand factors. Consequently, G.N.E. is the appropriate measure to be investigated in this study. We are interested in comparing the volume of Canada's output over time however, and since prices and output may not vary proportionately, it will be necessary to express G.N.E. in constant prices. Thus, the remainder of this chapter will

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[2]See Professor William C. Hood's Report to The Special Committee of the Senate on Manpower and Unemployment. Proceedings 1-10 Ottawa Queen's Printer, 1964, pp. 79-82; also see T.M. Brown, "A Forecast Determination of National Product Employment, and Price Level in Canada, from an Econometric Model", a reprint from Models of Income Determination (Princeton University Press, Princeton 1964) pp. 81-82.

[3]During the 1920's, prices and output did not move together but these years are generally regarded as unusual.

[4]Cf. L.R. Klein, "The Use of Econometric Models as a Guide to Policy", Econometrica, Volume 15 (1947) pp. 136-138.

attempt in the simplest way, to give a general explanation of the determination of G.N.E. at constant prices, i.e. real G.N.E,

This explanation naturally involves a consideration of the components of G.N.E. These, as given by the Dominion Bureau of Statistics (D.B.S.) National Accounts, which provide most of the data which will be used subsequently, consist of the following:

1. Personal expenditure on consumer goods and services
2. Government expenditure on goods and services
3. Business gross fixed capital formation
4. Changes in inventories
5. Exports of goods and services
6. Imports of goods and services.

By definition G.N.E. equals the sum of components 1 to 5 minus component 6. It therefore follows that changes in the level of any one of these components would, in the absence of any offsetting forces, produce some effect on the level of G.N.E. Thus, in order to give a complete explanation of G.N.E. it seems necessary to explain how each of these components is determined, and how they all interact to produce changes in the level of G.N.E. Looked at in this way, the problem is two-fold: it consists of (a) explaining the basic causes of changes in the components of G.N.E., and (b) explaining how changes in these components interact to produce changes in G.N.E.

With regard to the first part of this explanation there has been much controversy over the factors which have been named as important in determining each of the components of G.N.E. The difficulty stems largely from the fact that many of the hypotheses which have been advanced to explain these components have not been tested.

However, since in the model which will be used subsequently to explain Canada's G.N.E. no attempt will be made to construct equations to explain these components, the problem of constructing these hypotheses will be ignored. But in order to deal with the second problem, viz. that of explaining how changes in these components interact to produce changes in G.N.E., it is necessary to discuss briefly some of the main factors which seem important in determining consumers' expenditures and to introduce the consumption function,[5] a relationship which plays a key role in the determination of G.N.E.

Consideration will now therefore be given to personal expenditure on consumer goods and services, the first component of G.N.E. that was mentioned. The immediate task is to isolate

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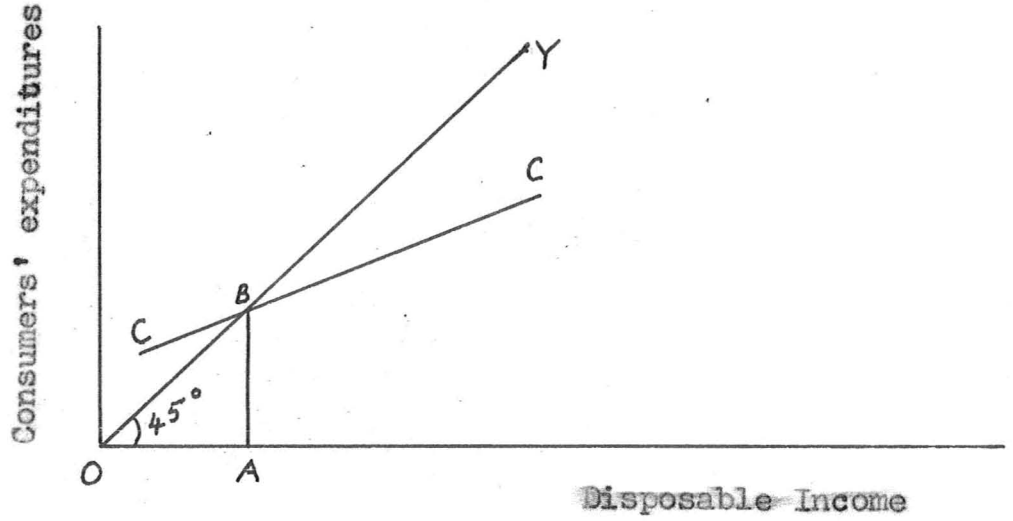
[5] Many discussions of the consumption function are found in the literature. See, for example, J.M. Keynes, The General Theory of Employment, Interest and Money, London: Macmillan and Co. Ltd. 1936 pp. 89-131; Milton Friedman, A Theory of the Consumption Function, New York: National Bureau of Economic Research, 1957; and H.S. Houthakker's survey article: "The Present State of Consumption Theory", Econometrica, vol. 29, no. 4, 1961, pp. 704-740.

those factors which seem important in determining these expenditures. It would appear from general observation that the first of these factors is the level of disposable income. From the total income which consumers receive as payments from producers and as transfer payments from the government and from abroad, they are required to pay a certain amount as taxes and are left with a remainder known as disposable income. This disposable income is divided between saving and spending. So in order to understand the determinants of personal consumption on goods and services it is helpful to understand how this division of consumers disposable income between saving and spending affects the level of consumers' expenditures. Since, however, saving is that residual which is left out of disposable income after consumers have purchased goods and services, the analysis may be simplified by concentrating on the determination of the level of spending. For, given the level of disposable income and the level of spending, the level of saving will follow by definition.

Now, it is quite plausible theoretically to argue that the level of consumers' expenditures will be largely determined by their disposable income. For although borrowing and dishoarding from accumulated cash balances may temporarily permit consumption to exceed disposable income, consumers' spending will to a great extent be determined by, and in general will be less than, their disposable income. Thus, in normal times the economy as a whole does have positive saving. Empiric-

ally,[6] also, disposable income has proven to be a very powerful explanatory variable of consumption. Hence both on theoretical and on empirical grounds it can be concluded that it is a very important determinant of consumers' spending.

Indeed, the recognition that the level of disposable income is perhaps the most important single factor influencing consumers' expenditures has led to the formulation of a theoretical relationship between consumers' expenditures and disposable income known as the consumption function. This function describes the relation between consumers' expenditures and disposable income[7] as income changes. A characteristic of this function which is theoretically plausible and which fits the empirical evidence is exemplified by the following diagram:



[6] See L.R. Klein, Economic Fluctuations in the United States 1921-1941. (John Wiley & Sons Inc., New York 1950) p. 98 and p. 109; L.R. Klein and A.S. Goldberger, An Econometric Model of the United States 1929-1952, (North Holland Publishing Company, Amsterdam, 1955 pp.4-10 and 51.

[7] Actually consumers' expenditures may be taken as a function of other measures of income, e.g. Y. This is done in a later section of this chapter.

In this diagram disposable income is plotted along the horizontal axis and consumers' expenditures along the vertical axis, and the consumption function is given by the line CC. Now, if the economy always consumed all of its disposable income then the consumption function would be given by the 45° line, OY. At every level of disposable income, for example, at the horizontal distance OA, consumers' expenditures (measured by AB) would be equal to disposable income. The average propensity to consume which is given by the ratio of the total consumers' expenditures to total disposable income (i.e. $\frac{C}{DI}$) would always be 1, and the marginal propensity to consume given by the ratio of the change in consumers' expenditures to the corresponding change in disposable income i.e. $\frac{\Delta C}{\Delta DI}$ would also be 1.

However, in practice, consumers' expenditures are seldom equal to their disposable income, for as was pointed out previously the economy as a whole does have positive saving, in normal times. Hence the consumption function given by CC is more relevant. It shows that as disposable income rises to the right consumers' expenditures rise by a constant amount but not as rapidly as income i.e. the marginal propensity to consume is less than 1 at all levels of disposable income, but the average propensity to consume is greater than 1 to the left of the point B, is exactly equal to 1 at the point B and is less than 1 to the right of B. This means that consumers' expenditures will rise less rapidly than disposable income, hence

saving will increase as income rises and it will become necessary (in a closed economy) to increase private investment (I) and/or government expenditure (G) if aggregate demand[8] is to be maintained. It should be apparent therefore that the consumption function plays a very important role in the analysis of G.N.E. and later this role will be illustrated.

The above theoretical consumption function is built on the assumption that the only factor affecting the level of consumers' expenditures is the level of their disposable income and that all other factors which may affect consumption remain constant. But there are in fact other factors which may affect consumers' expenditures. These may produce shifts in the consumption function, and hence may lead to some instability in it.[9] A reference will therefore be made to some of these other factors.

One of these factors seems to be the distribution of income among consumers. For the greater the amount of income in the hands of those consumers with a high propensity to spend the greater is the level of consumers' expenditures likely to be.

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[8] If C were compared with Y instead of DI the relevant consumption function would indicate how the total of all diversions from the flow of spending will tend to change as Y varies. In this case the total of all diversions at each level of income gives a measure of the increases required in (I+G) to maintain aggregate demand (G.N.E.) at that level.

[9] See T.M. Keynes, op. cit. pp. 113-131, and R. Ruggles and N.A. Ruggles, National Accounts and Income Analysis, 2nd ed. New York, McGraw-Hill Book Co., Inc. 1956, pp. 330-334.

Another important determinant of consumers' expenditures is the level of population. In general, with a given national income, total consumption would be expected to be greater, the greater the size of the population.

It is also plausible that the community's current consumption of goods and services will to some extent be influenced by its past pattern of consumption. People's habits change slowly and hence tend to persist even after a new situation has arisen. Empirical tests[10] have been made of this hypothesis and they have provided much support for it.

Further, it is conceivable that people's views about the future may influence their present consumption. For example, a difference in expectations with regard to future income streams may result in a difference in current consumption between two consumers who are currently obtaining the same amount of disposable income. And considering consumers as a whole, the differences in expectations between groups which have the same disposable income may lead to differences in spending between these groups.

It is also possible that the level of consumption may be affected by the rate of interest, since a high rate of

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[10] See T.M. Brown, "Habit Persistence and Lags in Consumer Behaviour", Econometrica, July (1952), pp. 355-371; L.R. Klein and A.S. Goldberger, op. cit. p.8.

interest may induce consumers to increase their current saving and hence spend less; or it may induce less saving if consumers are interested in achieving a fixed annuity in the future.

And still there are many intangibles, such as tastes, which may affect consumption but whose influence like that of expectations is difficult to measure empirically. It should not be assumed however, that all of these factors are equally important in explaining consumption at any instant. In order to construct a relationship between consumption and some or all of these explanatory variables for a particular economy, it is necessary to determine this relationship from sound economic theory as well as from the empirical evidence provided by that economy. It is only being suggested that some of these variables are likely to be important in this relationship, and hence an empirical consumption function, unlike the theoretical consumption function discussed earlier, is not likely to contain disposable income as its only explanatory variable.

The next task is to explain how changes brought about in consumption, as a result of changes in some or all of the above explanation factors, will lead to changes in G.N.E. For simplicity the analysis begins with the individual consumer, and assumes that there is no government and hence there are no excise and sales tax on the goods and services which he consumes. If this consumer receives an increase in his income it may take him some time to adjust to this new income. Thus,

his immediate reaction may lead to an increase in personal saving rather than an increase in expenditure. But after this consumer has adjusted to his new level of income he is likely to increase his expenditure on goods and services (since it can be assumed that the normal consumer is not satiated with these). This will cause the sales of these goods and services to rise, and hence there will be an increase in the receipts of the producers of these goods and services. If producers are to maintain their inventory levels and still meet the increased demand, then a greater volume of goods and services must be produced. That is, G.N.E. must be increased and hence there will be an increase in the income accruing to the factors of production. Thus the change in consumers' spending would be reflected in increased expenditure and increased income.

This same type of analysis may be extended to consumers as a whole.[11] In this case, as in the case of the individual consumer, it is to be expected that there will be a process of adjustment both on the part of consumers and of producers. Consumers will take time to adjust their expenditure and saving to the desired levels, and producers will take time to adjust their output and inventories to the levels they desire. But once this adjustment is made the original increase in consumers' expenditure is likely to give rise to a cumulative

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[11] It is realised that aggregation raises some difficult problems but these will not be discussed here.

change in G.N.E., i.e., the original increase in expenditure will give rise to an increase in income which is likely to produce a further rise in expenditure, and so on. The limits of these cumulative changes will be discussed later.

An argument similar to the above would have been applied if, instead of assuming an increase in income, resulting in a subsequent increase in expenditure, it was assumed that there was an increase in saving giving rise to a subsequent decrease in expenditure. For on this assumption producers could be expected to react to the fall in expenditures (after sufficient time had elapsed for them to adjust to this new situation) by decreasing the level of output, and hence decreasing their payments to the factors of production (in this case to individuals and themselves since the assumption of no government still holds). Eventually inventories would increase by the amount of the reduction in consumers' expenditures, and, in a manner similar to that described above, a process of adjustment would take place as producers try to achieve their desired inventory levels. Normally, profits would fall and payments of wages and salaries to individuals would decrease thus lowering personal income and hence G.N.E. on goods and services.

Similarly, the possible repercussions of both an increase and a decrease in consumers' expenditures may be extended to the government and foreign sectors. Generally an increase in consumers' expenditures will lead eventually to an increase in

government revenue and imports; while a fall in consumers' expenditures will lead eventually to a fall in government revenue and a fall in imports.

Of course, these repercussions could be traced still further. The reduction in consumer expenditure for example, will probably cause some individuals to decrease their expenditure still further, leading to further decreases in the above mentioned items of the government and foreign sectors. And the whole process may become cumulative.

This description is admittedly simplified because a decrease in personal income, say, may not necessarily lead to a decrease in imports. It may result in a decrease in consumers' assets or in an increase in the government's deficit, either of which will have the effect of counteracting the fall in personal income. Similarly, the effect of a rise in personal income will definitely depend on the size and sign of the marginal propensity to import. Also, producers may react quite differently when there is a change in demand for goods, than when there is a change in demand for services. But these complications will not be discussed here. The important thing to note at this point is that ceteris paribus an increase in consumers' expenditure forms an injection into the economic system, which has the effect of increasing G.N.E. while a decrease in consumers' expenditures resulting from say increased saving, forms a leakage from the economic system and

hence results in a decrease in G.N.E.

The next component of G.N.E. which will be considered is gross domestic investment. Since however, this component will be regarded as exogenous in the model explaining the determination of Canada's G.N.E. (in Chapter III) no attempt will be made here to explain it in terms of those variables which seem important in determining it.[12] Instead, it will only be explained how changes in gross domestic investment expenditure lead to changes in G.N.E.

Before doing this however, it seems helpful to point out firstly, that "gross domestic investment embraces expenditures on a wide variety of producers' goods such as the construction of homes and apartment houses, the erection of plants, and the installation of machinery together with changes in inventories."[13] Secondly, that it is a basic assumption of economic theory that producers make investment expenditures in the hope of making future profits. And thirdly, that producers, like consumers, may spend part of their income and save the other part.

If it is assumed that there are changes in the deter-

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[12] Indeed, all the components of G.N.E. which appear in the model explaining the determination of Canada's G.N.E. are regarded as exogenous, so the rest of this chapter will only explain how changes in each of these components (except consumers' expenditures which were previously discussed) lead to changes in G.N.E.

[13] R. Ruggles and N.D. Ruggles, op. cit. p. 296.

minants of gross domestic investment expenditures which bring about an increase in the purchases of producers' goods, this increase in purchases will have the immediate effect of reducing the inventories of dealers in these goods. But if this reduction in inventories causes the inventory levels of sellers to fall below the levels they desire, these sellers are likely to adjust their inventories to the desired levels, as soon as they find this possible. One way of regaining the desired inventory levels for example, is to increase their output, and this would lead to an increase in G.N.E.

It is also possible that an increase in investment expenditures may not result in these changes in inventories. Instead it may directly increase payments to individuals or increase the income retained by producers. This may occur, for example, if the increase in expenditures took the form of new construction in houses. It may then be expected that those who work in the construction industry would adjust to their new income, after sufficient time had elapsed, by increasing their consumption expenditures. And this will necessitate further adjustment on the part of the producers. Thus a whole chain of adjustments will be set in motion.

It is therefore evident that an increase in the rate of gross domestic investment expenditures will, in the absence of offsetting forces, give rise to a cumulative increase in the level of G.N.E., while a decrease in the rate of gross

domestic investment will lead to a cumulative fall in G.N.E. However, a number of factors will in general tend to reinforce or limit the cumulative movement which is set in motion by changes in saving or investment. Therefore, in order to understand the process by which G.N.E. is determined, it is necessary to examine these, as well as the conditions under which equilibrium is finally established in the economy. This will be done in a later section of this chapter. What should be noted now is that an increase in producers' investment expenditures, like an increase in consumers' expenditures, forms an injection into the flow of G.N.E., while an increase in producers' saving like an increase in consumers' saving forms a leakage from this flow.

Next we consider the effect which government expenditure on goods and services has on the level of G.N.E. When the decisions of the government sector are such that government receipts exceed government outlays, the government is withdrawing income from the economy in much the same way that individuals who do not consume all of their disposable income, withdraw income in the form of personal saving. Similarly, when the government's outlays exceed its receipts the government is dissaving. Hence government's surplus represents government's saving and government deficit represents government's dissaving. And, if an increase in government saving is not offset by increased spending in another sector, G.N.E.

will be decreased; similarly, if government's dissaving is not offset by increased saving elsewhere in the economy G.N.E. will be increased.

In order to give concrete content to these assertions it may be helpful to trace through the possible repercussions to which an announcement of a future tax reduction may give rise. If this tax reduction is to become effective in say two months' time some consumers and producers may even increase their purchases before the actual tax reduction is effective. This is likely to be the case since both groups would have increased income available to them in the future. Knowing this, they increase their spending and this increased spending will lead to increased income for those persons who are engaged in producing goods and services on which expenditures have increased. Thus, this may lead to further spending and G.N.E. will be increased as a result of the cumulative process which is set in motion.

Further increases in expenditures may also be expected when the tax reduction goes into effect, since certain consumers and producers might not have been able to increase their expenditures before this increased income becomes available. This further increase in expenditure would reinforce the increase in G.N.E. Alternatively, a proposed increase in taxes may be expected, in the absence of offsetting forces, to lead to a fall in G.N.E.

Similarly, changes in government outlays such as those related to unemployment benefits would lead to change in personal income and, if there are no offsetting influences, would by a cumulative process similar to that described above, lead to a change (increase or decrease as the case may be) in G.N.E.

Lastly, changes in the foreign sector can have a very important effect on the level of G.N.E. This is especially true in the case of Canada. Exports, like government and consumer spending, will add to the flow of spending and hence increase G.N.E., while imports like consumer and government saving will decrease expenditure on domestic goods and hence decrease G.N.E.[14] For example, assuming unemployment, an increase in the exports of the domestic economy means that money incomes have been increased by an amount equal to the value of this increase in exports. But since exports have been sent to foreign countries to be consumed or held as capital investment - this means (assuming no increase in imports) that the volume of goods on which income earners can spend has not been simultaneously increased. And, as these income earners, consumers and producers, consume part of their increased income they create a net increase in aggregate demand which leads to an increase in G.N.E. Imports, on the

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[14] Exports and imports, here mean, total current account credits and total current account debits respectively.

other hand, have the same effect on the aggregate demand in the domestic economy as an equivalent amount of saving. It therefore follows that exports form an injection into the economic system while imports form a leakage from the system.

Further, a change in exports or imports can lead to the same type of cumulative changes in G.N.E. as does a change in consumers or government expenditure. For example, an increase in exports, due to, say, increased incomes in foreign countries will lead to increased incomes of those engaged in the domestic export industry; and in the absence of offsetting influences such as increased saving, increased imports or increased taxation, would lead to an increase in expenditure. This increase in expenditure will in turn increase income and this process may continue until there is a cumulative increase in G.N.E.

This brings us to the end of the brief discussion of the basic concepts underlying changes in G.N.E. It has been pointed out that in order to understand how G.N.E. is determined one needs as far as possible to understand the determination of its various components as well as the processes through which changes in these components lead to changes in G.N.E. itself. However, in view of the subsequent assumptions that will be made in this study a fair amount of discussion has been devoted only to the determinants of consumption; and it has been mainly indicated how changes in this and the

other components of G.N.E. are likely to lead to changes in G.N.E. It has also been shown, at various stages, how certain changes in each sector constitute an injection into the flow of G.N.E. while other changes constitute a leakage from this flow. This was stressed because it is felt that an understanding of the role of these injections and leakages is crucial to an understanding of the determination of G.N.E.

It was also pointed out that an initial injection into the economy from say, the export sector may affect the investment sector, the consumer sector, the government sector, and then the foreign sector again and this process of interaction may repeat itself several times. Thus, the original injection will be passed back and forth among the sectors raising their incomes and receipts each time it goes around; and at the same time it is being siphoned off gradually in the form of leakages. Thus, the original increases will give rise to a cumulative increase which ends only when all of the original injection ends up in the form of leakages and each sector is allocating its resulting income as it desires, i.e. when equilibrium is established.

THE MECHANISM OF THE DETERMINATION OF G.N.E.

In order to complete the analysis of the way in which G.N.E. is finally determined it is necessary to explain more precisely how the limits of cumulative changes in G.N.E. are

determined. This may be done with the aid of the multiplier theory, and the concept of equilibrium which was referred to above.[15]

The heart of the theory of the multiplier is that changes in the consumers' expenditures resulting from an initial change in investment expenditures will, in turn, have repercussions on the level of G.N.E. Thus, the multiplier[16] is defined as the ratio of the total increase in G.N.E. to the initial increase in the investment which brings about this increase in G.N.E. If, for example, an increase in

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[15] It is also possible that the limits of these cumulative changes may be influenced by the operation of the acceleration principle, i.e. that changes in consumers' expenditures (and hence changes in G.N.E.) may themselves induce or discourage investment expenditures and hence alter the size of the multiplier. As a matter of fact there are many qualifications to the theory of the simple acceleration effect and these are what make the empirical application of the acceleration principle so difficult. However, this principle will not be incorporated in the subsequent model explaining Canada's G.N.E., hence it will be omitted from this analysis. For a discussion of the principle and the empirical difficulties encountered in its application the reader may see Robert Eisner's article "Capital Expenditures, Profits, and the Acceleration Principle" in Models in Income Determination, Studies in Income and Wealth Vol. 28, Princeton University Press, 1964; and some of the studies cited in this article.

[16] The multiplier is an inherent part of the Keynesian theory but it was developed earlier by R.F. Kahn. See his article: "The Relation of Home Investment to Unemployment" Economic Journal, June 1931, p. 173. Kahn's original multiplier which has been referred to above is the investment multiplier. Later in this thesis the term "multiplier" will be used generally to denote the magnitude of the change in the G.N.E. which results from a per unit change in any of its explanatory variables.

investment expenditures of $10 million leads to an increase in G.N.E. of $20 million, the multiplier is 2.

The multiplier is really determined by the marginal propensity to consume, the slope of the consumption function which was discussed earlier. For example, if every $ million increase in disposable income lead individuals as a group to increase their consumption expenditures by $\frac{1}{2}$ million then the slope of the consumption function or the marginal propensity to consume would be a $\frac{1}{2}$. But with a constant marginal propensity to consume of this size, the total increase in disposable income to which a continuous injection[17] of $1 million of investment expenditure would give rise is given by the infinite series: $ $(1+\frac{1}{2}+(\frac{1}{2})^2 + \ldots\ldots)$ million, since by a cumulative process the original $1 million, spent would give rise to consumption expenditures of $\frac{1}{2}$ million, thus making a total expenditure of $ $(1+\frac{1}{2})$ million at the end of the second round of spending. Later the $\frac{1}{2}$ million received by individuals would lead to an expenditure of $\frac{1}{2}^2$ million, thus bringing the total expenditure of $ $(1+\frac{1}{2}+(\frac{1}{2})^2)$ million at the end of the

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[17] It is important to note the difference between the multiplier effect of a continuous increase in investment expenditure and the multiplier effect of a single increase in investment expenditure. In the former case, the time path of G.N.E. (or income) will approach an equilibrium level which is higher than its original level; but in the latter case, this time path will decrease towards its initial level. See Thomas F. Dernburg and Duncan M. McDougall, Macroeconomics, McGraw-Hill Book Co. Inc., New York 1960, pp. 74-78.

third round of spending and so on - to infinity - if nothing happens to disrupt this pattern. The sum to infinity of the geometric series $(1+\frac{1}{2}+(\frac{1}{2})^2+ \ldots\ldots)$ is given by $\frac{1}{1-\frac{1}{2}}$ [18] which equals 2, the size of the multiplier.

The above multiplier indicates that a $1 million increase in investment expenditure raises the level of G.N.E. by $2 million, and it is easy to see that its size is determined by the size of the marginal propensity to consume whose magnitude is a $\frac{1}{2}$ in this case. This implies that any factor which affects the size of the marginal propensity to consume will also affect the size of the multiplier.

If instead of an increase there were a decrease in

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[18] Alternatively, this expression may be obtained by starting with the accounting identity: the sum of consumers' expenditures plus gross investment expenditures equals gross national income, i.e. $I + C = Y$
Then assuming that changes in I and C are equal to the change in Y we have

$$\Delta I + \Delta C = \Delta Y$$

Dividing through by Y and transposing we obtain

$$\frac{\Delta I}{\Delta Y} + 1 - \frac{\Delta C}{\Delta Y}$$

whence taking the reciprocal on both sides

$$\frac{\Delta Y}{\Delta I} = \frac{1}{1 - \frac{\Delta C}{\Delta Y}}$$

Since by definition $\frac{\Delta Y}{\Delta I}$ is the multiplier and $\frac{\Delta C}{\Delta Y}$ is the marginal propensity to consume we see that the multiplier $= \frac{1}{1-MPC} = \frac{1}{1-\frac{1}{2}}$
as in the above example, if it is assumed that the marginal propensity to consume out of total income (Y) is the same as the marginal propensity to consume out of disposable income DI.

investment expenditures, there would be a downward cumulative movement. Some individuals would have lower disposable incomes and this would cause them to decrease their expenditures and hence the disposable income of other individuals. And this process would continue, resulting in a cumulative decrease in income and expenditure.[19]

Either this downward or the upward movement in income and expenditure will be brought to an end only when individuals as a group are spending and saving the amount they desire with the level of disposable income which they have. At this stage equilibrium will be achieved, since by definition equilibrium is a state from which there is no tendency to move.

SIMPLE MATHEMATICS OF THE DETERMINATION OF G.N.E.

A simple mathematical exposition of the principle underlying the determination of G.N.E. may facilitate a better understanding of what has been said about the determination of this aggregate. Also, it may provide a background to an understanding of the model which is used to explain Canada's G.N.E. in Chapter III.

Consequently, it will be shown, in very simple mathematical language, how the government and international sector

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[19] It should be noted, however, that the consumption function may be and probably is not reversible, hence the downward cumulative movement may not operate in the same way as the upward movement.

can be included in the simplest Keynesian model in which saving and investment interact to determine G.N.E. The procedure is to start from the condition necessary for equilibrium in G.N.E. and then proceed to determine how changes in the system will affect its equilibrium.

By disregarding net foreign investment and the government for the time being, it may be assumed that the economy is one in which total expenditure on goods and services is made up of consumers' expenditures (C) and gross domestic investment expenditure (I). Thus, it follows from what was said on page 2 that the equilibrium level of G.N.E. or (Y) is given by the relationship:

$$Y = C + I \qquad (1)$$

Now, as the system stands Y cannot be determined unless C and I are known. The system is indeterminate for there is only one equation but three unknowns. But if C and I are known and given, or if they are expressed in terms of variables whose magnitudes are known, then Y can be determined.

For simplicity it is assumed that consumption is a function of Y, i.e. $C = f(Y)$,[20] and that investment is exogenous and is given by $\bar{I}$, i.e. $I = \bar{I}$. Substituting these relat-

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[20] Strictly speaking, even if Y were the sole explanatory variable of C we would not expect the relationship between them to be exact, owing to the possible influence of random disturbances, hence it would be more correct to say that $C = C(Y,u)$ where u represents such random disturbances. For the present however, such random disturbances will be ignored.

ions into the equation (1) the simplest Keynesian system of income determination is obtained:

$$Y = C(Y) + \bar{I} \qquad (2)$$

This system is now determinate, since it yields an equilibrium level of Y which may be shown as the intersection of $C(Y) + \bar{I}$ with the 45 0 line, or as the intersection of the propensity to save schedule - which is derived by subtracting C(Y) from Y - with the line representing $\bar{I}$.

From equation (2) we can obtain the investment multiplier which was derived in footnote 18, page 24. This is obtained by calculating the change in G.N.E. or income which results from a change in the investment, $\bar{I}$. Thus, differentiating (2) with respect to Y and transposing terms we obtain:

$$d\bar{I}/dY = 1 - C'(Y)$$

and whence the multiplier formula:

$$dY/d\bar{I} = \frac{1}{(1-C'(Y))} \qquad (3)$$

where $C'(Y) = \frac{dC}{dY}$, represents the marginal propensity to consume at each level of income.[21] The general principle then is to

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[21] We could be less general and assume that C is a linear function of Y, e.g. $C = a + bY$ where a is the intercept which the consumption function makes on the consumption axis and b, the slope of the consumption function is a constant. In this case from the equilibrium condition $Y = C + \bar{I}$ we obtain $Y = a + bY + \bar{I}$ (substituting for C) and hence $Y = \frac{1}{1-b}(a + \bar{I})$, which gives rise to $\Delta Y = \frac{1}{1-b}\Delta\bar{I}$ when we consider small changes in the system. This, it should be noted, produces the same investment multiplier which we derived in an earlier section.

start with the condition of equilibrium and such relationships as will make the system determinate and then proceed to obtain the required multipliers. Using this general principle we may proceed to modify the simple Keynesian system and obtain whatever multiplier[22] is needed.

For example, if the assumption of no government is relaxed our income or expenditure relation becomes:

$$Y = C + I + G \qquad (4)$$

This is a four variable system. If this system is to be determinate we must formulate hypotheses about C, I and G. Very simple hypothesis could be that G is exogenous and equals $\bar{G}$ while both C and I are functions of Y. We then substitute in (4) the relationships to which these hypotheses give rise and proceed to obtain the multipliers of the system.

In a similar way the foreign trade sector may be introduced into the system. The expenditure or income identity would then become:

$$Y = C + I + G + F_2 - F_1 \qquad (5)$$

where F_2 represents exports and F_1 represents imports. In order to make this system determinate we must now form additional hypotheses about F_1 and F_2, substitute in (5) the relationships

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[22] Later it will be necessary to distinguish between the multipliers that are obtained from such a system, and the multipliers that are obtained in Chapter IV p. On the basis of this distinction the multipliers referred to above are ultimate or reduced-form multipliers, while those of Chapter IV are proximate multipliers.

to which these hypotheses give rise and then calculate the multipliers of the system. And still we could go on to incorporate such other variables as are thought to be important in explaining Y, e.g. tax rate, producers' savings etc. Indeed the hypotheses formulated may vary from very complicated dynamic relationships involving lags and time derivatives to the very simplest of hypotheses in which all the explanatory variables of the variables being explained are assumed to be exogenous.

But it cannot be over-emphasized however, that if we are to obtain a good explanation of G.N.E. and good estimates of the multipliers we must formulate hypotheses which are both theoretically and empirically sound. Thus, in order to explain Canada's G.N.E. we must go to the historical record of the behaviour of this aggregate and see how best we can combine our analysis of that record with the theory which has been explained in this chapter.

CHAPTER II

SHORT-RUN CHANGES IN CANADA'S GROSS NATIONAL EXPENDITURE OVER THE PERIOD 1896-1962

This chapter analyses the historical behaviour of Canada's G.N.E. during the period 1896-1962. Its aim is to seek out the main factors which were responsible for the short-run changes in the level of this aggregate and to try to discover whether the pattern of these changes has been a stable one. If it is discovered that these factors have behaved in a stable manner then we shall be able to formulate an hypothesis to explain the short-run determinants of Canada's G.N.E.

The main difficulty which confronts this study is the lack of satisfactory data prior to 1926, for Canada's official national accounts figures, which are the most complete and comprehensive set of data currently available, only go as far back as that year. For the years prior to 1926 data on foreign trade, prices, investment, and G.N.E., are provided by a number of sources, but these data are in general, either incomplete or insufficient for the present purposes.

Among these sources[1] the most comprehensive set of data on G.N,E. and its components for these early years, are those provided by Firestone. Firestone, however, experienced many difficulties in making his estimates and some of them, particularly those of the earlier period which he covered, are necessarily tentative. But in spite of this and the objections which have been raised to his methods of obtaining these estimates there are two compelling considerations for using them. The first, which has already been mentioned above, relates to their wide coverage, and the second relates to the lack of any pronounced inconsistency between them and the data provided by the other sources listed in the first footnote of this chapter.[2] In view of these considerations it seems that the only reasonable way out is to base the earlier part of the historical analysis which follows on Firestone's data and data provided by the other sources which have been mentioned, and to base the later part of this analysis i.e.

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[1] See, for example, K.W. Taylor and H. Michell, Statistical Contributions to Canadian Economic History, vol. II, (The Macmillan Company of Canada, Limited, Toronto 1931); K.A.H. Buckley, Capital Formation in Canada 1896-1930, (University of Toronto Press, 1955); O.J. Firestone, Canada's Economic Development 1867-1953, Income and Wealth Series VII; (Bowes and Bowes Publisher Limited, London, 1958). W.A. Mackintosh, The Economic Background of Dominion Provincial Relations. (Kings Printer, Ottawa, 1939) and M.C. Urquhart (ed.), Historical Statistics of Canada, (The University Press, Cambridge, and The Macmillan Company of Canada Ltd., 1965). This last source reproduces data contained in the other sources as well as data obtained from other sources which have not been mentioned here.

[2] This consistency holds for movements of the various series rather than the levels of these series.

for the years 1926-62 mainly on the official national accounts data provided by the Dominion Bureau of Statistics. Consequently, the analysis which follows will be based for the most part on these sources.

SHORT-RUN CHANGES IN REAL G.N.E. 1896-1962.

Some indication of the short-run changes which occurred in the level of real G.N.E. over the period will be given before an attempt is made to seek out the main factors which seem responsible for these changes. Table I, which follows, gives annual estimates of Canada's G.N.E. in constant 1935-39 dollars over the period 1896-1962 and Chart I (which is based on Table I) presents graphically the different rates at which G.N.E. has changed over the period.[3]

Chart I shows that G.N.E. rose rapidly between the turn of the century (i.e. around 1899) and 1913; and that it rose slightly less rapidly during the First World War period, 1914-18. Immediately following the war there was a short-lived boom which was followed by a short depression. But

[3]It has been found convenient to use (1935-1939) constant dollars for this purpose since Firestone's estimates are already available in these dollars and it is thus only necessary to convert the official national accounts estimates for 1954-1962 from a 1949 to a 1935-1939 base. It is also felt that the use of a price index which falls roughly within the middle of the whole period will minimise the biases which result from changes in price weights over time and will thus make comparisons more meaningful. For similar reasons the 1949 constant dollar series provided by D.B.S. will be used later to analyse the behaviour G.N.E. and its components during the period 1926-1962.

TABLE I

ANNUAL ESTIMATES, GROSS NATIONAL EXPENDITURE IN (1935-39) DOLLARS, CANADA 1896-1962.

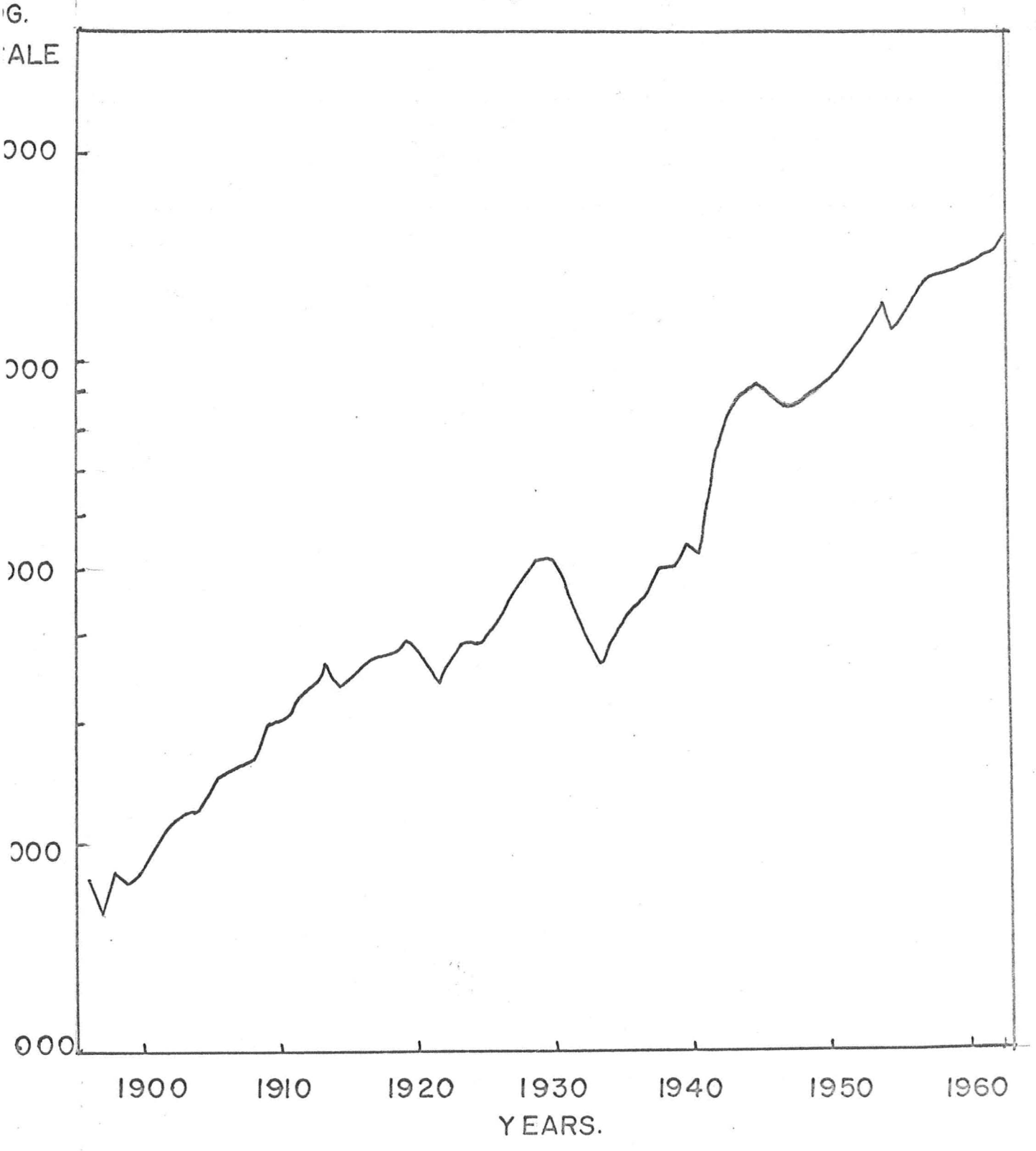
(In millions of dollars)

YEAR	G.N.E.	YEAR	G.N.E.	YEAR	G.N.E.	YEAR	G.N.E.
1896	1,794	1913	3,708	1930	5,127	1947	9,165
1897	1,559	1914	3,483	1931	4,475	1948	9,438
1898	1,846	1915	3,591	1932	4,096	1949	9,722
1899	1,769	1916	3,749	1933	3,772	1950	10,330
1900	1,849	1917	3,831	1934	4,208	1951	10,935
1901	2,031	1918	3,864	1935	4,530	1952	11,642
1902	2,179	1919	4,046	1936	4,738	1953	12,098
1903	2,244	1920	3,844	1937	5,201	1954	11,724[a]
1904	2,284	1921	3,495	1938	5,246	1955	12,742[a]
1905	2,457	1922	3,780	1939	5,664	1956	13,842[a]
1906	2,599	1923	4,015	1940	6,487	1957	14,020[a]
1907	2,612	1924	4,010	1941	7,481	1958	14,182[a]
1908	2,723	1925	4,182	1942	8,941	1959	14,674[a]
1909	3,031	1926	4,548	1943	9,374	1960	15,001[a]
1910	3,087	1927	4,926	1944	9,721	1961	15,386[a]
1911	3,355	1928	5,330	1945	9,315	1962	16,341[a]
1912	3,419	1929	5,337	1946	9,045		

[a]Obtained by converting the official national accounts 1949 constant dollar estimates to (1935-39) dollars. Source: Firestone, op. cit., Table 87, p. 276; and National Accounts Income and Expenditure 1926-1956 and 1962. D.B.S., Ottawa.

CHART I: CANADA'S G.N.E.

IN MILLIONS OF (1935-39) DOLLARS, 1896-1962.



SOURCE: TABLE I

G.N.E. recovered quickly and again rose almost continuously after 1921 through to 1929. Then came the Great Depression 1929-1933, during which a drastic decline was experienced in the level of economic activity. This depression was followed by a period of recovery and expansion, which lasted until 1939 when the Second World War broke out. The war lasted until 1945 and it is remarkable that for the greater part of these war years, G.N.E. experienced its most rapid rate of growth over the whole period 1896-1962. The decline which started in 1944 was arrested in 1946 and with the exception of the 1953-1954 recession, the post-World War II years have witnessed a continual increase in real G.N.E. As Chart I indicates however, the growth rate over this post-war period was less than that of the preceding periods of expansion.

In attempting to seek out the main factors which were responsible for the changes in G.N.E. which have been summarised above it will be convenient to take each of the periods indicated[4] and try to determine what effects were produced by changes in the magnitudes and timing of the various components of G.N.E. on the behaviour of G.N.E. It should be pointed out however, that little or no analysis of the war years will be attempted since it is felt that the process by which G.N.E. was determined during these years was not a normal one.

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[4]For convenience the years 1896-1920 will be treated as one period.

PERIOD OF EXPANSION 1896-1920.

The analysis of the historical behaviour of Canada's G.N.E. during the period 1896-1920, as well as during subsequent periods, is considerably facilitated by paying particular attention to Canada's role in the international economy. Perhaps the most striking factor in this respect is the great dependence of Canada on foreign trade. Though much of Canada's great land mass is unsuitable for occupation or cultivation, it still remains true that compared with most other important industrial nations Canada's population has traditionally been small in relation to its exploitable national resources. The result is that domestic demand has been insufficient to induce a high rate of economic expansion and consequently Canada's growth has been inextricably bound up with the behaviour of the demand for its exports. In view of the importance of exports, it also follows that any factors which will facilitate the production of Canada's exportable goods, such as increased private investment and public investment in transportation facilities, capital inflows etc. will contribute appreciably towards Canada's development.

However, the importance of exports constitutes only one aspect of Canada's dependence on foreign trade. Another aspect relates to the importance of imports in the Canadian economy. For climatic and economic reasons Canada must import goods and services from other countries, and since imports

form a leakage from the economy it is to be expected that their behaviour can have an appreciable effect on the current account of the balance of payments as well as in G.N.E. itself. It is therefore important to try to determine the nature of the relationship between changes in imports and changes in G.N.E. and its other components.

The relationship between changes in consumption expenditure and changes in G.N.E. is also of crucial importance. For notwithstanding Canada's great dependence on foreign demand, consumers' expenditures is by far the largest component of G.N.E. and it is therefore important to pay careful attention to their behaviour in relation to changes in G.N.E.

All these points therefore must be borne in mind as we attempt, firstly, an analysis of the short-run changes in Canada's G.N.E. during the periods 1896-1920. Unfortunately there are no statistics of the year to year changes of all the components of G.N.E. for these early years,[5] but Tables II and III give an indication of the distribution and the percentage changes in the distribution of G.N.E. for selected years, from 1890 to 1920. And by supplementing these tables with some of the findings of some of the historical studies of the Canadian economy which cover this period, it is possible to

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[5] There are fairly reliable annual data only for the international sector, less reliable statistics on investment for selected years and quinquennial periods, but no data on the year to year changes in consumer expenditures.

TABLE II

GROSS NATIONAL EXPENDITURE, BY SECTORS, IN CONSTANT (1935-1939) DOLLARS, CANADA, SELECTED YEARS, 1890-1920.

(In millions of dollars)

YEAR	EXPENDITURE ON CONSUMER GOODS & SERVICES	GROSS INVESTMENT			GOV'T EXPENDITURE ON GOODS & SERVICES	EXPORTS OF GOODS & SERVICES	IMPORTS OF GOODS & SERVICES	GROSS NATIONAL EXPENDITURE
		BUSINESS GROSS FIXED CAPITAL FORMATION	CHANGE IN INVENTORIES	TOTAL				
1890	1,112	210	19	229	89	112	-166	1,386
1900	1,476	227	21	248	134	228	-253	1,833
1910	2,276	610	224	834	241	325	-589	3,087
1920	2,768	651	138	789	380	695	-788	3,844

Source: Firestone ibid, Table 86, p. 275.

TABLE III[a]

PERCENTAGE DISTRIBUTION OF GROSS NATIONAL EXPENDITURE IN CONSTANT (1935-1939) DOLLARS, CANADA, SELECTED YEARS 1890-1920.

YEAR	EXPENDITURE ON CONSUMER GOODS & SERVICES	GROSS INVESTMENT[a]	GOVERNMENT EXPENDITURE ON GOODS & SERVICES	EXPORTS OF GOODS & SERVICES	IMPORTS OF GOODS & SERVICES	GROSS NATIONAL EXPENDITURE
1890	80.1	16.5	6.4	8.0	-12.0	100.0
1900	80.5	13.5	7.3	12.5	-13.8	100.0
1910	73.7	27.0	7.8	10.5	-19.0	100.0
1920	72.0	20.5	9.9	18.1	-20.5	100.0

[a]Figures rounded so that they add up to 100. Source Table II.

piece together a reasonable explanation of the short-run changes in G.N.E.

Table II indicates that sometime between 1890 and 1900 there was an appreciable rise in Canada's G.N.E. This rise, according to Chart I, would seem to start around 1899 - between 1896 and 1899 there was some fluctuations in G.N.E. While this dating does not exactly agree with the traditional 1896 dating of Canada's take off, it seems safe to assert that Canada's real G.N.E. showed a definite rate of increase towards the end of the 19th century, by which time the Canadian economy had already recovered from the effects of the Great Depression which started in 1873.[6]

Charts II and III indicate that the main forces making for expansion between 1890 and 1920 seem to have been increases in exports, gross investment and government expenditure. Consumer expenditure, the largest component of G.N.E., formed in 1900 only a slightly larger proportion of G.N.E. than it did in 1890 and its proportion both in 1910 and 1920 was less than it was in 1900. Imports, on the other hand, show a

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[6] See W.A. Mackintosh, op. cit., Chapter III, for a discussion of the effects which this Depression had on Canada. See also Firestone, ibid, pp. 226-228 for a suggestion that Mackintosh's pre-occupation with declining foreign demand, financial difficulties and declining price levels during most of the period 1873-1896, probably led him to lose sight of the fact that there were some relatively bright periods during the fourth quarter of the 19th century.

continuous upward trend, and made its biggest jump between 1900 and 1910. Of course, without a knowledge of the magnitudes and the rates of change of the components during the intervening years, it is extremely difficult to assess the effects which changes in these components had on G.N.E., but other historical studies furnish us with good reasons for attributing the changes in G.N.E. between the turn of the century and 1920 mainly to changes in the first three components listed above, and especially to the first two.

These studies indicate that between the late 1890's and 1913 there was a combination of favourable factors which produced rapid growth in the Canadian economy. Among these factors was an increase in the world's stock of gold by 50 per cent,[7] the rapid industrialisation and urbanisation after 1896 of Western Europe and the United States, and the rapid increase in the population of these areas.

The first of these factors, coupled with the rapid expansion of banking institutions gave rise, under the freely operating gold standard, to an increased demand for both raw materials and manufactured goods. This led to a persistent and world-wide rise in prices. However, the prices of raw materials including foodstuffs rose more rapidly than the prices of manufactured goods and since Canada's exports

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[7] See the Report of the Royal Commission on Dominion Provincial Relations (RCDPR), Ottawa 1939, p. 66.

consisted mainly of the former kind of goods there was a great incentive to increase their production.

Likewise, the second and third factors combined to create a rising demand for foodstuffs, particularly cereals and Canada's wheat in particular benefitted from this increase in demand. In addition, other circumstances also led to the increased production of wheat in Canada. Prior to the period 1896-1913 the American West had been the granary for the expanding population of Europe, but by the beginning of this period most of the good American lands had been used up and the further demand for grain led to an extension of the area under wheat cultivation into the open plains of the Canadian northwest.

As the following table shows, not only did the selling prices of Canada's primary exports rise, but in general they also rose at a faster rate than the prices of imports. In addition, transportation costs actually fell[8] and labour costs were kept down by the flow of immigrants who were attracted into Canada during this period of prosperity. As a result of the improved terms of trade to which these factors gave rise it became increasing profitable as long as capital and capital goods were available to exploit the virgin lands of the prairies.

Indeed, capital and capital goods were cheaper than they had ever been before. Interest rates had in 1897 fallen to the

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[8] RCDPR op. cit., p. 67.

TABLE IV

IMPORT AND EXPORT PRICE INDICES - COST OF IMPORTS AND PURCHASING POWER OF EXPORTS, CANADA, 1896-1915.

FISCAL YEARS	PRICE INDICES IMPORT	EXPORT	EXPORT PRICE AS A PERCENTAGE OF IMPORT PRICE	IMPORT PRICE AS A PERCENTAGE OF EXPORT PRICE
1896	87.9	93.1	105.9	94.4
1897	83.8	90.9	108.5	92.2
1898	88.8	97.0	109.2	91.6
1899	89.6	95.4	106.5	93.9
1900	100.0	100.0	100.0	100.0
1901	101.0	102.5	101.5	98.6
1902	98.0	104.3	106.4	94.0
1903	100.7	107.6	106.8	93.6
1904	103.1	108.7	105.3	95.0
1905	102.7	105.3	102.5	97.6
1906	107.7	113.4	105.3	95.0
1907	113.8	118.5	104.1	96.1
1908	117.0	124.2	106.2	94.1
1909	108.6	123.5	113.7	87.9
1910	109.3	124.8	114.2	87.5
1911	110.5	123.7	111.9	89.4
1912	107.2	120.7	112.6	88.8
1913	110.0	122.5	111.4	89.7
1914	112.9	116.9	103.5	96.6
1915	103.1	122.5	118.8	84.1

Source: K.W. Taylor, Statistics of Foreign Trade in Statistical Contributions to Canadian Economic History, Vol. II, Toronto 1931, p. 6.

lowest levels they had been in recorded history,[9] and throughout the period these low interest rates and high prices in creditor countries, especially Great Britain, encouraged these countries to provide money for public and private borrowing in Canada as well as to renew investment in this country. Consequently, between 1905 and 1915 net long term capital inflow as a percentage of G.N.E. rose to the highest levels it has ever reached in Canada.[10]

Without this increase in foreign capital the tremendous investment which characterised the period would not have been possible because the savings of settlers and immigrants were insufficient to support the investment that was necessary to exploit fully the opportunities for profit making and growth to which Canada's favourable export conditions gave rise. But with the availability of both these sources of capital some significant gains were made (in real terms) in foreign trade and investment. The following tables illustrate these gains as well as the trends of some of the factors which made them possible.

The rise shown in Table V by the real value of exports throughout most of the period 1900-1920 is "indicative of the increased profitability of applying capital and new techniques

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[9] RCDPR, op. cit., p. 67.

[10] See First Annual Review of the Economic Council of Canada, December 1964, p. 79.

TABLE V

ECONOMIC TRENDS, CANADA, 1900-1920.

YEAR	EXPORTS VALUED AT 1913 PRICES, 000 OF DOLLARS	IMPORTS VALUED AT 1913 PRICES, 000 OF DOLLARS	NET LONG-TERM CAPITAL MOVEMENT, M. OF DOLLARS	INDEX OF HOME INVESTMENT (1900 = 100)	INCREASE IN RAILWAY MILEAGE IN OPERATION	IMMIGRANT ARRIVALS 000	IMMIGRATION PER 000 POPULATION
1900	237,103	222,312	+29.8	100.0	407	42	7.8
1901	236,864	222,328	+35.1	106.6	483	56	10.3
1902	253,989	251,600	+40.3	117.1	574	89	15.9
1903	267,840	273,457	+51.7	141.6	294	139	24.1
1904	248,118	282,134	+58.9	161.3	443	131	22.1
1905	236,579	299,145	+109.5	194.7	1,056	141	23.2
1906	275,217	322,166	+102.3	229.3	936	212	33.8
1907	254,418	385,873	+91.1	272.2	1,023	272	41.6
1908	271,468	371,973	+218.1	236.1	520	143	21.3
1909	264,918	324,565	+249.4	293.4	1,138	174	25.2
1910	297,871	388,171	+308.2	367.8	627	287	40.3
1911	292,483	453,846	+343.4	431.6	669	331	45.3
1912	315,343	511,692	+316.1	509.6	1,440	376	49.9
1913	377,068	671,207	+541.7	509.2	2,464	401	51.6
1914	473,471	611,971	+320.6	320.8	1,491	150	19.9
1915	442,968	480,014	+234.8	111.0	4,087	37	4.6
1916	689,002	530,060	+201.8	131.4	2,103	56	7.0
1917	899,697	711,910	+16.2	112.5	1,384	73	9.0
1918	816,366	649,610	-135.8	132.4	-117	42	5.1
1919	655,244	564,288	-9.6	252.1	78	108	12.8
1920	614,995	579,339	+143.2	338.6	476	139	16.0

Source: Columns 2 & 3, M.C. Urquhart, op. cit., Series F.294-297, p.178
Columns 4-6, W.A. Mackintosh, op. cit., Table III, pp. 42-43.
Columns 7-8, Firestone, op. cit., pp. 240-243.

TABLE VI

PRAIRIE FARM AND TRANSPORT INVESTMENT COMPARED WITH GROSS DOMESTIC CAPITAL FORMATION.

(Millions of dollars)

QUINQUENNIAL PERIODS	GROSS DOMESTIC CAPITAL FORMATION	PRAIRIE FARM INVESTMENT	PERCENTAGE 2 IS OF 1	TRANSPORT INVESTMENT			PERCENTAGE 6 IS OF 1
				RAILWAY	OTHER	TOTAL	
1901-5	1,283	221	17.2	165	36	201	15.7
1906-10	2,287	319	13.9	473	66	539	23.6
1911-15	3,279	463	14.1	682	166	848	25.9
1916-20	4,033	370	9.2	423	238	661	16.4
1921-25	3,641	245	6.7	386	367	753	20.7
1926-30	5,831	454	7.8	583	642	1,225	21.0

Source: K.H.H. Buckley, op. cit., Table II, p. 8.

TABLE VII

GROSS SAVINGS OFFSETS IN CANADA, 1901-1930.

(Millions of dollars)

QUINQUENNIAL PERIODS	GROSS PRIVATE DOMESTIC INVESTMENT	GOVERNMENT DEFICITS	CAPITAL INFLOWS	CAPITAL INFLOW AS A PERCENTAGE OF G.N.E.	GROSS PRIVATE DOMESTIC SAVINGS (1+2-3)	GROSS SAVINGS AS A PERCENTAGE OF G.N.P.
1901-5	1,189	40	301	5.3	928	16.4
1906-10	2,039	255	784	9.2	1,510	17.8
1911-15	2,839	770	1,515	12.4	2,094	17.2
1916-20	3,741	2,195	262	1.3	5,674	27.1
1921-25	3,202	525	-72	-0.3	3,799	16.8
1926-30	5,229	400	563	2.0	5,066	17.2

Source: Buckley, ibid, Table XXI and XXII, pp. 63 and 64.

TABLE VIII

DOMESTIC CAPITAL FORMATION AND GROSS INVESTMENT, 1901-1930.

(Millions of dollars)

	1901-5	1906-10	1911-15	1916-20	1921-25	1926-30
1. Construction	681	1,439	2,007	2,122	2,271	3,109
2. Machinery and Equipment	380	586	912	1,322	1,211	2,097
3. Inventories	222	262	360	589	159	625
4. Gross domestic capital formation (1+2+3)	1,283	2,287	3,279	4,033	3,641	5,831
5. Foreign investment	-301	-784	-1,515	-262	72	-563
6. Gross investment (4+5)	982	1,503	1,764	3,771	3,713	5,263

Source: Buckley, ibid, Table IV, p. 135

to the resources of Canada by reason of improvements in transportation and shift of world demand toward the products in which Canada was gaining a comparative advantage. The response to this prospect of increased profitability was a great and rapid rise in the value of annual investment in Canada".[11] Indeed, we can safely assume that investment rose not only in value terms but also in real terms.

[11] Mackintosh, op. cit., pp. 42-43

TABLE IX

FEDERAL GOVERNMENT, BUDGETARY EXPENDITURE CLASSIFIED BY FUNCTION, 1896-1920.

(Millions of dollars)

YEAR	RESOURCES AND DEVELOPMENT	PUBLIC DEBT CHARGES	GENERAL GOVERNMENT	INTERNATIONAL CO-OPERATION	PAYMENTS TO PROVINCIAL & MUNICIPAL GOVERNMENTS	UNCLASSIFIED	TOTAL BUDGETARY EXPENDITURE
1896	2.2	10.6	4.3	-	4.2	2.3	40.9
1897	3.2	10.5	4.2	-	4.2	2.0	43.0
1898	4.6	10.8	4.1	-	4.2	1.8	49.0
1899	4.9	10.7	4.2	-	4.3	1.9	50.2
1900	5.0	10.8	4.1	-	4.3	2.7	55.5
1901	9.1	11.0	4.2	-	4.4	2.9	61.4
1902	8.4	11.1	4.3	-	4.2	3.5	59.1
1903	8.5	11.1	5.1	-	9.8	3.8	69.9
1904	11.7	10.6	5.6	-	4.5	3.6	76.5
1905	12.3	10.8	5.3	-	6.7	2.0	81.6
1906	8.7	6.7	4.1	-	6.7	2.7	64.6
1907	13.9	11.0	6.0	-	9.1	3.3	110.3
1908	18.5	11.6	7.1	-	9.1	4.1	131.5
1909	17.5	13.1	8.1	-	9.4	4.1	113.9
1910	15.6	12.5	8.2	-	9.1	3.7	121.6
1911	19.2	12.3	7.5	-	10.3	10.8	136.0
1912	17.7	12.6	9.8	-	13.2	4.4	143.1
1913	34.6	12.9	14.6	-	11.4	3.4	184.9
1914	42.5	15.7	13.2	-	11.5	8.4	246.4
1915	26.0	21.4	9.5	-	11.5	8.4	337.9
1916	30.2	35.8	14.4	-	11.5	18.3	496.7
1917	31.7	47.8	16.3	-	11.3	16.3	573.5
1918	23.9	77.4	8.0	.3	11.3	15.5	695.6
1919	62.3	125.4	23.2	.5	11.5	29.0	740.1
1920	58.8	139.5	20.2	.5	11.5	21.7	528.9

Source: M.C. Urquhart, op. cit., Series G 26-44, p. 202.

Both Tables V and VII show the important contribution of capital inflows to total investment. For example, in 1913 when capital inflow was at its peak of $541,700,000, it formed roughly two-thirds of Canada's gross investment.[12] Capital inflows also provided much of the foreign exchange which was necessary to offset the heavy balance of imports over exports which in general prevailed up to 1915, and they were also important in helping to meet the increasing debt and dividend charges on the loans which Canada received. (See Table IX). Table V also shows the generally upward trend in the inflow of migrants between 1900 and 1913. Without this heavy immigration of labour it is likely that the great investment which occurred would have been checked by rising wages.

Export trends give some indication of the direction which investment took over the period as illustrated by the substantial portion of gross domestic capital formation which went into prairie farm investment, which had a direct bearing on export prospects. But it is also easy to deduce from Tables VI and VIII that direct investment in export industries was by no means the major portion of investment. The increase in Canada's population and urban centres over the period necessitated a huge investment in railways, harbours, canals, public utilities, including telephones and in general the

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[12] R.E. Caves and R.H. Holton, The Canadian Economy, (Harvard University Press, Cambridge, Massachusetts 1959), p.96.

equipment of municipal, provincial and national services. Further, an increasing amount of investment also went into industries which catered for domestic needs. This explains, for example, the increasingly high proportion of gross domestic capital formation which went into machinery and equipment, much of which was not related to prairie farm investment (see Tables VI and VIII).

The upward trend in imports of goods and services between 1901 and 1916 (see Table V) also had a direct bearing on changes in investment and G.N.E. Much of the capital equipment which entered Canada, for example, was directly related to these changes. Also, this upward trend in imports had a direct bearing on the Dominion Government's revenue, the greater part of which came from customs duties. Revenues rose as imports rose and with these revenues and foreign borrowing the Federal Government was able to promote increasingly economic development during the period, (see Table IX). In particular the Dominion Government assisted greatly in railway development and the prairie settlement.[13]

Looking back over the pre-war period 1899-1913 it may thus be said that except for two minor recessions, the first of which, 1904, was due to short wheat crops in 1903 and 1904 and the second of which, 1907-1908, was due to a decline in

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[13] See S. Bates, Financial History of Canadian Governments, (Ottawa 1939), pp. 45-47, and RCDPR op. cit., p. 67-71.

exports and a slowing down in the rate of investment, (see Table V and Chart I), real G.N.E. climbed steadily. Underlying this trend in real G.N.E. were certain basic factors. Firstly, there was the important role played by exports and investment, part of the latter of which was directly related to export prospects. Secondly, there was the important role played by the inflow of capital and people, and thirdly, the increasing role of government expenditures. For although it may be argued that prior to World War I, government expenditures had, except for their early contributions to a transportation network, relatively minor visible effect either as a short-run pump priming or a long-run stimulus to complementary capital formation, these expenditures were nevertheless massive when compared with Canada's resources.[14]

Between 1913 and 1914 there was a sharp decline in G.N.E. (see Chart I). But during the First World War, 1914-1918, G.N.E. rose, at first quickly, and then at a declining rate. An examination of Tables V to IX reveals most of the basic forces making for these changes in G.N.E. but as was said earlier no attempt will be made to analyse them since the process by which G.N.E. was determined during these war years was not a normal one.

The year immediately following the war witnessed a short

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[14] See Caves and Holton, ibid, p. 238.

but intense boom. This boom was common to most countries of the world except the isolated countries of Central and Eastern Europe and was due mainly to the credit expansion in the U.S.A. and the scramble among countries to obtain goods that were not obtainable during the war.[15]

This immediate post-war boom was shortlived, however, as witnessed by the sharp decline in real G.N.E. (Chart I) between 1919 and 1921. A very significant factor in this recession seemed to have been the sharp contraction in exports between 1919 and 1922, (see Tables V and X). But while exports contracted by about a third between 1920 and 1921 imports contracted appreciably as well, and this together with the increase in capital inflow[16] mitigated the severity of the depression. Another factor which also made for the brevity of the recession was "the fact that much of the slump came in the form of lower prices and attempted inventory liquidation rather than durable investment. The annual rate of inventory

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[15] Mackintosh, op. cit., p. 38.

[16] It is important to note, however, that an increase in capital inflow need not always have an expansionary effect on the economy. If the capital inflow is used to purchase goods and services from foreign countries, then it will have the effect of increasing incomes and employment in these countries and not in the home economy. But if it is used essentially to finance domestic investment it will have an expansionary effect on the home economy. The increase in capital inflow, during the period 1920-1921, mitigated the severity of the depression precisely because it was mainly used for this latter purpose.

TABLE X

ECONOMIC TRENDS, CANADA, 1921-1925

YEAR	EXPORTS VALUED AT 1913 PRICES, 000 OF DOLLARS	IMPORTS VALUED AT 1913 PRICES, 000 OF DOLLARS	NET LONG TERM CAPITAL MOVEMENT, M. OF DOLLARS	INDEX OF HOME INVESTMENT 1926 = 100	INCREASES IN RAILWAY MILEAGE IN OPERATION	TERMS OF TRADE 1926 = 100	IMMIGRANT ARRIVALS
1921	504,846	559,423	+137.6	64.4	386	110.1	91,728
1922	493,858	512,909	+237.1	89.0	167	94.3	64,224
1923	692,218	582,271	+142.4	84.2	296	85.0	133,729
1924	820,438	605,613	+113.3	74.0	504	91.1	124,450
1925	769,597	581,516	-50.5	79.9	291	99.0	84,907

Source: Columns 2 and 3 of C. Urquhart op. cit., Series P294-297, p. 178.
Columns 3-8, W.A. Mackintosh op. cit., Table 5, pp. 76-77.

investment in railways, manufacturing and public utilities fell by $375,000,000 from 1920-1921 although in constant dollars it rose by $43,000,000."[17] Thus by 1922 a period of expansion began.

THE PERIOD OF EXPANSION 1922-1929.

The analysis of short-run changes in Canada's G.N.E. is much easier in this period for we have in addition to our previous sources, the official national accounts figures from 1926 onwards and some useful information which has been produced by Malach's

[17] Caves and Holton, op. cit., p. 99.

research[18] on Canadian business cycles.

For convenience this period will be divided into two phases: 1922-1925 and 1926-1929. Except for a slight recession in 1923-1924, the first of these phases witnessed a moderate recovery which was stimulated by increasing exports (see Table X) and domestic investment which was undertaken to utilise new developments in technology. Between 1921 and 1925 Canadian exports rose in real terms by a little more than 50 per cent but imports fluctuated irregularly, and in 1925 stood only about 5 per cent above their 1921 level. Consequently, the balance of commodity trade became positive. But real exports did not attain their highest previous level until after 1925 and depressed export trade in grain and livestock during the first few years of the 1920's, seems to have been largely responsible for the slow rate at which the boom developed.

Malach[19] points out that gross domestic investment rose much more sharply than exports between 1921 and 1925 (187 per cent) and that about two-thirds of this investment came between 1921 and 1923. But while about three-quarters of the total increase in gross domestic investment went into increased inventory accumulation it was plant and inventory equipment

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[18] V.W. Malach, "External Determinants of the Canadian Upswing, 1921-1929" CJEPS, (February 1951); "Internal Determinants of the Canadian Upswing, 1921-1929" CJEPS, (May 1950).

[19] "Internal Determinants of the Canadian Upswing," ibid, pp. 193-196.

made possible by the adoption of new products and new technology, which provided the major force which encouraged high spending levels throughout the economy. Consumption expenditures lagged behind the rise in exports and gross domestic investment, and they actually fell in 1924 compared with 1923, in both real and monetary terms.

The second phase of this period, 1926-1929 was more prosperous than the first, (see Chart I, Tables VI to VIII, and Chart II which follows). Chart II which is based on the official national accounts estimates is particularly helpful in analysing the behaviour of G.N.E. and its components during these and subsequent years, hence the analysis of the years 1926-1962 will be based mainly on it and the national account data on which it is based. Chart II and Table VIII in particular, indicate that the main factor which was responsible for expansion during this second phase of the 1920's, was the rising level of business investments in plant and equipment. Expenditure for this purpose rose from 10 per cent of G.N.E. in 1926 to 15 per cent in 1929. On the other hand, while expenditure on residential construction rose from year to year it exerted a much less stimulating influence on aggregate demand.[20]

Both consumer expenditure and government expenditure

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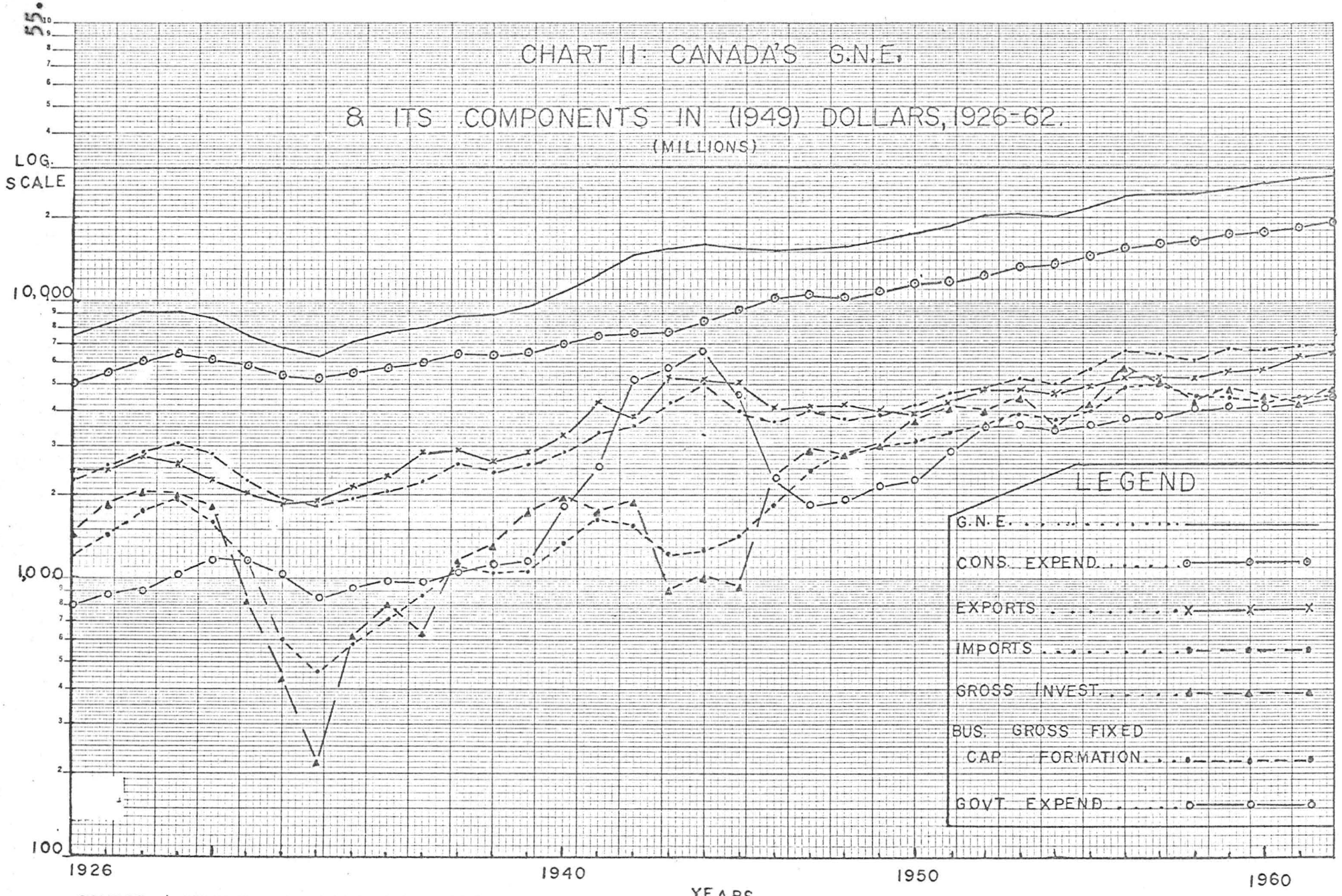
[20] Table V, National Accounts, 1926-1956, op. cit., p. 36.



SOURCE: NATIONAL ACCOUNTS, D.B.S., 1926-56 AND 1962.

on goods and services rose by about 30 per cent between 1926 and 1929. Much of the rise in the former was due to increased expenditure on durables while the rise of the latter was due mainly to provincial and municipal outlays which were made to extend and improve highways and to provide services for a growing and increasingly urban population.

Imports rose steadily, and in 1929 were 28 per cent higher than they were in 1926. But the rise in the level of exports was small in comparison. Apparently what was important in the behaviour of exports was the shifts which were occurring intheir composition. The most important of these was the relative rise in importance of the base metals, gold, wood pulp and newsprint industries, and the relative decline in agriculture. There was still a significant dependence on a few major exports however. Wheat and wheat flour comprised about a quarter, and together with newsprint, wood pulp, the base metals and gold they made up more than half of the total value of exports.

These shifts in the composition of exports caused a fairly stable export volume rather than a steadily rising export level to place a steadily rising investment incentive before the Canadian economy. Consequently, investment rose not only in those industries which were directly related to the export sector, but also in such capitalistic industries as construction materials, explosives, chemicals, electric

power and electric equipment and machinery.

Thus it would seem that although the most outstanding factor was the rise in investment, especially in plant and equipment, much of this investment was induced by export conditions. Mackintosh[21] sums up the pattern of behaviour during these years as follows, "favourable demand and improved techniques of production resulted in a great expansion of exports and a still greater expansion of imports. Following the increase in exports came a great increase in home investment and a rise in national income."

It should be emphasised however, that there was an appreciable lag between the major rise in export volume at the middle of the decade and the responding rise in investment during its latter half. This lag seems to have been due to the longer gestation period that was required for making investment in the new export industries.

THE GREAT DEPRESSION.

The rapid expansion which characterised the latter part of the 1920's was however, arrested by the Great Depression of 1929-1933. An examination of Chart II reveals that both exports and inventory investment had begun to decline between 1928 and 1929. Then between 1929 and 1930 both exp-

[21] Op. cit., pp. 53-54.

orts and gross investment fell at a faster rate than G.N.E. and all its other components (except government expenditure on goods and services which did not fall but continued to rise until 1930). Indeed, the fall in exports and gross investment was quite large: the former fell by 21 per cent and the latter by a little more than 20 per cent. After 1930, the depression worsened. Between 1930 and 1933 G.N.E. and all its components (except exports which started to rise in 1932) declined tremendously. But the rate of decline in gross investment was by far the fastest, and after 1930 changes in inventories which were previously positive became negative.

In 1933 when the trough of the depression was reached G.N.E. had declined from its 1929 level by 30 per cent in real terms. Business gross capital formation had fallen from $1,948 million to $462 million (1949 constant dollars). The value of exports had halved and the value of imports had fallen even more, thus bringing the current international account virtually into the balance at a very low level. But consumer and government expenditures both fell by a smaller amount than these other components, because consumer expenditure exceeded disposable income by 10 per cent, and government expenditure did not fall drastically as the government incurred a large deficit. In spite of these last two factors, however, G.N.E. and all these components fell by a much larger amount than they have ever done in any other depression.

The unusual severity of this depression, it has been claimed, resulted from the coincidence of an agricultural and industrial crisis, great magnitude of the contraction in international trade and the great instability of the monetary and financial systems in both debtor and creditor countries.[22] Mackintosh asserts that these depressing factors attained the magnitudes they did because of the failure to remedy certain maladjustments which existed in the whole international system before the onset of the depression. Further, the magnitude and speed of the depression generated fear and panic which led to numerous bank failures and a crash in prices, which aggravated the depression. Here, the specific economic and political factors which intensified the depression will not be examined in detail. But it should be noted that the factors which affected Canada most were bad crops and low prices and the great decline in international trade. This was a consequence of Canada's great dependence on exports and the fact that about two-thirds of these exports consisted of raw materials, such as food-stuffs, newsprint, lumber and minerals; and the prices of these fluctuated widely and trade in them was greatly reduced.

The industrial crisis caused a decline in the income accruing to the industrial sector and this affected both the prices of agricultural and non-agricultural products. Further,

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[22] See Mackintosh, op. cit., pp. 109-113.

both the monetary and financial crises added to these adverse effects on prices. But all these factors, though they played their part in depressing the Canadian economy did not do so to the same extent as did the agricultural crisis and the great decline in international trade.

Following the short wheat crop of 1929 exports fell more rapidly than they did in the preceding year. And indeed, during the depression exports fell more rapidly than G.N.E., but as already pointed out, they began to recover earlier - exports started to recover in 1932 while G.N.E. and its other components only started to recover in 1933.

PERIOD OF RECOVERY AND EXPANSION, 1933-1939.

After 1933 G.N.E. and all its components rose very rapidly. Exports which had started to rise in 1932 rose even faster as the quantum of world trade rose considerably. Then between 1933 and 1934 both exports and business gross fixed capital formation rose markedly, the latter rising by 27 per cent. Thus the revival in exports seems to have been the key factor causing the upturn from the Great Depression, and the increases in investment and the other components of demand added to the strength of the recovery which followed.

The increased income made available by increasing exports and investment enabled Canadians to increase their rate of consumption and this increase in consumption, together

with the increase in investment, gave rise to a simultaneous increase in imports as much of the consumption and investment goods had to be imported. Further, the general rise in government transfer payments and government expenditure on goods and services, made possible by a large government deficit, added to the forces which were making for recovery. The net result was that the value of G.N.E. increased by 13½ per cent between 1933 and 1934, and since prices rose only slightly, most of this increase represented an increase in volume.

Real G.N.E. continued to rise through 1935 and 1936 despite a sharp fall in gross investment in 1936 (see Chart II), and the armament boom added to the strength of the recovery which was taking place. Consequently, by 1937 the value of Canada's exports was larger than it had been in 1929 in real terms, and real G.N.E. although it was lower in volume and value than it had been in 1929, was increasing its rate of growth appreciably.

The progress of this recovery was interrupted in 1938 when real G.N.E. was only slightly higher than it was in the previous year. This drastic slowing down in the rate of increase of G.N.E. seems to have been related to a short but severe recession which developed in the U.S. in 1937-1938. Its effect on Canada is reflected, in particular, by a major decline in exports and a significant falling off of gross

domestic capital formation. However, real consumer expenditure was affected only slightly and government expenditure rose as a result of a substantial increase in the government's deficit. This helped to lessen the severity of the recession.

In 1939 G.N.E. and all its components began to rise. The most significant factor tending to increase G.N.E. was the expansion of investment in inventories which was probably related to the outbreak of the World War II. There was also a significant rise in exports and government expenditures, but consumer expenditures rose only moderately. As the war continued noticeable changes occurred in these trends (see Chart II), but since those war years are considered abnormal these changes will not be analysed. It may be recalled however that during the period 1940-1942 G.N.E. experienced its highest rate of increase over the whole period 1896-1962 (see Charts I and II).

THE POST WORLD WAR II PERIOD 1946-1962.

For convenience the post war years 1946-1962 will be divided into three phases: 1946-1949, 1950-1956 and 1957-1962.

1946-1949.

As Chart II shows, the first of these post-war years witnessed a drastic decline in government expenditures and exports, and a somewhat smaller decline in imports. However, business gross fixed capital formation, investment in business

inventories and consumer expenditure continued to increase, and this lessened the decline in G.N.E. - in real terms G.N.E. was only slightly lower than it was in 1945. The fall in government expenditure reflected the reduction in military expenditures both at home and abroad, while the rise in consumer expenditure and gross investment resulted from the accumulation of savings, the backlog of demand which were built up during the war, and the post-war "baby boom".

In 1947 only government expenditure continued to decline as G.N.E. and all its components showed some advances. Most prominent among these advances was the rapid expansion in business gross fixed capital formation. Exports rose somewhat but the rise in imports was much greater and this resulted in only a slight surplus on current international account. While these increases in demand were taking place however, output per man year was falling. Indeed, it has been estimated that output per man year fell every year from 1945 through 1949 except for a small rise in 1948, and productivity per man hour fell during 1948 and 1949.[23] The combined impact of these demand and supply forces and the progressive relaxation and removal of controls, beginning in the latter part of 1946 brought about a sharp inflation. Consequently, much of the increase in value of G.N.E. in 1947 was

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[23] G.D. Sutton, "Productivity in Canada", CJEPS, 19; 191-194, (May 1953).

due to rapid price increases (notice the small increase in real G.N.E. in Chart II.)

In addition to the problem of inflation there was an exchange problem. Canada's reserves of gold and foreign exchanges were rapidly depleted in 1947 as a result of the rise in imports, particularly from the United States. Further, this exchange problem was aggravated by the fact that a large part of Canadian overseas exports were financed by credit while imports were paid for in cash. In an attempt to remedy this exchange problem the expenditure of U.S. dollars was restricted.

Throughout 1948 the inflationary pressure persisted as demand continued to press on supply. It is noticeable however, that, mainly because of import restrictions, there was a fall in real terms in both imports and consumer expenditures. On the other hand, business gross capital formation rose, but investment in inventories were drastically reduced, apparently reflecting in part the drawing down of stocks of imported goods. Government expenditure however, reversed its downward trend, mainly as a result of the rapid growth of provincial and municipal expenditures. All these changes combined to produce only a very small rise in real G.N.E.

The years 1946-1948 were thus for the most part years of adjustment following the war. And it may be strongly

argued that the regulation of import and foreign exchanges prevented the normal process of income determination from working. By 1949 however, the external pressure on prices was weakened by the appearance of recessionary influences in the U.S. and supply was coming into better balance with demand. On the demand side all the components of G.N.E. except exports increased at a faster rate than they did in the previous year, the increase in gross investment being particularly outstanding. And on the supply side, the rise in real output of nearly 4 per cent was the first significant post-war increase.[24]

1950-1956.

But the outbreak of the Korean War in 1950 brought about a resurgence of inflationary pressures, and the adjustment which the war made necessary tended, as during the early post-war years, to obscure the normal process of income determination. Largely due to fears of shortages and the expectation of higher prices there was a sharp rise in business inventories and consumer expenditures in 1950. Imports rose sharply, but exports declined. And, as expected, prices rose rapidly so the Federal Government had to adopt measures to restrain inflationary pressures and channel resources into defence uses. By about the middle of 1951 however, the

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[24] National Accounts, 1926-56, op. cit., p. 21

wave of forward buying had subsided and thereafter the normal process of income determination was restored.

The main forces making for expansion in 1951 were exports, investments in plant and equipment and government expenditures - most of the last two being related to defence. Indeed, 1951 witnessed the first significant post-war increase in the volume of Canadian exports. Exports rose 10 per cent in both 1951 and 1952 (because of the 1953-1954 recession they did not rise another 10 per cent until 1956). Expenditure on plant and equipment rose by about 24 per cent in value and government expenditure on goods and services rose nearly 40 per cent, as defence expenditure absorbed 5½ per cent of G.N.E. in contrast to less than 3 per cent in 1950. G.N.E. responded to this pressure of demand by rising about 6 per cent in real terms.

1952 was even more prosperous. Government expenditure again increased significantly, rising by 31 per cent, and investment in plant and equipment continued to rise, much of it going into defence - supporting activities and the development of natural resources. A particularly noticeable development was the sharp rise in consumer expenditure. Its increase by 7 per cent in volume was the largest of any post-war year except 1946. Another important development was the improvement in the terms of trade associated with the appreciation of the Canadian dollar; export prices were significantly

lower than import prices and with the volume of exports rising considerably more than the volume of imports, the international current account came back into surplus. In consequence of these favourable developments the real G.N.E. increased by nearly 8 per cent, an increase which was larger than that of any previous post-war year.

In 1953 the period of rapidly rising defence expenditures came to an end and the satisfaction of civilian needs became the strong expansionary force in the economy. In real terms all the components of G.N.E. except exports, continued to rise. G.N.E. rose, but at a slower rate than it did during the preceding year, perhaps reflecting the recessionary influences that developed in the North American economy following the Korean Armistice.

In 1954 the signs of this depression became marked. In real terms there was a fall in all the components of G.N.E. (except consumer expenditure) from the levels they had attained the previous year. This was the first time in the post-war period that investment in plant and equipment was lower than in the preceding year; indeed purchases of machinery and equipment declined by 11 per cent. The pronounced shift from the accumulation to the liquidation of business inventories was, however, the most important influence in tending to depress the level of activity. (See Chart II). The result of these changes was that real G.N.E. actually dropped.

Expansion was renewed in 1955 as G.N.E. and all its components showed significant increases. Business investment in plant and equipment again turned upwards and investment in inventories became again positive. Consumer expenditure and residential construction gained by 8 and 12 per cent respectively and together they accounted for nearly two-thirds of the increase in G.N.E. Exports rose by 12 per cent and imports rose even faster - by nearly 16 per cent, causing the deficit on the international current account to rise. All these changes made the volume of G.N.E. 9 per cent higher than it was in 1954.

This expansion continued in 1956, the tremendous increase in the volume of investment in plant and equipment being the main expansionary force in this year.

Looking back over the first two phases of the post-World War II period one cannot help but discern some similarity between them and the two phases of the 1920's. Like the 1920's the rate of growth of G.N.E. was fairly slow during the first of these and quite rapid in the second. Also in the second phase of each period there was a residential construction boom which was accompanied by rapidly rising total investment in all types of economic activities.

1957-1962.

In the first of these years there was a slowing down

of the tremendous rate of increase of investment in plant and equipment which had occurred in 1956 but this component of demand was still the most important factor contributing to the small rise which occurred in real G.N.E. In 1957 gross investment formed about 25 per cent of G.N.E. This investment which was chiefly made in public utilities, the base metal and the newsprint industries, was in part financed by foreign capital, but private investment showed a spectacular increase which has not been surpassed during the remainder of the period.

Between 1957 and 1961 there was a slowing down in the rate of increase of G.N.E. Following a mild recession in the latter part of 1957, recovery began in 1958 and continued through 1959 but it was moderate. In 1960 there was a recession, the cause of which seems to have been a slackening of the demand for equipment and housing as well as a decrease in consumer purchases of durable goods other than automobiles. In 1961 however, a recovery was made. This upward swing in economic activity was characterised by sharply rising exports to U.S.A., Communist China and Eastern Europe, and the pronounced buildup of inventories which had been liquidated briefly in 1960.

The recovery which began in 1961 gathered momentum in 1962 and real G.N.E. in 1962 represented a 6 per cent advance over that of 1961. This expansion represented the

largest year-to-year gain since 1956 when the economy was stimulated by an exceptionally high level of capital expenditure. While all the components of demand contributed to this gain, the increase in consumer expenditures, exports and government expenditures were particularly marked, and there was a noticeable and encouraging slowing down in the rate of increase of imports. The expansion of 5 per cent in consumer expenditures was the strongest since 1959 and was largely due to a sharp increase in the purchases of new and old automobiles. Exports of goods and services rose by 8 per cent while imports rose by 5.7 per cent. This large rise in exports was mainly due to a higher level of demand in the U.S., but in part it also reflects the lower exchange value of the Canadian dollar. Government expenditure rose by 7.2 per cent, an increase which mainly reflected the large outlays made by the provincial and municipal governments. Thus beginning in 1961, the Canadian economy appears to have entered a new phase of expansion, and this expansion continued through 1962 in spite of the brief but acute exchange crisis which occurred in that year.

SUMMARY

The foregoing historical sketch indicates that over the period 1896-1962, the short-run changes in the level of economic activity were almost invariably related to certain determinants of the Canadian economy. The main impetus to

the expansion which took place during the period 1896-1913 was provided by favourable conditions in the export market, and the incentive which these conditions provided directly and indirectly for both private and public investment. Further, this increase in investment was greatly facilitated by a large inflow of capital.

Likewise, the expansion of the 1920's was stimulated by increasing exports and domestic investment designed to utilise the new technological development. In this period, however, capital imports did not play as important a role as they did in the earlier expansion.

In the post-World War II years the influence of foreign trade, and investment has again been marked, and the influence of government expenditure on goods and services has been of increasing importance. Also, capital inflows have been much more important in this period than in the 1920's, but these inflows were a much smaller proportion of G.N.E. than they were during the period 1896-1913. While, however, no change has appeared in the dependence of G.N.E. on exports over these post-war years, the dependence of G.N.E. on gross investment has apparently declined. This seems to be due to the increasingly important role played by government expenditures on goods and services.

Similarly, it has been noted that the depressions and

recessions of the period 1896-1962 have in general been caused by unfavourable conditions in the export market, a decline in gross investment and/or a decline in government expenditure on goods and services. For example, the two minor recessions of the period 1896-1913, that of 1903-1904 and that of 1907-1908 were due respectively to poor wheat crops and the consequent reversal in exports, and a decline in the rate of investment. Also the factors which affected Canada most during the Great Depression of 1929 and 1933 were bad crops and low prices and the decline in international trade. The recessions of the post-World War II period have also been due largely to unfavourable changes in foreign trade and gross investment. For example, the recession of 1953-1954 was due to both of these factors. A slight exception to this pattern was the mild recession of 1960 which seems to have been caused by decreased consumer purchases of durables other than automobiles, and a slackening of the demand for equipment and housing.

Throughout the whole period 1896-1962 the behaviour of consumer expenditure, the largest component of G.N.E. has been relatively stable and changes in this component have tended to lag behind changes in G.N.E. Also, in normal periods, changes in imports have been produced by, or have been related to changes in consumer expenditure and gross investment. Thus, it would seem that the main short-run

changes in Canada's G.N.E. have been brought about primarily by changes in exports, gross investment and government expenditure on goods and services and that the pattern by which these components determine G.N.E. has persisted with only some change in their relative importance. For example, the post-war period has witnessed a great increase in government expenditures.

CHAPTER III

A SIMPLE MODEL OF THE SHORT-RUN DETERMINATION OF CANADA'S GROSS NATIONAL EXPENDITURE

This chapter develops, on the basis of the background knowledge provided by Chapters I and II, an hypothesis concerning the determination of Canada's G.N.E. This hypothesis is ultimately expressed in the form of mathematical relationships which will be estimated statistically in the next chapter.

The historical evidence provided in Chapter II suggests that essentially the same mechanism of income determination has been operating during each of the growth phases which Canada has experienced between 1896 and 1962. There has been in general a consistent relationship between changes in G.N.E. and changes in the levels of exports, gross investment and government expenditures on goods and services. It seems that most frequently it is favourable export prospects which provide the inducement to investment, but that some of gross investment and almost all of government expenditures are undertaken independently of conditions in the export market.

In the absence of wars it would also seem that these

determinants of G.N.E. operate in the manner which has been indicated by the multiplier theory explained in Chapter I, i.e. a change in expenditure resulting from changes in the level of any of these determinants leads to a change in the level of disposable income which leads to a further change in consumer expenditures. This often leads to a cumulative process through which G.N.E. is increased by an amount which greatly exceeds the initial change in expenditure. Thus favourable export conditions may lead to a boom which, if it continues uninterrupted, will lead to an increase in expenditure and income which is a positive multiple of the original increase in exports. Further, these increases in income may induce investment both in the export and domestic industries i.e. they may produce an accelerator effect.

So during periods of growth, new investment projects are also likely to be undertaken. But as this growth continues investment tends to exceed domestic saving and there is thus the need for a net inflow of foreign capital. This implies a tendency, which was noted earlier, for imports to exceed exports if the boom continues.

The historical sketch given in Chapter II also indicates that during a period of contraction a process which is the opposite of that described above goes into operation; and that generally contraction is initiated by a decrease in exports, which causes a decrease in export expenditures and hence a fall in consumers' disposable income. These decreas-

es produce, both through a multiplier and a possible accelerator effect, a fall in G.N.E.

Since it is believed that this pattern of short-run income determination has been relatively stable over the historical period which has been considered, and that it is likely to persist, it seems justifiable to explain Canada's G.N.E. by an hypothesis which is based on this pattern. The main hypothesis suggested by this pattern in the behaviour of G.N.E. is that changes in this aggregate are primarily determined by changes in the levels of exports, gross investment, and government expenditure. These are the "prime movers" and changes in any or all of these components are likely to lead to changes in G.N.E. through the operation of the multiplier. Other factors such as consumer expenditure and imports do affect G.N.E. but they are not the prime sources of changes in Canada's G.N.E. The direction of causation seems to run from exports, gross investment, and government expenditure to G.N.E. An increase in any of these components, for example, causes G.N.E. to increase, but since the rise in G.N.E. is likely to result in larger disposable incomes, consumers will spend more and so both consumption and imports will increase.

The process by which the "prime movers" determine G.N.E. must necessarily be regarded as very short-run however. Eventually the changes brought about in consumption and imports

- as a result of the change in G.N.E. which was originally initiated by changes in the "prime movers" - will lead to further changes in G.N.E. and this will give rise to a cumulative process which will continue until a new equilibrium is achieved. It is therefore important to recognize that the simple equations of relationships which are based on the hypothesis formulated above do not account for these latter changes and the feedbacks that are involved.

It will be helpful in setting out this hypothesis further to say a few words about the elements of model construction. An economic model is really a mathematization of an economic hypothesis or theory. It consists of at least one structural equation, which is supposed to represent some sector or some regular feature of the economy, but it may contain a number of such equations as well as a number of identities, depending on the size and complexity of the economic model. In the simplest of cases, the model may consist of one equation which consists of a dependent variable, i.e., the variable which is being explained, and one or more independent or exogenous variables. For example, it may be hypothesised that G.N.E. is determined by gross investment, exports, and certain random disturbances (here the possibility that G.N.E. may be influenced by random disturbances is introduced because in general it would be naive to expect an exact behaviourial relationship between G.N.E., investment

and export; some relevant explanatory variables may be omitted from the relationship or some error in measurement may be made), i.e.

$$G.N.E. = f(I, F_2, u) \ldots\ldots\ldots \quad (1)$$

where G.N.E. is a function of gross investment (I), exports (F_2) and random disturbances (u).

In equation (1) the form of the function is not specified. But in order to obtain a quantitative and numerical measurement of this relationship one has to be more specific in describing the functional relationship and must discover on the basis of the theory or empirical investigation whether G.N.E. is, for example, a linear or logarithmic function of the other variables. If, say, it is discovered, or there is reason to believe, that the functional relationship is linear then (1) may be rewritten as

$$G.N.E. = a + bI + cF_2 + u \ldots\ldots\ldots \quad (2)$$

where a is a constant term, b is a measure of the change in G.N.E. which results from a unit change in gross investment, and c is a measure of the change in G.N.E. which results from a unit change in exports. In this example G.N.E. is the dependent variable; I and F_2 are the explanatory or independent variables. And, since G.N.E. is thought of as being explained by a random as well as a systematic component, u represents the random component and all the other terms on the right hand side of (2) constitute the systematic component of the explan-

ation of G.N.E.

In constructing a model it is also necessary to distinguish between the endogenous and exogenous variables. Endogenous variables are those which are determined by the operation of the economic system under consideration. Thus, G.N.E. is endogenous in the relationship above, since it can be said that it is determined by the economic system in accordance with certain hypotheses or theories which have been developed by economists. It should be noted that each endogenous variable must be explained by an equation of relationship, which may consist of exogenous or endogenous variables, or a mixture of these.[1]

An exogenous variable, on the other hand, is not explained by the economic system under consideration. An example of such a variable is government expenditure. This variable is regarded as exogenous because economists have not yet developed any economic or hypothesis theory to explain it. This is mainly due to the fact that government expenditure is determined to a large extent by politicians whose behaviour may be affected by political, sociological, as well as by other factors which are not determined by the economic system.

It should be noted that exogenous and lagged variables,

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[1]For simplicity a full discussion of predetermined variables, which include both exogenous and lagged variables, is omitted here.

collectively called predetermined variables, exert a one-way effect on the economic system while endogenous variables affect and are affected by the economic system in return. In equation (2) for example, if I and F_2 are both exogenous, then these variables affect G.N.E. but they are not affected by G.N.E. in return. If however, one of these variables, say I, is endogenous then I will affect G.N.E. and G.N.E. will also affect I thus giving rise to a two-way effect.

Where the line is drawn between exogenous and endogenous variables is quite often arbitrary, however. In equation (2), for example, it may be plausible to assume that I and F_2 are exogenous in the short-run but this assumption about I especially, may not always be valid; and in some cases I may be regarded as endogenous and explained in terms of those variables which arebelieved to be important in its determination.

Model construction, also, necessitates our knowing the condition under which a model is complete. A model is said to be complete when the number of equations in the entire set of structural equations is just sufficient to determine all the endogenous variables, assuming that all exogenous and lagged variables, i.e. the predetermined variables are given. Thus, there must be as many structural equations as there are endogenous variables.

It is also useful in the present context to distinguish between the short-run or proximate, and the long-run or ultimate multipliers. The former type of multipliers measure the short-run effect of an explanatory variable on the variable that is being explained, whereas the latter type of multipliers measure the total or ultimate effect on the variable being explained e.g. the investment multiplier given by $\frac{dY}{dI} = \frac{1}{1-C'(Y)}$ on page (27) measures the effect which a change as I has on Y after sufficient time has elapsed for all the repercussions of the simple economic system $Y = C + I$ to work themselves out. But if Y were the only endogenous variable and it were related to I linearly by the equation $Y = a + bI$ then the short-run multiplier would be $\frac{dY}{dI} = b$; this multiplier does not take into account all the possible repercussions produced by the other endogenous variable of this simple economic system. Similarly, in equation (2) discussed above, G.N.E. is the only endogenous variable and the multipliers which are given by $\frac{\partial G.N.E.}{\partial I} = b$ and $\frac{\partial G.N.E.}{\partial F_2} = C$ are short-run or proximate multipliers.

The above discussion lays the ground-work for formulating, in mathematical language, certain relationships which are derivable from the hypothesis concerning Canada's G.N.E. In formulating these relationships the assumption shall be made throughout that they are all linear. For alth-

ough it has not been found possible to conduct much research for deciding on the best functional form of these relationships theoretical considerations as well as certain rough statistical analyses (such as an examination of scatter diagrams and the time pattern of the residuals) indicate that the assumption of linearity is highly plausible.

Since it has been hypothesised that G.N.E. may be explained in terms of exports, gross investment and government expenditures, some attempt will be made to ascertain whether it makes a difference to the explanation of G.N.E. if all or part of the changes in inventories are included in gross investment. To test this the following relationships are constructed for later statistical testing:

$$G.N.E. = a_1 + bI + cF_2 + dG + u_1 \quad \ldots\ldots\ldots\ldots \quad (1)$$

$$G.N.E. = a_2 + bI' + cF_2 + dG + u_2 \quad \ldots\ldots\ldots\ldots \quad (2)$$

$$G.N.E. = a_3 + bI'' + cF_2 + dG + u_3 \quad \ldots\ldots\ldots\ldots \quad (3)$$

$$G.N.E. = a_4 + bI''' + cF_2 + dG + u_4 \quad \ldots\ldots\ldots\ldots \quad (4)$$

where the symbols: G.N.E. a, b, c, I, F_2, G and u have their usual meanings and d, I', I'', and I''' have the following meanings:

d - the change of G.N.E. which results from a unit change in G (i.e. the short-run) government multiplier.

I' - gross investment (I) minus changes in non-farm inventories.

I'' - gross investment minus changes in farm inventories.

I''' - gross investment minus changes in both farm and non-farm inventories.

(The parameters of each equation will be different, so subscripts are used only to distinguish between them.)

Now, if the assumption is made that all the explanatory variables in equations (1) to (4) are exogenous, then each of these equations constitutes a complete, though simple, model of the determination of G.N.E. Since it will be indeed assumed that these explanatory variables are exogenous, some attempt will be made to justify this assumption. It was pointed out earlier that G may be regarded as exogenous because, to a great extent, it is not determined within the economic system but it is determined largely by political, sociological and other factors which are determined outside the economic system. Exports, also may be regarded as exogenous since they are largely determined by the economic, political, social and other factors in foreign countries. There is some uneasiness however, in treating gross investment as exogenous although a part of gross investment at least is definitely determined by exogenous factors. For example, certain changes in farm inventories may be due to changes in weather conditions which are exogenous as far as the economic system is concerned. But, on the other hand,

many of the influences affecting gross investment expenditures are endogenous. Profits, for example, are determined within the economic system.

It is thus realised that certain shortcomings are inherent in treating all investment expenditures as exogenous. An attempt has been therefore made to make a partial remedy of this by taking changes in non-farm inventories out of gross investment in equation (2). Also, since it is controversial whether changes in farm inventories are more likely to be exogenous than changes in non-farm inventories, changes in farm inventories are taken out of I in equation (3) so that later a test may be made to see whether equation (2) explains G.N.E. better than equation (3). Lastly, in equation (4) both changes in non-farm and farm inventories are taken out of I. The rationale for this is to try to purge gross investment of some of its endogenous elements. But even after this is done it could still be argued that gross fixed capital formation is likely to be lessexogenous than either government expenditures or exports.

However, for convenience, all the explanatory variables in equations (1) - (4) will be assumed to be exogenous and these equations will be tested statistically in the next chapter. These tests should indicate whether the simple hypothesis formulated in this chapter will give a sufficiently good explanation of the short-run determination of Canada's G.N.E.

CHAPTER IV

STATISTICAL ESTIMATION OF THE EQUATIONS OF RELATIONSHIP EXPLAINING CANADA'S GROSS NATIONAL EXPENDITURE.

In this chapter the equations of relationship which were developed in Chapter III will be fitted to actual observed data. One of the primary purposes of this statistical analysis is to predict the value of G.N.E., the dependent variable, from a knowledge of the independent variables which have been used to explain it; and if good predictions are to be made the empirical data must be consistent with the hypothesis from which these equations are derived. If there is lack of consistency between the empirical data and the hypothesis, then the latter must be rejected.

It will be shown later than an hypothesis which is not rejected will have random residuals and reasonable multipliers, and that these multipliers will also have reasonable t_i values. (The t value of a multiplier is a measure of the number of times this multiplier contains its standard error. This measure is used - as will be shown - to appraise the reliability of the multiplier estimate). The reasonableness of an hypothesis is also indicated by statistical measures of its goodness of fit or the degree of relationship between

the independent variables and the dependent variables. So these measures will also be used to help assess the worth of the hypothesis which has been developed.

In order that the reader may understand the meaning and appreciate the significance of these statements some attempt will be made to describe very briefly the method of estimation which will be used, and the conditions under which its use is valid; and some justification will be offered for its use in estimating the equations of relationship explaining G.N.E. In addition, some brief discussion will be given to those statistics which are used in deciding on the reasonableness of the hypothesis. This is followed by a discussion of the data used. Then lastly, the statistical and forecast results obtained will be presented and briefly discussed.

STATISTICAL METHOD OF ESTIMATION - ORDINARY LEAST SQUARES

The parameters of the equations explaining Canada's G.N.E. are estimated by the method of Ordinary Least Squares (OLS). This method of estimation recognises that the data which are used to fit these equations are generated by both systematic and random forces and sets about to obtain a good explanation of the dependent variable, and hence good estimates of the parameters, by minimising the random component of this explanation. Further, it can be shown[1] that when certain

[1] See J. Johnston, Econometric Methods (McGraw-Hill Book Co., Inc.) New York, pp. 16-19, and pp. 108-112.

conditions are fulfilled this method yields the best unbiased linear estimates of the parameters. "Best" means that the estimates have the smallest variance among all linear unbiased estimates and hence in this case it means that the variance of the u's is a minimum. "Unbiased" means that an estimate "a" of a true population parameter α is such that the expected value of a, i.e. $E(a) = \alpha$. "Linear" refers to the fact that the constants of the equation must enter the equation linearly - they could not be logarithmic for example.

The following is an example taken from Johnston[2] to illustrate and explain the use of OLS to estimate the parameters of a simple linear hypothesis. Suppose that an investigation is made of the relationship between consumption expenditure (Y) and disposable income (X) in a cross-section of households for some given period of time. Then these households may be divided into groups according to household size and composition, and some attempt may be made to discover the relationship between Y and X within each group.

It is not expected that all households within a subgroup which have the same given income X' will make identical consumption expenditure Y' since some households will spend more than others. Thus, assuming a linear relationship between Y' and X', then the actual consumption figures for

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[2] Ibid, pp. 5-9.

households within this sub-group may be given by $\alpha + \beta X' + u_1$, $+ \quad X' + u_2$ etc. where u_1, u_2, ... u each represents the amount by which expenditures of particular households exceed or fall short of the central value of $\alpha + \beta X'$; where α is the constant term and β is the slope of the line. Thus, for the group as a whole, it seems more reasonable to construct a new hypothesis:

$$Y = \alpha + \beta X + u \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

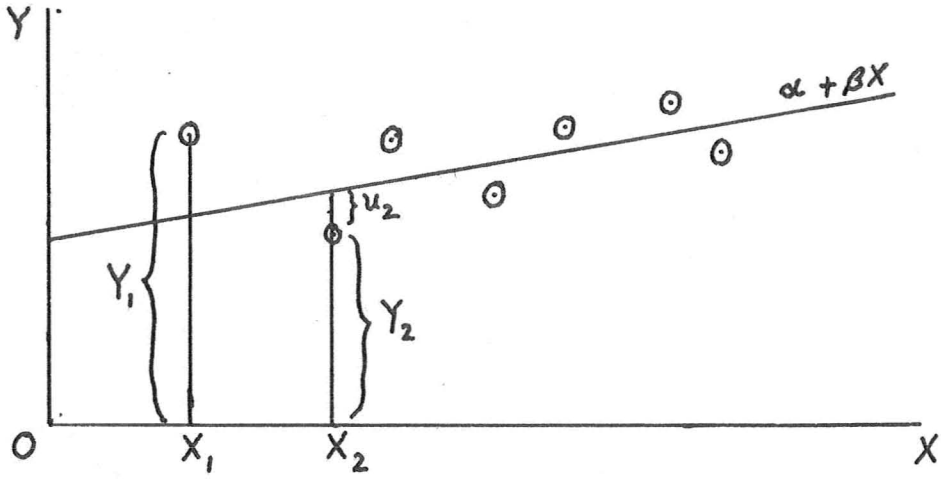
where for a given X, $\alpha + \beta X$ represents the mean value of consumption associated with the given value of X for the group as a whole, and u is a disturbance term which represents the net effect of those excluded variables which may have some - even if slight - effect on consumption.[3]

Since many of these excluded factors may operate in a given household and they are likely to pull in opposite directions, small values of u may be expected to occur more frequently than large values and u may be thought of as a variable with a probability distribution centred around zero and having a finite variance σ_u^2 i.e. u may be referred to as a stochastic term.

The above example may be made more relevant to our particular analysis by making a slightly different assumption. Instead of selecting a number of households from each income

[3] The inclusion of u may be justified by the fundamental randomness in human nature, and the possibility of making errors of observation or measurement. See Johnston, ibid, pp.6-7.

level, a sample of n households - one from each income level - may be selected. This sample could then be represented by points on a scatter diagram as follows:



It will be noticed that the actual points cluster around the true line of relationship $Y = \alpha + \beta X$. If the n values have been drawn independently the sample points would cluster more or less randomly around the straight line.

In the practical situation however, there would be n sample observations on X and Y such as in the above figure, but the true line of relationship $Y = \alpha + \beta X$ would not be known. The method of OLS tries to obtain an estimate of this true line of relationship by obtaining estimates of α, β and hence Y. If this estimating line is denoted by $\hat{Y} = a + bX$ then the principle of OLS enables one to derive formulae for finding a and b, i.e. the estimators of α and β respectively. And once these estimators are found $\hat{Y}$ can easily be calculated.

It was suggested earlier that a and b are obtained by

minimising the random component of explanation. It is easy to see how this is done by rewriting the above hypothesis as $Y_i = \alpha + \beta X_i$ (i = 1, 2 ..... n) where Y_i and X_i are the actual observations of Y and X, respectively in the ith sample. Now, since the equation of the estimating line is $\hat{Y} = a + bX$, $\hat{Y}_i$ would fall on this line and u_i which measures the random component of the ith sample is therefore given by $u_i = Y_i - \hat{Y}_i$. The residuals or deviations from the estimating line which are represented by u_i (i = 1, 2 ..... n) will be positive or negative as the actual point lies above or below the line. Therefore, if these residuals are squared and summed the resultant quantity must be non-negative and will vary directly as the spread of the points from the line. The principle of OLS is to make $\sum u_i^2$ as small as possible. A necessary condition for this is that the partial derivatives of the sum of $\sum u_i^2$ with respect to a and b should both be zero. Thus,

$$\sum_{i=1}^{n} u_i^2 = \sum_{i=1}^{n} (Y_i - Y_i)^2 = \sum_{i=1}^{n} (Y_i - a - bX_i)^2$$

and putting $\frac{\partial}{\partial a} \sum_{i=1}^{n} u_i^2 = 0$ and $\frac{\partial}{\partial b} \sum_{i=1}^{n} u_i^2 = 0$

two equations - called normal equations - are obtained, and these are solved for a and b. Since the aim is to describe the principle very briefly the formulae for a and b will not be derived, but these can be easily obtained by solving the two normal equations. In reporting the final least squares line the values obtained for a and b are substituted into the

equation of the estimating line, $\hat{Y} = a + bX$. If, for example, a = 31.0 and b = 2.3, the estimating line would be reported as:

$$\hat{Y} = 31.0 + 2.3X$$

The principle described above may also be extended to cases where there are two or more independent variables. Here however, the geometrical interpretation is slightly different. If, for example, Y is explained by X_1 and X_2, OLS may be used to estimate the parameters of this relationship. Once the three parameters of this relationship are determined a plane in a three dimensional space, the regression plane, is also determined. Now the observations on these variables can no longer be represented by points in two dimensional space. If, Y, X_1 and X_2 are measured on three mutually perpendicular axes, then each observation forms a point in three domensional space and the total of all these observations forms a scatter diagram in this space. In this case, the estimating equation obtained by the method of OLS is such that the sum of the squared deviations of the observed points from the estimating or regression plane is a minimum.

In cases where Y is explained by more than two explanatory variables, i.e. where the relationship consists of more than three variables, a diagram cannot be presented of the geometrical interpretation, but one can conceive of a space consisting of four or more dimensions. Thus, if there are

n variables each observation may be regarded as a point in n-dimensional space and the principle of OLS can be applied to minimise the sum of the squared deviations of the observed points from the n-dimensional estimating or regression plane.[4]

Although proofs will not be given to show that OLS yields the best unbiased linear estimates under certain conditions, it is necessary to state these conditions so that some judgment may be made on the extent to which they are fulfilled by the equations which are being estimated, and so that it may be decided whether OLS is likely to yield good estimates of their parameters. These conditions are:

(1) u_i are random variables with an expected value of zero,

(2) the probability distribution of u has constant variance σ_u^2 and zero co-variances,

(3) the X-variables are fixed in repeated samples,

(4) the number of observations exceeds the number of parameters to be estimated,

(5) no exact linear relations exist between any of the exogenous variables (X_i).

If condition (1) does not hold (or is violated to any

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[4] Of course, it is also realised that as the number of variables increases the mathematical labour involved in calculating parameter estimates can be greatly reduced by using matrix algebra instead of the ordinary algebra, which has been used above. However, it is thought better for expositional purposes to use ordinary algebra.

"significant" extent) the disturbances i.e. u_i where i = 1, 2, ... n will be auto-correlated and good estimates cannot be obtained. Later the von Neumann Ratio Test will be used to measure the degree of auto-correlation which exists among the residuals of each of the equations estimated. If this test indicates that there is a high degree of auto-correlation then some other form of relationship has to be obtained or one of the several methods for dealing with the problem of auto-correlation has to be tried. For example, one possible source of auto-correlation is the existance of a trend which introduces dependence between successive observations. If such a trend is present an attempt may be made to eliminate auto-correlation by working with deviations from this trend. Then if this method is successful OLS may be used to estimate the equation whose residuals had been previously auto-correlated. It should be borne in mind, however, that this or any of the other methods of eliminating auto-correlation may not always be successful.

The second condition is that the disturbances have to be homoscedastic, i.e. they must have a constant variance independent of X_i. This implies that the variation of Y about is mean level for each X, should be constant.

The third condition implies that in repeated sampling the sole source of variation in Y is the variation in u, and that the obtaining of good estimates of the parameters is

conditional upon the exogenous variables being fixed. However, least squares procedure is still valid when this assumption of fixed X_i is extended to make X_i random variables as long as there are no feed-backs from Y to X_i.[5] Another way of interpreting this third condition is to say that there is a one-way direction of causation from u to Y, and that u is independent of X. Thus, the existence of endogenous variables on the right hand side of a linear relationship explaining Y would tend to violate this condition. Though in the real world there may be cases where a one-way direction of causation exists among economic variables the economic system is usually so complex that in general there will be feed-backs from the dependent to the "independent" variables. This provides an argument for the use of a system which allows for feed-backs and which has to be estimated by simultaneous methods. It is assumed however, that any feed-backs which may exist between Y and the "independent" variables of the equations that are estimated will be so small that the use of OLS will not be invalid.

The fourth and fifth conditions are to ensure that the normal equations can be solved to yield estimates of the parameters. The fourth condition is generally satisfied, but where there is a large system of such equations and matrix algebra is used to obtain the values of the parameters, the

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[5] J. Johnston, Econometric Methods, op. cit., pp. 28-9.

fifth condition becomes important since it ensures that the matrix of the coefficients can be inverted. If, for example, one of the X's were a complete linear function of the others (complete multicollinearity) it would mean that the inverse of the matrix of coefficients does not exist and it would therefore be impossible to estimate these coefficients. Indeed, whenever multicollinearity exists to any significant extent it is found that the standard errors of the regression coefficients are so large that very little meaning can be attached to these regression coefficients. But, although it can be a troublesome problem it seems fair to say that multicollinearity is an inherent characteristic of economic data about which the present tools of statistical analysis can do very little. An attempt can only be made to select meaningful, explanatory variables which have a minimum of correlation among themselves.

So far the stated conditions under which OLS is the best unbiased linear estimates have not involved any conditions or assumptions about the probability distribution of u_i beyond those of zero mean, constant variance and zero co-variance. However, if it is postulated that the probability distribution of u_i is normal then it can be shown that the least square estimators i.e. a and b or our simple example are maximum likelihood estimators.[6] Maximum likelihood estimators are not

[6] J. Johnston, Econometric Methods, op. cit., pp. 20-21.

only unbiased but they are also consistent and efficient.[7] However, a discussion will not be given here to the desirable large sample properties of consistency and efficiency. The aim is not to weigh OLS against other methods of estimation but to try to assess the appropriateness of OLS. Hence the most relevant consideration here is that OLS is the best unbiased linear method of estimation and these properties hold for small samples if conditions (1) to (4) are fulfilled. (See pp. 86-87). And since it has been decided to estimate the relationships developed in Chapter III by this method consideration must be given to whether the basic conditions for obtaining good estimates from this method are met. An attempt will now therefore be made to justify the use of OLS to estimate the parameters of relationships (1) to (4) which were developed in Chapter III.

JUSTIFICATION FOR USING OLS TO ESTIMATE EQUATIONS OF RELATIONSHIPS EXPLAINING CANADA'S G.N.E.

It may be recalled that the equation whose parameters will be estimated are:

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[7] A consistent estimator, a, is such that as the sample size, n, approaches infinity, "a" converges on the true value α. An efficient estimator, a, is such that as the sample size $n \rightarrow \infty$ the distribution of the estimator, a, tends towards the normal distribution with mean α and with variance less than that of any other estimator also asymptotically normally distributed with mean α. See W.C. Hood and T.C. Koopmans (eds.); Studies in Econometric Method, Wiley, New York 1953 pp. 128-131.

$$G.N.E. = a_1 + b_1 I + c_1 F_2 + d_1 G + u_1 \ldots\ldots\ldots\ldots \quad (1)$$

$$G.N.E. = a_2 + b_2 I' + c_2 F_2 + d_2 G + u_2 \ldots\ldots\ldots\ldots \quad (2)$$

$$G.N.E. = a_3 + b_3 I'' + c_3 F_2 + d_3 G + u_3 \ldots\ldots\ldots\ldots \quad (3)$$

$$G.N.E. = a_4 + b_4 I''' + c_4 F_2 + d_4 G + u_4 \ldots\ldots\ldots\ldots \quad (4)$$

where all these symbols have the same meanings which they were given in Chapter III.

Now the justification for using OLS to fit these equations rests partly on theoretical considerations, partly on convenience and partly on the extent to which certain statistical tests indicate that the basic assumptions of OLS are not significantly violated. The assumption that the disturbances are mutually independent time-wise, for example, is a theoretical assumption of convenience and simplification rather than one of fact. But an examination of the time graph of the residuals of individual equations and an application of the von Neumann Ratio Test will help to indicate whether the disturbances are sufficiently random to justify the use of OLS. In fact, such tests will be made after equations (1) to (4) have been fitted to the data and it will be found that there is no significant amount of auto-correlation among the residuals of the individual equations. Justification for using OLS is also further reinforced by theoretical considerations since Neyman and David[8] have extended the

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[8] J. Neyman and F.N. David "Extension of the Markoff theorem on Least Squares", Statist. Res. Mem. II, p. 105.

Markoff theorem to show that OLS is still valid even when consecutive residuals are not independent but are auto-correlated.

The second condition of the Markoff theorem is a convenient theoretical simplication which is not likely to hold during the years under consideration. Indeed, during these years the disturbances u_i were not homoscedastic since the variation in Y about its mean for each X was certainly not constant, but though this is the case, the probability distribution of u_i is not known. However, in view of the arguments given earlier (see p. 88) this probability distribution can reasonably be assumed to be approximately bell-shaped with mean zero.

It is the fulfillment of the third condition which seems the most difficult to justify. For this condition implies that u_i must be independent of the X_i variables and that there must be no feed-back from the Y to these variables. Thus, if one of the X_i is an endogenous variable the condition is violated. It has already been argued that it is reasonable to treat as exogenous those variables that are not influenced by the economic process e.g. the weather, but that this is less true of foreign economic, and domestic political and economic variables. It has to be admitted that the assumption that all the X_i variables are exogenous is not strictly correct. But although endogenous elements are present in

varying degrees, a large component of each of these variables can reasonably be regarded as exogenous. Therefore, for convenience, these variables will be assumed to be exogenous.

As regards the fourth condition it can be seen that the number of years under observation is greater than the number of parameters to be estimated, hence the first part of the condition is satisfied. With regard to the existence of multicollinearity it is hoped that, although it may be present, multicollinearity will not be sufficiently great to prevent us from obtaining a measure of the separate effect which each of the independent variables has on Y. Furthermore, where the primary objective is forecasting, multicollinearity may not be too serious provided it is expected to continue in the future.[9] Thus, theoretical considerations and expediency as well as the statistical results which will be reported seem to justify the view that the use of OLS is permissible. But it should be emphasised that in view of the smallness of the sample size and the biases caused as a result of the failure of some conditions to be met completely, the "good" statistical estimates obtained should be viewed with some amount of caution.

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[9] J. Johnston, Econometric Methods, op. cit., p. 207.

USE OF VON NEUMANN RATIO, t_i VALUES, THE COEFFICIENT OF VARIATION AND THE COEFFICIENT OF CORRELATION IN APPRAISING THE REASONABLENESS OF THE HYPOTHESIS TESTED.

To complete the reaser's preparation for understanding and interpreting the statistical results which will be presented some brief discussion will now be given to the meaning and use of the von Neumann Ratio, t_i values, and the coefficients of variation and correlation all of which will be used in helping to appraise the reasonableness of the hypothesis which will be tested.

Since a vital condition for OLS to yield the best unbiased linear estimates of the parameters is that the disturbances, u of each equation should be mutually independent, it is necessary to have some measure of the degree of fulfillment of this condition and one such measure is provided by von Neumann Ratio.[10] This statistic indicates the presence or absence of auto-correlation in the residuals of each

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[10] The von Neumann Ratio $\frac{\delta^2}{S^2}$ is defined as the ratio of the variance of the first differences of the residuals to that of the variance of the residuals i.e.

$$\frac{\delta^2}{S^2} = \frac{\sum_{t=2}^{n} (u_t - u_{t-1})^2}{\sum_{t=1}^{n} u_t^2} \times \frac{n}{n-1}$$

Source: B.I. Hart, "Significance Levels for Ratio of the Mean Square Successive Difference to the Variance," Annals of Mathematical Statistics, Vol. 13, No. 4, 1942.

equation. Its expected value is 2.1[11] and numerical estimates in this neighborhood indicates that there is a significant lack of auto-correlation in the residuals. Further, the limits of acceptance of the von Neumann Ratio at a specified significance level may be determined from a table.[12] In addition to using this table some idea of randomness of the residuals, as was stated earlier, may also be obtained from a visual analysis of the time path of the residuals.

It is also important to have a measure to appraise the reliability of the parameter estimates which are obtained. Such a measure is provided by the t_i values which are associated with each parameter estimate. These t_i values are found to be very useful in testing the statistical significance of the regression coefficients (or multipliers) obtained from a sample size of less than 30 observations. The statistical theory underlying the use of the t_i values to execute tests of significance is this: the estimates which are obtained for the regression coefficients are obtained from one sample only but if a number of samples were drawn there would be differences among these estimates. It is therefore necessary to measure the amount of error between the estimated parameter and the true population parameter and infer from this the degree of confidence which should be attributed to

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[11] Ibid, p. 446.

[11] Ibid, p. 446.

a particular set of estimates. If, in addition to assuming that the disturbances u are random and independent, it is also assumed that their distribution is normal, then the statistic t which follows the t distribution with n-m degrees of freedom (where n is the number of observations and m the number of parameters estimated), provides just the type of measure that is needed, for

$$t = \frac{a - \alpha}{\bar{s}(a)}$$

where "a" is the parameter estimate, α is the true population parameter and $\bar{s}(a)$ is the sampling variance of "a" corrected for degrees of freedom. Hence t is a measure of the difference between the empirical regression coefficient and the hypothetical population coefficient.

The main significance test[13] which will be made in this thesis is that designed to determine whether the multipliers in equations (1) to (4) are significantly different from zero. To use the t- distribution to test the statistical significance of these parameters we postulate that they are generated by true population parameters α_i and set up a null hypothesis

$$H_o: \quad \alpha_i = 0$$

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[13] Although the above discussion is confined to test of significance of the multipliers only, tests of significance can be and will be used for determining the reliability of many of the statistics that will be obtained.

and an alternative hypothesis,

$$H_a: \alpha_i \neq 0$$

Then for a specified significance level, say α , the t-test states:

if $|ta_i| < |t^{df}_{\alpha/2}|$ the null hypothesis H_o should be accepted, and if $|ta_i| \geq |t^{df}_{\alpha/2}|$ the null hypothesis H_o should be rejected. $ta_i = \frac{a_i - \alpha_i}{\bar{s}\, a_i}$, hence ta_i becomes equal to $\frac{a_i}{\bar{s}(a_i)}$

where $\bar{s}(a_i)$ represents the sampling variance of the regression coefficients corrected for degrees of freedom (df). The value of $t^{df}_{\alpha/2}$ may be obtained from a table of values of the t-distribution. It should be noted that since any particular value of a regression coefficient, say a_1 may occur on either side of its true mean which is assumed to be 0, a two-tailed test is involved and hence $t_{\alpha/2}$ represents the probability that the regression estimate a_1 will fall in one of the tails of its probability distribution. Thus, another way of describing the significance test of a_1 is to say that the probability of a_1 falling in the tail of its own distribution is so small that if it does we reject the hypothesis that $\alpha_1 = 0$. Since this rejection will only take place when the value of ta_1 is higher than or equal to the value of $t^{df}_{\alpha/2}$ obtained from the t-table it follows that the size of the t-value of a parameter estimate provides a useful measure of the statistical significance of this parameter.

Now a measure of the goodness of fit of a relationship is provided by the coefficient of variation. This coefficient is denoted by $\bar{V}$ and is defined as

$$\bar{V} = \frac{\bar{s}(u)}{\bar{Y}} \times 100 \text{ where } \bar{s}(u) = \sqrt{\frac{u^2}{n-m}} \text{ is the standard}$$

error of estimate corrected for degrees of freedom and $\bar{Y}$ is the mean value of Y. $\bar{V}$ gives a measure of the size of the random component of a relationship relative to its systematic component and in cases where an equation of relationship fits the data it is to be expected that the size of the random component will be small in comparison to the size of the systematic component. $\bar{V}$ also implies the amount of stability there is in a relationship, for a stable relationship will have a small random component relative to its systematic component and an unstable relationship will have a large random component relative to its systematic component. Thus, in general the size of $\bar{V}$ is a useful indication of the reasonableness of an hypothesis.

Another useful measure of the reasonableness of an hypothesis is the coefficient of multiple correlation, R which is the square root of the coefficient of determination R^2. Both these measures not only give an idea of the foodness of fit of a relationship, but in particular they quantify the degree of relationship which exists between the X_i variables and Y, something which is not done by $\bar{V}$.

R^2 is defined as the proportion of explained variation in Y and is given by the relationship: $R^2 = 1 - \frac{\sum u^2}{\sum y^2}$, where $\sum u^2$ is the unexplained variation in Y after the relationship has been fitted, and $y^2 = \sum(Y-\bar{Y})^2$ is the variation of Y about its mean. Thus R^2 equals one minus the proportion of unexplained variation and will be the greater the smaller is $\sum u^2$ i.e. the tighter the fit. Also R^2 will be the larger, for a given $\sum u^2$, the larger is the total variation, $\sum y^2$. In reporting the degree of variation in Y which is explained by variation in the X_i variables it is necessary to take degrees of freedom into consideration thus $\bar{R}^2$ which is R^2 corrected for degrees of freedom is the appropriate measure of this variation and it is this measure which will be reported when the statistical results are presented. If all the X_i variables which determine Y could be exactly accounted for, then the variation in these variables would explain the total variation in Y, hence it would seem that the greater the proportion of the variation in Y which is explained by the X_i variables in equations (1) to (4) i.e. the nearer is the value of R^2 and of $\bar{R}^2$ to unity the more reasonable is the hypothesis explaining Y. It must be emphasised however, that $\bar{R}^2$ merely measures the degree of relationship and it in no way implies that the X_i variables <u>cause</u> Y. It is quite possible to find a high degree of relationship among variables that are not causally related, so one has to be careful not

to give too much weight to $\bar{R}^2$.

In summary then, it may be said that if the particular sample used to fit the relationship is not unrepresentative of the population, and if no spurious correlation exists among the variables forming the relationships tested, then the hypothesis embodied in these relationships will be reasonable if the residuals u of each relationship are random, if the multipliers have reasonable values and reasonable t-values, if $\bar{V}$ is small and $\bar{R}^2$ is near to unity. These considerations will be used as a basis for appraising the statistical result which will be presented, as well as a basis for selecting the equation of relationship which will be used for predicting Canada's G.N.E. in 1963. Before these statistical results are given however, the statistical data which is used in fitting equations (1) to (4) will be briefly discussed.

DISCUSSION OF SOURCE AND USE OF DATA

The following table contains the data that were used for fitting equations (1) to (4).

It will be observed from the sources quoted that all the data are obtained from the National Accounts Income and Expenditure published by the Dominion Bureau of Statistics (DBS). The series used are the 1957 constant dollar series

TABLE XI

DATA[+] USED FOR FITTING EQUATIONS (1) - (4)

YEARS	G.N.E.	I	I'	I''	I'''	F_2	G
1947	2.0439	.4067	.3423	.5129	.3576	.4912	.2762
1948	2.0821	.4052	.3966	.4038	.3956	.4975	.2839
1949	2.1626	.4404	.4218	.4488	.4350	.4770	.3175
1950	2.3114	.5159	.4666	.5022	.4543	.4743	.3349
1951	2.4531	.5668	.5057	.5370	.4736	.5193	.4188
1952	2.6514	.5683	.5583	.5342	.5146	.5751	.5250
1953	2.7525	.6276	.5880	.6051	.5628	.5702	.5251
1954	2.6714	.5103	.5150	.5251	.5340	.5476	.5098
1955	2.9018	.6143	.5978	.5905	.5682	.5894	.5319
1956	3.1508	.8100	.7288	.7826	.7014	.6333	.5664
1957	3.1909	.7566	.7261	.7640	.7335	.6391	.5722
1958	3.2284	.6511	.6707	.6629	.6825	.6365	.6113
1959	3.3398	.6900	.6486	.6976	.6562	.6610	.6205
1960	3.4144	.6576	.6305	.6502	.6231	.6884	.6255
1961	3.5023	.5979	.5707	.6394	.6122	.7402	.6544
1962	3.7195	.6806	.6447	.6616	.6257	.7729	.6761

Sources: Columns (1-7), (i) 1947-54. Table 9, Gross National Expenditure in constant (1957) Dollars, by Quarters 1947-61 DBS.

(ii) 1955-62. Table 5, Gross National Expenditure in constant (1957) Dollars, 1955-62 DBS.

[+]All data are expressed in 10^4m.57$.

- the most recent constant dollar series of the variables which occur in equations (1) to (4).

In testing our hypothesis concerning the determination of Canada's G.N.E. the data are used to fit equations (1) to (4) both for the years 1947-1962 and for the years 1951-1962.[14] This is done because it is felt that the normal process of income determination was not re-established in the post-war years until 1951. The controls which characterised the early post-war years prior to 1951 so distorted the economy that it seems that the economic structure of 1951-1962 is somewhat different from the economic structure of 1947-1962. But, on the other hand, there are very strong statistical arguments for extending the sample period back to 1947. It has already been argued that in general the smaller the size of the sample, the less reliable the parameter estimates. Therefore, it seems necessary in the present circumstances to include the earlier years, 1947-1950, in order to determine whether the economic advantages of greater uniformity offset the statistical advantages of using a larger sample.

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[14] These equations were also fitted for the period 1949-1962 in order to test a suggestion by Caves and Holton (see p. 106) that the normal process of income determination was re-established in the post-World War II years in 1949. The statistical results obtained were good, but in general they were not as good as those obtained for the above periods. Partly because of this and partly because it is felt that the normal process of income determination was not re-established until 1951, these results have not been presented.

It is hoped that the statistical results which will now be presented will not only indicate the reasonableness of the hypothesis tested but that they will also indicate whether the statistical argument for using the extended period 1947-1962 are sufficiently strong to outweigh the economic arguments for using the period 1951-1962.

STATISTICAL RESULTS

The following table contains the results obtained from fitting equations (1) to (4) for the years 1947-1962 and the years 1951-1962. An analysis of the eight estimating equations obtained and the statistics associated with them indicates that the hypothesis which has been tested is consistent with the statistical data. The size of the von Neumann ratio for each estimated equation indicates no evidence of auto-correlation. Also, the table of values of the correlation coefficient for different significance levels shows that for each of the equations this coefficient is significant at the .01 level. Further, in all the equations $\bar{V}$ is relatively small - in none of them is it as high as three per cent; and in general the t-values given by the numbers in paranthesis under the regression coefficients are reasonably high; all but one of the parameter estimates of the four estimating equations for the period 1947-1962 are significant at the .05 level and the eight parameter

TABLE XII

STATISTICAL RESULTS OBTAINED BY FITTING EQUATIONS (1)-(4) FOR THE YEARS (1947-62) AND (1951-62)

RELATIONSHIP TESTED	NO. OF YEARS	ESTIMATED RELATIONSHIP+	$\frac{\delta^2}{S^2}$	$\bar{V}$	$\bar{R}^2$
(1) $GNE=a_1+b_1I+c_1F_2+d_1G+u_1$	16	(1) $GNE=-1362+.6442I+3.220F_2+1.344G$ (2.407) (5.915) (2.996)	1.432	2.526	.9821
	12	(2) $GNE=-2966+.6425I+2.808F_2+2.092G$ (2.505) (3.416) (2.417)	2.060	2.084	.9731
(2) $GNE=a_2+b_2I'+c_2F_2+d_2G+u_2$	16	(3) $GNE=-1949+.8756I'+3.399F_2+1.055G$ (2.656) (6.291) (2.143)	1.634	2.441	.9833
	12	(4) $GNE=-3251+.8164I'+3.243F_2+1.508G$ (2.723) (4.089) (1.730)	2.217	2.005	.9751
(3) $GNE=a_3+b_3I''+c_3F_2+d_3G+u$	16	(5) $GNE=-861+.6588I''+2.954F_2+1.563G$ (2.234) (5.384) (3.755)	1.466	2.585	.9812
	12	(6) $GNE=-2663+.7375I''+2.910F_2+1.827G$ (2.864) (3.784) (2.221)	2.261	1.956	.9763
(4) $GNE=a_4+b_4I'''+c_4F_2+d_4G+u_4$	16	(7) $GNE=-1886+.9989I'''+3.305F_2+1.022G$ (2.998) (6.551) (2.216)	1.726	2.326	.9848
	12	(8) $GNE=-2883+.9220I'''+3.514F_2+1.040G$ (3.087) (4.637) (1.197)	2.257	1.880	.9781

+All the variables in the estimated relationships are in m.57$

estimates of F_2 are significant at the .01 level.[15] In general the parameter estimates for the period 1947-1962 are more reliable than those for the period 1951-1962 but $\bar{V}$ is persistently smaller in the latter period.

With regard to the economic significance of the parameter estimates it is to be noted that all the multipliers are positive as is to be expected. The export multiplier is very large and is always in the neighbourhood of 3. The government multiplier is always greater than 1 which is not surprising, but the investment multiplier is always less than 1. A possible reason for this is the fact that investment has a high import content which forms a leakage from the investment multiplier even in the very short run. With regard to the size of the parameters it is also noticeable that in every case the constant term is much smaller (algebraically) for the period 1947-1962 than for the period 1951-1962. The main point, however, is that on economic grounds the sizes and signs of all the parameters are acceptable.

Since on economic grounds all the parameter estimates are quite acceptable, and the von Neumann Ratio and the coefficients of correlation are good in all the estimated

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[15] With 12 degrees of freedom a t-value of 2.179 or more for a parameter estimate indicates that this parameter is significant at the .05 SL and a t-value of 3.055 or more that it significant at the .01 SL. With 8 degrees of freedom the corresponding t-values at these SL's are $t \geq 2.306$ and $t \geq 3.355$.

relationships, the choice of the best of these relationships must rest on the relative importance which should be attached to the reliability of the parameter estimates and the size of $\bar{V}$. Though these criteria are not independent, it is felt that in general the former is more important for policy making while the latter is more important when one is interested in forecasting performance. We are however, interested in both of these applications, consequently the estimated relationships (5) and (7) are selected as the best two relationships for the period 1947-1962, and the estimated relationships (2) and (6) are selected as the best two for the period 1951-1962. For the period 1947-1962 equation (5) has a $\bar{V}$ that is slightly above that of the other equations but it has by far the most reliable parameters - it is the only equation which has two of its parameters significant at the .01 level. On the other hand, equation (7) has the lowest $\bar{V}$ for this period, and although its parameters are not as reliable as those of (5) they are all significant at the .05 level. Neither equation (1) nor equation (3) is as good as equations (5) or (7) on the basis of the above two criteria.

For the period 1951-1962 equation (2) has a $\bar{V}$ that is slightly higher than the other estimating equations but it has the most reliable parameters. Equation (6) on the other hand has the second lowest $\bar{V}$ but its parameter estimates are more reliable than that of all the other equations

except equation (2). So when both criteria are taken into consideration equations (2) and (6) are preferable to equations (4) and (8) for this period. It is also worth noting that both equations (5) and (6) use the same data for their respective periods, thus it seems to be better to use the I'' measure rather than the other measures of investment.

A further test, the test of prediction will be imposed on these four relationships in order to help select the best of them. It is recognised however, that this test is not decisive because the relationship which is the best predictor of the 1963 G.N.E. may not be the best predictor of G.N.E. in say the next five years. In deciding on the forecasting ability of these relationships the simple[16] test used is to see which forecast of G.N.E. in 1963, $G.N.E._F$ (obtained by assuming that $E(u) = 0$), has the smallest deviation from the actual 1963 G.N.E., $G.N.E._{63}$. Thus, substituting the 1963 values[17] of the independent variables in these four estimated equations the $G.N.E._F$ value and the deviation $G.N.E._F - G.N.E._{63}$ obtained for each equation are presented in the

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[16] The statistically preferable method of comparing the forecasting ability of these equations would be to compare their standard errors of forecast but since here it is desired to see how well they can make a particular forecast it seems more practical (and certainly more easy) to use the above test.

[17] These values are obtained from Table 5 of the National Accounts Income and Expenditure in 1963. They have some margin of error and will almost certainly be revised.

TABLE XIII

FORECAST RESULTS

No. of estimated equations	$G.N.E._{63}$ in m. 57£	$G.N.E._{P}-G.N.E._{63}$ m. 57£
(2)	38,873	307
(6)	38,873	157
(5)	38,873	30
(7)	38,873	468

above table.

On the basis of the simple test which has been made the forecast results indicate that the estimated relationships (5) and (6), obtained by fitting the same equation $G.N.E. = a_3 + b_3 I'' + c_3 F_2 + d_3 G + u$ for the years 1947-1962 and 1951-1962 respectively, predict better than the estimated relationships (2) and (7); and that (5) is by far the best predictor for the year 1963. It is still not easy to make a choice between (5) and (7) or between (2) and (6) however: as regards the actual sizes of the t-values (5) is not obviously better than (6) and all the parameter estimates

of (2) are significant at the .05 level while one of the parameter estimates of (6) is not significant at this level. However, (5) is selected as the best estimating equation for the period 1947-1962 not merely because it predicts best or because all the t-values of its parameter estimates are significant at the .05 level - as are those of (7) - but because both (5) and (6) are based on the same basic equation, and also because (5) is the only estimated equation having two parameter estimates significant at the .01 level. Similarly, (6) will be selected over (2) because both (6) and (5) are based on the same equation which has explained consistently well over the periods 1947-1962 and 1951-1962 and also because the statistical results obtained for (6) are in toto at least as good as those obtained for (2). Finally, in selecting what is thought to be the best of the eight estimated relationships equation (5) is selected because of its general goodness to fit and because its parameters are so highly significant - two of these at the .01 level and one at the .05 level. Thus, the equation which is finally selected is based on the period 1947-1962, and is one in which changes in farm inventories are excluded from the gross investment series.

This finding gives support to Barber's view[18] that at

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[18] See Clarence L. Barber, "The Concept of Disposable Income", CJEPS, vol. 15, 1949, pp. 227-229.

the time inventories accumulate on farms they do not represent income available for (investment) expenditure even though they are counted as part of (G.N.E.).[19] Barber argues that because of the sharp variations which occur in farm inventories their inclusion in disposable income may give a distorted picture of the marginal propensity to consume or save. Similarly, it may be argued that in the present context, the inclusion of changes in farm inventories in gross investment may tend to give a biased measure of the short-run investment multiplier. There are thus sound theoretical reasons for excluding these changes.

In summary then our hypothesis which is a priori reasonable is also consistent with the statistical data and is therefore acceptable on the grounds of both its economic logic and its consistency with the empirical evidence. The statistical results are good whether the four equations which are based on this hypothesis are fitted to the period 1947-1962 or the period 1951-1962. But slightly better estimates of the multipliers are obtained by fitting these equations to the former period. And, in particular, the best estimates are obtained when changes in farm inventories are excluded from gross investment.

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[19] Words in parenthesis are my own.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter summarises the preceding four chapters, and makes certain conclusions with regard to the use of the estimating equation which was finally selected for explaining the short-run determination of Canada's G.N.E.

SUMMARY

It was pointed out in the first chapter of this thesis that a necessary prerequisite for the formulation of an equation or a system of equations to explain Canada's G.N.E., is the development of an hypothesis which is both theoretically and empirically sound. An attempt was made to develop such an hypothesis in Chapter III by combining the general theory of the determination of G.N.E., explained in Chapter I, with the analysis of the historical behaviour of Canada's G.N.E. that was made in Chapter II.

In the general theory developed in Chapter I it was shown that G.N.E. may be explained by (a) explaining the basic causes of changes in its components[1] and by (b) explaining

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[1] See p. 4.

how changes in these components interact to produce changes in G.N.E. Further, it was shown that the complexity of the system explaining G.N.E. will depend on the assumptions that are made about the components of this aggregate, for if a particular component is treated as exogenous it will not be explained by an equation, but if it is treated as endogenous it must be explained by an equation.

The analysis of the historical behaviour of Canada's G.N.E. showed that throughout the years 1896-1962, the short-run changes in Canada's G.N.E. were primarily brought about by changes in three of its components, viz., gross investment, exports and government expenditures. This analysis and the general theory explained in Chapter I provided the basis for the hypothesis developed in Chapter III: that gross investment, exports and government expenditure are the "prime movers" in Canada's G.N.E., and that although consumer expenditure and imports are both important components of this aggregate, the direction of causation seems to run from the "prime movers" to G.N.E. and then from G.N.E. to consumption and imports. Thus, in the short-run it is reasonable to explain G.N.E. by equations of relationships which contain the "prime movers" as the only explanatory variables. This simple hypothesis was then used to derive the four equations that were tested in Chapter IV.

Partly in an attempt to keep the model simple and

partly because it is felt that a large part of each of the components - gross investment, exports and government expenditure - is exogenous, all these components were treated as exogenous and the equations involving them were fitted by the method of OLS. The statistical results indicate that the hypothesis concerning the short-run determination of Canada's G.N.E. is quite consistent with the data and that a good explanation of G.N.E. and thus good estimates of the short-run multipliers can be obtained by fitting the four equations based on this hypothesis, both to the data for the years 1947-1962 and to that for the years 1951-1962. And, in particular, very good estimates of these multipliers are obtained by fitting to the years 1947-1962 that equation of relationship which explains G.N.E. in terms of I'', F_2 and G.

CONCLUSIONS WITH REGARD TO THE USE OF THE SELECTED ESTIMATED EQUATION

Because of the good statistical results which have been obtained it is felt that the selected estimating equation (and in fact, all the estimated equations) is empirically valid and hence it provides a very simple but useful tool for making short-term predictions. With such a tool at our disposal we should at least be in a better position to avoid the blunder - so often made - of basing important

policy decisions on economic hypotheses that have no empirical validity. It should therefore be a useful instrument in helping with the short-run control of the Canadian economy.

It is realized however, that though the selected estimating equation is useful and its simplicity is appealing, this very simplicity necessarily limits the uses to which it may be put, for a model cannot answer questions which it is not designed to answer. It will therefore be the purpose of the rest of this chapter to give concreteness to these views by illustrating some of the possible uses of this simple model (i.e. the selected equation of relationship) and by commenting on some of the factors which limit its ability to answer certain questions. It is hoped that this will make clear to the reader some of the uses which can and also some of those which cannot be made of this model.

One of the important - perhaps the most important - uses of the selected estimating equation has already been illustrated in Chapter IV.[2] It may be recalled that in that chapter, the actual 1963 values of I'', F_2 and G were substituted into the selected estimating equation:

$$\underset{}{G.N.E.} = -861 + \underset{(2.234)}{.6588I'} + \underset{(5.384)}{2.954F_2} + \underset{(3.755)}{1.563G}$$

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[2] See p.114.

and a forecast was obtained for the value of G.N.E. in 1963. This forecast value was only $30m more than its actual value of $38,873 - a very tolerable difference, since the ratio of the error to the actual value is only .00077.

In most practical cases however, the actual values of I'', F_2 and G would not be known in advance and if it were desired to forecast the value of G.N.E., in say the next six months, the estimated value of I'', would have to be obtained by taking a survey of the investment businessmen plan to make, and the inventory levels which they plan to have in the next six months; likewise F_2 would have to be estimated on the basis of existing export quotas, the level of economic activity in the main countries which import from Canada, and from the level of activity planned by the domestic export industries; and G would have to be determined from what the Federal, Provincial and Municipal Governments plan to spend in the next six months. The estimates obtained by the above or by other means could then be substituted in the estimating equation to obtain the required forecast value of G.N.E. Of course, these estimates of the explanatory variables are likely to differ from their actual values, and since the estimating equation is not an exact explanation of G.N.E. anyway, it is to be expected that the forecast value of G.N.E. would differ from its actual value, But most economists would agree that it is preferable to base a forecast on

this principle of estimation rather than to make a forecast on a mere guess.

The estimating equation may also be used to calculate the change in G.N.E. which results from changes in one, two or all three of its explanatory variables, if these changes are known. The coefficient of each independent variable i.e. each of the short-run multipliers, is a measure of the change in G.N.E. per unit change in the particular independent variable to which it refers. Thus, for the selected estimating equation the multipliers are given by:

$$\frac{\partial G.N.E.}{\partial I''} = .6588, \quad \frac{\partial G.N.E.}{\partial I''} = 2.954 \text{ and } \frac{\partial G.N.E.}{\partial I''} = 1.563$$

Now, if the given changes in the independent variables I'', F_2 and G are $\Delta I''$, ΔF_2 and ΔG respectively, then the required change in G.N.E. is given by:

$$\Delta G.N.E. = .6588\,\Delta I'' + 2.954\,\Delta F_2 + 1.563\,\Delta G \qquad (1)$$

Similarly, the change in G.N.E. produced as a result of a change in G only, is obtained by putting $\Delta I''$ and ΔF_2 each equal to zero in (1), and the short-run effect which an increase in government expenditures will have on G.N.E. can immediately be determined. Since G is an important policy variable the usefulness of the model in (a) providing a measure of the change in G.N.E. which results from a change in G or (b) in providing a gauge for the change which should

be made in G to obtain a given change in G.N.E. is quite clear.

But although the model may be used to calculate the change in G.N.E. produced by the above changes or by all the other possible combinations of changes in the independent variables (I'', F_2 and G), it cannot provide a measure of the ultimate effect on G.N.E. produced by a particular set of changes in the independent variables. This is so because the model does not allow for any feedbacks between G.N.E. and C and between G.N.E. and F_1. It may be recalled that it was pointed out in Chapter I that the ultimate size of the multiplier is determined by the marginal propensities to consume and import. Thus, in order to obtain the ultimate size of the multipliers it is necessary to construct a system of equations, such as that suggested in Chapter I,[3] which would make provisions for the feedbacks mentioned above. From such a system we could obtain G.N.E. in terms of all the predetermined variables, i.e. the reduced form equation of G.N.E., and the coefficient of each predetermined variable would furnish a measure of the ultimate multiplier effect which a change in this variable has on G.N.E.

This comment it is hoped will emphasise an important point which the reader should bear in mind, viz., that the

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[3] See p. 29.

multipliers of the selected estimating equations are only short-run multipliers. They measure only the short-run effect on G.N.E. of specified changes in the exogenous variables which appear in this equation. These short-run multipliers will thus be smaller than the long-run or ultimate multipliers which measure the effects on G.N.E. of changes which occur in the predetermined variables that appear in the reduced form-equation of G.N.E. For these latter multipliers would measure the effect on G.N.E. only after sufficient time had elapsed for the various feedbacks in the system to take place and for equilibrium to be restored. It should be noted for example, that the short-run investment multiplier obtained from the selected estimating equation is only .6588 but that the long-run multiplier, $\frac{1}{1-\frac{dC}{dY}}$, of the Canadian economy would be in the neighbourhood of 1.76.[4]

Now, in addition to its inability to provide measures of the long-run multipliers there is a number of other measures which this model cannot furnish simply because the variables which give rise to these measures are not in the model. But this criticism would be true of even the most complicated model which has been constructed. A further limitation of the model results from its static nature; because it does not contain any lagged variables of G.N.E. say, it is not poss-

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[4] T.M. Brown, op. cit., p. 369.

ible to estimate the time path of G.N.E. These limitations however, are a consequence of the model's simplicity and they may be overcome by extending the model and expressing it as a system of simultaneous equations. When this is done the resulting system may be solved by simultaneous methods of estimation. But this undertaking is beyond the scope of this study. In spite of its limitations however, the simple model constructed in this thesis may be used to furnish quantitative answers to questions concerning the short-run effects of some policy measures.

With regard to future research, the above discussion suggests that the construction of a full-scale econometric model, which takes into consideration both demand and supply factors - some of which in fact are not fixed in the short-run - would be the ideal way to obtain short-run multipliers as well as to obtain long-run multipliers and the answers to many of the questions which our simple model cannot provide. But such a task is likely to be too formidable for an individual researcher however, and in any case it is being undertaken by various government departments and the Bank of Canada in Ottawa.

Consequently, I suggest the construction of a simultaneous equation demand model of the type constructed by Brown in his 1952 Econometrica article. Annual or quarterly data

may be used and Brown's model could possibly be extended to include equations which explain investment, exports, imports and the demand for money. Such a model should enable us to go beyond just estimating short-run and long-run multipliers to estimating the time paths of the endogenous variables which appear in it. This would be a big step forward, for what is most important to policy makers is the time path of response rather than simply the initial and ultimate response of these endogenous variables.

From a quantitative view point, the policy maker is, for example, more interested in knowing what part of the response of G.N.E. to changes in investment occurs after each period of time, rather than in knowing just the initial and final response of G.N.E. to these changes. So it seems highly desirable to conduct research which is designed to furnish answers to these questions. In fact, it is encouraging to note that some work has already been done in this direction. In the United States, Goldberger,[5] in addition to estimating the impact multipliers[6] of the Klein-Goldberger model,[7] has

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[5] Arthur S. Goldberger, Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model, North Holland Publishing Company, Amsterdam, 1959.

[6] Each of the impact multipliers measures the change in an endogenous variable induced in the first year by a unit change in a predetermined variable, with all other predetermined variables being held constant.

[7] L.R. Klein, and A.S. Goldberger, An Econometric Model of the United States 1929-1952, North Holland Publishing Company, Amsterdam, 1955.

estimated the intermediate run response of each endogenous variable to a change in a particular predetermined variable, and has also investigated the dynamic properties of this model. The construction of a demand model (or preferably a full-scale model) of the Canadian economy and its investigation along the lines adopted by Goldberger should prove most helpful to Canada's policy makers. Indeed, it is hoped that the findings of this thesis will provide some useful background knowledge to such an undertaking.

BIBLIOGRAPHY

BOOKS AND PAMPHLETS

Ackley, G. Macroeconomic Theory, New York: The Macmillan Company, 1961.

Allen, R.G.D. Statistics for Economists, London: Hutchinson's University Library, 1949.

Bailey, M.J. National Income and the Price Level. New York: McGraw-Hill Book Company, Inc., 1962.

Bates, Stuart. Financial History of Canadian Governments: A Study Prepared for the RCDPR. Ottawa: King's Printer, 1939.

Beach, E.F. Economic Models, New York: John Wiley & Sons, Inc., 1957.

Brennan, M.J. Preface to Econometrics. Cincinnati: South Western Publishing Co. 1960.

Buckley, K.A.H. Capital Formation in Canada 1896-1930. Toronto: University of Toronto Press, 1955.

Cairncross, A.K. Home and Foreign Investment 1870-1913, Studies in Capital Accumulation. Cambridge, England: Cambridge University Press, 1953.

Caves, R.E. and Holton, R.H. The Canadian Economy. Cambridge, Massachusetts: Harvard University Press, 1959.

Croxton, F.E. and Cowden, D.J. Applied General Statistics. New York: Prentice Hall, Inc., 1955.

Daley, D.J. "Long Cycles and Recent Canadian Experience", (mimeo.) Ottawa, 1963.

David, F.N. Probability Theory for Statistical Methods. Cambridge, England: University Press 1949.

Dernburg, Thomas F. and McDougall, Duncan M. Macro-economics. New York: McGraw-Hill Book Company, Inc., 1960.

Duesenberry, J.S. Business Cycles and Economic Growth. New York: McGraw-Hill Book Company, Inc., 1958.

Easterbrook, W.T. and Aitken, H.J.A. Canadian Economic History. Toronto: The Macmillan Company of Canada Limited, 1958.

Ezekiel, M. and Fox, K.A. Methods of Correlation and Regression Analysis. (3rd ed.) New York: Wiley, 1959.

Firestone, O.J. Canada's Economic Development 1867-1953. Income and Wealth Series VII, London: Bowes and Bowes Publisher Ltd., 1958.

Friedman, Milton. A Theory of the Consumption Function. New York: National Bureau of Economic Research, 1957.

Goldberger, A.S. Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model. Amsterdam: North Holland Publishing Company, 1959.

Gordon, R.A. Business Fluctuations. New York; Harper 1961.

Hamberg, D. Business Cycles. New York: The Macmillan Company, 1960.

Hansen, Alvin H. A Guide to Keynes. New York: McGraw-Hill Book Company, Inc., 1953.

_____ Business Cycles and National Income. New York: W.W. Norton, 1951.

Hood, W.C. and Koopmans, T.C. (eds.) Studies in Econometric Method. New York: John Wiley & Sons, Inc., 1953.

Hood, W.C. and Scott, Anthony. Output, Labour and Capital in the Canadian Economy. Ottawa, Royal Commission on Canada's Economic Prospects, 1957.

Innis, Harold A. Essays in Canadian Economic History. Toronto: University of Toronto Press, 1956.

Johnson, H.G. Canada in a Changing World Economy. Toronto 1962.

_____ The Canadian Quandary: Economic Problems and Policies. Toronto, New York: McGraw-Hill Book Company, Inc., 1963.

Johnston, J. Econometric Methods. New York: McGraw-Hill Book Company, Inc., 1963.

Keynes, J.M. The General Theory of Employment, Interest and Money. London: Macmillan, 1936.

Kindleberger, Charles P. International Economics (Revised Edition). Homewood, Illinois: Richard D. Irwin Inc., 1958, Chapters 9-11 and Chapter 17.

Klein, L.R. and Goldberger, A.S. An Econometric Model of the United States 1929-1952. Amsterdam: North Holland Publishing Company, 1955.

Klein, L.R. A Textbook of Econometrics. Evanston: Row, Peterson and Company, 1953.

_____ The Keynesian Revolution. New York: The Macmillan Company, 1947.

_____ Economic Fluctuations in the United States 1921-1941. New York: John Wiley & Sons Inc., 1950.

Knox, F.A. Dominion Monetary Policy, 1929-34: A Study Prepared for the RCDPR. Ottawa: King's Printer, 1939.

Mackintosh, W.A. The Economic Background of Dominion Provincial Relations. Ottawa: King's Printer, 1939.

Malach, V.W. International Cycles and Canada's Balance of Payments, 1921-1933. Toronto, 1954.

Matthews, R.C.O. The Trade Cycle. Cambridge: The University Press, 1959.

Patinkin, Don. Money Interest and Prices. Illinois: Row, Peterson and Company, 1956, Chapters 9-14.

Polak, J.J. An International Economic System. Chicago: University of Chicago Press, 1953.

Report of the Royal Commission on Dominion Provincial Relations (RCDPR), 3 vols., Ottawa, 1939.

Report of the Special Committee of the Senate on Manpower and Employment. Ottawa: Queen's Printer, 1961.

Ruggles, Richard and Ruggles, Nancy. National Accounts and Income Analysis. 2nd ed. New York: McGraw-Hill Book Company Inc., 1956.

Schultz, H. The Theory and Measurement of Demand. Chicago: University of Chicago Press, 1938.

Slater, David W. Consumption Expenditures in Canada. Ottawa, Royal Commission on Canada's Economic Prospects, 1957.

_____ Canada's Imports. Ottawa, Royal Commission on Canada's Economic Prospects, 1957.

The Economic Council of Canada, First Annual Review. Ottawa, December, 1964.

Theil, H. Economic Forecasts and Policy. 2nd ed. North Holland Publishing Company, Amsterdam, 1961.

Valvanis, S. Econometrics: An Introduction to Maximum Likelihood Methods. New York: McGraw-Hill Book Company Inc., 1959.

Wold, H. Demand Analysis: A Study in Econometrics. New York: Wiley, 1953.

ARTICLES

Barber, Clarence L. "The Concept of Disposable Income." CJEPS, vol. 15, 1949.

_____ "Inventory Fluctuations in Canada, 1918-50." CJEPS, August 1952.

Bennion, E.G. "The Cowles Commissions's Simultaneous Equations Approach: A Simplified Explanation." Review of Economics and Statistics, vol. 34, 1952.

Brown, T.M. "A Forecast Determination of National Product, Employment and Price Level in Canada from an Econometric Model," a reprint from Models of Income Determination. Princeton University Press, 1964.

_____ "Habit Persistence and Lags in Consumer Behaviour." Econometrica. July 1952.

Chambers, E.J. "The 1937-8 Recession in Canada," CJEPS, vol. 21, (August 1955).

Christ, C.F. "A Test of an Econometric Model for the United States, 1921-1947." Conference on Business Cycles. New York: National Bureau of Economic Research, 1951.

_____ "Aggregative Econometric Models, A Review Article." AER, vol. 46, June 1956.

Clark, J.M. "Business Acceleration and the Law of Demand," in American Economic Association, Readings in Business Cycle Theory. New York: McGraw-Hill Blakiston, 1944.

Eisner, R. "A Distributed Lag Investment Function," Econometrica. January 1960.

_____ "Capital Expenditures, Profits and the Acceleration Principle" in Models in Income Determination, Studies in Income and Wealth, vol. 28, Princeton: Princeton University Press, 1964.

Farrell, M.J. "The New Theories of the Consumption Function," Economic Journal, December 1959.

Ferber, R. "Research on Household Behaviour," American Economic Review, March 1962.

Friedman, M. and Schwartz, A.J. "Money and Business Cycles," Review of Economics and Statistics, Supplement. February 1963.

Frisch, R. "Propagation Problems and Impulse Problems in Dynamic Economics." Economic Essays in Honour of Gustav Cassel. London: George Allen and Unwin, 1933, pp. 171-206.

Gordon, R.A. "Investment Behaviour and Business Cycles," Review of Economics and Statistics, 1955.

Haavelmo, T. "The Statistical Implications of a System of Simultaneous Equations," Econometrica, vol. II, 1943.

_____ "The Probability Approach to Econometrics," Econometrica, supplement (1944).

Hart, B.I. "Significance Levels for Ratio of the Mean Square Successive Difference to the Variance." Annals of Mathematical Statistics. vol. 13, no. 4, 1942.

Hecksher, E. "Quantitative Measurement in Economic History." Quarterly Journal of Economics, vol. VIII, no. 2, February 1939.

Hicks, J.R. "Mr. Keynes and the Classics: A Suggested interpretation," in Readings in the Theory of Income Distribution. New York: McGraw-Hill Blakiston, 1946, pp. 461-472.

Hood, W.C. "Empirical Studies in Demand," CJEPS, vol. 21, August 1955.

Houthakker, H.S. "The Present State of Consumption Theory," Econometrica, vol. 29, no. 4, 1961.

Johnson, H.G. "The General Theory after Twenty-Five Years," American Economic Reviews, Papers and Proceedings, May 1961.

Kahn, R.F. "The Relation of Home Investment to Unemployment" Economic Journal, June 1931.

Klein, L.R. "The Use of Econometric Models as a Guide to Policy," Econometrica, vol. 15, 1957.

_____ "Single Equation vs. Equation System Methods of Estimation in Econometrics." Econometrica, vol. 28, 1960, pp. 866-671.

Koopmans, T.C. "Measurement Without Theory." Review of Economics and Statistics, vol. 29, 1947.

Leontief, W.W. "Econometrics." Chapter II of A Survey of Contemporary Economics. H.S. Ellis (ed.). Philadelphia: The Blakiston Company 1948.

Machlup, F. "Period Analysis and Multiplier Theorty." Quarterly Journal of Economics, vol. 41, 1939.

Malach, V.W. "The International Business Cycle and Canada, 1929-1939." CJEPS, vol. 21, February 1955.

_____ "External Determinants of the Canadian Upswing, 1921-9", CJEPS, vol. 17, February 1951.

_____ "Internal Determinants of the Canadian Upswing, 1921-9", CJEPS, vol. 16, May 1950.

_____ "The Effectiveness of Canadian Fiscal Policy," Journal of Finance, vol. 7, December 1952.

Marcus, Edward. "A Comment on the 1937-8 Recession in Canada," CJEPS, vol. 22, May 1956.

Meier, G.M. "Economic Development and the Transfer Mechanism: Canada, 1895-1913," CJEPS, vol. 19, February 1953.

Metzler, L. "Three Lags in the Circular Flow of Income." Income, Employment and Public Policy, New York: W.W. Norton, 1948, pp. 11-13.

Meyer, J.R. and Kuh, E. "Acceleration and Related Theories of Investment," Review of Economics and Statistics, 1955.

Munzer, E. "Exports and National Income in Canada," CJEPS, vol, 11, February 1945.

Rosenbluth, G. "Changes in Canadian Sensitivity to United States Business Fluctuations," CJEPS, vol. 23, November 1957.

_____ "Changing Structural Factors in Canada's Cyclical Sensitivity, 1903-52." CJEPS, vol. 24, February 1958.

Samuelson, P.A. "Dynamic Process Analysis." Chapter X of A Survey of Contemporary Economics. H.S. Ellis (ed.) Philadelphia: The Blackiston Company, 1948.

_____ "Interactions Between the Multiplier Analysis and the Principle of Acceleration." Review of Economic Statistics, vol. 21, 1939.

_____ "The Simple Mathematics of Income Determination," in Income, Employment and Public Policy: Essays in Honor of Alvin Hansen, New York, 1948.

Slater, D.W. "Changes in the Structure of Canada's International Trade." CJEPS, vol. 21, February 1955.

Smith, D.C. "Corporate Saving Behaviour." CJEPS, August 1963.

Suits, D.B. "Forecasting and ~~the~~ Analysis with an Econometric Model." The American Economic Review, vol. 52, 1962.

Sutton, G.D. "Productivity in Canada." CJEPS, vol. 19, May 1953.

Urquhart, M.C. "Public Investment in Canada." CJEPS, Vol. 11, November 1945.

STATISTICAL SOURCES

National Accounts, Income and Expenditure, 1926-56. Ottawa: DBS, 1958.

_____ 1962. Ottawa: DBS, 1963.

_____ 1963. Ottawa: DBS, 1964.

Taylor, K.W. and Michell, H. Statistical Contributions to Canadian Economic History, vol. II, Toronto: The Macmillan Company of Canada Limited, 1931.

Urquhart, M.C. (ed.) Historical Statistics of Canada. The University Press, Cambridge and the Macmillan Company of Canada Limited, 1965.

See also references to Buckley, Firestone and Mackintosh in first section of Bibliography.

UNPUBLISHED MATERIAL

English, H.E. "The Role of International Trade in Canadian Economic Development since the 1920's." Unpublished Ph.D. Dissertation, University of California, 1957.

Thompson, R.W. "The Balance of Payments and the National Income in a Dependent Economy: Canada 1926-38". Unpublished Ph.D. Dissertation, University of London, 1961.