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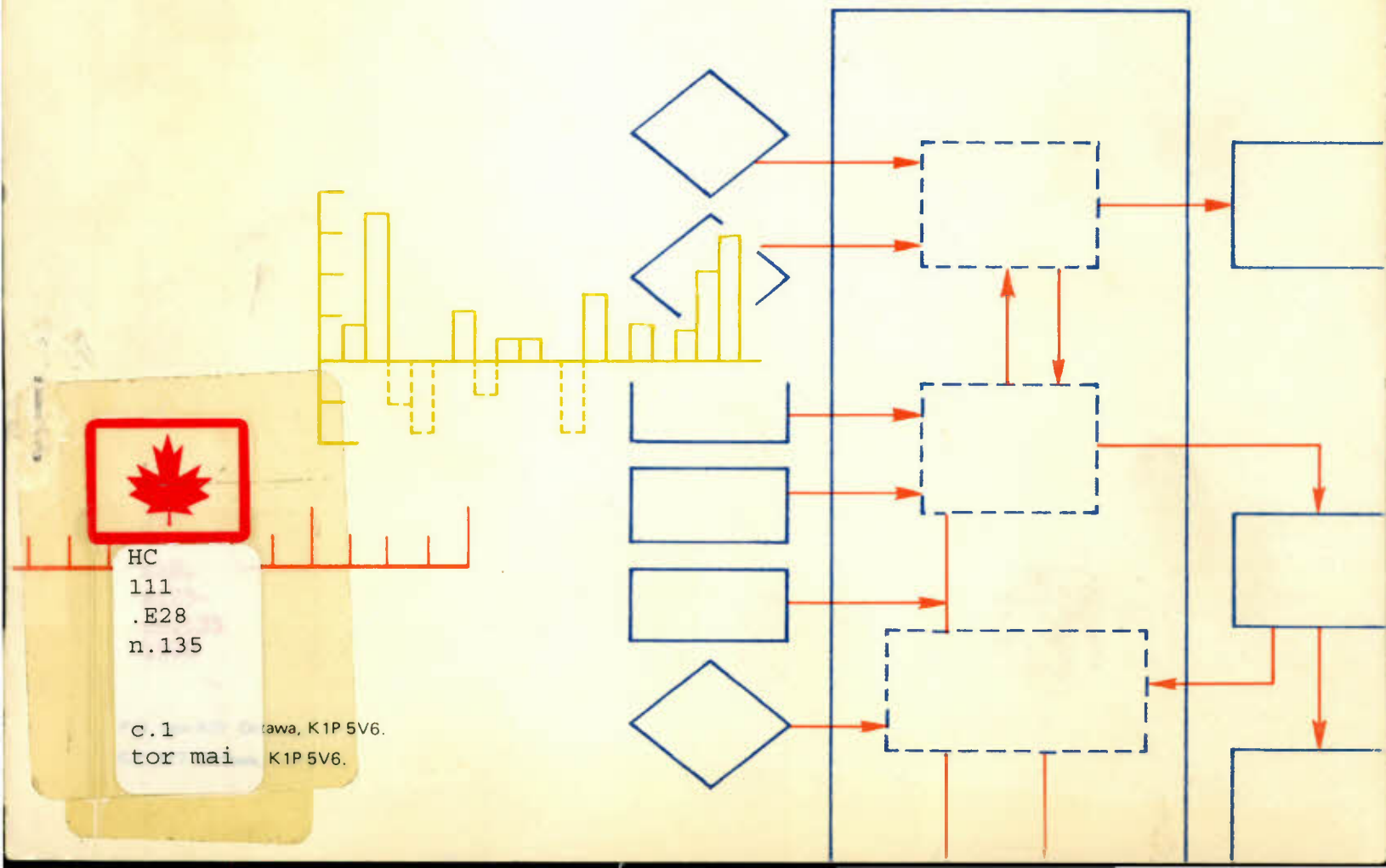

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DISCUSSION PAPER NO. 135

Canada's Comparative Advantage

by Donald J. Daly

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RÉSUMÉ

La structure du commerce extérieur canadien (passé et actuel) est marquée par l'avantage comparatif du Canada par rapport aux autres grands pays industrialisés, qui domine la composition par secteur aussi bien des exportations que des importations. Le lecteur trouvera dans la présente étude quelques comparaisons concernant le Canada et les autres pays industrialisés, dont les États-Unis, le Japon et l'Europe Occidentale.

En examinant les événements passés et leurs causes dans l'optique de l'avantage comparatif (les aspects positifs de l'avantage comparatif), l'auteur examine la situation relative du Canada par rapport à l'offre de facteurs de production, la performance comparée de la productivité par industrie, et le rythme de l'évolution technologique, y compris la rapidité avec laquelle on adopte la nouvelle technologie. Il insiste en particulier sur la question des économies d'échelle dans la fabrication, et les conséquences que comportent pour le Canada la production et la vente, principalement au pays, de plusieurs produits manufacturés, considérant surtout que les producteurs de plusieurs autres pays ont accès à des marchés libres beaucoup plus considérables. Il examine également ce qu'il en coûte de développer une nouvelle technologie à l'intérieur d'un marché restreint, et il analyse les données touchant la rapidité d'adoption de la nouvelle technologie au Canada comparativement aux autres pays. Ces considérations sont essentielles à l'intelligence de la tendance que le Canada a suivie, dans le passé, en exportant toute une gamme de produits primaires (céréales, minéraux et produits forestiers) et en devenant un importateur net d'un grand nombre de produits manufacturés. Cet échange est important à la réalisation de revenus réels élevés au Canada.

L'auteur étudie également les conséquences de l'avantage comparatif sur les politiques. Dans le passé, le revenu réel a été moins élevé au Canada qu'aux États-Unis principalement en raison de plus faibles niveaux de production horaire par employé dans la fabrication, et le rétrécissement de l'écart de productivité ces dernières années a été plus que compensé par le fait que les salaires et les gains horaires moyens en dollars canadiens ont grimpé plus rapidement qu'aux États-Unis depuis la fin des années 60. Les avantages et désavantages comparatifs peuvent changer avec le temps, mais leur évolution est lente et graduelle. La question fondamentale réside dans l'orientation et la rapidité de l'évolution dans les domaines où cette évolution est souhaitable et réalisable. Au Canada, l'un des problèmes provient du fait que la fabrication, un secteur dont le désavantage comparatif est particulièrement évident -- coûts élevés, faibles niveaux de

productivité et longueur des délais dans l'adoption de la nouvelle technologie -- a également été, depuis quelques décennies, l'un des secteurs du commerce mondial dont la croissance a été la plus rapide. Dans ce contexte, le dernier chapitre présente une évaluation des gains à être éventuellement dérivés d'une politique commerciale et d'une politique des sciences. L'auteur fait également des suggestions concernant les recherches ultérieures.

ABSTRACT

The structure of Canadian trade (both historically and currently) are affected by Canada's comparative advantage in relation to the other major industrialized countries, which dominate the area composition of both exports and imports. This study emphasizes comparisons with the other industrialized countries, namely United States, Japan and Northwest Europe.

Using comparative advantage as a framework for analyzing what has happened and why (the positive aspects of comparative advantage), the study looks at the relative position of Canada with respect to factor supplies, differential productivity performance by industry, and the pace of technological change, including the speed of adoption of new technology. Special consideration is given to economies of scale in manufacturing, and the implications for Canada of producing and selling many manufactured products primarily within the domestic market, especially when producers in many other countries are selling within much larger markets on a free trade basis. Emphasis on the costs of developing new technology in a small market are also considered, together with evidence and analysis relating to the speed of adoption of new technology in Canada compared to other countries. These considerations are central in understanding the historic pattern in which Canada exports a range of primary products (grains, minerals and forest products) and is a net importer of a wide range of manufactured products. This exchange is important in achieving high real incomes in Canada.

The study also considers the policy implications of comparative advantage. Levels of real income in Canada have been lower than in the United States primarily because of the lower levels of output per person and per hour in manufacturing, and the narrowing in the productivity gap in recent years has been more than offset by a more rapid rise in wage rates and average hourly earnings in Canadian dollars than in the United States since late in the 1960's. Comparative advantages and disadvantages can change over time, but it would appear that they can change only slowly and gradually. The key questions relate to the direction and speed in which shifts are desirable and feasible. One of Canada's problems is that manufacturing, one of the major areas of comparative disadvantage from high costs, low productivity levels, and slow adoption of new technology, has been one of the fastest growing areas in world trade for some decades. In this context, the last chapter assesses the potential gains from commercial policy and science policy. Suggestions for further research are also discussed.

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ACKNOWLEDGEMENT

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1. INTRODUCTION TO THE STUDY

The major purpose of this study is to examine Canada's international trade and industrial structure from the points of view of previous theoretical and applied work in the tradition of economic literature on comparative advantage.

Historically, two different but related themes in the theory of comparative advantage can be distinguished. One theme relates to the positive aspects of economics and deals with such questions as the following:

Why does Canada's international trade take place?

What are the factors that broadly explain why Canada exports certain types of products and imports others?

How is the pattern of international trade reflected in differences in industrial structure between Canada and its major trading partners?

These are the types of questions addressed in Chapters 2 to 4. It is a central part of all theories of comparative advantage that these questions can only be answered with considerable attention being given to inter-country comparisons. In applying this framework to Canada, comparisons with the United States, Japan and the major countries in northwest Europe are involved. About 85 per cent of Canada's merchandise trade takes place with these major industrialized countries, and these countries receive the major emphasis in the quantitative material that is included in these chapters.

The second major theme in the models of comparative advantage deals with the public policy or normative aspects of the theory, and raises questions such as the following:

How does Canada's international trade (and the industry and commodity specialization which it involves) affect the levels of real national income in relation to labour, capital and land inputs in Canada?

How might emerging trends in the domestic and world economies affect Canada's relative position in the next decade or so?

How might alternative economic policy options and scenarios affect Canada's real income levels?

Some of these policy options to be considered include commercial policy and science policy (including both research and development of new products and processes and the diffusion of new technology). Many of these issues touch on the appropriate future emphasis on primary and secondary industries in Canada, and such questions as an appropriate industrial strategy for Canada.

This study was the outgrowth of two rather independent developments. One important development is the availability of an increased amount of evidence on inter-country comparisons in a common conceptual and statistical form. The initial aim of these studies by E. F. Denison and others was to assess past economic growth over time and between countries, and to develop orders of magnitude of the quantitative importance of a wide range of specific factors. The industrialized countries now covered in this framework include the United States, Canada, eight countries in northwest Europe, and Japan. These ten countries dominate Canadian international trade and permit comparisons of the major human, natural and capital resources with this group of countries and also the differences between countries in levels of output in relation to total factor input. For some, but not all countries, additional information at the level of some individual industries is available. This seems to have been the first comprehensive attempt to use the results for inter-country comparisons at a point in time (in aggregate and with some disaggregation) to assess the inter-relations between real income levels, comparative advantage, and international trade.

A second development is an increased degree of discussion and debate about the structure of Canadian industry, the current and future positions of domestic manufacturing, the traditional emphasis on exports of primary products (especially non-renewable natural resources), and the limited processing of those products taking place domestically. Major studies of commercial policy (by the Economic Council of Canada) and national independence (by the Ontario Economic Council) have recommended tariff reductions to achieve more efficient and competitive Canadian manufacturing. Earlier, the Carter Commission had recommended neutrality in tax and other policies to achieve a more efficient use of resources domestically. A recent study for the Science Council has emphasized the role of technology in the "underdevelopment" of Canadian manufacturing. An increased degree of public support for more nationalistic policies in foreign direct investment and communications industries (e.g. TV advertising, Canadian magazines and periodicals, etc.) is apparent. The government has introduced measures which would provide more subsidies and protection for Canadian agriculture, policies to encourage more research and development domestically, and regional incentives for capital investment. In light of this debate about goals and policies, what can one say about areas of strength and weakness in the Canadian commodity-producing industries?

These questions cover a wide range of theoretical and empirical issues, together with another range of issues relating to the goals of public policy and the costs and benefits of alternative policy options. It is not possible to resolve all these issues in a single study, especially when some topics have been discussed recurrently almost since Confederation. Two areas should be mentioned specifically as having been excluded. On the theoretical side, the emphasis has been on <u>applications</u> of theory, and no attempt has been made to summarize or add to the mathematical discussions of trade and comparative advantage in the many countries - many products type of discussion. Secondly, the emphasis

is on the effectiveness with which domestic resources are combined to produce output rather than how fully the available resources are utilized. This study will thus concentrate on the longer-term aspects of resource allocation between industries and on the efficient use of resources within Canadian industries in an international environment. Macro aspects of stabilization, price inflation, and unemployment will be largely ignored.

The industrial emphasis in the study concentrates on the commodity producing industries -- manufacturing, mining and agriculture -- which account for only about one-fourth of gross domestic product in the later 1970's. These are much more significant in relation to international trade than domestic production. It would have been desirable to have included some discussion of such industries as construction, trade and the services (whose output is largely produced and consumed locally), but little recent inter-country comparisons in these industries have been made.

Some of the basic data and studies relied on take considerable time and effort to produce, and such studies have had low priority in Canada in recent years. Although many of the underlying factors in Canada's comparative advantage change only slowly, more current data to illustrate this would have been used if they had been available. This was one of the early studies initiated by the Economic Council as part of an expanded programme of research on productivity, and one of its purposes has been to survey existing material and make recommendations to develop and strengthen the basic data and analysis. Recommendations for future research in this area are made later in this study.

2. THEORY AND EVIDENCE ON CANADA'S COMPARATIVE ADVANTAGE

Introduction

The primary emphasis in this and the next two chapters is the application of the various theories of comparative advantage to the Canadian economy, with an attempt to use available quantitative data to the maximum degree possible. Some initial sketching of the theoretical framework is necessary, especially since there are important alternative differences in emphasis on the reasons for possible differences in relative prices between countries in the absence of international trade. This theoretical contribution will be dealt with first.

The major part of these chapters will emphasize the available evidence, set in the perspective of the theories initially distinguished. Some of the evidence is not available for recent years, but it is extremely unlikely that later data would modify the picture in any way. This material primarily emphasizes a relatively static view of comparative advantage, but will provide some evidence on changes over the last several decades when these are available and relevant. In chapter 5, however, longer-term trends in the composition of international trade will be outlined in order to put the discussion into a more forward looking and future oriented perspective, as background to the discussions of the public policy options.

Theories of Comparative Advantage Distinguished

Comparative advantage has been a part of the discussion in international trade for more than a century and a half -- since initially put forth by David Ricardo in 1817, and has been discussed extensively in the literature on international trade.[1] Much of the discussion has followed the Ricardian method in the sense that it is primarily deductive, is based on some initially simplifying

assumptions about behaviour of individual consumers and producers, and frequently assumes unchanged technology.

This study will summarize the broad lines developed in the literature, and will then use the framework to organize the evidence on Canada, with special emphasis on the contrasts between Canada on the one hand and the United States, northwest Europe and Japan on the other.

Almost all the pure theories of international trade emphasize that trade takes place between countries because, in the absence of trade, differences exist in relative prices between the countries concerned. Trade tends to equalize prices of commodities, although the presence of tariffs and transport costs can limit this. Recent literature also recognizes the existence of non-traded goods, which are very important quantitatively in all modern economies. There are important differences in emphasis in the literature on the reasons for differences in relative prices.

The modern theory of comparative advantage finds the source of the differences in the relative prices of goods produced in different countries in the inequalities of supplies and prices of the main inputs into the process of production (land, capital and labour). This stream of theory originates with the Swedish economists Eli Hecksher and Bertil Ohlin; Paul Samuelson, Harry Johnson and others have explored many aspects of this framework since.[2] Two key assumptions traditionally made in this theory are the existence of similar production conditions in different countries, and constant returns to scale. The differing relative use of the various factors of production in different countries and differing relative supplies of factors in the various countries are regarded as crucial in explaining the differing structure of relative prices. International specialization then emerges as a result of specialization by each of the various countries in those industries that involved more intensive use of the factors that were relatively more abundant (and thereby less expensive) in that country.

Central in the earlier alternative theory of the source of differences in relative prices is an emphasis on differences in production conditions between industries in different countries. Ricardo initially emphasized the differences in relative labour productivities between countries, and this has continued to be a central part of the Ricardian tradition, with more recognition of other factors and other costs in addition to labour than Ricardo had allowed. In light of the importance of labour income in net national income, and labour cost in relation to value added in individual manufacturing income, the emphasis on the importance of labour productivity makes this approach still currently relevant, especially when inter-country comparisons of productivity by industry show such dramatically large differences.

Both of these theories of relative price differences in relation to comparative advantage are static and rarely allow for changes in technology or for non-price elements in trade. Recent developments in this area include the role of "availability" as a determinant of international trade, research and development as a source of new technology, the product-cycle hypothesis on the introduction of new products, and the role of the multinational corporation in foreign investment and international trade.[3] Individual countries can differ in their strengths in these fields, and Canada's relative role will be assessed where some evidence is available.

All three of these approaches to comparative advantage will be examined subsequently, one approach at a time. It is recognized, of course, that there are simultaneous interactions present in theory and practice, but this is not attempted in this study and does not seem to have been done systematically in either theoretical or applied work.

Although this study will emphasize the "real" factors in Canada's comparative advantage, it is also possible in theory and practice for capital flows, exchange rates, wages, costs and prices to contribute to disequilibrium situations that could affect the competitive position of individual sectors.

In recent years, for example, the competitive position of Canadian manufacturing has been influenced by differential changes in wages and the exchange rate, and such evidence will be introduced where relevant without departing too far from the primary focus of the study.

Canada's Regional and Commodity Composition of International Trade

Canadian trade on both the export and import side is heavily concentrated with the major industrialized countries. Trade with the United States, northwest Europe and Japan amounted to 88 per cent of Canadian exports and 85 per cent of Canadian imports in 1977, as shown in Table 1. The similarities and contrasts with these countries will be emphasized in subsequent comparisons among countries to assess comparative advantages and disadvantages.

TABLE 1

Canada
Export and Import Shares by Area
1977

Area	Exports	Imports
U.S.A.	69.9	70.3
E.E.C.	10.6	8.6
Other O.E.C.D.	1.8	2.3
Japan	5.7	4.3
Latin America	4.3	5.8
All other countries	7.6	8.7
	100.0	100.0

Source: Based on Bank of Canada Review, September 1978, pp. S122-23.

It is of interest to compare the levels of gross domestic product among these major countries on both a per person employed and a per capita basis. By 1976, Canada was about 7 per cent below the United States on a per person employed basis, and 13 per cent below on a per capita basis. This reflects the significant catching up in the Canadian position relative to the United States

since the 1960's. A similar narrowing in the positions of Japan and the other individual European countries relative to the United States has also taken place, as shown in Table 2, a trend that has continued over most of the period since the end of the Second World War. Results for 1970 and 1976 for seven major industrialized countries are shown in Table 2. Clearly Canada is in the range of the highest real income levels of the major industrialized countries in the world.[4]

TABLE 2

INTERNATIONAL COMPARISONS OF GROSS DOMESTIC PRODUCT,

1970 and 1976

(Percentages of U.S. Values, Other Country Weights)

Measure	Year	U.S.	Canada	Japan	France	West Germany	U.K.	Italy
GDP per person employed	1970	100.0	84.8	44.3	65.6	61.5	51.2	49.2
	1976	100.0	93.2	53.1	74.0	68.4	51.7	51.3
GDP per capita	1970	100.0	82.0	54.6	67.8	67.3	57.5	42.7
	1976	100.0	86.8	61.1	74.0	68.1	56.8	42.8

Source: Figures for 1970 from Denison and Chung, How Japan's Economy Grew So Fast (Washington: The Brookings Institution, 1976), Table 2-1, p. 5 for all countries but Canada. Canada is based on relative prices in Canada and the United States for 1965 in Dorothy Walters, Canadian Income Levels and Growth: An International Perspective, (Ottawa: Queen's Printer, 1968), 260. Figures for 1976 are updated from OECD, Main Economic Indicators, May 1978; Department of Finance, Economic Reviews April 1978, (Ottawa: Supply and Services, 1978).

How does the broad commodity composition of Canadian exports compare with the industrialized countries? About three-quarters of the exports of the industrial areas are in the form of manufactured products as shown in Table 3. On the other

hand only about one-quarter of the exports of the developing areas are of manufactured products. This reflects the general tendency for higher per capita income countries to export a high proportion of manufactured exports, while exports of developing countries (with per capita incomes far below those shown in Table 2 except for the oil producing countries) contain a high proportion of primary products. The commodity composition of Canadian exports contains a much lower proportion of manufactured exports than the other high income countries. The proportion of primary products in exports from Canada is about halfway between that prevailing in the developing areas and that in the industrial areas. Only in exports of non-ferrous metals and road motor vehicles (reflecting the Canada-U.S. free trade agreement on vehicles and parts) does Canada have significant exports of manufactured products, compared to the composition for all industrial areas.

TABLE 3

Export Composition by Commodity Group,
Canada, Industrial Areas, and Developing Areas

	Canada	Industrial Areas	Developing Areas
	(1976)	(1976)	(1973)
Food	12.2	10.8	20.8
Raw materials	11.3	3.2	8.4
Ores and minerals	8.5	1.1	4.6
Fuels	13.8	4.3	39.3
Total primary products	45.8	19.4	73.1
Non-ferrous metals	5.2	1.9	3.8
Iron and steel	2.2	6.2	0.9
Chemicals	3.9	10.5	1.7
Engineering products	13.0	35.0	4.5
Road motor vehicles	19.8	10.0	0.3
Textiles and clothing	0.7	5.4	7.2
Other manufactures	9.0	10.2	7.1
Total manufactures	53.8	79.2	25.5
Residue	0.4	1.4	1.4
Total Exports	100.0	100.0	100.0

Source: GATT, International Trade, 1976/77 (Geneva, 1977), Appendix Tables A to E.

One important question that runs through this study is why are manufactured exports so much less important in Canada than in the U.S., Europe and Japan? A second, and related question, is why is the net deficit in manufactured products so large? In this and the following two chapters, evidence on the similarities and contrasts between Canada and the high income industrialized countries will be considered. The individual sections will follow the distinctions made in the various theories of comparative advantage (factor inputs, productivity differences, and technological change) distinguished initially. Each section will consider the individual topics in isolation, but it is recognized that the final result reflects the simultaneous interaction of all the forces, and these interactions can influence both the analysis and the concluding policy chapter. Some links between individual themes and pieces of evidence in preceding sections will be introduced at times, but a simultaneous handling of the interrelations has not been attempted in this paper. It is recognized that the procedure followed involves the use of a partial equilibrium analysis, when a general equilibrium treatment might be preferable. Although some theoretical papers have dealt with comparative advantage in a many country, many commodity situation (including non-traded goods), they have not been made operational. A serious gap, for example, is a reasonably complete theory that could explain the differences in production conditions in different industries in different countries, a topic which is quite important for Canada.

Factor Supplies and Prices

The modern theory of comparative advantage recognizes the importance of a number of factors of production in the production process, and thus builds on modern price theory. However, it also makes a number of important assumptions, presumably to keep the theory sufficiently simple to make it manageable. Two assumptions that are normally retained are the assumptions that there are

constant returns to scale in the individual industries, and that the production conditions in the individual industries are similar in different countries. Some empirical evidence on these assumptions will be examined in the following two chapters.

In the Hecksher-Ohlin model, the relative supplies of various factors are assumed to vary between countries, as reflected in different relative prices of factors between countries or differences in the elasticities of supply of different factors. Very little attention has been given in the literature as to how to make these distinctions operational in practice. In this study, data on international comparisons from the Denison analytical and statistical approach to economic growth will be used. The Denison approach to accounting for economic growth has now been applied to the United States, Canada, eight countries in Europe, and Japan. (The approach has been applied to some other countries also, but they are less important for Canadian trade). The material on factor inputs has been standardized between countries on a per-person employed basis. The discussion will start off on those factors of production with which Canada is relatively well endowed, and will consider later those factors that are currently relatively "scarce" in Canada. It is recognized that it would be desirable to have comparisons of prices of factors rather than to rely primarily on physical measures, and these will be introduced in several places. However, these data are less available, and are sometimes hard to explain and interpret when they have been assembled.

Land and Mineral Resources

As one would expect, Canada is clearly better endowed with natural resources than any other region (or individual country within Europe) considered, as shown in Table 4. Although many people are aware of the general tendency, it has rarely been shown quantitatively. The quantities of arable land per person

employed in Canada are more than twice the U.S. level, more than ten times the European level, and more than forty times the Japanese level. However, these comparisons are only a part of the picture. Climate and rainfall are less favourable than in other countries for a wide range of fruits, vegetables, and livestock and thus Canada is a net importer of a wide range of food products. The availability of land is reflected in radically different types of agriculture. Japan, for example, now grows about as much rice as they consume by the very intensive use of small plots of land. Farm production per worker in Canada was consistently well below the United States from 1947 to 1965, and the narrowing since has been insufficient to modify that conclusion.[5] The extent of financial assistance to agriculture has grown during the 1970's[6] and Canada has introduced a number of protectionist steps on agricultural products. Gale Johnson concluded that Canada had a clear comparative advantage in wheat, barley, oats, rapeseed and flaxseed, but a clear disadvantage in manufactured dairy products, sugar, wool, lamb and mutton.[7]

TABLE 4

Land Area and Mineral Production
Per Person Employed, 1960 and 1970
(Relatives, U.S.=100)

	Land Area Per Person Employed		Value in $ U.S. of Mineral Production Per Person Employed	
	All Land	Arable Land	Denison List	Expanded List
Canada (1970)	1036	218	181	222
United States	100	100	100	100
Northwest Europe (1960)	13	20	26	26
Japan (1970)	6.4	5.2	3.7	

Sources: United States and Europe: Denison and Poullier, Why Growth Rates Differ, Table 14-2, p. 184; Japan: Denison and Chung, How Japan's Economy Grew So Fast (Washington: Brookings Institution, forthcoming), Appendix O; and D. Walters, Canadian Income Levels and Growth: An International Perspective (Ottawa: Queen's Printer, 1968), Table 64, updated to 1970 with sources as described on pp. 233-34.

Mineral production is relatively more important in Canada than in any other country studied. On the basis of twenty major minerals, mineral production in Canada was about 120 per cent higher in 1960 than in the United States, about eight times larger than in Europe, and almost fifty times larger than in Japan (all comparisons valued at U.S. prices).[8] Relative to other countries, Canada is clearly the best endowed of all the high income countries in terms of natural resources in the form of land and minerals. Canadian mineral production is relatively larger in 1970 than a decade earlier. Over the post-war period Canada has obtained a larger share of world mineral trade which in total has not been buoyant in relation to world GNP. However, the qualities of Canadian ore deposits are not outstanding in relation to other countries; and the friction between the federal government and the provinces on mineral rents and the changes in federal mining taxation should caution against complacency. New diamond drilling exploration has declined from earlier highs and it is not yet clear that the price increases in a wide range of mineral products a few years ago have reversed that tendency.

Business Capital Stocks

Although it would be widely accepted that North America is relatively more capital-intensive than Europe or Japan, the results to date suggest somewhat higher levels of capital stock per person employed in Canada than in the United States. The available data are contained in Tables 5 and 6. The Japanese data relate to 1970 while data for the other countries refer to 1962. (Later data for Canada may be added in the final draft. It might be noted that the machinery and equipment capital stock per employee increased more rapidly in Canadian manufacturing than in the United States from 1967 to 1974.[9]) The large additions to the capital stock from the high level of investment increased the input of nonresidential structures and equipment in Japan from 65.00 in 1962

to 172.46 in 1970, an increase of 165 per cent, substantially higher than the increase of 12 per cent in employment in nonresidential business.[10] In 1960 the level of business capital stock per person employed would still have been well below the European level and even lower relative to North America.

TABLE 5

Capital Stock in Nonresidential Structures and Equipment
Per Civilian Employed

1962
(Relatives, U.S.=100)

	1962 U.S. Price Weights
Canada	107
United States	100
Northwest Europe	45
Japan (1970)	59

Sources: D. Walters, Canadian Income Levels and Growth: An International Perspective (Ottawa: Queen's Printer, 1968), p. 85 (based on an average of gross and net capital stock per person employed) and Denison and Chung, How Japan's Economy Grew So Fast (Washington: Brookings Institution, 1976), Chapter 11 and Appendix Table 0-1, p. 250.

TABLE 6

Canada - U.S. Capital Stock in U.S. Prices
Per Person Employed in the Enterprise Sectors, 1960
(Relatives, U.S.=100)

	Equipment	Structures	Total Fixed Capital
Agriculture	103	156	122
Manufacturing	103	149	123
Other enterprise	63	112	94
All enterprise	79	120	102

Source: D. Walters, Canadian Income Levels and Growth: An International Perspective (Ottawa: Queen's Printer, 1968), p. 83.

The results in Tables 5 and 6 have not as yet been revised to incorporate into the capital stock estimates the 1976 National Accounts revisions and considerable growth has occurred in investment, capital stock and employment in all countries. However, the results in Table 6 for manufacturing suggest a level of equipment per person employed in Canada roughly comparable to the United States, and levels of structures higher in each broad industrial group. These results on capital stock quantities do not correspond to the higher costs of machinery and equipment relative to wage costs which have historically prevailed in Canada. Some data on these relative factor costs are shown in Table 8 for Canada and the United States. It can be seen that an important narrowing has taken place between 1965 and 1975 in all relative prices, although some differences are still large. Average hourly earnings became higher in Canada in 1975. Some of the reasons for the occurrence of similar or higher levels of machinery and equipment per person employed, in spite of higher capital-to-labour costs, include the ease of using imported machinery (when domestically produced equipment would be even more expensive to develop for a small market; the industrial structure contains a somewhat higher share of capital intensive industries (such as mining, smelting and refining); the small population thinly spread over a wide geographic expanse leading to heavy overhead costs in transportation and communication; favourable tax treatment on depreciation of capital assets; the higher real costs of having water, sewers and building foundations below frost level and costs of insulation and double windows; and greater seasonality.[11] These factors tend to lead to a higher stock of capital assets per person employed, without a comparable increase in real output.

Table 7 provides an updating of the machinery and equipment component of Table 6 for manufacturing. By the mid-1970's, the stock of machinery and equipment was about one-third higher than in the United States, whereas it had been about the same in 1960.

TABLE 7

Machinery and Equipment per Employee Ratios,
Valued in U.S. 1961 Prices, All Manufacturing,
Canada/United States

1967	1.21
1968	1.27
1969	1.28
1970	1.28
1971	1.30
1972	1.30
1973	1.32
1974	1.36

Source: James G. Frank, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: The Conference Board in Canada, 1977), p. 113, which contains data for individual manufacturing and all manufacturing in 1961 prices in each country, but did not allow for the higher prices for machinery and equipment then prevailing in Canada. An allowance was made using 118.1 for machinery and equipment prices in Canada (U.S. weights), the difference in 1962 prepared by E. C. West in D. Walters, Canadian Income Levels and Growth, p. 260.

TABLE 8

Comparative Material and Factor Prices
Canada and United States, 1965 and 1977
(U.S.=100)

	1965	1977
Average hourly earnings in manufacturing	81	105.2 (1975)
Machinery and equipment prices	125.6	124.9 (1975)
Long-term corporate bond yields	123.2	117.1
Selected raw materials prices	120	n.a.

Sources: D. J. Daly, B.A. Keys, and E. J. Spence, Scale and Specialization in Canadian Manufacturing (Ottawa: Queen's Printer, 1968), p. 29, updated from U.S. Survey of Current Business, Part II, p. 85, February 1976, p. 13 and S-15, Canadian Statistical Review, August 1978, p. 56, and National Income and Expenditure Accounts, Vol. 1, 1926-1974, p. 2.1 and Fourth Quarter, 1974, p. 37.

Labour Input

As the comparisons thus far have been based on a per person employed basis between countries, the major area to be considered here is differences in educational levels of the labour force. Earlier work by Bruce Wilkinson, Gordon Bertram and Dorothy Walters has established that the level of education of the labour force in Canada is lower than in the United States.[12] Increased expenditures on education have taken place since then, and this appears to have brought the rate of increase in the level of education of the labour force in Canada roughly into line with what has been taking place in the United States, but the educational levels continue below the United States with no discernible change in sight.

With the studies done by E. F. Denison and his associates, comparisons can also be made with the levels of education of the labour force in northwest Europe and Japan (results are shown in Table 8). The education levels in northwest Europe are lower than in the United States. Some countries in northwest Europe (such as Norway and the United Kingdom) were slightly higher than Canada, while Italy was significantly lower. The difference between the U.S. and Japanese education levels in 1970 is less than that between the U.S. and Canada in 1960. As the contribution of education to economic growth in the three countries was roughly comparable during the 1960's, it would appear that the level of education in the labour force was higher in both 1960 and 1970 in Japan than in Canada. This reflects Japan's high priority on mass education and literacy since the Meiji Restoration which was further accentuated in the more recent post-war period. The primary and high school systems are among the most intensive and rigorously demanding systems of mass instruction in the world. and university entrance exams in the strong universities are rigorous. The proportion continuing to post-secondary education in Japan is currently lower than in Canada, but standards of marks and attendance

are lax compared to the stiff standards in early years.[13] There is much less variation in education levels of individuals in Japan than in Canada, and there are fewer in the Japanese labour force with only primary school education than in Canada. The Canadian educational level is pulled down relative to that in Japan by the larger proportion with only primary school education. The difference in levels of education of the labour force among the four industrialized countries and regions shown in Table 9 are small compared to the large differences in land, mineral resources, and capital stocks considered earlier.

TABLE 9

Relative Education Levels, 1960 and 1970
(United States=100)

United States	100
Japan (1970)	95.6
Canada (1971)	93.4
Northwest Europe (1960)	92.7

Sources: Dorothy Walters, Canadian Income Levels and Growth, p. 60, and E. F. Denison and W. K. Chung, How Japan's Economy Grew So Fast: The Sources of Postwar Expansion (Washington: Brookings Institution, forthcoming) Appendix Table 0-1, p. 250. The Canadian data are based on 1971 census data using the same methods and income weights as in the Denison-Chung study).

There is also some evidence to suggest that the extent of continuing education, vocational training on the job, and job rotation are relatively more important in the United States, Japan and Germany than in Canada.[14] In so far as this tendency prevails, Canada shows up with somewhat higher levels of education (based on the measures of formal education only in Table 9) relative to some of the other countries than a more comprehensive measure of education would show. Although this may overstate the Canadian education levels, there is no basis yet for suggesting the extent of any such bias.

Education is regarded as one important factor in change, the diffusion of technology, and the incorporation of improved techniques into current practices. On the basis of currently available information, Canadian managers have moved into positions of senior management much later in their working lives than has been United States practice. This can make them much less open to new ideas and methods than U.S. managers, and can be one of the factors contributing to the slower adoption of new products and new processes in Canada than in the United States.[15] This topic will be considered further later.

The Japanese management system is so markedly different from North American practice that some brief comments are desirable. Seniority with the firm (or its affiliated companies) is far more important in the selection of top managers than is the practice in North America. However, the initiative for new procedures and change originates at the lower level in Japanese organizations, both private and public, and much higher priority is put on achieving concensus. Japanese firms have been able to achieve much greater increases in productivity in manufacturing than North America or Europe with radically different approaches to decision making, promotion, wages, etc. The high average age of management in Japan has not contributed to resistance to change to the same degree as appears to have occurred in Canada.

To summarize, from the side of factor inputs, the direct measures of factor availabilities per person employed indicate that Canada's comparative advantage lies very heavily on the land and natural resource side in relation to her major trading partners, and to a lesser degree on capital stocks, especially in relation to Japan and Northwest Europe. Conversely, Canada's comparative disadvantage lies in the lower level of education (especially at the post-secondary level) relative to the United States and Japan.

These conclusions are very similar to those that have been arrived at from comparisons of the resource content of exports and imports by Harry Postner, using input-output data, and the earlier input-output studies of Canadian trade by Wahl and Williams.[16] This approach follows what Balassa has called "revealed comparative advange," based on trade and production data,[17] which then links this to factor requirements (direct and indirect) by an input-output table. By a comparison of the resource content of exports and imports and the use of input-output tables to relate industrial output to factor use, Postner could compare the resource content of international trade. Some of his major conclusions of relevance here are as follows:

> Canada's total international trade in 1961 can be regarded as one of net exporting (positive) the factor services of elementary labour, both types of gross fixed capital, and the two natural resources, in exchange for the net import (negative) of the factor services of higher educated labour.... Renewable natural resources is the relatively most important net export (positive). Nonrenewable natural resources is a close second in importance. Conversely, university labour is the factor relatively most displaced (net import - negative) by Canadian international trade. The complete ranking of factor services, from high to low, is (1) renewable natural resources; (2) nonrenewable natural resources; (3) gross machinery capital (4) gross structures capital; (5) elementary labour; (6) high school labour; and (7) university labour.... The relative ordering, from high to low, of the net trade in factor services has changed slightly in importance by 1970. The new ranking is: (1) nonrenewable natural resources; (2) renewable natural resources; (3) gross structures capital; (4) gross machinery capital; (5) elementary labour; (6) high school labour; and (7) university labour.[18]

The general ranking on the basis of foreign trade data of seven distinguished factors corresponds quite closely with the five direct measures of factor supplies compared for Canada, United States, Northwest Europe and Japan.

In discussing the implications of his study for comparative advantage, Postner concluded

> The prime source of Canadian comparative advantage in international trade is her factor abundance of natural resources. Canada should typically have a comparative advantage in the production of highly natural resource-intensive commodities, especially the nonrenewable type. On the other hand, Canada's comparative disadvantage is typically greatest with respect to highly labour-intensive commodities, particularly university labour.[19]

However, the Postner study did not allow for differences in production conditions between individual industries, or any changes associated with tariff reductions, and this is a significant omission, as will be seen in Chapter 4.

3. ECONOMIES OF SCALE AND MARKET SIZE IN MANUFACTURING

The last chapter discussed the available evidence on Canada's comparative advantage in terms of the available factor supplies in relation to other countries. Another important element is the effect of differential differences in productivity by industry, which are quite important for Canada, as we shall see. However, an important theme in the study as a whole is that these differences in productivity by industry are heavily influenced by economies of scale and the possibilities of selling in a small as contrasted to a large market. This chapter will summarize the evidence on the various concepts of economies of scale in relation to Canada, and assess the possible scope for higher productivity and lower costs with access to larger markets.

The terminology and analytical framework that will be used in considering the various concepts of economies of scale will be that developed recently by F. M. Scherer.[20] Three alternative concepts of economies of scale will be distinguished in this chapter, reflecting the main possible sources of scale economies in an integrated multi-plant, multi-product form in manufacturing. Product specific scale economies refer to changes in cost per unit of output with longer lengths of run (or cumulated past production). Such a concept can be applied to a very narrowly defined product, such as a particular screw (distinguished by length, head size and type and finish), a tin can (of a particular size and rust preventative), air frame, motor, etc. These definitions are much finer than can be distinguished in census of manufacturers or Dun and Bradstreet lists of primary products by plant. Plant-specific scale economies refer to costs of alternative size plants producing a particular product, or group of products in the same industry (e.g. brewing, cigarettes, cement, or storage batteries). It is useful to think of these two types of scale economies as production economies. Company-wide scale economies refer to savings on

non-production costs in a group of plants operated by one company in the same broad industry group. There may be economies of scale to the company as a whole from doing some functions for a group of plants rather than each plant doing such functions on their own. Examples of such possible areas include advertising, research and development, raising capital funds, and developing a distribution system through a chain of retail dealers, for example. These definitions do not assume that larger size operations on any one of these three dimensions need necessarily lead to lower costs -- costs can be higher rather than lower, which would involve diseconomies of scale.

It should be emphasized that these three economies of scale distinguished can sometimes be interrelated. For example, the widespread prevalence of short runs and high costs from a significant degree of product diversity may limit a company to producing for a small domestic market and preclude that firm from becoming sufficiently large to compare in size with companies whose home market is large and who also have subsidiaries and direct investment in other countries.

For our purposes, we want to use these distinctions to provide orders of magnitude for the differences in costs per unit of output associated with the differences in economies of scale between Canadian and U.S. manufacturing. Two questions will be explored under each of the headings on economies of scale, namely: Are there significant differences between Canadian and U.S. manufacturing on this dimension? Do any differences play an important role in cost and productivity differences between the two countries?

Product Specific Scale Economies:

A number of recent studies have emphasized the importance of product-specific scale economies in a number of countries. In light of the importance of this theme, Appendix A explores the theoretical underpinnings of this phenomenon and illustrates a number of important areas to which it can be applied. For our purposes, the main conclusions can be summarized briefly, drawing on previously published studies. Interviews with a number of Canadian firms (both subsidiaries of U.S. parents and Canadian owned manufacturing firms) have indicated that many Canadian plants produced many more varieties and models of products than plants of the same size in the same industry in the United States.[21]

Chart 1 illustrates the cost and revenue implications of importing a manufactured product or producing it domestically within Canada. Consider a product produced in the United States (say $100.00) and where the quantities being produced there are sufficiently large that the effect of any imports into Canada on the U.S. price are sufficiently small to be ignored. At the current exchange rate (which we will take as $1.15 Canadian dollars per U.S. dollar for convenience), that price would be $115.00 in Canadian currency. With the existing Canadian tariff, let us assume that the duty paid value on that product would be $125.00 Canadian, shown as P_1. A Canadian firm would product it domestically rather than import it, if its average total cost was $125.00 or less.

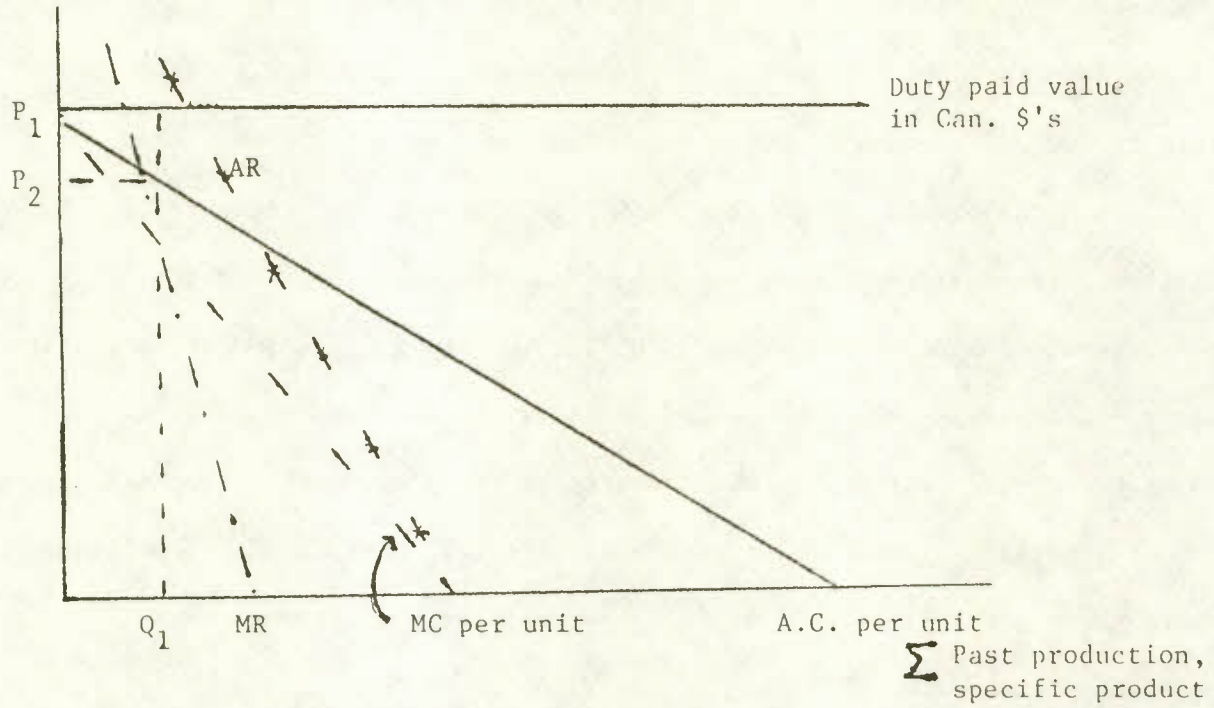
Let us assume an average cost curve for a specific product, which is declining slowly as shown in Chart 1. A variety of factors can contribute to such declines, as reflected in the discussion of progress cost curves and experience curves (see Appendix A for further discussion and illustrations of where these concepts are relevant). Examples for such declines are the spreading of fixed costs over longer runs (examples of fixed costs would include overhead costs of capital facilities and administrative and supervisory personnel, set up time of operators, etc.); alternative machinery and plant facilities

with large as compared to small volume; learning by doing by employees, etc. In this situation, the associated marginal cost curve will be falling even more rapidly.

Chart 1 also shows the associated marginal revenue curve and the average revenue (or demand curve). The average and marginal revenue curves are shown as falling even more rapidly than the average and marginal cost curves. The initial equilibrium production position for maximum profits to the producer would be at Q_1, where marginal revenue and marginal costs are equal. As long as the price he received was equal to his average cost or higher, (as at P_2), he could cover all his costs and receive a normal profit. As long as his price was under the duty paid value (P_1), he would provide all the domestic market. If his price was to move up to P_1 or above, he would experience import competition. If the price he was obtaining for Q_1 production was much above his average costs, he would obtain abnormally high profits, and he would find other producers would initiate production of a similar product. As long as the marginal revenue curve was falling more steeply than the marginal cost curve, there would be no incentive for him to expand production, even though the producer knew his average costs would fall with additional production. Although the example is simplified, it corresponds to the decisions on production, pricing, and imports described by many Canadian manufacturers.

CHART 1

Long Run Marginal Cost and Marginal Revenues,
Example of Product Specific Scale Economies



A study by Richard Caves has confirmed that this tendency for greater product diversity in Canadian plants was quite widespread in individual industries, based on comparisons of plants operated by subsidiaries with plants in the United States. His results were based on material from Dun and Bradstreet, which provides a listing of the six major products produced in each plant of the major manufacturing companies in both Canada and the United States. The study indicated that for about eighty per cent of the individual subsidiary plants, the range of products is greater than in plants of the parents in the United States.[22] Unfortunately, however, the definition of products in the Dun and Bradstreet data is still very broad compared to the detailed product varieties emphasized in company interviews. Also, there is no information from the Dun and Bradstreet data on the relative importance either of the primary activity or on the five varieties of secondary products, or their share of total plant production.

Although the phenomenon of greater product diversity in Canadian plants than in U.S. plants in the same industry is now well established and accepted, the effects of this on productivity and cost differences is still fragmentary and incomplete. Earlier interviews in Canada turned up examples in both steel products and fine paper products, where output in the domestic plants would triple if the U.S. length of run could be achieved with the same labour and capital, but this would reduce profits for the reasons outlined earlier. Some additional examples from Canada and other countries were provided in the international comparisons study by F. M. Scherer et.al.[23] Based on statistical studies, interviews, and about a hundred papers by students at York (many of whom were currently working in manufacturing), it is my opinion that this is the most important single source of the differences in cost and productivity between the two countries. It is not, however, the only area of scale economies in Canada that can lead to lower costs.

Plant-specific scale economies: It has been recognized for many years that the presence of the tariff can lead to a larger number of plants that are sub-optimum in size, based on the engineering concept of minimum efficient size. In some cases these plants might serve regional markets (such as breweries, which are further encouraged by the preferences of the provincial distributors to buy from plants within the province). Some evidence that high tariffs are associated with plants of less than optimum size, based on engineering standards, is provided in Table 10.

TABLE 10

The Ratio of Actual Plant Size to Efficient Plant Size - Grouped by Effective Tariff Rate for Thirteen Canadian Manufacturing Industries: Circa 1967

Level of Effective Tariff	Number of Industries	Average Value of Ratio of Actual to Efficient Plant Size
High	6	0.48
Low	7	1.12

Source: Paul K. Gorecki, Economies of Scale and Efficient Plant Size in Canadian Manufacturing Industries (Ottawa: Bureau of Competition Policy, Consumer and Corporate Affairs, 1976), p. 54.

However, the increases in costs for plants of less than optimum size are frequently small (less than five or ten per cent).[24] Some industries which experience significant increases in costs with small plants (such as steel and cement), had levels of cost and, in 1963, net output per employee close to U.S. levels. Other industries with low-levels of output per employee (such as cigarettes or petroleum refining), would not experience large increases in costs from small plant size. On the other hand, there are a number of plants involved in producing refrigerators and freezers, while one of efficient size would be larger than the whole Canadian market and significant increases in cost could be experienced. On the basis of the evidence on plant size difference by industry and the effects of smaller plant sizes on costs, perhaps 5 percentage points of the productivity difference between Canadian and U.S. manufacturing can be explained by differences in plant size. This is not a major factor in a difference of more than 30 percentage points during the 1960's.

A number of Canadian industries contain plants of less than minimum efficient size, but this does not seem to have been an important factor in higher costs on the basis of present information, which is admittedly neither perfect nor complete.

Company Specific Scale Economies:

The previous two sections have dealt with production economies at the produce and plant level. Additional economies can occur in some non-production areas of costs such as advertising, finance, research and development, and managerial services. These are areas that were explored in the Final Report and several studies by the Royal Commission on Corporate Concentration.

Advertising is an example where large firms can have financial advantages over small firms. For example, costs of advertising per minute of prime time is lower with larger amounts of advertising time than smaller amounts for the CBC (both English and French networks) and CTV in the published rate structures. In all three rate structures, the costs per minute for 300 minutes, for example, are about 30 per cent less than for 12 minutes or less.[25]

These savings are illustrative of other advantages of brand images and marketing advantages that can be important in such products as brewing and cigarettes. These advantages can offset the higher production costs from product diversity discussed previously under product specific economies of scale, but none of the studies have been able to deal with these conflicting influences on costs per unit simultaneously.[26]

A recent survey by Comanor and Wilson concludes a discussion of economies of scale in advertising as follows:

> Taken together, these results suggest that economies of scale in advertising are generally present, which provides an important advantage to large sellers and large advertisers....These economies may be an important factor leading to the anticompetitive implications of heavy advertising expenditures.[27]

There are also advantages in lower rates in the capital market and greater flexibility in alternative sources for raising funds for large established firms than small firms. This is illustrated in Table 11 for both debt issues and common shares for Canada for recent years. It is widely recognized that interest rates on outstanding corporate bonds have been consistently higher in Canada than the United States. For example, from 1974 to 1977, the industrial average on U.S. corporate bonds was about 8.8 per cent, compared to 10.3 per cent for the McLeod, Young, Weir Canadian bond yield average for 10 industrials.[28]

TABLE 11

Costs of Issue of Public Security Issues, Canada, 1974-77 (excluding Mining Issues)

Size of Issue (millions)	Debt Issues	Common Shares
$1-3 (issuer has no previous securities in market)		10 - 12½ %
About $5 (issuer has no previous securities in market)	up to 7 %	10 - 12½ %
$1 - 5 (issuer known, good credit rating)	3 - 5 %	up to 8 %
About $10 (good, well-recognized credit)	2 %	up to 8 %
$25 and over (good, well-recognized credit)	1½ - 2 %	up to 8 %

Source: Report of the Royal Commission on Corporate Concentration (Ottawa: Supply and Services 1978) p. 264.

Although these data indicate that there are some economies of scale for those costs in larger firms in Canada, their importance as a factor in cost disadvantages on the Canadian side should not be exaggerated. There are certainly some spill over effects of advertising from the United States into Canada from magazines and television produced in the United States. However, advertising costs are rarely more than 5 per cent of the sales dollar for manufacturing firms, and Canadian content regulations in television and the tax treatment of TIME, NEWSWEEK and Canadian publications have tended to give additional protection for Canadian producers. Interest costs in manufacturing have been about one per cent of sales in Canada in recent years, so higher interest rates are likely to have contributed to less than two-tenths of one per cent difference in total costs between the two countries. It seems quite unlikely that differences in costs for financial and advertising can be critical (except in special cases) in the large cost differences in manufactured product prices that are present.

Research and development is a further source of difference in costs and technological change between Canada and the United States, and this will be considered later. At this stage it might be noted, however, that these R and D costs have been a little under one per cent of total costs in Canadian manufacturing in recent years.

It might be useful to summarize the implications of these results on economies of scale thus far in relation to their implications for public policy. A key implication is that there are significant potential gains in increased productivity and reductions in costs per unit by a reduction in the current high degree of product diversity in Canadian manufacturing. However, there are no incentives for the individual firms to move in this direction if

their selling prices to sell the additional volume would have to be cut more drastically than the expected reduction in average cost.

This discussion of economies of scale will be returned to again as it is very relevant to Chapter 4 and Chapter 6 on policies.

4. DIFFERENTIAL PERFORMANCE IN PRODUCTIVITY AND TECHNOLOGICAL CHANGE

Comparative advantage from a consideration of factor inputs alone (as discussed in Chapter 2) would be seriously incomplete. Some consideration of differences in the effective use of resources and adaptation to change is also essential in any comprehensive assessment of Canada's comparative advantage.

Intercountry Productivity Differences by Industry:

As noted initially, Ricardo emphasized differences in labour productivities between industries as the major source of differences in comparative costs between countries and comparative advantage. Evidence on the relevance of this point of view accumulates from each new published study of intercountry differences on productivity by industry. It should be emphasized that only relative differences matter. If differences at the aggregate level existed but the differences were identical for each component industry, adjustments at the macro level in exchange rate and wage-price levels would ensure balance of payments equilibrium and only factor supplies would be relevant for comparative advantage. In his recent survey, Irving Kravis shows significant differences in agriculture, mining and manufacturing between countries.[28a] After examining data for about sixty countries, Kuznets found that international differences in product per worker were greatest in agriculture and least in the service sectors.[29] Manufacturing appeared in an intermediate position. There tends to be a higher coefficient of variation in the nineteen studies of differences within manufacturing surveyed by Kravis where industries are finely divided.

It is not possible to compare differences between industries in Canada and her major trading partners for as many countries as in the discussion of factor supplies. Only for the United States has anything systematic and comprehensive been done. However, so much Canadian trade, both exports and

imports, takes place with the United States that this limitation is unfortunate but not critical.

All the comparisons discussed in this section are based on levels of output per person employed (or per man hour) in the same industries in different countries. It is recognized, of course, that other factors of production (such as stocks of machinery and equipment) are used simultaneously in production. However, the large share of labour income in net national income (about 80 per cent in all the industrialized countries being considered here) means that this is the key factor to be considered. Furthermore, when measures of capital as well as labour are used, the major conclusions in inter-country comparisons are very similar.[30]

Although the service sector is a large and growing group of industries in the major developed countries, very few comparisons (even between Canada and the United States) have been made. Retail and service sales per person engaged in distribution have been examined as part of a larger study comparing Great Britain and North America. With U.S. quantity weights, the Canadian levels were 222 in 1951, compared to 233 in the United States in 1948 (Great Britain = 100).[31] Some increase in sales per person probably took place from 1948 to 1951 but, as the increase in real domestic product in retail trade was about 12 per cent,[32] the lack of comparability in census years is probably not serious. It is unfortunate that no more current studies of Canada-U.S. comparisons of the important trade and service sectors have been made.

Levels of agricultural output per person are farther below the United States than the difference for the economy as a whole. The estimates by Hayami and associates put the 1957-62 average in Canada at 74 per cent of the U.S. level, while the Auer data for the same period would put it at 65 per cent of the U.S. level.[33] This is a greater gap than the 85 to 90 range in gross domestic product per person employed in Canada relative to the United States which prevailed between 1955 and 1968.[34]

The levels of output per person in mining are dramatically higher in Canada than in the United States, as much as 68 per cent higher in 1970. This is based on the gross value of output in the two countries, valued at U.S. 1970 prices. The 22 major mineral products included cover 93 per cent of the gross value of production (the excluded items primarily cover items that cannot be disclosed in the basic publications, or small valued items some of which are not covered in the detail for one country).[35] However, the proportion of the labour force in mining was about 1.4 per cent of the labour force, so the higher output per person has only a small affect on the total, being about one-fifteenth the size of manufacturing, for example.

Data for the levels of output per man hour in total manufacturing are shown on a comparable basis for the United States, Canada and Japan in Table 12 and Chart 2. In 1976, the level of output per man hour in Canadian manufacturing was almost 30 per cent below the level in the United States. This gap is substantially wider for manufacturing than the difference in real GDP per person employed of 7 per cent shown previously in Table 2 for the same year. However, by the mid and late 1970's, the gap is relatively smaller than it was in the mid-1950's (when it was 54 per cent of the U.S. level in 1955) or the early 1960's (when it was 61 per cent of the U.S. level in 1963). As manufacturing amounted to about 22 per cent of the labour force in Canada in 1971, this can have an important affect on the real income differences for the economy as a whole.

TABLE 12

Output Per Hour in Total Manufacturing,
United States, Canada and Japan
(U.S. 1967=100)

	U.S.	Canada	Japan
1955	74.0	40.1	12.2
6	73.5	41.8	12.9
7	75.0	42.1	14.1
8	74.6	43.6	13.2
9	78.1	45.9	15.4
1960	78.8	47.5	17.7
1	80.7	50.1	20.0
2	84.5	52.7	20.9
3	90.4	54.8	22.6
4	95.2	57.2	25.6
1965	98.2	59.3	26.6
6	99.7	61.4	29.3
7	100.0	63.3	33.6
8	103.6	75.4	37.9
9	104.9	71.5	43.8
1970	104.5	72.6	49.4
1	110.3	77.8	51.1
2	115.7	81.3	54.5
3	118.8	85.0	60.9
4	112.6	86.4	61.1
1975	118.2	84.3	58.7
6	123.2	88.2	63.4
7	126.1	92.4	66.9
8	129.2	96.3	72.5

Sources: All estimates are based on relative price and quantity data for manufactured products rather than exchange rate adjustments. The U.S.-Canada level comparison for 1974 is based on James G. Frank, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: The Conference Board in Canada, Nov. 1977), Table 9, p. 66 based on Canadian price weights. U.S. annual estimates carried forward and back by indexes of output per hour in U.S. Department of Labor, Bureau of Labor Statistics, Output Per Hour, Hourly Compensation and Unit Labor Costs in Manufacturing, Twelve Countries, 1950-1976, (Washington: Mimeo, Nov. 1977) and U.S. Department of Labor News, "International Comparisons of Manufacturing productivity and Labor Costs, Preliminary Measures for 1978", July 10, 1979. Annual estimates for Canada are carried forward and back by indexes of output per man hour in manufacturing in Statistics Canada, Aggregate Productivity Measures, 1946-1977, (Ottawa: Oct. 1978), p. 53. These results are almost identical to those that can be obtained by updating earlier results for 1963 by E. C. West.

The U.S.-Japanese level comparison for 1967 is based on Kenzo Yukizawa, "Relative Productivity of Labour in American and Japanese Industry and Its Change, 1958-1972" paper presented at the International Economics Association meeting in Tokyo, September 1977, Table 3, p. 13. Adjustments were made to convert this to a man hour basis, as Japanese hours worked are longer, based on OECD Monthly Statistics, January 1971, p. 16. An adjustment was also made to allow for relatively more purchased materials to gross value in Japan than in the U.S.A., based on Kazuo Sato, "Did Technical Progress Accelerate in Japan?", paper presented at the International Economics Association meeting in Tokyo, September 1977, p. 24, footnote 3. Annual estimates for Japan were carried forward and back by indexes of output per hour in U.S. Department of Labor, Bureau of Labor Statistics, Op.cit.

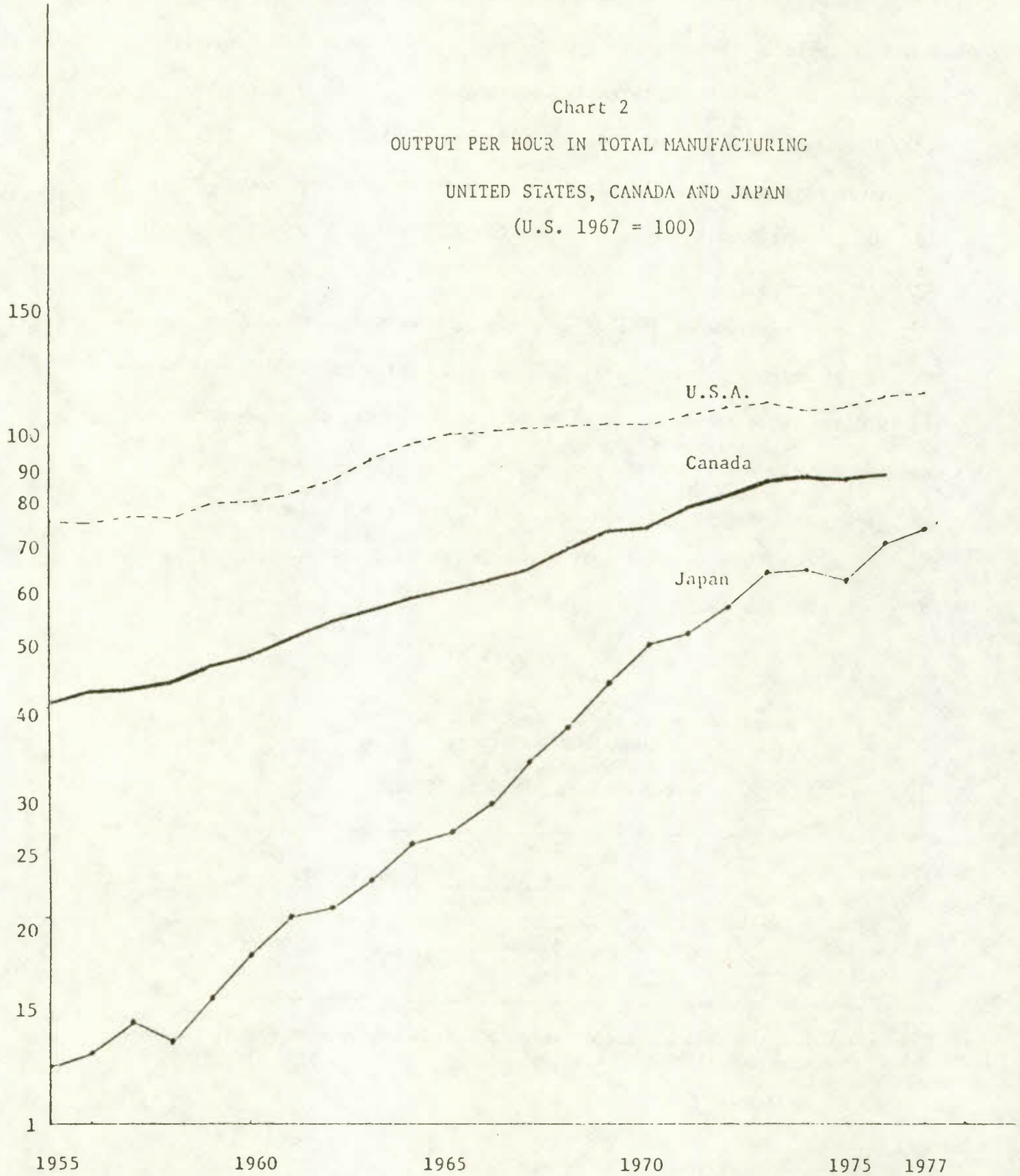
These comparisons on a man-hour basis show a larger gap for Japan relative to North America than in the basic study by Yukizawa, reflecting the much longer hours worked in Japan than in North America. The adjustment to allow for the relatively larger material-purchases in Japan also lowers the Japanese position relative to North America.

Chart 2

OUTPUT PER HOUR IN TOTAL MANUFACTURING

UNITED STATES, CANADA AND JAPAN

(U.S. 1967 = 100)



Levels of output per man hour in Japan can also be compared with Canada in Table 12, based on an extrapolation backwards and forwards using the comparisons of the United States and Japan prepared by Kenzo Yukizawa. By 1977, the level in Japan was about 86 per cent of the Canadian level. This is a major narrowing from the mid-1950's, when Japanese manufacturing was only 30 per cent and 16 per cent of the Canadian and U.S. levels respectively in 1955.

It is interesting that there seems to have been some slowing down in the rate at which Japan has been catching up to North American levels during the 1970's. Table 13 shows the rates of change for the three countries for selected periods over the last two decades. The rate of increase in Japan is just over 5 per cent per year in the 1970's, compared to almost 11 per cent in the 1960's, but this is still well above the 2 and 3 per cent per year in Canad- and the United States during the 1970's.

TABLE 13

Annual Rates of Change in Output Per Hour,
Total Manufacturing,
United States, Canada and Japan,
Selected Years, 1955 to 1978

	1955 - 1963	1963 - 1971	1971 - 1978
United States	2.53	2.52	2.29
Canada	3.98	4.48	3.09
Japan	8.01	10.74	5.12

Source: Calculated from data in Table 12. This comparison was suggested by Dennis DeMelto.

It is significant that there are substantially larger differences in the levels of net value added per employee in manufacturing plants of different sizes in Japan than in both the United States and Canada. For example, in Japan, plants employing more than 1,000 employees had levels of net value added per production worker that were 50 per cent above the average for all manufacturing establishments. There is a tendency in the same direction for larger plants in both Canada and the United States, but the differences are not nearly so pronounced in North America. The levels of net value added per employee in plants employing more than 1,000 employees is about twenty per cent above the average for all manufacturing establishments in both the United States and Canada.[36] The point of this in relation to Canada is that the levels of net value added per employee man hour in the larger establishments in Japan have apparently been higher in Japan than in Canada since early in the 1970's.

It is also significant that large producers in manufacturing play a relatively more important role in exports than in domestic production, and this role has increased over time. Exports by large firms amounted to about 20 to 25 per cent of Japan's exports before the First World War, but this had increased to roughly 75 per cent in 1970. The share of small firms in manufactured exports fell over the period from the mid-1950's to 1970 both in total and in each of the 20 individual industries studied. Japan's recent export success is primarily the result of the productivity and competitiveness of a few large firms in a limited number of industries rather than dependence on a multitude of small producers.[37] These pieces of evidence suggest that the levels of output per man hour in the Japanese firms most actively involved in exports are currently already higher than in the larger Canadian establishments.

A further important theme in the various inter-country comparisons of productivity differences within manufacturing industries is the significant variation from one industry to another. This was apparent in the first such study of Canada-U.S. comparisons done by E. C. West for the year 1963. A similar wide variation from one industry to another is shown in the results for 1974 in the study by J. G. Frank, shown in Table 14.[38] These data are based on levels of output per man-hour of input, but similar large variations exist even after capital inputs, as well as labour, are allowed for. When labour income is such a dominant part of both GDP at factor cost and value added in manufacturing, the results are very similar both with and without allowances for other factor inputs such as capital.

TABLE 14

Real Net Output Per Man-Hour
By Manufacturing Industry in 1974
(Canadian Output U.S. Output, in Per cent)

Sawmills, Sash and Door Mills	145
Veneer and Plywood Mills	145
Iron and Steel Mills, Steel Pipe and Tube	120
Woollen Textile Mills	115
Baked Products	108
Motor Vehicles, Parts and Accessories	103
Fruit and Vegetable Processing	101
Other Knitting Mills	97
Synthetic Textile Mills	95
Soft Drinks	94
Men's Clothing Manufacturers	91
Hosiery Mills	87
Iron Foundries	86
Slaughtering and Meat Processing	85
Household Furniture	74
Non-Ferrous Metal Smelting, etc.	73
Pulp and Paper Mills	73
Cotton Yarn and Cloth Mills	71
Petroleum Refining	70
Fabricated Structural Metals	69
Fish Products	69
Major Appliance Manufacturing	68
Breweries	66
Heating and Air Conditioning	66
Other Paper Converters	65
Paper Bag and Box Manufacturing	62
Truck and Bus BOdies	61
Dairy Products	59
Soap and Cleaning Products	58
Biscuit Manufacturers	58
Paint and Varnish Manufacturing	50
Tobacco Products Manufacturing	49
Confectionary Products	46
Total Sample	77

Source: James G. Frank assisted by Ian Ladd and Gene Swimmer, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: The Conference Board in Canada, 1977), pp. 62-66, based on Canadian price weights.

It is of interest that the coefficient of variation for the Canadian manufacturing data is roughly similar to that found in fifteen surveys of inter-country productivity comparisons within manufacturing. (Summaries are shown in Table 15). The number of industries distinguished in both the West and Frank studies for Canada are slightly greater than the median and mean number of industries distinguished in fifteen such studies for other countries. The unweighted arithmetic mean of the coefficients of variation is 0.348, and the Canadian results of 0.382 and 0.324 are both within one standard deviation of 0.18. In other words, the variation in productivity differences in Canadian manufacturing can be regarded as being from the same population as other studies. Thus, the Ricardian tradition emphasizing inter-country productivity differences by industry is very relevant for other countries, and not limited to Canada and the United States.

TABLE 15

Productivity Differences within Manufacturing
Summary of Industry Numbers and Coefficients of Variation
(Fifteen price and quantity comparisons)

	Number of Industries	Coefficient of Variation
Median	26	0.318
Mean	27	0.348
Canada - West (1963)	29	0.382
Frank (1974)	33	0.324

Source: Irving B. Kravis, "A Survey of International Comparisons of Productivity," Economic Journal, March 1976, Table 6, p. 34. Studies based on exchange rates have been excluded. Means, medians and standard deviation have been prepared for the present study.

It is easier to establish the existence of large productivity differences between industries in different countries than to give an exhaustive interpretation for the Canada-U.S. differences which is also broadly consistent with studies done for other countries. Many of the studies have measured the productivity differences, but have given more limited attention to the reasons for such differences. "One of the relatively few positive findings that emerges from more than one study is an association between the labour productivity ratios (i.e., productivity in country i to productivity in country j) for the various industries and the relative size of the individual industries (i.e., size in i to size in j) as measured by total output or employment. The difficulty, however, is to know which way the causation runs."[39] The key importance of market size differences in explaining the Canada-United States productivity differences also emerges in a recent study by Irwin Barnhardt.[40] Relative industry size was important in the U.S./U.K. comparisons of Rostas, Frankel, and Paige and Bombach, and the U.S.-Japanese comparison by Yukizawa, in addition to West's Canada/U.S. comparison. West concluded that establishment size was not very important, but that greater product diversification was a significant source of difference in productivity between the two countries.[41] This emphasis on the relatively greater importance of product-specific scale economies than plant-specific scale economies was also found in the studies by Scherer and associates of twelve industries in six countries.[42]

It would be a digression from our discussion of Canada's comparative advantage to explore all the factors that could contribute to the productivity differences shown in Tables 12 and 14 and to test them all completely. First, productivity differences of that magnitude between two countries as physically close and so closely related by information and ownership can only persist for extended periods with the presence of important tariff and non-tariff impediments to trade. (The strict Ricardian model allows for different

production conditions in a free trade, no transport cost situation. The discussion here both recognizes and emphasizes the presence of these impediments in the observable differences.) Even if the relative factor supplies in the two countries were identical, a less efficient use of resources in Canada in certain commodity producing industries would put such industries at a comparative disadvantage.[43] Second, allowing for time to adjust, reductions in tariff barriers, especially on a multilateral basis would lead to a narrowing in the productivity differences from their past level. Increased output from a given level of labour and capital inputs would be expected, and an increased amount of intra-industry trade would emerge.[44] This topic will be considered further in the last chapter, where the material on economies of scale and market size from the last chapter and the differences in productivity levels in the current chapter will be drawn together in the context of the policy recommendations.

Performance Differences Between U.S. and Canadian Owned Firms:

Subsidiaries of United States parents are significant in production, investment, assets and employment in Canadian commodity producing industries. Many previous studies have pointed out the quantitative importance of foreign ownership and control, and no attempt will be made to summarize that earlier discussion here.[45] Our purpose is limited to discussion of two areas, namely: What differences in performance are there within individual industries between United States - controlled and Canadian - controlled establishments? What differences are there in costs of producing knowledge between United States - controlled and Canadian - controlled firms in the same size categories? New data are now available on both these questions.

Data have been available for a decade on value added per employee, sales per employee, and selling value of factory shipments per employee. These all showed higher values for all foreign controlled establishments in manufacturing than all manufacturing enterprises in 1961. These differences are less for larger enterprises than for all enterprises (ranging between 6 and 21 per cent higher for all large enterprises, but between 17 and 37 per cent higher for all enterprise sizes).[46] Similar data for 1970 are shown in Table 16. It is striking how frequently the levels of net value added per employee are higher in the U.S. controlled rather than in the Canadian controlled establishments, with the unweighted average being 25 per cent higher in the U.S. controlled establishments. It might be noted that payments for materials and purchased components by Canadian subsidiaries would have been excluded from these estimates of net value added, but not purchased services.

TABLE 16

Comparison of United States-Controlled and Canadian-Controlled Establishments Productivity Performance 1970 (a)

Major Industry Group	(1) U.S.-Controlled	(2) Canadian-Controlled	Ratio (1)/(2)
Food and Beverages	$16 745	$12 816	1.31
Rubber and Plastic Products	14 921	10 544	1.42
Leather Industries	7 643	7 145	1.07
Textile Industries	13 467	8 303	1.62
Knitting Mills	8 532	7 372	1.16
Clothing Industries	7 204	6 717	1.07
Wood Industries	9 877	8 969	1.10
Furniture and Fixtures	9 888	9 100	1.09
Paper and Applied Products	15 796	14 700	1.07
Printing, Publishing and Allied	15 975	12 102	1.32
Primary Metal Industries	16 524	14 997	1.10
Metal Fabricating Industries	14 867	11 806	1.26
Machinery Industries	16 963	11 501	1.47
Transportation Equipment Industries	16 799	10 698	1.57
Electrical Products Industries	11 806	11 475	1.03
Non-Metallic Mineral Products	15 605	13 209	1.18
Petroleum and Coal Products	24 019	25 059	0.96
Chemicals and Chemical Products	21 523	12 849	1.68
Unweighted arithmetic mean			1.25

(a) Productivity performance is expressed in terms of value added per person employed. Purchased services have not been excluded from value added, and the relatively greater importance of these services for U.S. controlled establishments will overstate the differences somewhat.

Source: Statistics Canada Catalogue 31-401: Domestic and Foreign Control of Manufacturing Establishments in Canada, 1969-1970.

It has sometimes been suggested that transfer pricing policies by manufacturing firms (relating to the costs charged by parent companies to the subsidiaries for components and managerial services, or valuing exports to the parent) could understate reported values of value added and profits in the Canadian subsidiary. In so far as this occurs in practice, the differences in

net value added between U.S. and Canadian controlled establishments could be understated. In the Canadian automotive industry there is a high degree of transfer of intermediate components and final products across the border between Canada and the United States, and the valuation methods can influence comparisons of value added and profits in the two countries. The recent study of the automotive industry raised the question of valuation, but did not provide any clear indication of its significance.[47] Very little information on the extent or effects of transfer pricing between parents and subsidiaries in manufacturing is in the public domain in Canada.[48]

It should also be noted the Dun and Bradstreet data analyzed by Caves indicate that Canadian owned plants are less diversified than U.S. owned plants in the same industry.[49] Thus, the higher levels of value added per employee in U.S. owned plants came about in spite of a greater degree of product diversity and the lower level of output per person that earlier discussion has suggested one would expect.

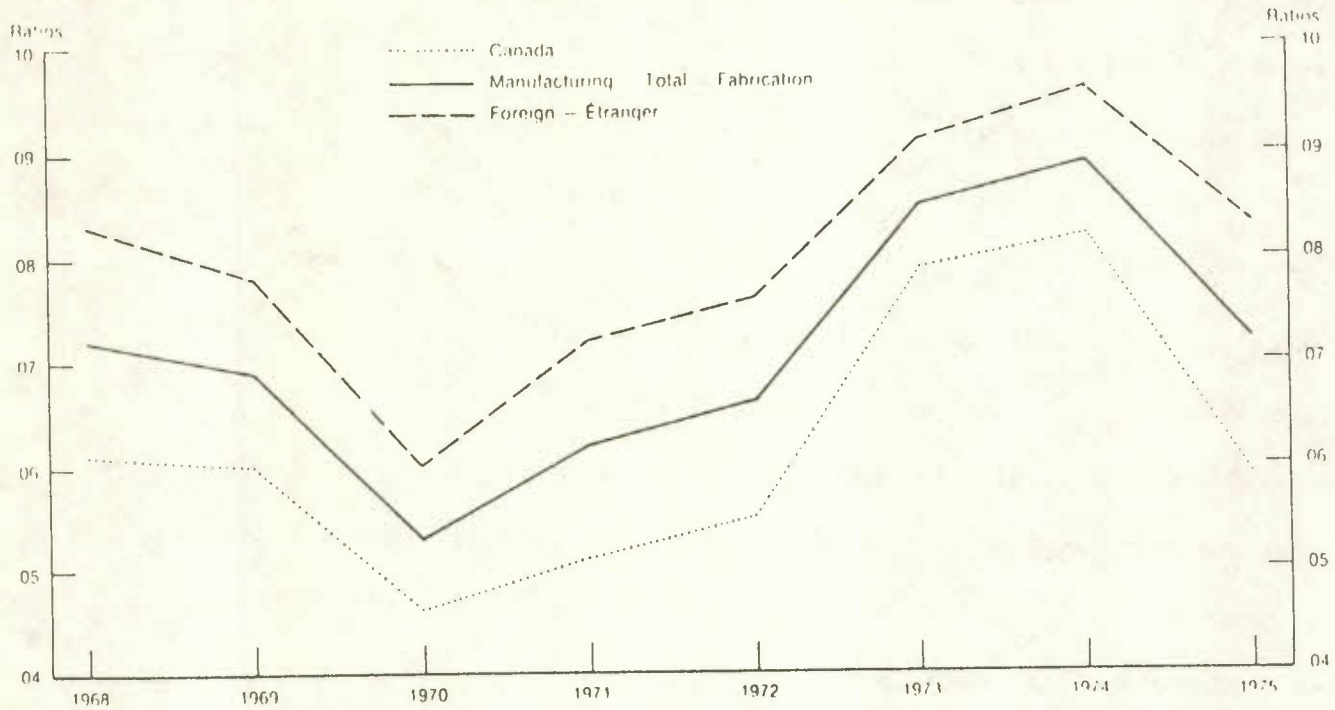
The possibility that foreign direct investment creates a spillover effect in Canadian manufacturing has been studied by Steven Globerman. For a sample of industries (varying from 42 to 61), he tests for the influence of foreign ownership after allowing for differences in capital stock per employee, labour quality, the presence of plant size economies of scale, and nominal tariff rate. Some effect of spillovers from foreign direct investment are detected after allowing for these other factors, but they are less important than the effects of capital deepening or plant level economies of scale.[50]

It is also significant that profits to sales ratios and profits to asset ratios are higher for foreign controlled than Canadian controlled companies during the 1970's, as shown in Charts 3 and 4.[51]

Chart 3

Profits — Sales Ratios for Manufacturing Corporations by Control, 1968-1975

Ratios bénéfices — ventes, des corporations manufacturières par contrôle, 1968-1975

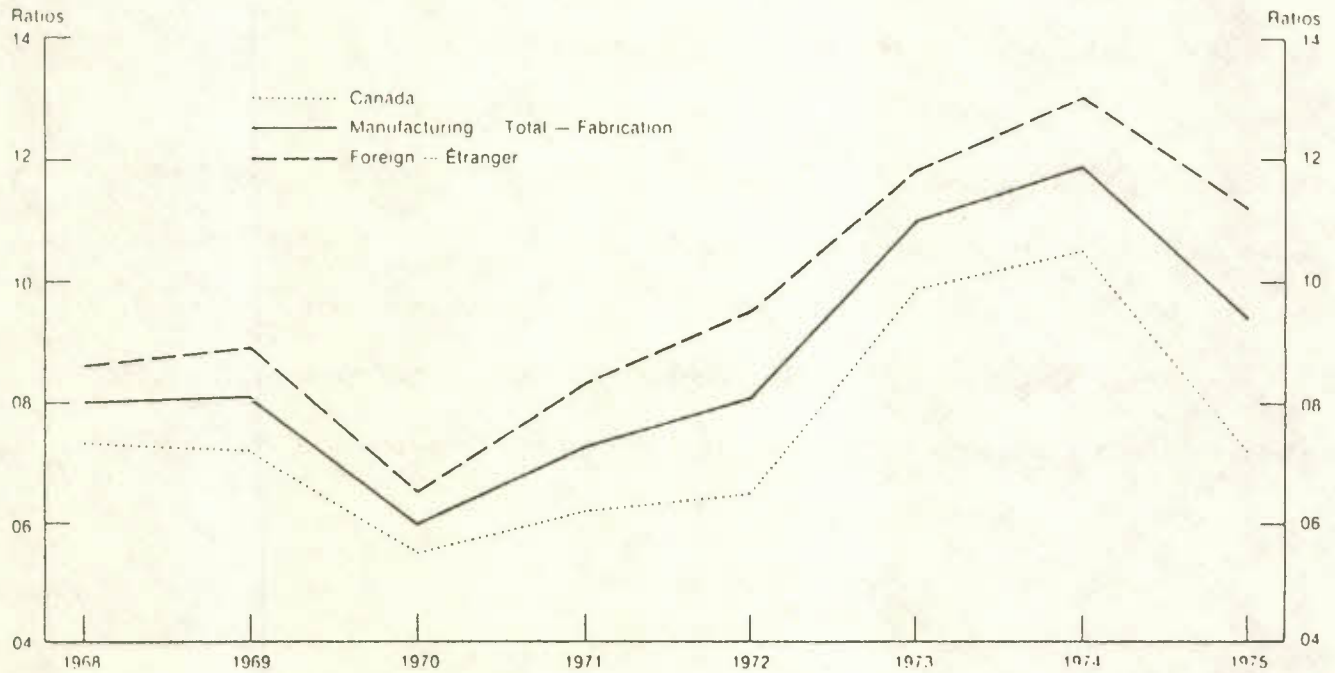


Source: CALURA Report for 1975, p. 52.

Chart 4

Profits — Assets Ratios for Manufacturing Corporations by Control, 1968-1975

Ratios bénéfices — actifs, des corporations manufacturières par contrôle, 1968-1975



Source: CALURA Report for 1975, p. 53.

An earlier table provided data on the levels of productivity in Canadian controlled and U.S. controlled establishments by industry. These differences persist even after allowances for differences in establishment size as well as industry differences, with the differences being relatively larger for small establishments than larger ones. This is illustrated in Table 17. In further tests of significance by industry and asset size, D. C. MacCharles concluded that value added per employee was consistently less for the Canadian sector of control, was relatively constant for the foreign sector of control, but increased in the Canadian sector of control as the establishments became larger. The conclusion that smaller firms in the Canadian sector are considerably less productive than the foreign sector is a significant finding but this result largely disappears once the establishments become larger. It indicates the existence as well as the importance of plant-level economies of scale due to learning-by-doing, production of knowledge, indivisible inputs, product diversity, etc. in the Canadian sector of control. ANOVA tables to test the statistical significance of the underlying data found significant differences (especially among smaller establishments) at the aggregate for manufacturing and a high proportion of the major industry group level.[52]

TABLE 17

Average Value-Added per Employee,
Manufacturing Sector Classified by
Size of Establishment and Sector of Control,
1974

	Size of Establishment (Shipments, $000)				
Sector of Control	< 250	250-1,350	1,350 - 5,375	5,375 - 13,475	>13,475
Canadian	14,329	15,190	16,542	19,003	23,854
Foreign	85,485	29,460	24,438	24,453	24,378
Ratio, Can./Foreign	0.168	0.516	0.677	0.777	0.979

Source: Statistics Canada, Special tabulation of 1974 Census of Manufacturing, correspondence from D. C. MacCharles, June 12, 1979. The smallest establishment size (fewer than 9 employees) contain very few foreign controlled establishments.

These results are even more striking when the large differences in value added per employee within individual industries are borne in mind. These variations from plant to plant in the United States were pointed out by W. E. G. Salter many years ago, and large differences in value added per employee in the top and bottom quantiles from establishment data for the United States continue to be present in recent data.[53] Similar variability emerges in the work by Imre Bernolak in the Interfirm Comparison work in Industry, Trade and Commerce. In the light of the typical variability from plant to plant, the significant contrasts between Canadian-controlled and foreign-controlled plants is even more striking.

D. C. MacCharles has also studied the possibilities of economies of scale in the production and purchase of knowledge for companies of different asset sizes, with emphasis on the differences in ownership. His Ph.D. dissertation and subsequent additional research provided data for U.S. owned and Canadian owned companies in the same industry and asset size categories,

emphasizing the costs associated with either producing the knowledge within the firm, or purchasing the services. The data on these expenses in relation to both sales and value added showed only modest declines with larger asset sizes for U.S. owned firms, and very little differences in these expense ratios between large Canadian owned firms and U.S. owned firms in the same industry and asset size groups. However, the costs were substantially higher in relation to both sales and value added for small Canadian firms than U.S. owned firms in the same industry and asset size groups. The interpretation for these results was that the smaller U.S. firms could purchase R and D and managerial services from the parent, pay the average costs for those services, and still incur smaller expenditures relative to sales and value added than if they had to produce such services internally within the firm themselves, which is the option that the Canadian owned firms tended to follow. These costs were about twice as high in relation to sales for Canadian firms as they were for the U.S. subsidiaries, a difference roughly comparable to profits in relation to sales. The studies also found these differences in expense ratios statistically significant between Canadian owned and U.S. owned firms in comparable industry groups and asset sizes. However, for firms with more than $10 million in assets, the ratios of these selected costs in relation to both sales and value added were rather similar, suggesting that these differences in costs and performance were not large. However, in the smaller sized firms the situation is quite different as Canadian owned firms have significantly higher costs associated with the internal production of these managerial and knowledge services than U.S. owned firms in the same industry and asset size groups.[54] U.S. owned firms tend to buy these services from their parents.[55] It is possible that the tendency for smaller subsidiaries to buy these managerial and knowledge services from the parent that emerges from the corporate data is

related to the higher levels of value added per employee for smaller U.S. organizations at the establishment level that emerged earlier.

Economic Aspects of the Production and Use of New Technology:

Earlier chapters have summarized the evidence on Canada's factor supplies and productivity differences by industry in an international perspective. Although there were occasional references to any major historical changes, the analytical description is primarily a comparatively static picture. Chapter 2 also distinguished some recent theories of comparative advantage that were more dynamic and contained elements of non-price theories. These theories can be regarded as more dynamic versions of the Ricardian tradition, as they emphasize technological change and diffusion which are related to the Ricardian emphasis on productivity. This section of the chapter will shift to these more dynamic considerations, emphasizing the considerations affecting the production and adoption of new technology in a small economy.

Technological change has been an important factor in the increase in real output in relation to both factor inputs and total population since the industrial revolution. During the present century, similar conclusions are drawn whether output is compared with labour input only (a major input as reflected in the high proportion of national income going to labour), or whether other factor inputs such as capital or natural resources are also included. For Canada, by 1979, real GNP and real consumer expenditures were both roughly five times the 1926 level, which involves increases of about 3.2 per cent per year for more than five decades. On a real GNP per person employed basis, the 1979 level was more than three times the 1926 level, an increase of about 2.3 per cent per year.[56] Technological change has been an important factor in these significant changes (but other factors such as an increase in

the capital stock, higher levels of education in the labour force, economies of scale and inter-industry shifts) have also been important.

The emphasis in this section will be on how factor supplies, market size and productivity differences in Canada in relation to other countries influence corporate and public options on the costs of producing new technology. These costs influence the nature and extent of new technology produced within Canada and thus the future rate of growth of real national income in relation to the inputs of labour and other factor inputs. This approach will throw some badly needed perspective on the demand for scientific and research personnel in Canada, but the perspective is to assess these developments in relation to economic performance rather than putting priority on more job creation for specialized R and D personnel.

The first point to emphasize is that the costs of R and D are only a very small part of the total cost of getting a new innovation implemented and delivering the new product to the consumer or industrial market. The costs of research, advanced development and basic invention normally only run to 5 or 10 per cent of the total cost, as shown in Table 18. Most of the discussion of science policy by scientists and such organizations as the Science Council of Canada put primary emphasis on this aspect of the total process of innovative activity, with almost no consideration of the rest of the total process, which dominates the total situation from a cost point of view.

TABLE 18

Cost Distribution Breakdown for Innovation Activity

Activity	Percentage of Total Cost
Research - advanced development - basic invention	5 - 10
Engineering and designing the product	10 - 20
Tooling - manufacturing engineering (getting ready for manufacture)	40 - 60
Manufacturing start-up expenses	5 - 15
Marketing start-up expenses	10 - 25

Source: Report of the Senate Special Committee on Science Policy, A Science Policy for Canada, Vol. 2, 1972, p. 395.

It is also important to recognize the distinction between science and technology. Jack Baranson emphasized this distinction in discussing new approaches to the role of technology transfer in economic developments as follows:

> Technology is derived from a continuum of activities encompassing research, development and engineering which in turn is often intimately linked to ongoing production and marketing activities. Most industrial change -- which includes the design and engineering of the products themselves, the materials that go into them, the equipment that is used in processing materials, the work methods and management control systems -- is a continuing, ongoing process consisting of a myriad of elements, and results generally in small incremental changes. The diverse "products" of science and technology activities are derived from often unique social environments. Technology "products" are further linked to user environments that provide the signals for what is needed in the way of new or adapted products or processes....
>
> The tendency to couple science - and - technology as a hyphenated whole fails to acknowledge two separate and distinct sub-cultures. Scientists are generally in pursuit of knowledge and understanding for their own sake -- their ethos is to publish all new discoveries and never to plagiarize. But technologists are concerned with practical applications of scientific knowledge -- they are linked to productive enterprise which in turn must realize a profitable return on invested time and effort. Technologists are generally employed by people whose market-oriented ethos is to appropriate ideas wherever they can and

> to keep them to yourself once you have made discoveries that have commercial value.[57]

Availability and Costs of Producing New Technology

Thus far, the major source of new technology, new products, new processes and new managerial, organizational and administrative approaches and procedures have come from the major industrialized countries. The major source of many of these new ideas during most of the present century has been the United States of America. At the end of the Second World War, the United States was the leading industrialized country in the world, with the highest real GNP per capita and per person employed of any country in the world, and the largest market economy in terms of population. Since 1950, however, real GNP per capita and per person employed has gone up more rapidly in Japan and the individual countries in Northwest Europe than in the United States, so there has been an appreciable narrowing in real income differences between the United States and the other major industrialized countries. In these circumstances, one would expect a growing proportion of new innovative activity to come from the other industrialized countries, and there seems to be a growing proportion of industrial products where the technological leadership has been shifting from the United States to these other industrialized countries.

Once an innovation has been developed in some particular country, is it easy or difficult for information on that innovation to become available in other countries and to be applied elsewhere? For one thing, with the improvement in transportation and communication, and the increased range and number of international conferences, knowledge of new technology becomes available to the other industrialized countries far more rapidly than three or four decades ago. The diffusion of technology has also been facilitated by the increased number and size of transnational (or multinational) enterprises,

with corporate headquarters in such countries as United States, Japan and European countries, and affiliated or subsidiary companies in both industrialized and developing countries. E. F. Denison's conclusions on the spread of technological and managerial knowledge between countries is particularly significant in the light of his extensive involvement in international comparisons of income differences and growth experience.

> Advances of knowledge differ from other growth sources in one highly important respect. Any scientific discovery, theory or knowledge of any new materials, machines, techniques, procedures and practices that arises anywhere in the world quickly spreads to all industrialized countries. Secrets are few and tempoary. By accelerating its own contribution to advances of knowledge, one industrialized country cannot expect to gain more than a temporary advantage over the others with respect to knowledge available for use, and in growth rate terms, the differential gains are small. . . . Individual inventors and firms are most familiar with and best able to exploit potential markets in their own country. Hence, insofar as the pattern of opportunity varies among countries, advances of knowledge may on the average have greater applicability in the country of origin than abroad. But this point does not greatly qualify the idea that knowledge is an international commodity.[58]

Subsequently, a number of case studies indicate that these conclusions can be extended to high technology types of industries, and to developing countries in western Europe and Asia. Jack Baranson has studied twenty-five case studies in such high technology industries as aircraft, automotive, computers, consumer electronics and chemical engineering.[59] A number of the major findings are of interest for our purposes here.

> The new enterprises-to-enterprise arrangements for transferring late generation technology and production techniques are designed to contribute to rapid and extensive implanting of operative technology to enterprises and economies with even modest absorptive capabilities. . . . We found that in at least twenty of the twenty-five case studies, an equally competitive technology was available from foreign enterprises. This has had a bandwagon effect on U.S. firms that now argue that if they do not provide the technology, someone else will. . . . It is no longer merely mature products and standardized technologies that are moving abroad. Certain U.S. firms, for the various reasons outlined, now feel compelled to release to foreign enterprises their most recently dveloped technology (in terms of product designs, process engineering, and production systems). In some instances, the "product" has become the implanting of design and engineering capabilities that are the spawning grounds of future industrial competitors.[60]

These quotations from larger studies of technology transfer suggests that it is relatively easy to move technology between countries. What does this imply for the production of new technology in a small country producing and selling industrial products primarily in the domestic market? First of all, let us simplify the situation and assume that Canada had relatively the same proportion of its total population involved in doing research and development as the industrialized countries as a group, and that they were relatively just as productive and creative in developing new ideas and obtaining patents. Canada would irevitably find it economical to obtain a significant proportion of its new technology from other countries, from the sheer difference in population size. In 1975, for example, Canada had a population of 22.8 million compared to about 290 million in the fifteen European OECD countries (most of whom, but not all, were also members of the enlarged European Economic Community), 214 million in the United States, and 111 million in Japan.[61] In other words, the population in the other industrialized countries was more than twenty-five times the size of the Canadian population, and under these simplifying assumptions would be producing a comparably larger number of innovations.

In addition, it would be rather unlikely that business firms in Canada would find it potentially profitable to invest as much in research and development in Canada as companies operating in larger markets (even if there were no differences in research productivity -- however defined and measured). This interpretation is related to the product specific economies of scale emphasis discussed in previous pages, that can be illustrated with a simple example. Suppose that the costs of developing an innovation were $500,000. to an individual firm, and that the total costs of R and D were essentially the same in Canada and the United States. Assuming the eventual sales of the

product were in proportion to population, the R and D costs per unit of output would be 10 times as high in Canada as in the United States! A typical firm in Canada would be bound to assess the situation along these lines and act accordingly. The higher costs to firms of producing R and D per unit of output in Canada than firms operating in larger markets is bound to limit the demand for R and D skills in Canada.

There have been a number of studies of research and development costs in relation to size of firm. In summarizing the discussions, Scherer et.al. indicated that economists have made progress toward pinning down the conceptual ramifications of this question and answering it, as follows:

> The a priori arguments are well known. Large firms are said to have an advantage in mustering financial support for costly, risky research and development (R & D) projects; they may realize scale economies due to indivisibilities in research skills and equipment; and they may be able to spread the costs of a given research project over a larger existing or anticipated sales volume. Conversely, the cumbersome decision-making processes of large organizations may impede innovation and drive out the creative individuals most apt to make significant new technical contributions.[62]

In a number of industries studied, small firms were not too seriously handicapped by low expenditures on R & D in relation to sales, in spite of high threshhold expenditures on R & D. This could come about because technological innovation was unimportant or unnecessary to market success or because specialist suppliers from other industries provide good access to the latest relevant technology in materials and processes. R & D intensity increased with size of firms, with middle size firms devoting the most effort relative to their size (sales of roughly $75 million to $200 million in most industries about 1965). Only about 40 of Canada's largest non-financial corporations had annual sales exceeding $200 million in 1964, but the results from Scherer, McFetridge and Weatherley and others suggest that smaller Canadian firms need not be seriously handicapped by small size and low R & D expenditures in relation to sales. It is interesting that firms

that have low market shares in the United States tend to spend relatively less on R & D than if their market shares are large as shown in Table 19. Businesses in weak market positions may be farther ahead to emphasize imitation and fast adoption rather than investing in research and development themselves.

TABLE 19

Research and Development Costs in Relation to Sales and Market Share, Return on Investment

	Percent of R & D Costs to Sales		
Market share	Low Under 1.4	Average 1.4% - 3.0%	High Over 3.0%
Under 12%	11.4	9.8	4.9
12% - 26%	13.8	16.7	17.0
Over 26%	22.3	23.1	26.3

Source: Sidney Schoeffler, Robert D. Buzzell, and Donald F. Heany, "Impact of strategic planning on profit performance," Harvard Business Review, March - April 1974, p. 142.

The evidence on the presence of economies of scale in the production of new research combined with the earlier evidence on small market size and small firms in Canadian manufacturing suggest that less R and D will be done in the small Canadian market than in larger firms and markets. Thare are some examples, of course, of Canadian firms who have active research and development programmes and who have achieved scale economies by exporting to world markets, but these are exceptional special cases rather than the typical Canadian manufacturing firm.

The extent of foreign ownership and control is an additional factor that would further limit the demand for research and development to be done in Canada. Canadian subsidiaries would frequently find it cheaper to buy the

latest technology from the parent (even if paying an appropriate share of the total costs of development), rather than develop it within the smaller company and market in Canada. This interpretation recognizes foreign ownership and control as a contributory factor in low research and development expenditures in Canada (whether measured in relation to GNP, manufacturing sales or value added), rather than almost the only factor as suggested in a number of the studies by the Science Council and others.[63]

These points all suggest that the demand for research and development services by Canadian firms, both Canadian owned and foreign owned, are likely to be small because of the availability of such information at low cost from elsewhere (with a lag, but not one that need be long), and the high costs per unit of producing new technology in the domestic market. A lower level in demand for these services by industry is bound to affect the supply of these services in the Canadian economy.

Earlier in this study it was pointed out that the proportion of the labour force in Canada with a university degree was lower than in the United States (Table 9 and related discussion). It is also still true that the proportion of young people going to university in Canada currently continues to be well below the current proportions in the United States, although the differences are somewhat less with the growth of numbers in universities and post-secondary institutions that has taken place since the early 1960's.

Furthermore, the proportion of trained scientists who are in industry is lower in Canada than in the United States, and the proportions who are in universities and in government are correspondingly higher. The share of research and development done in the business enterprise sector in Canada was 37.7 per cent, the lowest of ten industrial countries and well below the 65.7 per cent average for the nine other countries.[64] With the proportion

of scientists in industry lower, and the proportion of the labour force with formal training in science and engineering (as in other fields) also lower than in the United States, a smaller proportion of the manufacturing work force in the professional and technical fields is to be expected. In 1971, about 5.3 per cent of the manufacturing workforce were classed as in the professional and technical occupational category in Canada, about three-fifths of the 9.1 per cent in the same category in the United States in 1970.[65]

Advanced higher education is usually regarded as desirable for the specialized staffs in research and development work. However, only about 12 per cent of the scientific and technical workers in Canada have five or more years of higher education, compared to 24 per cent in the United States. For life and physical scientists, the Canadian percentage is 39 per cent compared to 50 per cent in the United States.[66]

There are thus factors on both the demand and supply side that contribute to the low proportion of the labour force in the private sector with training in science and engineering skills, and a corresponding low proportion of spending on R and D in Canada, and these factors are closely interrelated.

The Introduction of New Products

This section will give special attention to evidence on the timing of the introduction of new products and the speed with which new processes are adopted -- both of which are symptomatic of change and potential dynamic aspects of comparative advantage.

Hufbauer has assembled data on the first production dates that new synthetic materials were introduced in the various countries. For the 35 produced in Canada, most were first produced earlier in the United States than in Canada, with an average lag of about fifteen years. The lag in first production in Canada seems to have been shorter since 1930 than earlier. The United States was the innovating country for about 30 products, followed closely by Germany with 22; while France, Italy and the United Kingdom contributed

eleven in total. Japan and Canada were the innovating countries in one product each.[67] First production was earlier in Canada than in Japan almost as frequently as later. Presumably access to the United States and foreign ownership largely offset the smaller market size in Canada.

The Diffusion of New Technology

In light of the significant proportion of the total costs of getting a new innovation to the market (as reflected in Table 18 earlier), it is important to consider the economic considerations in adopting new technology. It is important to emphasize that the private rates of return to the successful adoption of new technology can be quite high, and that rapid adoption of existing best practice can be an important factor in technological change at the level of the plant and firm on the one hand, and the rate of economic growth in the economy as a whole on the other. Considerable learning by management, scientists and workers can take place in the process of adoption of new technology, as well as in new research and development.[68]

An associate at York, S. Globerman, has done a number of studies of the diffusion process of new technological developments in Canada, duplicating studies that E. Mansfield had done previously for other countries. These processes related to the use of numerical control machine tools, special presses to speed up the removal of water in the manufacture of paper, and tufting equipment in the making of carpeting. In each instance, the adoption of the new technology was slower in Canada than in the United States, and in Europe as well in the case of the special presses to remove water in making paper. It was also found that new synthetics were first produced later in Canada than in some of the larger industrialized countries.[69]

A number of reasons can be suggested for this tendency for new products and processes to be adopted more slowly in Canada than in other larger industrialized economies. In light of the significant start up costs on new innovations (the engineering, designing, tooling and manufacturing and marketing start up costs shown in Table 18 earlier), these costs are all higher per unit of finished product than would be encountered in a larger market. The potential market into which those products would be sold would, however, be smaller than in a large market. There is thus less economic incentive to introduce a new product or process into a small market, on both the cost and demand side. With further costs of bilingualism in marketing and labelling, this could be a further factor that should be noted.[70]

In addition, the Canadian tariff moderates the competitive pressure from imports, so there is less pressure from foreign sources of supply that would put external pressure to adopt the new technology more quickly. A possible further factor that can contribute to slow adoption of new technology is the quality of management in Canada, and their openness to change. This is an important area and more study of the factors contributing to the extent to which management actively seeks out and creates change, or responds quickly to changes in the business environment on the one hand, or resists change on the other can be an important factor in the performance of both individual firms, industries and the country as a whole. A number of factors that can contribute to a positive attitude to change can be suggested. One would be if the manager or his parents had made a major change in occupation or location which had been successful. Another possibility would be the completion of some form of higher education or learning that exposed the manager to new ideas, especially if the education was related to applied fields in engineering, business, industrial psychology, etc. A variety of previous types of managerial

experience could also be helpful, especially working with an effective manager who provided a good learning environment for his associates. Age can also be a factor, although openness to change is sometimes more attitudinal than chronological age.

Although more evidence and anlysis of Canadian management would be desirable, the partial studies available suggest a number of comparisons with management in the United States. The general level of formal education of Canadian managers tends to be lower in Canada than in the United States, reflecting the continuing lower share in both the labour force as a whole and in the younger age groups completing a university education. Second, the proportion of young people taking an M.B.A. continues to be lower in Canada than in the United States in spite of the large expansion in graduate business programmes in Canada since the early 1960's. Thirdly, a survey of top managers in Canada suggested they moved into positions of middle and senior management later in their working lives than an earlier similar survey for the United States. Canadian managers seemed to have moved into senior management more on the basis of experience and seniority with their organization, rather than formal training for management or a variety of different professional and managerial positions in different organizations.[71] It is thus possible that the factors in the Canadian environment that reduce the competitive pressures for change, soften and blunt the incentives for and gains from change are further reinforced by management backgrounds and attitudes that resist rather than facilitate change. If change is to be facilitated, when a number of factors operate to slow and blunt it, a number of steps need to be introduced to facilitate it, each of which can be mutually reinforcing.

The proportion of the labour force with training in science and engineering is also relevant to the adoption of new technology. It was pointed out previously that the share of these in the private sector is small, compared

to other countries. There is also less incentive to move into these fields as the mean incomes of occupations in natural sciences, engineering and mathematics relative to all occupations are not as high in Canada as in the United States, being 60 per cent higher in Canada in 1970, compared to 68 per cent higher in the United States.[72] There would seem to be less incentive to do basic and advanced university work in the natural sciences and engineering in Canada than in the United States.

These considerations which influence the production and adoption of new technology and openness to change will be relevant to the policy discussion in Chapter 6.

5. MAJOR DEVELOPMENTS IN THE WORLD ENVIRONMENT

The three previous chapters have looked at Canada's comparative advantage in relation to the major industrialized countries, using the available data for the past. In this chapter, some major developments in the world environment will be highlighted initially and related to the previous discussion on Canada's comparative advantage. This chapter can be brief, as this topic has been explored quite extensively in recent studies by the Economic Council of Canada and the World Bank.[73]

One of the important developments in the world environment has been the increased importance and influence of the European Economic Community and Japan relative to North America. With the entry of Britain, Denmark and Ireland into full membership in the European Economic Community in 1973, the whole of western Europe has become effectively organized into a free-trading unit for industrial products. In 1960, out of twenty-three industrial countries, Canada's domestic market was close to or larger than sixteen other countries. By 1980, however, the market in Canada will be less than one-quarter of the average size of the larger economic units which will have been formed by then. The European Economic Community by 1980 will have about 310 million people, the United States about 230 million, and Japan about 115 million. These population numbers are all substantially higher than the Canadian market. Canada will thus be one of the very few industrial countries in the world without free trade access to a population of one hundred million or more.

It is of interest that Japan and the individual European Common Market countries (with the exception of the United Kingdom) have all been experiencing significantly higher rates of increase in output per man hour in manufactured products than in North America. This has been reflected in an increased share of these countries in the world market for manufactured products. This has been

one factor in the strength of their currencies relative to the U.S. and Canadian dollar during the 1970's.

A second major development is the increased economic and political power and influence of the developing countries. Data on population, income level and growth rate for some of the major countries and regions are shown in Table 20 It is significant that the population in the developing countries (ex. Communist China) is almost three times that in the developed countries. It is also interesting that real GNP per capita has gone up by 3.0 per cent per year from 1950 to 1975 in the developing countries (ex. China) and by 4.2 per cent in China. There has been considerable variation in the experiences of individual countries, of course, but about 30 non-OPEC countries have achieved increases in real GNP per capita in excess of 2.0 per cent per year since 1950. These increases compare with 2.0 per cent in the United States and 2.2 in both Canada and the United Kingdom over the same twenty-five year period.[74] This suggests a more favourable experience for the developing countries, both individually and as a group, since 1950 than has been generally recognized. They do continue to have real income levels substantially below the developed countries (Table 20, column 2) and these differences will persist for extended periods into the future even if these differential growth rates between the developing and developed countries persist.[75]

TABLE 20

Population and Real GNP Per Capita,
1950 - 1975

Region	1975 Population (millions)	GNP per capita: 1975 (1974 U.S. $'s)[b]	GNP per capita: Annual growth rate, 1950-75
South Asia	830	132	1.7
Africa	384	308	2.4
Latin America	304	944	2.6
East Asia	312	341	3.9
China, People's Republic	820	320	4.2
Middle East	81	1,660	5.2
Developing countries	2,732	375	3.4
Developing countries excluding China	1,912	400	3.0
Developed countries[a]	654	5,238	3.2

a. All OECD countries except Greece, Portugal, Spain and Turkey.
b. Based on 1974 exchange rates. These tend to seriously overstate the real income gaps between rich and poor nations, but more satisfactory data on a comprehensive basis are not available.

Source: David Morawetz, Twenty-five Years of Economic Development, 1950 to 1975, (Washington: The World Bank, 1977), p. 13.

Exports from these developing countries tend to consist of petroleum (particularly from the OPEC countries whose income and balance of payments position is quite different from the others), primary products, and labour intensive manufactured products. Per capita imports of manufactured products from the developing countries into the major developed countries was relatively low. For example, the average for 1971 to 1975 was $26 in Canada, $34 in the United States, $28 in the EEC and $22 in Japan. The increases in imports of manufactured products from the developing regions to the major industrialized countries has been more rapid than in total imports over the last decade, however.[76]

The level of effective tariff rates on labour intensive manufactured products in the industrialized countries continues to be high.[77]

A third major development has been a clear tendency for international trade in manufactured products to grow more rapidly than both manufacturing production and total trade in most of the industrialized countries. This has been influenced to an important extent by the reductions in both tariff and non-tariff barriers to trade under the various multilateral negotiations as part of the General Agreement on Tariffs and Trade during the post-war years, and the regional reductions by the European Economic Community and the initial European Free Trade Association. By 1968 there was complete free trade within the European Common Market and by 1977 there was a full implementation of the tariff-free exchange of manufactured products between the EFTA countries and the European Economic Community. The increased flow of trade in manufactured products was more rapid than increased volume of manufactured production among most of the industrialized countries. These changes have been particularly dramatic over the last two or three decades, as shown in Tables 21 and 22. There has been an increased interdependence in trade flows for most of the industrialized countries in recent decades, and this has been especially marked in trade in manufactured products.

A fourth major development in the world environment of relevance to Canada is the declining relative importance of the mining industry in individual countries and trade in minerals and metal exports on a world basis. Mining has tended to decline in importance as a share of the individual industrialized economies, as measured by employment and national income by industry. Mining in the United States reached its peak share of the economy in 1930; the major countries in Europe experienced a declining share much earlier (Germany in 1907, Austria in 1910, Belgium in 1920, and Great Britain in 1921,

for example). In Canada, mining reached its peak share in 1911. A similar decline in the share of metal exports has gone on since before the First World War. From 1929 to 1959, total metal exports increased by about 75 per cent, while international trade in manufactured products more than tripled. The more rapid growth in manufactured product exports than in metal exports has continued since 1960. This tendency for a slower growth in international trade in primary products than in manufactured products has been quite widespread, with the important exception of petroleum products.[78] Since 1960, the increases in export volume of primary products (the first three lines of Table 22) have been well below the increase in total exports, while the increases in manufactured products (the last three columns of Table 22) have all been greater than the increase in total exports.

TABLE 21

World Levels of Trade Volume,
Selected Years, 1911 to 1960
(Index Numbers, 1913=100)

Period	Manufactures	Primary Produce
1911 - 1913	94	97
1936 - 1938	100	125
1948 - 1950	132	116
1960	297	208

Source: David W. Slater, World Trade and Economic Growth: Trends and Prospects with Applications to Canada (Toronto: University of Toronto Press for the Private Planning Association of Canada, 1968, p. 8.)

TABLE 22

Changes in Volume of Commodity Exports,
All Market Economies,
1960 - 1976

Food, etc.	+111
Raw materials, excl. fuels	+ 78
Fuels, etc.	+165
Chemicals	+427
Machinery	+350
Other Manufactures	+251
Total	+217

Source: Industry, Trade and Commerce, Canada's Trade Performance, 1960-1977, Volume 1, General Developments (Ottawa: Supply and Services, October 1978), p. 6. The exports from the market economies amount to about 90 per cent of all world exports in 1976. Ibid., p. 4.

These developments in the world environment are of some importance for Canada and its comparative advantage outlined in earlier chapters. For one thing, Canada historically has had an important comparative advantage in mineral products, both in terms of the supply of mineral products in relation to total population and labour force, and in the markedly high levels of output per person in the mining industry in Canada compared to the United States. However, trade in minerals and metal products has been a declining share of world trade for some decades, and some of the developing countries are becoming a more important source of supply.

World trade in manufactured products has been growing at a rapid rate during the post-war years, more rapidly than the growth in both the real GNP's and manufacturing production in the developed countries. However, Canada has been a high cost, low productivity producer of manufactured products historically and the shift from wage levels below the United States as had been the situation for many years to levels above in recent years has essentially

offset the greater increases in output per man hour that has taken place since the 1950's. The substantially lower levels of wage rates in the developing countries and the extent of increases in imports of selective products in recent years has intensified import competition domestically. Canada has some serious comparative disadvantages in the production of manufactured products, one of the important high growth areas in world trade.

Canada has participated to an important extent in the increased interdependence in world trade in manufactured products. The narrowing in the productivity gap in manufacturing between Canada and the United States has been discussed in Chapter 4, and a number of Canadian manufacturers have been increasing the share of exports in their domestic production. This increase was particularly rapid during the 1960's, when the Canadian dollar was at a discount, and before the more rapid increase in wages and unit labour costs in Canada than in the United States that began at the end of the 1960's. The increase in exports was particularly marked in the area of automotive trade under the Canada-United States Automotive Products Agreement, but was not limited to that area of manufactured products. The increase in Canadian exports of manufactured products was from an initially low base in 1960, but further increases in imports of manufactured products led to a larger net trade deficit in manufactured products (especially high technology items) in the 1975 - 77 period than earlier.[79]

It might also be noted that Canadian trade is heavily concentrated on both the export and import side with the United States. It has had the highest real income in the world, but the rates of growth in real GNP per capita have been higher in all the industrialized and many of the developing countries than in the United States since 1950.

What sort of options does Canada have in the future to use its human resources and capital and natural resources effectively to continue to achieve high and rising levels of real national income? This is the range of questions to be considered in Chapter 6.

6. CANADIAN POLICY OPTIONS AND FUTURE RESEARCH

Earlier chapters set out the quantitative dimensions of Canada's comparative advantage in relation to other countries using the available evidence to make the differences as clear and explicit as possible. In looking at the past and its relevance to the future, it is possible that dynamic changes could take place in the future, as they have in the past. In a sense, possible policy changes are to a degree designed to modify patterns for the future from what they have been historically. However, it is also true that any changes over the 1980's are likely to be small. The existing heavy reliance on natural resource industries in domestic employment, production, investment and exports is likely to change only slowly. The existing distribution of education in the labour force reflects the formal education levels completed in Canada (or the country they emigrated from in the case of immigrants). Typically, the formal education a worker enters the labour force with is the level they have on retirement some four decades later. It will take a long time before the higher levels of education of post-war entrants to the labour force have replaced the lower levels of older workers as they retire. Quick changes are not to be expected. The question is the direction in which a number of marginal changes can be made. This chapter will consider some of the possible options with special emphasis on manufacturing (and the other commodity producing industries to a lesser degree). It provides some evidence and perspective on industrial strategy for Canada, and what some of these policy options would involve for levels of real GNP per capita and per person employed.

a) The Quantity and Quality of the Factors of Production

Chapter 2 discussed the quantity and quality of Canada's factors of production in an international perspective, with special emphasis on the quantity of the various factors of production on a per person employed basis. The levels

of land, natural resources and capital stock were all higher than in the United States, Japan or the individual countries of Northwest Europe. On the other hand, levels of education in the Canadian labour force continued to be lower than in both the United States and Japan. These differences were partially offsetting in relation to the United States, so that almost none of the differences in real income per person employed as estimated for the year 1960 could be explained by any differences in factor input per person employed.[80] A major theme that emerges then is that the primary emphasis of policy should be on the more effective use of resources rather than increasing the supply of individual productive factors.

A number of observers in the United States have recommended a variety of stimulants to business investment as a partial corrective to the slowdown in productivity growth that has taken place in the United States since 1973. Such proposals include the shift to replacement cost in estimating depreciation charges for tax purposes, reduction of corporate income tax rates, further acceleration of depreciation charges, elimination or reduction of double taxation of corporate dividends, revisions of the capital gains tax, and some adjustments of the personal income tax.[81] Many of these proposals reflect a flow of funds or a savings oriented theory of investment. An alternative theory of investment is the acceleration principle, which would emphasize the pressure of demand against capacity as the primary determinant of corporate investment decisions.[82] According to this second view, if corporations were operating at low rates of capacity utilization, they would be unlikely to expand capacity significantly even if their internal flow of funds were to be increased by tax changes. After all, why would they be willing to further increase investment and capacity if they were not using their existing capital facilities fully?

Some Canadian observers have suggested changes in tax legislation for the same considerations put forth by John Kendrick and others in the United States.[83] However, it would seem inappropriate to extend the recommendations to further stimulate capital investment and the size of the capital stock in Canada. For one thing, the evidence discussed in Chapter 2 (esp. Tables 5, 6 and 7) indicates that Canada already has higher levels of capital stock per person employed than in the United States, and this difference has been growing during the 1960's and 1970's. Some further adjustments in taxation may be appropriate (such as a shift from historic cost to replacement cost depreciation), but it seems more appropriate to put the primary emphasis on the more efficient use of the capital resources Canada already has than to stimulate it further by additions to the levels of capital stock in relation to labour inputs. Furthermore, further increases in the internal flow of funds on an after tax basis would be unlikely to lead to a further acceleration in investment until operating rates have increased further.

Education of the labour force is a further important area for Canada. Chapter 2 contained evidence that the levels of formal education of the labour force in Canada are lower than in the United States, and slightly below the level in Japan, in spite of the increases in high school and post-secondary education of young people that have taken place in recent decades. It was also suggested that less vocational training and systematic in-service training by corporations and other organizations takes place in Canada than in other countries. There has also been less emphasis on training in commerce, business and administration in Canada than in the United States. There has clearly been a somewhat limited supply of people in the Canadian labour force with relevant training. However, there are also some indications that the demand for these types of training has not been as vigorous and persistent as in the United States. For example, the starting salaries of bachelor degree graduates have fallen from a

level above the average industrial earnings in the late 1960's to the same or below by late in the 1970's.[84] Furthermore, there has not been as rapid a movement of those with university degrees into positions of middle and senior level management as has taken place in the United States.[85] A resolution of the issues on the direction and extent of resources to education will not be attempted here. For the purposes of this study it should be remembered that changes in education levels of the Canadian labour force can occur only slowly. About 400,000 young persons move into the labour force from the educational system each year during the late 1970's, which is a bit under 4 per cent per year of the total labour force[86] (and this is one of the highest rates of any of the industrialized countries in the world). It will thus take some decades to raise the average level of education in the total labour force, and the average education of new labour force entrants continues to be lower in Canada than the United States. Canada will continue to be at a comparative disadvantage in education levels relative to the United States for the balance of the current century, if not longer. This affects the feasibility of seriously recommending on emphasis of knowledge intensive industries, for example.

Under these circumstances, primary consideration should be given to areas in which Canada already has a comparative advantage, or industries in which major improvements can be made in the efficiency with which resources are used without large offsetting transitional costs.

b) Economies of Scale in Manufacturing and the Size of the Canadian Market

Chapters 3 and 5 pointed out that Canada is now one of the few industrialized countries in the world whose manufacturers do not have access to a market of one hundred million people or more on essentially a free trade basis. This is a significant change from as recent a period as 1960, when there were about fifteen other countries with a comparable domestic population

or less. It is primarily the tariff and non-tariff barriers to trade in the small countries and their trading partners that is the primary factor that limits their sales of manufactured products to the small domestic market. Transport costs, marketing costs and other factors can also be cost factors that make export markets less profitable and more competitive than sales in a smaller, protected market.

The major cost disadvantages from small market size are associated with an excessive degree of product diversity at the individual plant level. The differences in product diversity are both very widespread and have a significant impact on higher costs. Plant sizes are also sometimes less than the minimum efficient scale, but this tends to be in industries with high, rather than low, effective tariff rates. These smaller plants tend to have higher costs, but the impact on costs tends to be smaller than the higher costs associated with the significant degree of product diversity. There are differences in costs on the non-production side as well (advertising, financing costs, and research and development), but these are usually only a small part of total corporate costs, and thus cannot be as major a factor in the cost differences as those identified in production costs.

These cost factors are clearly interrelated. As long as many Canadian companies in manufacturing (both domestically and foreign owned) tend to be high cost on the production side in domestic and world markets, they are unlikely to become world scale national corporations. Measures of rationalization at the company level or other steps to encourage world scale companies are unlikely to be very successful unless the major factors encouraging high costs and inhibiting world scale companies are dealt with first.[87]

c) Commercial Policy

A major theme in earlier parts of this study is that the Canadian economy has serious comparative disadvantages in the production of a wide range of manufactured products. Although a variety of factors interact in both the reasons for this and possible solutions, a central reason for the high cost, low productivity phenomenon is the persistence of a significant degree of product diversity in a large number of plants, firms, and industries (both Canadian owned and U.S. owned). There are no incentives for the firm to modify these practices on their own individual initiative. Furthermore, there are insufficient pressures on companies from external sources, as long as the levels of effective tariff rates in Canada æe high. There are, of course, some exceptions. Primary steel, for example, has introduced relatively more modern plants with the use of the oxygen process and electric furnaces and has been quite efficient without using the full tariff protection available. Some electric products such as hydro electric generators, hydraulic turbines, are also competitive in world markets.

The magnitude of the decline in the value of the Canadian dollar after the summer of 1976 has eased the extent of price competition from imports in the Canadian market. The problem is not exclusively of the kind that is sometimes termed as market failure (where monopoly or highly concentrated industries with significant barriers to entry can charge prices above marginal costs and earn high profits). Instead, the situation is one where the predictable response of the firms to the environment created by government policy is to encourage firms to produce a wide range of products, even when business firms are fully aware that this will lead to higher costs per unit and lower levels of output in relation to existing inputs of labour and capital. Market concentration and high tariffs in combination are involved.

Extended discussion of the potential gains to Canada from tariff reductions in any form does not seem appropriate at this time, primarily because of a number of studies of this topic in recent years, including the Economic Council study Looking Outward.[88] The recent multilateral tariff negotiations are now in the process of being approved by governments with implementation beginning in 1980. Several conclusions from earlier studies might be mentioned to provide perspective.

The potential gains to Canada from tariff reductions are significant. For example, R. J. Wonnacott has estimated the gains from free trade with the United States of 8.2 per cent in 1974. The study recognizes that this estimate may be conservative as it does not allow for changes in the pattern of consumption, does not allow for increased returns to the non-labour factors of production, and is based on increased productivity in the manufacturing sector only (without allowing for secondary effects in other industrial sectors). Furthermore, these gains only relate to the gains from a free trade area with the United States and not the additional economic gains from a multilateral free trade approach to reductions in tariff and non-tariff barriers.[89]

Another important consideration is that reductions in tariff and non-tariff barriers will require adjustments on the part of existing plants and firms in both their production and marketing strategies. One of the purposes of tariff reductions is to encourage such adjustments on a widespread basis, as it is unlikely that significant adjustments can be initiated any other way. The big question is whether such adjustments will be easy or difficult for business firms and workers to make. In so far as increased specialization and a reduction in the degree of product diversity is necessary to reduce costs per unit, this should be a relatively simple problem for business management to deal with once they have decided that such changes are necessary and desirable. It would be a

much more difficult adjustment problem if companies had to increase plant sizes on a widespread basis, or if major consolidations of firms seemed necessary.

An important theme in this study (and the empirical work on which it is based) is that the persisting lower levels of real output per man and per man hour in Canada than in the United States are related to a significant degree to the presence of tariffs and non-tariff barriers to trade in Canada and other countries. It is both interesting and significant that the productivity differences in both manufacturing and the automotive and parts industries have narrowed with the reductions initiated under the Kennedy Round and the Canada-United States Automotive Agreement.[90] These considerations led to a reduction in the size of the potential gains from a Canada-United States free trade agreement that R. J. Wonnacott had made for 1974 compared to the earlier estimate for the same type of a-rangement he had previously made for the late 1950's.[91]

Although the presence of tariff and non-tariff barriers are emphasized in the persistence of lower levels of productivity in individual Canadian manufacturing industries, other influences on the domestic side can also be present (such as management differences, for example). A number of regression studies have failed to find high correlations between differences in productivity and Canadian tariff rates, especially when other variables such as market size are allowed for.[92]

It is surprising in light of the weight of the evidence on the general effects of tariffs on productivity that a number of recent studies have implicitly assumed that the previous differences in productivity would persist in spite of reductions in tariffs. These studies of the Canadian economy naturally end up with smaller gains from tariff reductions and an exaggerated view of the magnitude of the adjustment problem.[93] These studies all made estimates on the basis of input-output models and consistently assumed constant returns to scale, no increased real output in relation to labour and capital

inputs from reduced tariffs, and unchanged input-output coefficients. An important exception is a study by Industry, Trade and Commerce that made adjustments to the input-output coefficients and other parameters on the basis of specialist knowledge of the departmental commodity and industry officers.[94]

There are, of course, a number of steps that governments can take to facilitate the necessary adjustments from a high cost, low productivity position as a producer of manufactured products into a more internationally competitive position, and time must be allowed for these adjustments to take place.[95] Some of the major recommendations would include the maintenance of appropriate aggregate demand policies during the transition, that the government accept the economic costs of moving to new occupations and locations (including training, relocation, early retirement in industries adversely affected by rapid trade liberalization), and re-examine the existing programmes for change and modernization in industry, including the faster adoption of new technology. All of these steps would help reduce the transitional costs of moving from the present situation in manufacturing to one where Canadian manufacturing would be internationally competitive in a wider range of products and use the existing resources of labour, capital and natural resources more effectively.

There are, however, a number of uncertainties about the medium term, and that is what the geographic distribution of new plant locations would be in North America with further tariff reductions. The most comprehensive study of the location of industry in North America was done by R. J. Wonnacott and Paul Wonnacott for five Canadian and thirteen U.S. regions. That study examined wage costs, transport costs, proximity to natural resources and manufactured supplies, capital costs, and federal taxes. Most of the cost data related to the year 1958 with later material in only a few tables.[96] At that time, wages in Canadian manufacturing were well below the United States, and the Canadian dollar was on a fixed exchange rate at a discount in relation to the U.S.

dollar when the book was written. Since then, however, Canadian wage rates in manufacturing have moved above the United States, and the Canadian dollar has been at a premium (of about three cents some months of 1974 and 1976) and a discount of about 15 per cent in late 1977. In addition, there have been some shifts in wage levels in the United States (with wages in the Northeast moving further above the national average, and wages in the South further below the national average). There has been a relative shift of industry away from the northeast towards the south and west.[97] There has also been a further increase in the extent of international trade that takes place between affiliated companies. A re-examination of industrial location in North America with tariff reductions seems essential in light of the extent of changes that have taken place over the last two decades. It would also be desirable to examine the extent to which changes in the exchange rate could affect the competitive position of Canadian manufacturing, and the longer-term changes in the location of manufacturing industry.

d) Science Policy

There is occasional interest in the longer term prospects in Canada for high technology industries, or what the Japanese term knowledge intensive industries. There are a variety of considerations relating both to the availability of the various factors of production and market size that affect the ease with which Canada could be an effective international competitor in these areas. Some of these considerations would be the general level of education in the labour force, the proportion of the labour force with backgrounds in science and engineering, the degree of openness to change, and market size (that can reduce the overhead costs of new projects over long runs).

Earlier chapters have provided evidence on all these points for Canada in an international context, and on most of them the Canadian score is low rather than high. The general level of education in the Canadian labour force is lower than the United States or Japan, and the average education of younger labour force entrants continues below the United States. The proportion with science and engineering training is also less than in the United States, and the proportion of those with such training in the private sector is well below that in the major industrialized countries. Chapter 4 pointed out that manufacturers in other industrialized countries could spread the overhead costs of research and development over longer runs and larger markets than was normally possible for Canadian firms. Furthermore, a number of studies have shown that Canada tends to be slow adopting new technology and new products tend to be produced first in other, and larger, markets. Changes in a number of these factors in Canada relative to other countries would be necessary before widespread success in knowledge intensive industries in the world market would become more promising.

In the light of this analysis, one must question the emphasis of current science policy in Canada that provides a significant tax incentive to industry to expand research and development expenditures, while providing only minimal support to facilitate the dissemination of information on current best practice technology. Payments by the federal government to Canadian industry for research and development exceeded $100 million per year late in the 1960's, and the combination of a variety of direct incentives and the tax incentive introduced in the 1978 budget would approach $200 million per year. Compared with these incentives to primary research and development (that only amounts to about 10 or 15 per cent of the total costs of introducing new products, including engineering and marketing production and start up costs), federal assistance on the more costly share of the total technological process is small.

For example, the Technical Information Service of the National Research Council had a budget of only $1.9 million in 1977-78 and was one of the few federal government organizations in Canada with the basic objective of increasing the productivity of Canadian manufacturing through better utilization of existing technology. There is also some encouragement to the better utilization of existing technology through the Interfirm Productivity Comparison project in Industry, Trade and Commerce, and the same department's Programme to Enhance Productivity and the Footwear and Tanning Industries Adjustment Programme. The CASE programme in the Federal Business Development Bank presumably makes some recommendations towards implementing modern technology.

One of the industries experiencing import competition was the textile industry, which is heavily centred in Quebec. An industry-government task force recommended the establishment of a Productivity and Development Centre for the clothing industry in October 1972 to encourage improved technological and managerial practices within the industry. A similar recommendation was made by the Textile and Clothing Board in its Clothing Inquiry report. Some assistance is provided to the Winnipeg Regional Productivity Centre but no action has yet been taken by the federal government on these recommendations in the major producing regions of Ontario and Quebec. It is still valid, however, that the major emphasis in federal policy has been on the creation of new technology, rather than fast adoption of existing technology.

Only if research and development projects are successful on both the technical and marketing sides does any real benefit accrue to the consumer in the form of lower prices and to the economy in the form of higher output in relation to inputs. The present form of incentive for research and development covers only a small part of the total cost of bringing a new product to successful and profitable production, and when it primarily emphasizes new technology, the primary benefit accrues to the professional staff who have been directly involved in research and development.

There have been reports over the years of new products and processes that have initially been developed in Canada (sometimes with government financial assistance on the research and development costs), that have been eventually brought to successful commercial production in other countries. It would be helpful to know more about such situations, including the technical, the organizational and the marketing aspects that led to the contrast in experience between Canada and the other countries.

(e) Canada's Comparative Advantage in the Future

Preceding pages of this study have shown marked contrasts in the areas of industrial strengths on the one hand, and industrial weaknesses on the other, using comparisons with the major industrialized countries as a basis of comparison.

Some of the natural resource industries come off very favourably in such a comparison -- Canada is clearly one of the best endowed with natural resources of any of the high income countries in the world. It is also true that these products have not been growing rapidly in relation to world trade, and Canada is experiencing increased competition from alternative sources of supply (including the developing countries). Furthermore, changes in taxation, pollution standards, and federal-provincial rivalries and conflicts have contributed to a less favourable domestic environment for further expansion than has been true historically in Canada.

On the other hand, some areas of manufacturing have been identified as competitively weak in relation to world markets, in the sense that costs have been higher than in other countries (although this has been partially offset by the lower value of the Canadian dollar in late 1978). Canada has not had as high a proportion of the labour force with the technical and managerial skills that are needed for high technology industries, as in the

United States. Furthermore, the levels of real output in many of the individual manufacturing industries (both standardized mature products and the dynamic high technology products) are relatively low in relation to labour and capital inputs. In addition, the shift from a pattern of wage rates in many Canadian manufacturing industries being lower than in the United States to levels above the U.S. national average has further accentuated the problems of high costs per unit, especially when wages are such a high proportion of value added and national income in manufacturing. Canadian firms (both Canadian owned and subsidiaries) are aware of practices being effectively used elsewhere, but the smaller protected Canadian market both reduces the external pressure to adopt new technology quickly and blunts the financial incentive both on the cost and market size side.

On the basis of the evidence and analysis developed here, it is quite unrealistic to expect these comparative disadvantages to be seriously modified in any major way without further reductions in the tariff and non-tariff barriers to trade in manufactured products both in Canada and in the other major industrialized countries. Although changes in tariff barriers are necessary, they are clearly insufficient, and a number of recent Canadian studies have discussed additional policy changes to facilitate the adjustment process to reduced tariffs. Some studies have suggested that changes in Canadian tariff policies be deferred until domestic costs and the associated changes in industrial structure and performance be corrected, but this is unlikely to happen from exhortation or government direction if there are neither financial incentives or financial pressures for change.

In the meantime, any steps to shift resources from industries where Canada has a comparative advantage internationally, to industries where costs are high and productivity is low by international standards would only

further lower Canadian real incomes below their potential. Measures to encourage high technology industries would involve supporting areas where Canada clearly now has serious comparative disadvantages.[98] An improvement in competitiveness in Canadian manufacturing would improve the opportunities of getting into export markets that have been experiencing the greatest growth, but is also highly competitive and more open to change than what workers and management have been accustomed to.

It is now one hundred years since Sir John A. MacDonald introduced some of the major elements of national policy. Some of the questions being raised then about the Canadian economy are still with us today.

f) Future Research

This study has put heavy emphasis on the use of inter-country comparisons using the framework of economic growth accounting. Work along these lines was initiated by the Economic Council in its early days, but research on intercountry comparisons of productivity has not been a high priority topic in recent years. This study has had to rely on earlier work, or limited updating in some cases. Three interrelated areas are recommended for consideration as part of any re-examination of productivity.

An important step is a re-estimation of real GNP on an intercountry basis. Dorothy Walters and Craig West did this initially for 1965, and some updating has been done for this study. In recent years the United Nations and World Bank have sponsored an International Comparisons Project that has considerably improved the methodology, commodity specification and comprehensiveness of such measures. They have also recommended that such studies be updated about every five years. Such measures are superior to those made by conversions using exchange rates. It has been established that these are normally biased to overstate the real income differences between countries, and the exchange

rate changes of recent years have normally not been associated with analogous changes in real income per capita.[99] It is now about fifteen years since the only comprehensive comparison of real GNP between Canada and the United States was made, and this is far longer than the International Comparisons Project would regard as desirable. A new survey comparable to that used in the International Comparisons project would be extremely useful.

A second proposal is to redo an aggregative economic growth comparison of Canada in relation to the other industrialized countries. Economic growth with important changes in education, capital stock, productivity and demand pressures have taken place, and new estimates of GNP, capital stock and census data have become available. Later work by E. F. Denison has introduced some changes in method (such as an emphasis on the business sector, revised weights for educational differences, and annual estimates), and it is desirable that these be incorporated into future Canadian work. It is important that changes over time and intercountry comparisons at a point in time be done simultaneously, as the analysis can be far richer if both are done simultaneously than if comparisons over time or between countries at a point in time were done independently. Ed Denison has estimated that this might take three man years of professional time, with associated support staff.

The third recommendation would be to do more intercountry comparisons of output per man hour for individual industries to supplement and complement the comparisons for the economy as a whole. Comparisons for manufacturing and mining have been done for Canada and the United States for the 1970's, but comparisons for trade, services, transportation and construction have not been done. These are quantitatively very important in terms of employment and national income. The evidence for Canada and other countries is that these differences by industry can be very large and persistent, but for large sectors of the Canadian economy, the evidence is either dated or nonexistent.

Growth and technological change is clearly an important element in Canada and other counries, both industrialized and developing. These are important elements in Canada's comparative advantage and levels of real income. More detailed and more current data and analysis for Canada in the future is desirable. Such information is an important underpinning for economic analysis and policy along lines illustrated in this study.

FOOTNOTES

(Note: These will eventually appear at the bottom of each page, but are numbered consecutively in this draft).

1. As illustrations of some of the main standard texts and books of readings in international trade covering these topics, see Jagdish Bhagwati, ed., International Trade: Selected Readings (Middlesex, England: Penguin, 1969) pp. 77-168; Richard E. Caves and Harry G. Johnson, Readings in International Economics (Homewood, Ill.: Richard D. Irwin, 1968), pp. 3-98 and 503-604; Richard E. Caves, Trade and Economic Structure (Cambridge: Harvard University Press, 1967, pp. 1-189; Richard E. Caves and Ronald W. Jones, World Trade and Payments, An Introduction (Boston: Little, Brown and Company, 1973), pp. 103-226; Miltiades Chacholiades, International Trade Theory and Policy (New York: McGraw-Hill, 1978), pp. 13-309; P. J. Ellsworth and J. Clark Leith, The International Economy, Fifth edition (New York: Macmillan, 1975), pp. 8-191; Herbert G. Grubel, International Economics (Homewood, Ill.: Richard D. Irwin, 1977), pp. 11-89; Charles P. Kindleberger, Fourth edition, International Economics (Homewood, Ill.: Richard D. Irwin, 1968), pp. 19-69; Franklin R. Root, International Trade and Investment (Cincinnati: South-Western, 1973), pp. 55-136; W. M. Scammell, International Trade and Payments (Toronto: Macmillan, 1974) pp. 13-133; Jacob Viner, Studies in the Theory of International Trade (New York: Harper and Bros., 1937), Chapter VII.

2. Eli Heckscher, "The Effects of Foreign Trade on the Distribution of Income," Economisk Tidskrift, 1919, translated and printed in Howard S. Ellis and Lloyd A. Metzler, eds., Readings in the Theory of International Trade (Homewood, Ill.: Irwin, 1950), pp. 272-300, and Bertil Ohlin, Interregional and International Trade, rev. ed., (Cambridge, Mass.: Harvard University Press, 1967). For additional references and discussion of tests of the two main alternative theories of relative prices, see D. J. Daly, "Uses of International Price and Output Data" in D. J. Daly, ed., International Comparisons of Prices and Output (New York: Columbia University Press, 1972), esp. pp. 91-123.

3. Irvin B. Kravis, "'Availability' and Other Influences on the Commodity Composition of Trade," Journal of Political Economy, April 1956, pp. 143-55; Raymond Vernon, "International Investment and International Trade in the Product Cycle," Quarterly Journal of Economics, May 1966, pp. 190-207; H. G. Johnson, Comparative Cost and Commercial Policy Theory in a Developing World Economy (Stockholm: Alqvist and Wiksell, 1968); Raymond Vernon, ed., The Technology Factor in International Trade (New York: Columbia University Press, 1970).

4. All of these comparisons are based on relative price comparisons of the individual expenditure components of GNP, rather than comparisons based on exchange rates (which tend to understate real income levels relative to the U.S.). Wide swings in exchange rates between individual countries have frequently not corresponded to changes in these real purchasing power parity equivalents based on GNP price comparisons between countries. Evidence on and discussion of the reasons for the differences in income levels and growth is contained in the various studies by E. F. Denison and others listed in the sources for Table 4 and other tables.

5. L. Auer, Canadian Agricultural Productivity (Ottawa: Queen's Printer, 1970), pp. 14, 15, 18 and 63. The constant dollar comparisons are based on 1949 prices, and in that year, prices of some of the main crops and livestock were roughly similar of offsetting. Updating can be done by the agricultural data in Aggregate Productivity Measures, 1946-1977 (Ottawa: Statistics Canada, 1978) and unpublished worksheets made available by Statistics Canada. Results by Hayami and associates give 226 for the United States and 168 for Canada in the 1957-62 period, or 74 per cent of the U.S. New Zealand and Australia are both well above North American levels at 322 and 241 respectively (U.K.=100). Y. Hayami, with B. Miller, W. Wade and S. Yamashita, An International Comparison of Agricultural Production and Productivities (University of Minnesota Agricultural Experiment Station, Technical Bulletin No. 277). Quoted in Irving B. Kravis, "A Survey of International Comparisons of Productivity," Economic Journal, March 1976, p. 28.

6. The total tariff and non-tariff protection to agriculture in 1970 was 7.00, while it was 27.50 in wheat and 18.20 in industrial milk. See Economic Council of Canada, Looking Outward (Ottawa: Information Canada, 1975), p. 17. All comparisons are expressed as a percentage of domestic price. For comparisons of 177 commodities see Roma Dauphin The Impact of Free Trade in Canada (Ottawa: Supply and Services for the Economic Council of Canada, 1978), pp. 44-49.

7. Economic Council of Canada, Looking Outward (Ottawa: Information Canada, 1975), p. 148.

8. This procedure uses data on current production of mineral products, weighted by U.S. prices. An alternative possibility would be to measure mineral reserves, but this measure depends on the degree of exploration, and the technology and transportation costs of mineral recovery. Reserves and production have increased over time. See Harold J. Barnett and Chander Morse, Scarcity and Growth: The Economics of Natural Resource Availability (Baltimore: Johns Hopkins Press, 1963), pp. 151-251. The measure used seems a helpful proxy for a rough guide to comparative advantage between countries in the mineral industry.

9. James G. Frank, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: The Conference Board in Canada, 1977), pp. 71 and 113. These data overstate the Canadian levels relative to the United States by not allowing for the higher prices of machinery and equipment in Canada, as shown in Table 6. This would not affect the conclusion of more rapid growth in the capital stocks in Canad- than in the United States that is made in the text.

10. Patrick and Rosovsky, Asia's New Giant: How the Japanese Economy Works (Washington: The Brookings Institution, 1976), pp. 82 and 90.

11. See D. J. Daly and S. Globerman, Tariff and Science Policies: Applications of a Model of Nationalism (Toronto: University of Toronto Press, 1976), pp. 43-45. Harry Postner points out that a series of studies have shown that Canadian exports are more capital intensive than imports, while similar U.S. studies have shown the reverse. Harry Postner, Factor Content of Canadian International Trade: An Input-Output Analysis (Ottawa: Information Canada, 1975), p. 28.

12. Bruce W. Wilkinson, Studies in the Economics of Education, Economics and Research Branch, Department of Labour, Occasional Paper No. 4 (Ottawa: Queen's Printer, 1966); Gordon W. Bertram, The Contribution of Education to Economic Growth, Staff Study No. 12 for the Economic Council of Canada (Ottawa: Queen's Printer, 1965); Dorothy Walters, Canadian Income Levels and Growth: An International Perspective, Staff Study No. 23 for the Economic Council of Canada (Ottawa: Queen's Printer, 1968), Chapter 6.

13. Frank Gibney, Japan: The Fragile Super Power (Tokyo: Charles E. Tuttle, 1975), pp. 225-31 and Aso Makato and Ikuo Amano, Education and Japan's Modernization (Tokyo: Ministry of Foreign Affairs, 1972).

14. Klaus Weiermair, "Industrial Training and Industrial Excellence: Canada's Record in International Perspective," (York University, Downsview, mimeo 1978).

15. For evidence on which this paragraph is based and further discussion of the reasons for this pattern, see D. J. Daly, chapters on "New Approaches in the development of managers" and "Managerial manpower in Canada" in H. C. Jain, ed., Contemporary Issues in Canadian Personnel Administration (Toronto: Prentice-Hall, 1974); D. J. Daly and Rein Peterson, "On Bridging the Gaps," Management Science, 1973, pp. 550-69; D. J. Daly and S. Globerman, Tariff and Science Policies: Application of a Model of Nationalism and D. J. Daly, "Canadian Management: Past Recruitment Practices and Future Needs" (Downsview: Background Paper for Management in the 1980's Conference, 1979).

16. Harry Postner, assisted by Don Gilfix, The Factor Content of Canadian Trade: An Input-Output Analysis (Toronto: Information Canada, 1976); D. Wahl, "Capital and Labour Requirements for Canada's Foreign Trade," Canadian Journal of Economics and Political Science, August 1961; and J. Williams, "The Resource Content in International Trade," Canadian Journal of Economics, February 1970. These authors have consistently maintained the Heckscher-Ohlin assumptions of similar production conditions between countries and unchanged input-output coefficients.

17. B. Balassa, "Trade Liberalization and Revealed Comparative Advantage," The Manchester School of Economics and Social Studies, 1965.

18. Harry Postner, The Factor Content of Canadian Trade: An Input-Output Analysis, pp. 26-27.

19. Harry Postner, Ibid., p. 31.

20. F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally and Company, 1971), pp. 72-103; F. M. Scherer, "Economies of Scale and Industrial Concentration" in Harvey Goldschmid et.al, Industrial Concentration: The New Learning (Boston Little, Brown, 1974) pp. 16-54 and F. M. Scherer, et.al. The Economics of Multi-Plant Operation: An International Comparisons Study (Cambridge: Harvard University Press, 1975). These distinctions have been developed more fully with emphasis on applications to Canada in D. J. Daly, "Economies of Scale and Canadian Manufacturing" in L. Auerbach, ed., Appropriate Scale for Canadian Manufacturing (Ottawa: Science Council of Canada, Feb. 1978), pp. 9-26 and D. J. Daly, "Size and Economies of Scale" in Paul K. Gorecki and W. T. Stanbury, eds., Perspectives of the Royal Commission on Corporate Concentration (Montreal: Institute for Research on Public Policy), pp. 87-97.

21. D. J. Daly, B. A. Keys and E. J. Spence, Scale and Specialization in Canadian Manufacturing (Ottawa: Queen's Printer, 1968), pp. 20-25 and other studies cited in Daly and Globerman, Op.cit., p. 24.

22. Richard E. Caves, Diversification, Foreign Investment and Scale in North American Manufacturing Industries (Ottawa: Information Canada for the Economic Council of Canada, 1975).

23. F. M. Scherer et.al., Op.cit., pp. 295-316, and occasional comments on the effects of product diversity on costs of individual products in Canada.

24. D. J. Daly and S. Globerman, Op.cit., pp. 22-23 and Paul Gorecki, Economies of Scale and Efficient Plant Size in Canadian Manufacturing Industries (Ottawa: Bureau of Competition Policy, Consumer and Corporate Affairs, 1976), pp. 64-74. Other conclusions drawn in this paragraph are based on tables in this study and the detailed tables in the study by E. C. West, Op.cit. See D. J. Daly, "Economies of Scale and Canadian Manufacturing," Op.cit., for additional discussion.

25. D. G. McFetridge and L. J. Weatherley, Notes on the Economies of Large Firm Size (Ottawa: Supply and Services, 1977), pp. 66-70.

26. Donald J. Lecraw, Economies of Scale in Canadian Manufacturing: A Survey (Ottawa: Supply and Services, May 1978), pp. 37-40, and Report of the Royal Commission on Corporate Concentration (Ottawa: Supply and Services, 1978), pp. 62-63. See also D. J. Daly, "Size and Economies of Scale" in Paul K. Gorecki and W. T. Stanbury, Perspectives on the Royal Commission on Corporate Concentration (Montreal: Institute for Research on Public Policy, 1979), pp. 87-97.

27. William S. Comanor and Thomas A. Wilson, "The Effect of Advertising on Competition: A Survey," Journal of Economic Literature June 1979, p. 470.

28. Bank of Canada Review, October 1978, pp. S54 and S55.

28a Irving Kravis, "A Survey of International Comparisons of Productivity," Economic Journal, March 1976, pp. 26-39.

29. Simon Kuznets, Economic Growth of Nations (Cambridge: Harvard University Press, 1971), pp. 208-14.

30. See D. J. Daly, "Uses of International Price and Output Data" in D. J. Daly, ed., International Comparisons of Prices and Output (New York: Columbia University Press, 1972), and subsequent comments by Bhagwati and reply by Daly.

31. Margaret Hall, John Knapp and Christopher Winston, Distribution in Great Britain and North America: A Study in Structure and Productivity (London: Oxford University Press, 1961), Table 1, p. 5 and passim.

32. Economic Review, April 1975 (Ottawa: Information Canada, 1975), p. 127.

33. L. Auer, Canadian Agricultural Productivity (Ottawa: Queen's Printer, 1970), Appendix Table B-6, p. 63, and Irving B. Kravis, "A Survey of International Comparisons of Productivity," Economic Journal, March, 1976, p. 28.

34. D. Walters, Canadian Growth Revisited, 1950-1967 (Ottawa: Queen's Printer, 1970), p. 46. Revisions in the Canadian national accounts in 1976 would further reduce the real GNP differences between Canada and the Unites States since the 1970 study by D. Walters.

35. The concept used is the gross value of production in mining, with the products covered in both countries being valued at U.S. prices. The coverage.amounts to 92.6 per cent of U.S. mineral production and 93.3 per cent of Canadian production. The products included are Dorothy Walters' expanded list, plus cement, sand and gravel, and stone. More specifically, these are coal, natural gas, crude petroleum, iron ore, copper, uranium, zinc, lead, gold, salts, asbestos, nickel, cement, sand and gravel, and stone. Sources are Bureau of Mines, Minerals Yearbook 1973, Vol. 1 (Washington: U.S. Government Printing Office, 1974), pp. 45, 88 and 89, and Energy, Mines and Resources, Canadian Minerals Yearbook, 1971 (Ottawa: Information Canada, 1972), pp. 483, 484 and 547. For a fuller discussion of the mining industry in Canada see D. J. Daly, "Mineral Resources in the Canadian Economy: Macro-Economic Implications," in Carl L. Beigie and Alfred O. Hero, Jr. in The Evolution of Policies and Issues, Vol. 1 of series Natural Resources in U.S., Canadian Relations (Montreal: C. D. Howe Research Institute, forthcoming), Chapter 5.

36. D. J. Daly, "Corporate Strategies and Productivity Performance in Japan's Manufacturing Industries," in Keith A. J. Hay, ed., Canadian Perspectives on Economic Relations with Japan (forthcoming, 1979). This examines the reasons for the high rate of productivity increase in Japanese manufacturing.

37. William V. Rapp, "Firm Size and Japan's Export Structure: A Microview of Japan's Changing Export Competitiveness Since Meiji," in Hugh Patrick, ed., Japanese Industrialization and its Social Consequences (Berkley: University of California Press), pp. 201-248.

38. E. C. West, Canada-United States Price and Productivity Differences in Manufacturing Industries, 1963 (Ottawa: Information Canada, 1971), pp. 18-22 and 26 and James G. Frank assisted by Ian Ladd and Gene Swimmer, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: The Conference Board in Canada, 1977), pp. 62-66.

39. Irving B. Kravis, "A Survey of International Comparisons of Productivity," Economic Journal, March 1976, p. 38.

40. Irwin Bernhardt, "Sources of Productivity Differences Among Canadian Manufacturing Industries," (University of Waterloo, mimeo, 1978). He uses both West's data for 1963 and Frank's data for 1972. Market size is influenced by tariff and nontariff barriers in both Canada and the United States, of course.

41. E. C. West, Canada-United States Price and Productivity Differences in Manufacturing Industries, 1963 (Ottawa: Information Canada, 1971), pp. 48-49.

42. F. M. Scherer, "The Determinants of Industrial Plant Size in Six Nations," Review of Economics and Statistics, 55, 1973, pp. 135-45; F. M. Scherer, "Trans-National Mergers as a Source of Production Scale Economies," mimeo Berlin: International Institution of Management, 1974; and F. M. Scherer, et.al., The Economics of Multi-Plant Operation: An International Comparisons Analysis (Cambridge: Harvard University Press, 1975).

43. For a fuller discussion of the production effects of tariffs in Canada, see D. J. Daly and S. Globerman, Tariff and Science Policies: Applications of a Model of Nationalism, Chapter 3, pp. 21-30.

44. Harry Postner's discussion of the effect of multilateral free trade does not allow for such changes. He notes that the analysis is restricted to the static effects of free trade (p. 102) and recognizes that Canadian supply shifts are assumed to be roughly balanced by foreign industrial supply shifts (p. 115). The depreciation of the Canadian dollar he gets under those assumptions is to be expected. There is a substantial amount of evidence and discussion that multilateral free trade would lead to greater adjustments within Canadian manufacturing than elsewhere and it is unfortunate that the evidence against the assumptions used was not considered. Quite different input-output coefficients and ratios of output to input in individual manufacturing industries would emerge under multilateral free trade than is measured in historical experience, a point that was made on early drafts of the Postner study. See Harry H. Postner, Factor Content of Canadian International Trade: An Input-Output Analysis, pp. 102-21.

45. Without attempting to be comprehensive, the following studies illustrate some of the more important recent studies: John Fayerweather, Foreign Investment in Canada - Prospects for National Policy (White Plains, N.Y.: International Arts and Sciences Press, 1974); Gray Report, Foreign Direct Investment in Canada (Ottawa: Information Canada, 1972); Eric W. Kierans, "The Contribution of the Tax System to Canada's Unemployment and Ownership Problems" in J. Chant, ed., Canadian Perspectives in Economics (Toronto: Collier-Macmillan Canada, 1972), Chapter B-2; Kari Levitt, Silent Surrender: The Multinational Corporation in Canada (Toronto: Macmillan, 1970); Gilles Paquet, ed., The Multinational Firm and the Nation State (Toronto: Collier-Macmillan Canada, 1972); A. Rotstein, ed., An Industrial Strategy for Canada (Toronto: New Press, 1972); A. E. Safarian, Foreign Ownership of Canadian Industry (Toronto: McGraw Hill, 1966); A. E. Safarian, The Performance of Foreign-Owned Firms in Canada (Montreal: Private Planning Association of Canada, 1969).

46. A. E. Safarian, The Performance of Foreign-Owned Firms in Canada, Table 25, p. 82. Safarian's 1966 study compared the costs of production of the subsidiary and its parent company, but did not contain data or discussion on value added per employee in domestically owned and foreign owned firms within Canada. It is of interest that there are some data indicating higher ratios of sales to assets and sales to salaries and wages for foreign-owned mining companies than Canadian-owned companies in the same asset size groups. See D. J. Daly, "Mineral Resources in the Canadian Economy: Macroeconomic Implications," Op.cit.

47. The Canadian Automotive Industry: Performance and Proposals for Progress (Ottawa: Inquiry into the automotive Industry, Simon Reisman, Commissioner, mimeo, October 1978), p. 108. The data in Table 3.23, p. 110 which shows higher levels of motor vehicles per man hour worked in Canada than in the United States does not allow for the higher proportion of material purchases to finished motor vehicles in Canada than in the United States which would overstate the levels of net output (excluding purchases of materials) relatively more in Canada. Keith Hay brought this point to my attention.

48. Dennis DeMelto has provided examples on pricing of crude oil and sugar in correspondence dated February 13, 1979.

49. Richard E. Caves, Diversification, Foreign Investment and Scale in North American Manufacturing Industries, p. 38 and Table 5-1, p. 39. For 9 categories of plant sizes in Table 5-1, on average the plants of U.S. subsidiaries in Canada had about twice as many secondary manufactured products as the domestic plants in the same employment size categories.

50. Steven Globerman, "Foreign Direct Investment and 'Spillover' Efficiency Benefits in Canadian Manufacturing Industries," Canadian Journal of Economics, Feb. 1979, pp. 42-56.

51. Statistics Canada, Corporations and Labour Unions Returns Act, Report for 1975, Part I - Corporations (Ottawa: Industry, Trade and Commerce, 1978), pp. 24 and 26.

52. Correspondence from Donald C. MacCharles, June 12, 1979. This section has benefitted from discussions and correspondence over several years on these questions.

53. W. E. G. Salter, Productivity and Technological Change, Second Ed., (Cambridge: Cambridge University Press, 1966), pp. 48-99, and Benjamin Klotz, Roy Medoo, and Reed Hansen, "A Study of HIgh and Low 'Labor Productivity' Establishments in U.S. Manufacturing," in John Kendrick and Bea Vaccara, eds., New Directions in Productivity Measurement and Analysis (Chicago: University of Chicago Press for NBER, forthcoming).

54. Donald C. MacCharles, The Cost of Administrative Organizations in Canadian Secondary Manufacturing Industries (Toronto: University of Toronto, Ph.D. Dissertation, Department of Political Economy, 1978) and D. C. MacCharles "Long-Run Scale Economies in the Administrative Organizations of Firms in Canadian Secondary Manufacturing Industries," (Saint John, N.B.: University of New Brunswick, mimeo, Sept. 29, 1978), and later correspondence and tables. These differences in purchased services compared to internal production emerge in relation to both sales and value added.

55. John N. H. Britton, "The Influence of Corporate Organization and Ownership on the Linkages of Industrial Plants: A Canadian Inquiry," Economic Geography October 1976, Table 2, p. 314. The tendency for subsidiaries to be dependent on their parent firms for a variety of services and components has been a source of discussion and concern in some of the studies referred to in footnote 54 earlier and footnote 73.

56. Statistics Canada, National Income and Expenditure Accounts, Volume I, The Annual Estimates, 1926-1974, p. 98 and comparable table in later issues.

57. Jack Baranson, "Needed: New Approaches and Responses," Economic Impact, 1979/2, pp. 21-22.

58. Edward F. Denison assisted by Jean-Pierre Poullier, Why Growth Rates Differ: Postwar Experience in Nine Western Countries (Washington: The Brookings Institution, 1967), p. 280.

59. Jack Baranson, "Technology Transfer: Effects on U.S. Competitiveness and Employment" in William G. Dewald, ed., The Impact of International Trade and Investment on Employment (Washington: U.S.G.P.O., for U.S. Department of Labor, 1978), pp. 177-207.

60. Ibid., p. 201.

61. David Morawetz, Op.cit., p. 93.

62. F. M. Scherer et.al., The Economies of Multi-Plant Operations, Op.cit., pp. 325-326. See also F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally, 1970), pp. 352-363; Franklin M. Fisher and Peter Jemin, "Return to Scale in Research and Development: What Does the Schumpeterian Hypothesis Imply?" Journal of Political Economy, 81 (Jan. Feb., 1973), pp. 56-70; D. G. McFetridge and L. J. Weatherley, Notes on the Economies of Large Firm Size (Ottawa: Supply and Services for the Royal Commission on Corporate Concentration, 1977), pp. 209-244 and Donald J. Lecraw, Economies of Scale in Canadian Manufacturing: A Survey (Ottawa: Supply and Services for the Royal Commission on Corporate Concentration, 1978), pp. 28-34 and additional references cited therein.

63. Science Council of Canada, Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing (Ottawa: October 1971); Arthur J. Cordell, The Multinational Firm, Foreign Direct Investment, and Canadian Science Policy (Ottawa: Background Study No. 22 for the Science Council of Canada, 1971); Pierre L. Bourgault, Innovation and the Structure of Canadian Industry (Ottawa: Background Study No. 23 for the Science Council of Canada, 1972); and John N. H. Britton and James M. Gilmour, assisted by Mark G. Murphy, The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment (Ottawa: Background Study No. 43 for the Science Council of Canada, 1978). Their views are well summarized in a sentence from page 95 of the most recent study as follows: "The low level of innovative capability in Canadian manufacturing derives directly from the pervasive influence of foreign control of firms in Canada" (italics in original).

64. Daly and Globerman, Op.cit., p. 107, Table 2 in Appendix A.

65. Britton, Gilmour and Murphy, Op.cit., p. 75, Tables III. 2 and III.3, based on census data for both countries.

66. Daly and Globerman, Op.cit., p. III, Tables in Appendix A.

67. G. C. Hufbauer, Synthetic Materials and the Theory of International Trade (Cambridge: Harvard University Press, 1966), Table C-3, pp. 131-32.

68. Ibid., pp. 76-78, with references to studies by Vernon, Leonard, Enos, Tilton, Utterback and Mansfield.

69. Ibid., pp. 86-89.

70. Ibid., pp. 85-87. Some of these pages make the cost implications of small scale production more explicit than previously.

71. D. J. Daly, "New Approaches in the Development of Managers" and "Managerial Manpower in Canada" in H. C. Jain, ed., Contemporary Issues in Canadian Personnel Administration (Toronto: Prentice-Hall, 1974), pp.24-28 and 96-105; D. J. Daly and Rein Peterson, Management Science, Vol. 20, No. 4, Dec. 1973, pp. 550-569; Daly and Globerman, Tariff and Science Policies, pp. 32-39 and 50-53. Further material on Canadian management will appear at a conference planned by the Economic Council of Canada and other sponsoring organizations on "Management in the Eighties" in October 1979.

72. Ibid., p. 110, Table 7 in Appendix A, based on census data.

73. Economic Council of Canada, Looking Outward, esp. Chapter 5, pp. 47-60; Economic Council of Canada, For a Common Future: A Study of Canada's Relations with the Developing Countries (Ottawa: Supply and Services, 1978), esp. pp. 37-75; and David Morawetz, Twenty-five Years of Economic Development, 1950 to 1975 (Washington: The World Bank, 1977).

74. David Morawetz, Op.cit., pp. 80 and 84 and elsewhere.

75. Ibid., p. 29.

76. Economic Council of Canada, For a Common Future, Op.cit., pp. 45-57.

77. Harry G. Johnson, Economic Policies Toward Less Developed Countries (Washington: The Brookings Institution, 1967), pp. 94-107 and D. J. Daly, Adaptation in Canadian Manufacturing (Ottawa: Economic Council of Canada, 1978), p. 2 ff.

78. D. J. Daly, "Mineral Resources in the Canadian Economy: Macro-Economic Implications," in Carl E. Beigie and Alfred O. Hero, Jr. eds. Natural Resources in U.S.-Canadian Relations, Vol. 1, The Evolution of Policies and Issues (Montreal: C. D. Howe Research Institute, forthcoming).

79. Industry, Trade and Commerce, Canada's Trade Performance, 1960-1977, Volume 1, General Developments (Ottawa: Supply and Services, October 1978), pp. 43-78 and John N. H. Britton et.al., Op.cit., pp. 35-55. The tone on the role of trade in manufactured products from these two government organizations, both published in October 1978, is dramatic, with the Science Council describing developments as export weakness, trade failure, and export failure and import dependence in chapter and section titles.

80. D. J. Daly and D. Walters, "Factors in Canada-United States Real Income Differences," International Review of Income and Wealth Dec. 1967, pp. 285-309 and Dorothy Walters, Canadian Income Levels and Growth: An International Perspective (Ottawa: Queen's Printer for the Economic Council of Canada, 1968),pp. 169-180. Subsequent statistical revisions in the national accounts would narrow the difference for 1960, and developments since have seen a further narrowing, but these changes would not affect the points made in the text.

81. John W. Kendrick, "Remedies for the Productivity Slowdown in the United States," Chapter 8 in Shlomo Maital and Noah M. Meltz, Lagging Productivity Growth: Causes and Remedies (Princeton: mimeo, 1968) and a paper by John W. Kendrick in William Fellner, ed., Contemporary Economic Problems, 1979 (Washington: American Enterprise Institute, 1979).

82. Robert Eisner, "Capital Expenditures, Profits and the Acceleration Principle," in Models of Income Determination (Princeton: Princeton University Press, 1964), pp. 137-176.

83. Arthur Donner, "Lag in Productivity Gains Poses Problems," Globe and Mail, July 9, 1979.

84. Statistics Canada, Out of School - Into the Labour Force (Ottawa: June 1978), p. 41.

85. D. J. Daly, "Managerial Manpower in Canada" in H. C. Jain, ed., Contemporary Issues in Canadian Personnel Administration (Scarborough: Prentice-Hall of Canada Ltd., 1974), pp. 96-105 and D. J. Daly and Rein Peterson, "On Bridging the Gaps," Management Science 20, No. 4, pp. 550-569.

86. This is based on an average participation rate of 63 per cent, for males and females from 18 to 24 years of age. The number moving out of the educational system is about 600 thousand per year from 1977 to 1980. See Statistics Canada, Out of School - Into the Labour Force (Ottawa: June 1978), p. 56.

87. Recommendations by Myron Gordon give limited attention to the broad range of factors contributing to Canada's manufacturing costs and international competitive position. See M. J. Gordon, "Canadian Manufacturing: A Strategy for Development," The Business Quarterly Winter 1974 and Myron J. Gordon, "A World Scale National Corporation Industrial Strategy," Canadian Public Policy, Winter, IV:I, 1978, pp. 46-56.

88. Economic Council of Canada, Looking Outward: Ronald J. Wonnacott, Canadian Trade Options (Ottawa: Information Canada for the Economic Council of Canada, 1975); and D. J. Daly and S. Globerman, Tariff and Science Policies.

89. Ronald J. Wonnacott, Op.cit., pp. 179, 181 and 182.

90. D. J. Daly and S. Globerman, Op.cit., pp. 29-30.

91. R. J. Wonnacott, Canada's Trade Options, pp. 173-182 and Daly-Globerman, Op.cit., pp. 27-28.

92. E. C. West, Op.cit., pp. 47-58; Richard E. Caves, "Economic models of political choice: Canada's tariff structure," Canadian Journal of Economics, May 1976, pp. 278-300; Tim Hazeldine,

Irwin Bernhardt, "Sources of Productivity Differences Among Canadian Manufacturing Industries," (Waterloo: University of Waterloo, mimeo, 1978). Some of these studies include market size differences between individual industries in Canada and the United States as a factor, and when this is done some of the tariff influences are swamped by the market size variables. This is illustrative of the traditional problems of simultaniety and intercorrelation. Although Tim Hazeldine's study was more oriented to testing whether manufacturing firms priced up to the Canadian tariff, a similar range of issues are present.

93. Robin W. Boadway and J. M. Treddenick, The Impact of the Mining Industries on the Canadian Economy (Kingston: Centre for Resource Studies, 1977); Roma Dauphin, The Impact of Free Trade in Canada (Ottawa: Supply and Services for Economic Council of Canada), pp. 72-77; Harry H. Postner, The Factor Content of Canadian International Trade: An Input-Output Analysis (Ottawa: Information Canada for the Economic Council of Canada, 1975); J. R. Williams, Resources, Tariffs and Trade: Ontario's Stake (Toronto: University of Toronto Press for the Ontario Economic Council, 1976). These assumptions have also been used in estimating the static effects of the various tariff cutting formulae under the Tokyo Round for the major industrialized countries, but the total welfare gains are recognized to be substantially higher -- five times larger in the Brookings Study. See William R. Cline, Noboru Kawanabe, T. O. M. Kronsjo and Thomas Williams, Trade Negotiations in the Tokyo Round: A Quantitative Assessment (Washington: The Brookings Institution, 1978), pp. 77-81 and William R. Cline, et.al. "Multilateral Effects of Tariff Negotiations in the Tokyo Round," in Wm. G. Dewals, ed., The Impact of International Trade and Investment on Employment (Washington: U.S. Government Printing Office, 1978), pp. 265-284 and Comment by D. J. Daly, pp. 288-289.

94. Department of Industry, Trade and Commerce, A Structural Analysis of the Canadian Economy to 1990 with Quantitative Estimates of the Potential Impact of Tariff Reductions in the Tokyo Round of Tariff Negotiations (Ottawa: 1978). This study used a finer level of industry disaggregation than in the earlier simulations shown in the Economic Council of Canada, Looking Outward, pp. 166-170. The effects of free trade on employment were negative for most sectors and in the aggregate, but the employment effects seem sufficiently small that they could be offset by expansionary macro policies, especially when the exchange rate was permitted to adjust.

95. For a fuller discussion of such measures see Economic Council of Canada, Looking Outward, Chapter 13, "Adapting to Freer Trade," pp. 166-168; Daly-Globerman, pp. 61-67; and Roy A. Matthews, Industrial Viability in a Free Trade Economy: A Program of Adjustment Policies for Canada (Toronto: University of Toronto Press for the Private Planning Association of Canada, 1971).

96. R. J. Wonnacott and Paul Wonnacott, Op.cit., pp. xv-xvii, which list 20 tables relating to 1958, which are about four-fifths of the quantitative tables listed in the index.

97. John N. H. Britton, "Canada's Industrial Performance and Prospects Under Free Trade," Canadian Geographer, XXI, 4, 1977, pp. 351-371 and J. N. H. Britton, "Locational Perspectives on Free Trade for Canada," Canadian Public Policy IV, 1, pp. 4-19.

98. D. J. Daly, "Weak Links in 'The Weakest Link'," Canadian Public Policy, Summer 1979, pp. 307-317, and Kristian S. Palda, The Science Council's Weakest Link: A Critique of the Science Council's Technocratic Industrial Strategy for Canada (Vancouver: The Fraser Indstitute, 1979). The Science Council puts primary emphasis on foreign ownership and control as the major factor in the poor performance of Canadian manufacturing, and would encourage high technology sectors by retaining and strengthening previous tariff and non-tariff barriers and providing additional encouragements and tax incentives.

99. Irving Kravis et.al. A system of international comparisons of gross product and purchasing power (Baltimore: The Johns Hopkins University Press, 1975) and Irving Kravis et.al. International comparisons of real product and purchasing power (Baltimore: The Johns Hopkins University Press, 1978). The third phase, with additional country coverage, is now in press.

APPENDIX A

THE EMPIRICAL APPLICABILITY OF

THE ALCHIAN-HIRSHLEIFER MODERN COST THEORY

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About fifteen years has elapsed since Armen Alchian's basic paper on "Costs and Outputs" was published,[1] and a shorter period since Jack Hershleifer's companion article.[2] Although a number of new and related concepts were initially introduced by Alchian, the propositions that will be followed up here are those relating to decreasing cost per unit as the total planned volume increase, (Propositions 4 and 5) and increased knowledge and lowered cost consequent to accumulated production experience (Proposition 9 in the initial article).[3] Hirshleifer added another distinction of relevance here, namely width of output, which is a flow concept relating to the amount of the total rate of output going to a specific order.[4]

The initial article by Alchian emphasized the basic theory and had only limited reference to applications, although he was clearly familiar with a number of important ones. He referred to the choices between printing and mimeographing, number of aircraft models and numbers of each type which are produced, the progress cost curve and batch size,[5] but a review of applications was not his purpose. The article by Hirshleifer was partially devoted to a reinterpretation of classical cost theory which involved rate and planned volume of output moving together. In addition, he widened the range of empirical applications by discussing the relevance of the theory to transportation (including non-discriminatory quantity discounts and size of shipment) and utility charges, military aircraft costs and to econometric studies of costs.[6] As illustrations of width of output applications, he gave group hotel rates, size of offices leased in office buildings, and book printing.[7] Although both writers were aware of and interested in the relevance of this new view of costs to applied problems, it is fair to say that the reader of the two basic articles could still regard the theory as essentially being limited to a few special cases.

The major theme of this note is that the range of possible applications is very broad through contemporary manufacturing production, and to summarize some of these major areas of application, some of which have been well documented since the initial articles were published.

PROGRESS COST CURVES

Both Alchian and Hirshleifer recognize this application.[8] It has been used to estimate costs for bidding and tendering on orders beyond the range of previous company experience, and a manual to assist the small firm in its use has been prepared and distributed.[9] Experience in many products indicates lower production costs per unit with longer volumes of production of the same item, and this negative relation is roughly linear if logarithms of both price and total quantity are used. Some of the reasons for this include the spreading of overhead costs (including set up costs) over larger quantities, the selection of different techniques of production depending on length of run, and learning by doing through experience with the same capital facilities. These applications have been discussed most fully in engineering studies, but are still covered all too rarely in the economic and cost accounting literature.

INTERNATIONAL TRADE AND PRODUCT DIFFERENTIATION

A dominant theme in the theory of international trade has been the development of the implications of the Hecksher-Ohlin model, which emphasizes differences in factor prices and factor availabilities as central in the explanation of comparative advantage and the structure of trade and production in individual countries. A key assumption that is usually made initially and maintained in that framework is that individual countries had the same production

conditions in various industries and constant returns to scale. Much of the literature developed the logical implications of a two country, two product, two factor situation, although there was some extension to a larger number of products and factors.

As part of a larger study of the differences in real net national income per person employed between Canada and the United States, it became clear that there were significant differences in the pattern of manufacturing between the two countries, especially in costs and production conditions. The contrasts were especially marked in secondary manufacturing where product differentiation was present. These differences had persisted for prolonged periods in spite of quite full knowledge in Canada of practices in plants in the United States, and a significant degree of ownership and control by United States firms.

A key variable which has frequently been omitted in the theoretical literature in the international trade field is the Alchian-Hirshleifer concept of planned volume of output, or length of run (to use the term frequently used by businessmen). The volume of output was typically much smaller in Canada than in the United States, especially in such secondary manufacturing products as consumer goods and capital equipment. Such short runs were made possible and even encouraged by domestic tariffs, that led to higher prices, higher costs per unit of output, and lower levels of output per unit of labour and other inputs.[10] The Alchian-Hirshleifer concept thus helped explain the differences in costs and productivity conditions when tariffs were present, and had important implications for commercial policy and the nature and severity of the transitional adjustment process to lower tariffs.[11]

Typically, estimates of the costs of tariffs and the gains from free trade for a number of countries are basically made of the costs to the consumer, and explicitly or implicitly do not allow for changes in production conditions such as those associated with product diversity or specialization and related

production volumes. The estimates for Canada are the first, and perhaps still the only, estimate of the costs of tariffs that explictly allow for changed production conditions to develop after free trade.[12] These estimates, which are conceptually more appropriate, are larger than for other countries where the Alchian-Hirshleifer theory of costs had not been taken into consideration.

Progress cost curves and the Alchian-Hirshleifer theory has also been applied to the changing competitive position of Japan in such manufactured products as nylon and automobiles. Rapid increases in accumulated volumes of output associated with high rates of domestic growth have encouraged larger and faster declines in costs per unit in Japan than other industrialized countries in North America and North West Europe.[13] This has moved Japanese levels of national income per capita ahead of the United Kingdom and Italy by 1970.[14] This has also been a key factor in the increased share of Japan in world trade in manufactured products during the 1960's, and the exchange rate changes between Japan and other major trading countries early in the 1970's.

There has now been a major new volume developing the theory and measuring trade in differentiated products on a world basis.[15] This explores the theory systematically, including such topics as product differentiation, economies of scale, and product cycles, and measures the large and increasing extent of trade in differentiated products for a wide range of industrialized countries. It also explores the policy implications of free trade, and the observed effects of trade liberalization for such groupings as the European Economic Community, the Central American Common Market and Australia and New Zealand. Such moves to trade liberalization and economic integration have "resulted in greater trade expansion and fewer adjustment problems than had been anticipated by analysts who had based their predictions on the more traditional model of inter-industry specialization."[16]

INDUSTRIAL CONCENTRATION

Recent studies of factors affecting costs per unit in a number of key industries in six nations have emphasized the importance of product-specific scale economies, and related this to the Alchian-Hirshleifer theory.[17] A doubling of individual production run lengths from 1970 levels would lead to a greater percentage reduction in costs than a doubling of plant sizes in a number of sample industries. This pattern appeared in such sample industries as cigarettes, fabrics, paints, shoes, bottles, bearings and refrigerators. This phenomenon has been recognized in the European and Canadian literature, but had been ignored almost completely by U.S. industrial organization economists.[18]

U.S. manufacturers interviewed experienced little difficulty in exploiting the most important product-specific scale economies for the best selling items, but the production of the lower volume items was frequently too small to take full advantage of the potential cost reductions associated with large volume. For some commodities, the total demand in North America must be supplied by one manufacturer if production costs are to be minimized. A nation-wide firm with a number of plants can centralize the production of low-demand items in one plant, achieve product-specific scale economies and ship the product to regional markets. Regional suppliers with fewer plants would either not be able to supply a full line of products, incur high costs per unit on short-runs of less popular items, or try to buy low-demand items from specifalized plants or larger nationwide firms. The achievement of low cost production with effective competition and the policy implications of these issues are questions that are only now being raised and researched in the industrial organization field.

Another interesting result is some evidence that second production sources for World War II aircraft programs were associated with steeper progress cost curves than when second sourcing competition was not employed. For bomber

producers the first observed values were less than the relevant class average values. Although second sourcing is clearly not appropriate in every situation, it raises the possibility that second sourcing competition can contribute to greater efficiency in certain situations.[19]

MONOPOLISTIC COMPETITION

One of the major developments in micro-economic theory of the 1930's was the introduction of monopolistic competition as an intermediate market classification between perfect competition and monopoly. Key in that classification was product differentiation, in which a number of firms produced products slightly different in size, color or convenience, and advertising encouraged purchasers to buy that brand variety in preference to others.[20]

In relation to unit prices, a major theme in this literature is that the demand curve and the associated marginal revenue curve facing the individual firm is downward sloping, and not perfectly elastic as it is for the firm in perfect competitition where the individual firms are price takers. By product design and advertising, the literature emphasizes the scope for the firm to shift the demand curve to the right, and influence its elasticity to maximize profits. Profit maximization would typically occur in the short term where marginal cost and marginal revenue were equal, and this would typically be at output levels less than the minimum point on the average cost curve. The major theme of the literature is that equilibrium and profit maximization are crucially determined by the market demand and marginal revenue aspects of product differentiation.

However, a logical implication of the Alchian-Hirshleifer theory of costs is that short runs involve higher costs per unit than long runs. Product differentiation by an individual firm through producing additional varieties of brand names (the modern North American car or brands of toothpaste are obvious examples) is bound to shift upwards the traditional marginal and average cost

curves (which depict costs of producing alternative rates of output of that product per unit of time). Product diversity is costly, but very pervasive in contemporary economies. A recognition of this point in the literature on monopolistic competition is significant by its absence![21] *

CONCLUSION

Rather than being applicable to a few special cases, the Alchian-Hirshleifer version of cost theory is applicable to a wide range of situations where product differentiation is applicable -- production, industrial organization (including such areas as company size and plant specialization), international trade in manufactured products and unit costs in the area of monopolistic competition. Recent research has documented this importance in a number of key areas of application, but other areas are still unexplored. The purpose of this note has been to emphasize its key importance and widen the appreciation of the relevance of the theory, especially for those interested in the integration of economic analysis and business practice.

*Any evidence to the contrary from readers of this preliminary version would be welcome.

FOOTNOTES

1. Armen Alchian, "Costs and Outputs" in Moses Abramovitz and Others, ed., The Allocation of Economic Resources, (Stanford: Stanford University Press, 1959), pp. 23-40.
2. Jack Hirshleifer, "The Firm's Cost Function: A Successful Reconstruction?", Journal of Business,XXXV No. 3, July 1962, pp. 235-54.
3. Alchian, Op.cit., pp. 26 and 35-36.
4. Hirshleifer, Op.cit., p. 241.
5. Alchian, Op.cit., pp. 29, 30, 35 and 39.
6. Hirshleifer, Op.cit., pp. 235, 236, 239, 242-45 and 253-55.
7. Ibid., pp. 241-2.
8. Alchian, Op.cit., pp. 35-36 and Hirshleifer, Op.cit., footnote 2 continuing on p. 236.
9. E. C. Keachie, Manufacturing Cost Reduction Through the Curve of Natural Productivity Increase. (Berkley: University of California, Institute of Business and Economic Research, 1964), and L. E. Preston and E. C. Keachie, "Cost Functions and Progress Functions: An Integration", American Economic Review, March 1964, pp. 100-107. Both studies contain additional references to the literature.
10. D. J. Daly, B. A. Keys and E. J. Spence, Scale and Specialization in Canadian Manufacturing, Economic Council of Canada Staff Study No. 21, (Ottawa: The Queen's Printer, 1968), and D. J. Daly, "Uses of International Price and Output Data", in D. J. Daly, ed. International Comparisons of Prices and Output, (New York: Columbia University Press, 1972), pp. 85-141. It is of interest that such specialists in international trade as Bela Balassa, Jagdish N. Bhagwati and Harry Johnson were unable to point out any previous applications of the Alchian-Hirshleifer concepts of cost theory in the international trade field.

11. Economic Council of Canada, Looking Outward: A New Trade Strategy for Canada, Ottawa: Information Canada, 1975 especially Chapters 3, 10 and 13. D. J. Daly and S. Globerman, Tariff Policy and Science Policy: Applications of a Model of Economic Nationalism, (Toronto: University of Toronto Press for the Ontario Economic Council, forthcoming), especially Chapter 3.

12. Ronald J. Wonnacott and Paul Wonnacott, Free Trade Between the United States and Canada: The Potential Economic Effects, (Cambridge: Howard University Press, 1967), esp. Chapter 15 and Ronald J. Wonnacott, Canada's Trading Options, Economic Council of Canada, (Ottawa: Information Canada, 1975), esp. Chapter 15. See also Daly and Globerman, op.cit. Chapter 3 for references to estimates for other countries, earlier references to Canada, and the related conceptual literature.

13. James C. Abegglen and William V. Rapp, "Japanese Managerial Behavior and Execessive Competition", The Developing Economies, vol. 8, No. 4, December 1970, reprinted in Donald S. Henley, ed. International Business - 1973: A Selection of Current Readings, (East Lansing: Michigan State University, 1973), pp. 65-82 and James C. Abegglen, "Dynamics of Japanese Competition", in United States International Economic Policy in an Interdependent World, Compendium of Papers: Volume II (Washington: U.S. Government Printing Office, 1971), pp. 153-182. The Boston Consulting Group has emphasized experience curves in a number of their studies and in their executive development courses.

14. Irving B. Kravis et.al., A System of International Comparisons of Gross Product and Purchasing Power, (Baltimore: The Johns Hopkins University Press, 1975) Table 1.3, p. 8.

15. Herbert G. Grubel and P. J. Lloyd, Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products, (New York: John Wiley and Sons, 1975).

16. Ibid., p. 143.

17. F. M. Scherer, "Economies of Scale and Industrial Concentration" in Harvey Goldschmid et al. Industrial Concentration: The New Learning (Boston: Little, Brown, 1974), pp. 16 - 54.
and F. M. Scherer, Alan Beckenstein, Erich Kaufer and R. D. Murphy, The Economics of Multi-Plant Operation: An International Comparisons Study, (Cambridge: Harvard University Press, 1975).

18. Scherer, "Economics of Scale and Industrial Concentration."

19. F. M. Scherer, The Weapons Acquisition Process: Economic Incentives, (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1964), pp. 119-126. Dr. Scherer brought this point to my attention.

20. Edward H. Chamberlin, The Theory of Monopolistic Competition, Eighth Edition, (Cambridge: Howard University Press, 1962) and bibliography; Edward H. Chamberlin, Towards a More General Theory of Value, (New York: Oxford University Press, 1957); and Robert E. Kuenne, Monopolistic Competition Theory: Studies in Impact, (New York: John Wiley and Sons, 1967) and a large related literature.

21. Harry Johnson draws attention to the Canadian discussion of tariffs and efficiency in the context of international trade theory, but the literature at that time had not drawn in the Alchian-Hirshleifer theory explicitly. See Harry G. Johnson, "International Trade Theory and Monopolistic Competition Theory" in Kuenne, ed. Op.cit., pp. 216-218.