FOREIGN DIRECT INVESTMENT IN CANADIAN MANUFACTURING: TECHNOLOGICAL DIFFERENCES BETWEEN FOREIGN AND DOMESTIC FIRMS

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To my wife Koula

and to my two sons

Yiannis and Spyros

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ABSTRACT

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The controversial nature of foreign direct investment has prompted considerable research into its causes and effects in host countries. Beacause of data limitations and other statistical complexities relatively little attention has been directed towards studying many important questions related to the relative efficiency of foreign and domestically controlled firms.

The objective of this thesis is to compare technological perfomances of Canadian and foreign controlled firms in Canadian manufacturing. In particular, the relative performance of these groups of firms is assessed with respect to such important technological characteristics as factor intensities, elasticities of substitution, scale elasticity and cost efficiency.

In the past various studies have found that foreign and domestic firms indeed differ. However, the explanations offered for these differences are incomplete. The major problem in modeling appears to be the unavailability of appropriate data. On the other hand, studies that have tried

to identify the technological characteristics of Canadian manufacturing industries using cost or production models, have ignored the possible difference between foreign and domestic firms.

The model employed in this study assumes that each firm is cost efficient in that it minimizes the cost of producing its output level. The implications of this cost minimization assumption are exploited in the econometric analysis. Data has been collected for foreign and domestic firms in Canadian manufacturing at the four-digit ISIC level. Information recently made available by Statistics Canada has been used to construct previously unavailable capital stock series.

Sufficient information was available to study in detail eight industries in Canadian manufacturing. For each of these industries a cost function was estimated for foreign and domestic groups of firms. Technological characteristics have been evaluated and computed and compared on the basis of the estimated model.

The results of this thesis suggest that even though there are significant differences between foreign and domestic firms in the industries studied, these differences are not systematic across industries. General summary comparisons are, for the most part, ruled out. One result that does arise frequentlv however is that foreign firms employ more capital intensive production techniques. Interestingly, the explanation of this result does not appear to rest in differences in technical structure but rather in differences in relative factoe prices paid and the scale of production.

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CHAPTER I

INTRODUCTION

Foreign Direct Investment (FDI) can be defined as the investment undertaken by companies in foreign ventures in which they have a controlling and managing interest.[1] This 'managing' feature effectively distinguishes FDI from portofolio investment which is usually defined as the acquisition of securities by individuals or institutions, without any necessary control over, or participation in their management. It could appear then that something other than money capital might be involved in FDI. This could be managerial or technical guidance, or it could involve the dissemination of valuable knowledge in the form of research and development, production technology, marketing skills or managerial expertise, none of which typically accompanies portofolio investment.

As an economic phenomenon FDI is of recent origin. In 1914 ninety percent of all international capital movement took the form of portofolio investment. Gradually, however, the composition has been shifting. The collapse of the World monetary system in 1930 caused a profound change in both attitudes and approaches towards international investment. By 1939, most of today's leading Multinational Corporations (MC) had established foreign branches or subsidiaries. Foreign direct investment became the main form of international investment. In recent days, despite the recovery of the international bond market, portofolio investment accounts for less than one fifth of all international investment.[2]

The majority of studies dealing with FDI can be separated into two broad groups. The first group contains studies of the determinants of foreign direct investment. Different rates of return to capital, monopoly positions, tariff levels as well as other factors have been used to explain FDI.[3] The second group of studies examines the effects that FDI has on the economy of the host country. The effects on growth, balance of payments and on technology are the main areas around which most of the literature has been developed.

Despite the fact that three-quarters of total foreign direct investment is directed to developed economies, a majority of the research into the effects of FDI has examined the developing country case. As well, the traditional focus of attention for studies in developed economies has been the performance of foreign affiliates, especially those of large MC's. In particular, balance of payments effects, profitability, and other financial effects have been studied. The effects of FDI on technology have not been adequately examined. However, it is apparent that the nature of technology actually employed by foreign firms is one of the most important and controversial issues of all foreign investment debates.

It is the goal of this thesis to examine the nature and effects of technology transferred through foreign investment to a developed economy, Canada.

The main objective of this study is to compare the performance of Canadian and foreign controlled manufacturing firms in Canada with respect to technology. Since the major part of foreign direct investment originates in the United States, it is useful to separate the foreign firms into U.S. owned and other. The different groups of firms will be compared with respect to such important technological characteristics as factor intensities, elasticities of substitution and technological efficiency.

A comparison of the different groups of firms with respect to efficiency will help to explain whether foreign investment partially offsets other costs by saving domestic resources and/or increasing the average productivity of manufacturing. With respect to factor intensities, the main question is whether foreign firms introduce a more capital intensive technology and so doing they increase capitalization in the economy. Other potential costs of FDI and increased capitalization have been identified as aggrevation of employment problems, worsening of income inequalities, negative influences on technology used by other industrial firms, inhibition of domestic research and development and introduction of biases into education and science policy.[4]

The potential importance of FDI problems for Canada is underlined by the fact that the degree of foreign ownership and control is substantially higher in Canada than in any other industrialized country. More than fifty percent of manufacturing in Canada is foreign controlled.[5]

The literature contains many studies which have examined differences in capital labour ratios and productivity. However, the explanations offered for these differences are incomplete. The major problem in modeling appears to be that insufficient data were available to construct and analyse complete models. In all studies, the question of efficiency was addressed indirectly through the effect of foreign investment upon competition. On the other hand, studies[6] that tried to identify the technological characteristics of Canadian manufacturing industries using some model, especially production or cost functions, have ignored the possible differences between foreign and domestic firms. Even though firms may have been grouped according to their size or provincial origin, no account has been taken of the important control characteristics.

The availability of a new body of data[7] now provides the opportunity to construct complete microeconomic and econometric models which can be used to analyse the technology issues raised above. This is the principal aim of this study.

CHAPTER II

FOREIGN INVESTMENT AND FOREIGN CONTROL IN CANADIAN MANUFACTURING

It was said at the beginning that one of the objectives of this study was to compare foreign and domestic firms in Canadian manufacturing with respect to technology. Formally this study deals with the results of foreign direct investment and not with direct investment itself. However, it is useful to briefly study this latter issue in order to broaden the context of the study undertaken here and to provide valuable background information.

In this chapter we first present a brief history of foreign investment in Canada with more emphasis in foreign direct investment and its role in the recent years. Foreign control in the Canadian economy is a consequence of this investment. The importance of this control in Canadian manufacturing as well as some differences between foreign and domestic establishments is the subject of the rest of this chapter. The whole analysis in this chapter is based on the new body of data mentioned earlier.[8]

1. Growth of Foreign Investment in Canada

Foreign investment has been important in Canada for many years. On the one hand it helped the Canadian economy at its early stages of development. Alternatively, it has increased the dependence of the Canadian economy upon foreign capital so that the possibility of the loss of Canadian political sovereignty from foreign investment is argued to be a major issue.

During the nineteenth century much of the observed capital flow arose from the sale of Canadian bonds in England. The borrowed capital was used to build railways, roads and other public utilities, to exploit mineral resources, to help establish certain manufacturing industries and to supplement tax revenues.[9]

Direct investment, although not then as large as portofolio investment, was used for manufacturing and resource development, particularly in lumber. This investment increased in the last quarter of the 19th century when high tariffs were imposed on imported manufactured goods in order to protect young domestic industries.

Total foreign investment gradually increased in Canada during the first half of the 20th century. However, the rate of investment rose sharply in the 1950's and has stayed high ever since.

During the nineteenth and early twentieth centuries, Britain was Canada's main source of foreign capital. However, World War I brought a change in this traditional flow of funds. The major supplier of investment funds became the United States. In 1920 the share of U.S. foreign investment was about 44% and became almost 80% by the end of 1974 (Table 1). This change in source was accompanied by a shift from portofolio to direct investment (Table 2). At the time of the Great Depression, direct investment accounted for about one third of the total investment and

Table 1

DISTRIBUTION OF FOREIGN INVESTMENT IN CANADA
BY COUNTRY OF ORIGIN. SELECTED YEARS

YEAR	US %	UK %	OTHER %	TOTAL VALUE (000,000)
1900	13.6	85.3	1.1	1232
1910	19.3	77.4	3.3	2529
1920	43.7	52.9	3.4	4870
1930	61.2	36.3	2.5	7614
1939	60.0	35.8	4.2	6913
1950	75.6	20.2	4.2	8664
1960	75.3	15.1	9.6	22214
1970	79.3	9.1	11.6	44037
1974	77.5	8.9	13.6	60189

Table 2

DISTRIBUTION OF FOREIGN INVESTMENT IN CANADA
BY TYPE OF INVESTMENT. SELECTED YEARS

YEAR	DIRECT INVESTMENT		PORTOFOLIO INVESTMENT		OTHER		TOTAL VALUE (000,000)
	TOTAL VALUE	%	TOTAL VALUE	%	TOTAL VALUE	%	
1926	1782	.29	3691	.66	260	.05	6003
1930	2427	.32	4892	.64	295	.04	7614
1939	2296	.33	4332	.63	285	.04	6913
1950	3975	.46	4369	.50	320	.04	8664
1955	7728	.57	5158	.38	641	.05	13527
1960	12872	.58	7914	.36	1428	.06	22214
1965	17365	.59	10076	.34	2171	.07	29612
1970	26358	.60	14790	.33	2889	.07	44037
1974	36237	.60	20505	.34	3447	.06	60189

rose to sixty percent by the end of 1974.

With regard to the FDI components, United States business firms had been setting up and taking over manufacturing and mining plants in Canada well before World War I. The importance of U.S. direct investment in Canada steadily increased from 1920 to 1940. After this period and especially after World War II, this flow increased rapidly (Table 3). The Canadian tariff policy is the main explanation given in the literature.

> "Prevented by tariffs from exporting goods American producers leaped the tariff wall with capital in hand instead of goods".[10]

Table 3

DISTRIBUTION OF FOREIGN DIRECT INVESTMENT IN CANADA BY COUNTRY OF ORIGIN. SELECTED YEARS

YEAR	U.S		U.K		OTHER		TOTAL
	VALUE	%	VALUE	%	VALUE	%	VALUE
1926	1403	78.7	336	18.8	43	2.4	1782
1930	1993	82.1	392	16.2	42	1.7	2427
1939	1881	81.0	366	16.0	49	2.1	2296
1950	3426	86.2	468	11.8	81	2.0	3975
1955	6513	84.2	890	11.5	325	4.3	7728
1960	10549	82.0	1535	11.0	788	6.1	12872
1965	14049	80.9	2033	11.7	1264	7.4	17356
1970	21403	81.2	2504	9.5	2452	9.3	26358
1974	28996	80.0	3525	9.7	3716	10.3	36237

2. Foreign Direct Investment

As mentioned above the value of foreign direct investment grew very rapidly especially during the period following the Second World War. The book value of foreign direct investment doubled between 1950 and 1955 and grew by another two thirds to 1960. From 1960 to 1974 the mean annual growth rate was about 7.7%. At the same time the share of the U.S. has stayed almost constant (around 80%), while the share of the U.K. has decreased. This decrease was compensated by an increase in the share of all other countries.

With respect to the sectoral distribution of foreign direct investment, Table 4 indicates that the most important sector is manufacturing which absorbs half of the total amount invested. However, there has been a small decline in the role of manufacturing in recent years. From 52.9% in 1926 the share of manufacturing dropped to 39.5% in 1974.

The second most important sector receiving FDI is Petroleum and Natural Gas, accounting for one fourth of the total. The remaining one-fourth is divided among the rest of the sectors where the decreasing role of utilities may be noted.

Since U.S direct investment represents 80% of the total it is reasonable to suppose that the above sectoral distribution is mostly due to the structure of U.S foreign direct investment. In 1974 43% of U.S direct investment was absorbed by the manufacturing sector while 25% was absorbed by the Petroleum and Natural Gas sectors. We also noticed the decreasing role of utilities as well as the small decline in the share of manufacturing, from 58% in 1926 to 43% in

Table 4

FOREIGN DIRECT INVESTMENT IN CANADA CLASSIFIED
BY INDUSTRY GROUP. SELECTED YEARS

(SHARES OF INDUSTRIES)

	1926	1930	1939	1950	1955	1960	1965	1970	1974
Manufacturing	52.9	44.9	49.7	58.6	44.4	41.4	41.8	40.8	39.5
Petroleum and Natural Gas	--	5.8	--	--	22.7	25.7	26.5	24.9	24.5
Other Mining and Smelting	9.5	8.9	9.9	11.9	10.5	11.1	11.6	12.2	11.1
Utilities	15.4	18.6	18.0	10.0	4.1	2.2	1.7	1.6	1.4
Merchandising	7.6	6.6	7.3	7.9	6.9	5.8	6.1	6.4	6.5
Financial	11.7	12.6	12.4	9.2	9.1	11.3	9.7	10.8	11.8
Other	2.9	2.6	2.7	2.4	2.3	2.5	2.6	3.3	6.2
Total Value ($000,000)	1782	2427	2296	3975	7728	12872	17356	26348	36237

Table 5

U.S DIRECT INVESTMENT IN CANADA CLASSIFIED
BY INDUSTRY GROUP. SELECTED YEARS

(SHARES OF INDUSTRIES)

	1926	1930	1939	1950	1955	1960	1965	1970	1974
Manufacturing	58.3	46.7	52.3	59.0	43.5	41.2	43.8	43.1	42.8
Petroleum and Natural Gas	--	7.0	--	--	25.1	27.3	26.0	24.7	24.6
Other Mining and Smelting	10.0	9.6	10.5	13.2	12.0	12.8	13.3	13.3	11.7
Utilities	17.7	21.3	21.2	11.0	4.1	2.1	2.0	1.7	1.6
Merchandising	6.3	5.5	6.3	6.4	5.8	4.7	4.9	5.9	6.4
Financial	4.2	6.8	6.7	7.8	7.3	9.7	7.4	8.2	9.2
Other	3.5	3.1	3.0	2.6	2.2	2.2	2.6	3.1	3.7
Total Value ($000,000)	1403	1993	1881	3426	6513	10549	14059	21403	28996

1974 (Table 5).

Another important aspect is the method by which this foreign investment has been financed. Table 6 shows the increasing importance of retained earnings. The proportion of the net increase in undistributed earnings in the net increase in the book value of foreign direct investment has increased from one third or less in 1960 to 90% in 1974.

Table 6

RELATIVE IMPORTANCE OF CAPITAL INFLOW AND RETAINED EARNINGS IN FDI

YEAR	1950	1955	1960	1962	1965	1970	1972	1973	1974
C/RE	1.5	1.3	2.4	1.5	.7	.9	.4	.3	.1

C = Capital Inflow
RE = Retained earnings

Finally, it is important to note the sectoral distribution of foreign direct investment within Manufacturing. The two most important sectors are "Wood and Paper Products" and "Iron Products", which together have received more than 50% of total foreign direct investment directed to manufacturing. The role of these two sectors has changed during the last thirty years. They still represent 50% of the total but their shares in 1974 are almost the opposite of those in 1926 (Table 7). The role of the other sectors has remained almost unchanged except in the case of Chemical products where there is a small but

Table 7

FOREIGN DIRECT INVESTMENT IN CANADIAN MANUFACTURING
(SHARES OF INDUSTRIES)

	1926	1930	1939	1950	1955	1960	1965	1970	1974
Vegetable Products	13.1	15.1	13.7	11.5	11.6	11.9	10.9	10.5	11.8
Animal Products	2.2	3.8	4.4	2.7	2.6	2.3	2.6	2.4	2.5
Textiles	3.0	3.0	3.4	3.4	2.8	2.2	1.9	2.0	2.6
Wood and Paper	31.2	34.7	28.0	23.0	22.8	19.3	19.8	18.8	18.7
Iron and Products	19.5	18.8	16.9	18.9	23.4	26.9	27.9	30.0	31.8
Non-Ferrous Metals	9.0	10.6	11.9	13.8	18.2	18.4	15.5	15.0	10.5
Non-Metalic Miner	11.8	1.8	10.0	14.0	3.5	4.5	3.6	3.8	4.5
Chemicals	7.3	9.3	9.7	9.9	13.2	12.5	16.2	14.9	15.5
Miscellaneous	2.9	2.8	2.0	2.8	1.9	2.0	2.5	2.1	2.1
Total Value (000,000)	944	1090	1142	2331	3434	5342	7255	10767	14796

steady increase offset by the decrease in the share of non-metallic minerals. Again the sectoral distribution of foreign direct investment within manufacturing is dominated by the structure of the U.S direct investment which represents about 80% of the total. In Table 8 we can see that more than 50% of U.S foreign direct investment goes to "Wood and Paper Products" and "Iron Products" industries. The next most important sector is Chemicals which also shows steady growth.

3. Determinants of Foreign Direct Investment

A brief review of the different explanations of FDI determinants provided in the literature might help in understanding the performance of foreign firms.

Table 8

U.S DIRECT INVESTMENT IN CANADIAN MANUFACTURING
(SHARES OF INDUSTRIES)

	1926	1930	1939	1950	1955	1960	1965	1970	1974
Vegetable Products	8.4	10.0	9.8	9.5	10.6	11.2	10.2	10.0	11.2
Animal Products	2.2	4.0	4.8	2.8	2.9	2.5	2.8	2.5	2.6
Textiles	2.2	2.1	2.0	2.0	1.9	1.7	1.6	1.7	2.3
Wood and Paper	31.3	35.8	28.5	22.0	23.2	20.4	19.9	17.8	16.6
Iron and Products	22.0	21.3	19.1	20.7	24.9	27.5	28.6	32.8	35.5
Non-Ferrous Metals	10.1	12.1	13.2	15.4	20.6	20.4	16.6	16.3	11.0
Non-Metallic Miner.	13.3	1.8	11.4	15.2	2.8	3.1	2.6	2.7	2.8
Chemicals	7.3	9.2	8.9	9.6	11.1	11.0	15.4	13.8	15.3
Miscellaneous	3.0	3.7	2.3	2.8	2.0	2.2	2.3	2.4	2.7
Total Value (000,000)	818	932	984	2024	2835	4348	6167	9231	12432

As it is mentioned in a study done by the Government of Canada[11], foreign investment flows can be linked with trade flows. What usually makes one country an exporter (investor) and the other country an importer (receiver) is the possession of some distinctive feature such as technological superiority or the possession of a resource or skill which is in limited supply.

The importance of these points is revealed, in part, by the industrial distribution of imports and foreign investment in Canada, high in industries such as automobiles, machinery, scientific instruments, and electrical products. On the other hand, there are a number of other factors which affect the decision whether to invest or export. In the case of Canada, cost factors and tariff barriers appear to have been very important. As well, factors related to market position (a foreign investor may locate in Canada to foreclose the possible development of a Canadian firm which could become a competitor), home environment (for example, the efficiency of the New York capital markets have probably been a considerable factor in fostering United States direct investment abroad), and host environment (Canadian governments have tried to attract foreign capital to meet the growth aspirations for the country) all affect the FDI decision.

There have been also a number of empirical tests of the determinants of FDI. Horst[12] has shown that, for U.S firms, exports and subsidiary sales represent alternative means of utilizing their technological superiority over Canadian competitors. The Canadian tariff and the relative cost of inputs seem to be the main factors that determine whether the U.S advantage will be exploited through exports or subsidiary sales. These results were also confirmed by Bauman.[13]

Another hypothesis that has been tested is the intangible capital hypothesis. According to this theory, domestic producers have some advantage over foreigners, mainly a stock of knowledge about the local legal and institutional environment. The key to the explanation of the existence of foreign firms lies in the firms possession of intangible assets that can more than offset the above disadvantage. This theory together with other alternative hypotheses was tested by Caves[14] for Canadian and U.K manufacturing industries. His results showed that the intangible asset variables, mainly the industry's advertising and research intensity, were significant in both countries. Also the multiplant economies hypothesis worked well in both countries. Caves found that Canadian tariffs do not support the hypothesis that tariffs determine the choice between exports and direct investment. A measure of relative factor cost showed also some significance.

Bauman[15] attempted to explain inter-industry variations in the pattern of U.S direct investment in Canadian manufacturing industries. He showed that the theories of mergers and takeovers originally developed in the context of a closed economy, can be usefully applied to the problems of foreign direct investment.

Finally Pattison[16] tested the role of financial markets as a factor affecting foreign direct investment. His conclusion was that although financial factors have played a role in encouraging foreign investment, they are not as important as they used to be.

4. Foreign Control in Canadian Manufacturing

Since direct investment involves the purchase of an amount of the capital stock of a firm and hence some control, it is important to examine the control in Canadian manufacturing industries including the distribution of this control among different geographical areas and among different sectors within manufacturing.

At this point we clarify the notion of country of control. As noted above, the relevant unit of account is the establishment. The classification of establishments by control reflects the control classification of the corporations to which they belong. In this study a corporation is considered foreign controlled if 50% or more of its voting rights are known to be held outside Canada or are held by one or more Canadian corporations that are themselves foreign controlled.[17]

Magnitude of Foreign Control

As it is shown in Table 9, 53% of Canadian manufacturing is foreign controlled. Foreign control in this case is measured in terms of gross output, however, other measures give similar results (for example, measured in terms of shipments foreign control is 53.4% and measured by value added it is 51%). Even in the more detailed breakdown in the twenty major industries the same picture unfolds. Half of these industries are foreign controlled and half of them domestic controlled. The same is true for the top ten industries which account for the 81.2% of total gross output.

Another point to notice from Table 9 is that domestic control increases if we look only at the manufacturing activity of the establishments. This is true not only on the average but also for every major industry. This means that foreign controlled establishments and especially those controlled by U.S companies, tend to engage more in non-

Table 9

SHARES OF FOREIGN AND DOMESTIC CONTROL
IN CANADIAN MANUFACTURING INDUSTRIES

(Measured by Gross Output, 1974)

	MANUFACTURING ACTIVITY			TOTAL ACTIVITY		
	CANADA	U.S	OTHER	CANADA	U.S	OTHER
1. Food and Beverage	63.0	27.0	10.0	62.5	26.9	10.6
2. Tobacco	.4	39.5	60.1	.4	40.0	59.6
3. Rubber and Plastics	33.7	58.6	.7	28.7	65.0	6.3
4. Leather	77.9	17.2	4.9	75.6	19.9	4.5
5. Textile	48.8	42.8	8.4	47.7	42.8	9.5
6. Knitting Mills	78.3	16.7	5.0	77.6	17.5	4.9
7. Clothing	87.3	12.1	.6	86.1	13.4	.5
8. Wood	74.1	20.0	5.9	74.7	19.7	5.6
9. Furniture and Fixtures	82.5	14.6	2.9	81.5	15.6	2.9
10. Paper	53.8	31.7	14.5	54.4	31.6	14.0
11. Printing & Publishing	88.3	8.4	3.3	86.8	9.6	3.6
12. Primary Metal	76.4	15.8	7.8	77.6	14.4	8.0
13. Metal Fabricating	61.6	32.2	6.2	61.1	32.7	6.2
14. Machinery	37.3	53.5	9.2	33.5	57.1	9.4
15. Transportation Equipment	15.1	82.1	2.8	11.4	86.5	2.1
16. Electrical Products	38.5	52.5	9.1	35.0	56.2	8.8
17. Non-Metallic Minerals	44.3	24.5	31.2	44.4	26.0	29.6
18. Petroleum and Coal	5.1	63.8	31.1	5.1	64.0	30.9
19. Chemical Products	19.3	60.4	20.3	18.0	61.4	20.6
20. Miscellaneous	46.1	48.1	5.8	43.7	50.7	5.6
Total	48.7	40.4	10.9	46.3	43.2	10.5

manufacturing activity.

Finally, except in the cases of Tobacco and Non-Metallic Mineral industries, U.S establishments are the major component of foreign control.

At this point it is useful to examine some of the major differences and similarities of domestic and foreign establishments which can be derived from an initial analysis of the data. These comparisons are also useful in explaining some results presented later in this thesis.

Size of Establishments

Canadian controlled establishments are significantly smaller than foreign controlled establishments. Measured by the number of establishments domestic control is 87.4% while measured by gross output it is only 46.3%. Also U.S establishments are bigger than other foreign establishments. The magnitude of these differences by industry is given in Table 10. The difference between foreign and domestic establishments becomes smaller if we take into account only the manufacturing activity of establishments. Thus, once more it becomes evident that foreign controlled establishments have a proportionally larger non-manufacturing sector.

Concentration of Foreign and Domestic Firms

This section is based on 1972 data since some of the statistics presented are available for 1970 and 1972 only.[18] The first three columns in Table 11 show the relative importance of each manufacturing industry by country of control. In the case of Canadian firms the five most

Table 10

SIZE OF ESTABLISHMENTS AND OUTPUT PER ESTABLISHMENT IN CANADIAN MANUFACTURING INDUSTRIES, 1974

	ESTABLISHMENTS				GROSS OUTPUT PER ESTABLISHMENT		
	No.	CANADA %	U.S %	OTHER %	CANADA	U.S	OTHER
1. Food & Beverage	5010	88.7	8.1	3.1	2372	11120	11547
2. Tobacco	24	25.0	33.3	41.6	468	37121	44282
3. Rubber & Plastics	783	79.0	17.7	3.0	1095	11082	6223
4. Leather	432	90.7	7.6	1.6	1221	3825	4071
5. Textile	936	87.0	9.2	3.8	1595	13722	7156
6. Knitting Mills	320	90.1	7.8	2.1	1688	4371	4401
7. Clothing	2172	96.8	3.0	.2	914	4448	2870
8. Wood	3111	94.8	4.1	1.2	1078	6700	6438
9. Furniture & Fixtures	2233	97.5	2.0	.5	536	4843	4575
10. Paper	650	70.1	21.3	8.6	9865	18722	20567
11. Printing & Publishing	3812	97.9	1.4	.7	623	5059	3285
12. Primary Metal	397	77.1	15.8	7.1	19454	17550	21975
13. Metal Fabricating	4021	89.1	8.8	2.1	1130	6125	4982
14. Machinery	1074	73.0	22.9	4.1	1699	9181	8640
15. Transportation Equipment	1003	79.4	18.3	2.3	2037	67146	13042
16. Electrical Products	784	60.0	33.6	6.4	4181	11926	9810
17. Non Metallic Minerals	1206	79.5	12.5	7.7	1196	7200	4933
18. Petroleum & Coal	105	33.4	40.9	25.7	8098	83058	63867
19. Chemical Products	1068	48.1	37.9	14.0	2028	8798	7958
20. Miscellaneous	2394	89.8	8.6	1.6	452	5418	3391
Total	31535	87.4	9.5	3.1	1629	14035	10552

Table 11

INDUSTRIAL CONCENTRATION AND CONCENTRATION OF FOREIGN CONTROL IN CANADIAN MANUFACTURING INDUSTRIES, 1972

	INDUSTRIAL CONCENTRATION			FOREIGN CONTROL IN THE TOP 8 ENTERPRISES			
	CANADA	U.S	OTHER	(1)	(2)	(3)	(4)
1. Food & Beverage	23.5	10.8	17.5	36.1	61.7	48.5	20.4
2. Tobacco	0.0	.7	4.3	78.8	99.9	78.9	2.2
3. Rubber & Plastics	1.5	3.6	1.4	72.2	51.7	--	--
4. Leather	1.0	.3	.3	20.3	50.2	34.0	14.4
5. Textile	2.9	2.8	2.5	51.3	74.5	56.4	29.0
6. Knitting Mills	1.1	.6	.3	19.2	39.3	23.4	18.5
7. Clothing	4.2	.7	.1	10.7	21.7	26.4	5.7
8. Wood	7.0	2.0	2.3	30.2	--	40.7	24.4
9. Furniture and Fixtures	2.6	.5	.4	15.7	28.7	27.0	9.9
10. Paper	10.0	6.2	11.2	49.5	55.3	39.2	59.4
11. Printing & Publishing	5.1	.6	.9	11.9	43.5	--	--
12. Primary Metal	13.2	2.6	6.0	23.9	89.9	--	--
13. Metal Fabricating	9.0	5.2	4.0	40.7	42.2	51.5	32.1
14. Machinery	2.9	5.4	3.6	71.0	40.9	89.6	59.7
15. Transportation Equipment	3.6	29.0	2.9	87.1	86.0	90.9	65.3
16. Electrical Products	4.3	7.5	4.8	64.8	75.6	67.8	55.2
17. Non Metallic Minerals	2.5	1.6	7.8	55.1	77.0	68.0	23.3
18. Chemical Products	.6	8.5	16.8	98.0	94.4	99.6	71.8
19. Chemical Products	2.3	8.5	11.6	81.8	64.7	90.9	67.8
20. Miscellaneous	2.1	2.7	1.2	53.9	63.7	61.8	40.5

Note: (1) Foreign Control of Industry Shipments
(2) Top 8 Firms Industrial Concentration
(3) Foreign Control in the Top 8 Firms
(4) Foreign Control in the Remaining Firms

important industries are Food and Beverage, Wood, Paper, Primary Metal and Metal Fabricating industries which all together count for 62.7% of the total. In the case of U.S firms the five most important industries are Food and Beverage, Transportation equipment, Electrical Products, Petroleum and Coal and Chemical industries which count for the 64.3% of the total. Finally, in the case of other foreign firms[19] the five most important industries are Food and Beverage, Paper, Non-Metallic Minerals, Petroleum and Coal, and Chemical industries which count for 64.9%. Thus, even though the areas of concentration are similar among foreign firms, the areas of concentration are different between domestic and foreign firms.

Another measure of concentration is given in the last four columns of Table 11. Looking at the top eight enterprises as one group and the remaining as another we notice that the degree of foreign control is much higher in the first group than in the second.

Labour Output Ratios

In Table 12 we present a variety of characteristics related to the labour use of domestic and foreign firms. It is clear from this table that domestic firms are more labour intensive and this is not true only on the total average but also for almost every major industry. Another difference that can be derived from the same table is that foreign firms pay a higher wage rate which is also true for most major industries, however, foreign firms do not pay higher

Table 12

OUTPUT LABOR RATIOS, AVERAGE WAGE RATES AND SALARIES IN CANADIAN MANUFACTURING INDUSTRIES BY COUNTRY OF CONTROL, 1974

	OUTPUT PER MAN-HOUR						AVERAGE WAGE RATES			AVERAGE SALARIES		
	MANUFACTURING ACTIVITY			TOTAL ACTIVITY								
	CANADA	U.S.	OTHER	CANADA	U.S.	OTHER	CANADA	U.S.	OTHER	CANADA	U.S.	OTHER
1. Food & Beverage	50.6	53.7	41.0	34.6	33.3	28.0	3.85	4.11	4.14	10793	10787	11192
2. Tobacco	14.2	55.4	58.6	11.0	41.4	36.7	2.21	4.77	5.28	8579	12075	13612
3. Rubber & Plastics	19.3	27.1	20.1	14.7	23.1	14.1	3.43	4.27	3.92	12263	11582	11806
4. Leather	12.4	11.0	12.5	10.5	10.2	10.2	2.96	2.72	3.17	10955	10348	8624
5. Textile	17.6	23.9	20.5	13.4	17.6	16.6	3.04	3.71	3.16	10745	11973	9777
6. Knitting Mills	12.6	13.9	19.3	10.0	10.8	14.0	2.72	2.57	2.75	12539	10227	10658
7. Clothing	11.8	12.3	12.4	9.8	10.1	9.9	2.84	2.68	3.00	12286	10839	12469
8. Wood	20.4	24.9	28.2	17.0	21.4	23.4	4.14	5.37	5.35	12992	13673	14392
9. Furniture & Fixtures	14.5	17.4	15.9	11.5	13.5	11.4	3.25	3.70	3.63	13066	11433	11022
10. Paper	35.6	39.0	36.8	27.2	29.0	27.4	5.12	5.19	5.13	14212	13866	12941
11. Printing	23.6	37.4	24.1	13.4	15.9	16.3	4.84	3.88	5.05	11090	10252	9972
12. Primary Metal	31.7	38.4	37.0	26.8	29.1	32.6	5.27	4.88	5.26	14883	13290	13634
13. Metal Fabricating	21.9	28.9	28.5	17.6	22.0	21.6	4.46	4.36	4.36	13067	11917	12041
14. Machinery	22.6	29.6	23.0	17.7	22.4	16.7	4.69	4.77	4.93	12581	11622	11486
15. Trans-portation Equipment	19.2	45.5	23.6	15.4	45.6	16.9	4.25	4.38	4.60	11772	14750	11382
16. Electrical Products	25.1	24.0	28.6	17.1	17.3	20.9	3.96	3.92	4.51	13172	11682	11797
17. Non Metallic Minerals	21.1	27.0	34.0	16.9	21.4	24.9	4.37	4.68	5.31	12468	12371	12512
18. Petroleum and Coal	173	311	383	111	128	164	4.95	6.41	6.05	12811	15367	16156
19. Chemical Products	39.9	64.1	53.5	24.4	33.3	29.3	4.37	4.83	4.70	12356	12988	12025
20. Miscellaneous	14.2	25.2	21.3	11.5	18.0	15.9	3.39	3.74	3.21	12612	11924	11216
Total	25.3	39.2	40.7	19.3	29.9	28.3	4.07	4.59	4.63	12357	12493	12067

average salaries.

5. Growth of Foreign Control in Canadian Manufacturing

Due to the fact that the data on which this chapter is based are available only for the years 1969, 1970, 1972 and 1974 we present the growth of foreign control over the last four years. The year 1969 is excluded because of the change in industrial classification that took place in that year and which therefore made comparison of industries very difficult.

By most measures, Canadian control of the manufacturing industries increased from 1970-1974. The share of manufacturing shipments rose from 48.0% to 48.9%, while the share of manufacturing value added increased from 48.1% to 50.7%. The proportion of the total number of employees working for Canadian controlled establishments rose from 55.6% to 56.9% even though it remained constant in the last two years. Total wages and salaries paid by Canadian controlled establishments rose from 50.9% to 53.9%. On the other hand, the proportion of establishments controlled in Canada declined, from 88.1% to 87.5% and the proportion of total shipments which they generated remained almost constant at about 46.4%.

Within the foreign controlled sector, the United States control decreased while that of other countries increased. Manufacturing shipments of United States controlled establishments declined from 42.2% to 40.2%, while the share of other foreign countries rose from 9.8% to 10.9%.

Although the changes are small the general trend over the period 1970 to 1974 seems to have been a decline in the share of manufacturing activity attributable to manufacturing establishments controlled in the United States, with the difference being split approximately evenly between establishments controlled in Canada and those controlled in other foreign countries.

It can be expected that the relative sizes of the various industries will not have remained constant, some growing more and some less than the average. Therefore it is possible that changes in Canadian and foreign control will be partly due to changes in the size distribution of industries. To check this possibility Rosenbluth[20] decomposed changes in the percentage of Canadian control into two parts. The first measures the "industry mix" effect, that is, the part of the total change due to changes in relative sizes of industries between different years, assuming constant levels of Canadian control (Value-added is used as measure of industry size). The second component is the "within industry change" effect. That is, the part of total change resulting from changes in Canadian control at the level of individual industries, assuming that relative sizes remain constant. Canadian control was measured using manufacturing shipments.

The method described above yielded the following results.[21] From 1970 to 1972 there was a 1.6% net increase in Canadian control. If the size distribution of industries had not changed over the period there would have been a 2.0%

increase. The negative industry mix effect indicates that industries in which the level of Canadian control rose tended to have lower shares of all industry manufacturing value-added in 1972 than in 1970. The same is true for the years 1972 to 1974 where the percentages were 1.6 and 2.1 respectively.

Looking now in the more detailed breakdown in the twenty major industries (Table 13) we note that during the years 1970-1974 in ten out of twenty industries, the share of the Canadian controlled firms increased. The remaining eight industries decreased (for two industries we do not have figures). The most dramatic change was in Primary Metals industry. The Canadian share was increased by 22.4%. This was caused by the re-classification from the United States to the Canadian control of ALCAN and INCO, which taken together, have a significant proportion of the manufacturing activity in this industry.

6. Conclusion

Summarizing the foregoing analysis, we conclude that foreign control constitutes a very high and stable proportion of Canadian manufacturing. This foreign control is concentrated mostly in those industries where technological innovation is likely to be very important, such as Transportation Equipment, Chemicals, Machinery and Electrical Products. Foreign firms are usually large firms with a non-manufacturing sector proportionally larger than domestic firms. Foreign firms use less labour-intensive techniques

Table 13

GROWTH OF DOMESTIC AND FOREIGN CONTROL IN CANADIAN MANUFACTURING INDUSTRIES

	1974 MANUFACTURING SHIPMENTS			1970 MANUFACTURING SHIPMENTS			CHANGE IN CANADIAN CONTROL	CHANGE IN U.S CONTROL
	CAN.	FOR.	U.S.	CAN.	FOR.	U.S.		
1. Food & Beverage	63.0	37.0	27.0	66.8	33.2	24.3	- 3.8	2.8
2. Tobacco	.5	99.5	39.1	--	--	--	--	--
3. Rubber & Plastics	34.0	65.9	58.5	27.3	72.7	67.9	6.7	- 9.4
4. Leather	78.1	21.9	17.1	79.8	20.2	17.4	- 1.7	- .3
5. Textiles	48.9	51.1	42.9	53.2	46.8	37.3	- 4.3	5.6
6. Knitting Mills	78.8	21.2	16.2	81.6	18.4	17.6	- 2.8	- 1.4
7. Clothing	87.6	12.4	11.9	90.2	9.8	--	- 2.6	--
8. Wood	73.8	26.2	20.5	74.9	25.1	20.8	- 1.1	- .3
9. Furniture & Fixtures	82.6	17.4	14.5	83.3	16.7	15.5	- .7	- 1.0
10. Paper	53.8	46.2	31.7	50.7	49.3	35.0	3.1	- 3.3
11. Printing & Publishing	88.5	11.5	8.2	88.1	11.9	8.2	.4	0.0
12. Primary Metal	76.5	23.4	15.9	54.1	45.9	37.7	22.4	-21.8
13. Metal Fabricating	62.2	37.8	31.7	60.1	39.9	34.2	2.1	- .5
14. Machinery	37.5	62.5	53.3	28.4	71.6	65.3	9.1	-12.0
15. Transportation Equipment	15.4	84.6	82.0	13.2	86.8	82.3	2.2	- .3
16. Electrical Products	38.5	61.5	52.1	35.4	64.6	52.8	3.1	- .7
17. Non Metallic Minerals	44.2	55.8	24.5	48.4	51.6	25.5	- 4.2	- 1.0
18. Petroleum & Coal	5.1	94.9	63.4	2.1	97.9	70.5	3.0	- 7.5
19. Chemical Products	19.2	80.8	60.5	18.7	81.3	60.2	.5	.3
20. Miscellaneous	46.4	53.6	47.9	--	--	--	--	--
Total	48.9	51.1	40.2	48.0	52.0	42.2	.9	- 2.2

and pay a higher average wage rate than domestic firms. Finally, even though there has been a decline in the foreign control in recent years, the changes have been very small.

Looking only at the size of foreign firms we note that major decisions such as those dealing with employment, balance of payments and energy use, which are presently of increasing policy importance, are very much affected by the decisions taken by foreign firms. In order for policy to be effective we must know whether foreign and domestic firms behave differently and why. That is, what will be the response of each group to any proposed policy alternative. It is not enough to know that there are differences or similarities between foreign and domestic firms in a specific industry, we must be able to explain the reasons for these differences.

A key issue which lies in the center of this problem and has received very little attention is the issue of technology - whether foreign and domestic firms use the same technology. The importance of this problem lies in the fact that other questions such as employment are strongly related to the question of technology.

As it was mentioned above, foreign firms actually employ more capital-intensive techniques. It is very important to know ceteris paribus whether this is the result of the noted higher wages, differences in the scale of production or, finally, differences in the production process employed by foreign firms.

A more capital intensive technology used by foreign firms might imply that foreign firms introduce a more advanced technology and increase the efficiency of the economy. However, the same event may arise from the fact that the know-how was developed outside Canada and hence the role of Canadians in the creation of technology is diminished. Also a more capital-intensive technology used by foreign firms likely implies that higher foreign control will bring relatively higher unemployment and higher energy intensity in the economy.

Another question that is also related to technology issue is how each group (foreign and domestic) responds to input price changes. This is related to how each group substitutes one factor of production with another and thus how it will change its input use after a change in factor prices. The problem of unemployment, which is very important in our days is related with issue.

From the above we realize that the technology issue is very important. Results that will show that there are differences between foreign and domestic firms in a given industry imply that a given policy measure may not be effective if it ignores those differences.

CHAPTER III

THE IMPACT OF FOREIGN DIRECT INVESTMENT ON TECHNOLOGY AND EFFICIENCY

1. Existing Evidence of the Canadian Experience

Ex ante, the technical relationship of foreign to domestic firms is ambiguous. Foreign firms may use a technology similar to that of domestic firms in order to exploit differences in the factor costs. On the other hand, it may be argued that foreign firms make little effort to change their technologies because it is on the basis of the advantages of possessing these technologi~~es that~~ they have been able to invest abroad.

With respect to efficiency it can be argued that the entry of new foreign firms populates the industry and increases efficiency through a higher level of competition. This might be true only if no firm or small group of firms can dominate the industry. In the opposite case and particularly in cases where foreign entry is achieved through the takeover of a domestic firm or where the dominance of a foreign firm already in the industry is increased by such an acquisition, foreign investment can make the industry less competitive by introducing greater concentration.

These are only some of the ways that foreign investment can affect the technology and efficiency of a given industry. The same variety of results can be found also in the literature concerning foreign direct investment in

Canadian manufacturing.

Safarian[22] using data from 1961 Canadian survey found that if one concentrates on only the largest size category of firms[23] and makes comparisons between the foreign and domestic firms, on the average, the second group would appear to have smaller firms, in terms of employees and shipments, with a lower capital intensity and paying lower wages and salaries per employee. However, the size distribution of the firms within each group would explain more the situation since the presence of very large firms affect the averages.

He found futher (using a different source of data reported under CALURA) that there did not appear to be a significant overall difference in profitability of foreign owned firms compared with domestic in the commodity producing industries. The exception may be in secondary manufacturing where foreign firms have somewhat higher profits.

When he compared subsidiaries with parent companies he found that in the group of large firms only 18% had unit cost in excess of the parent. In the smaller size group 60% had higher unit cost. The major reason given for lower unit cost was lower wage rates. The reasons given from those reported higher unit costs were shorter production runs, higher wages, import duties and higher costs of raw materials.

Finally, the great majority of foreign firms are producing items in Canada very similar to those of their parents. Also, most of these firms are producing something close to full product range of the parent company.

Concentrating more on the British-owned subsidiaries in Canadian manufacturing, Dunning[24], using a survey of 185 U.K subsidiaries, found that about half of them produced products sufficiently similar to those produced by their U.K associates, though in only 10% of the cases the products were absolutely identical. About 43% of the firms said that, in the case of comparable products, the manufacturing method was the same, while 53% said that the methods were basically the same but that marginal adjustments to factor mix or scale of production were necessary.

The evidence also shows that differences in labour productivity (measured as physical output per man year) were little more than marginal, in the majority of the cases, while production costs in Canada are at least 5% or more than those in U.K in three quarters of the sample. Some of the explanations given for these differences were the small share of the market, factor prices, differences in technical knowledge and management efficiency and efficiency of individual factor inputs.

Expressed as a proportion of their net worth, the average profits earned by British owned firms for the period 1955-1960 was found to be 6.8% while at the same time the Canadian firms earned 9.6%.

In the Gray Report[25], the impact of foreign investment on efficiency and on different technological characteristics of an industry was examined through its effect on competition. The level of competition is very much related to the degree of concentration. For the case of Canadian manufacturing there are three points relevant to that. First, foreign firms are typically larger than Canadian firms. In addition to being larger, foreign firms are more capital intensive. Second, there is a significant relationship between foreign ownership and the degree of market competition. Industries which are more than half foreign controlled are dominated by a small number of firms. Canadian controlled industries tend to have much more competitive market structures. A further aspect of reduced competition is the degree of product differentiation. There is evidence[26] of a close correlation between product differentiation and foreign control. Third, there is a close correlation between concentration in Canadian industries and concentration in United States.

The same study concludes that foreign investment in Canadian manufacturing may simply introduce concentration or artificial product differentiation with little or no offsetting benefits.

The main common characteristic of the above studies is the way they approach the problem. All of them rely merely on comparing different input-input or input-output ratios or profit ratios. Even if these averages do represent the existing situation they do not say any thing about the factors that determine these ratios. We do not know whether a difference in factor ratios is the result of different technology or the result of different input price ratios.

Also the question of efficiency (measured always by the unit cost) is examined by comparing subsidiaries with parent companies leaving aside the question of how efficient foreign firms are as compared to domestic firms. Apart from that, certain kinds of data, like profits, can not be considered as reliable.

A second small group of studies have tried to evaluate empirically the performances of foreign and domestic firms with respect to efficiency and technology.

According to Caves[27] the benefit for the host country is not the entry of a more efficient foreign firm in the industry and the introduction of a more productive knowledge, but rather the gains depend on spill-overs of productivity that occur when the multinational corporation can not capture its quasi-rents due to productive activities or to the removal of distortions by the subsidiary's competitive pressure. Thus foreign investment increase competition and so creates higher technical efficiency.

As a way of testing for these benefits, the impact of the presence of foreign ownership on the average profits of domestic firms was evaluated. If foreign investment increases competition then the profit rates of domestic firms should be inversely related to competitive pressure supplied by foreign firms. According to the results, the profits of the Canadian firms do show a weak inverse relationship with the foreign share in the industry.

These results can be questioned for one main reason.

Even if profits in Canadian firms do decrease under the pressure of foreign ownership, we can not say anything about the level of competition in the industry, unless we know something about the nature of foreign investment[28] and the average profits of the industry as a whole.

The same result was also reported by Gorecki[29], though using a different approach. To test how sensitive Canadian and foreign firms are to entry barriers he regressed foreign and domestic entry against some measures of barriers to entry (capital requirements, research and development intensity, risk, etc.). He found that foreign enterprises are very insensitive both to overall level of entry barriers and to several of the entry barriers taken separately. Thus foreign enterprises may provide a valuable stimulus to competition because of that sensitivity. These results suffer from the same shortcomings as Caves.[30]

The existence of indirect economic benefits was also investigated by Globerman.[31] To evaluate the significance of these benefits he specified a labour productivity equation for domestically owned manufacturing firms including some measure of potential spillover benefits as a variable. The value added per employee was used as a measure of labour productivity and different measures of foreign ownership as independent variables, together with some other variables that affect labour productivity. According to his results, differences in labor productivity among Canadian owned plants can be attributed in part to spillover benefits associated with foreign direct investment.

One of the main advantages of the second group of studies is that they go one step further so that they do not only describe the existing situation but also try to investigate the factors that determine it. However, the methods used are very ad hoc. In all cases some key variable was regressed against a number of independent variables each one measured in two or three different ways hoping that one of them will be significant.

2. The Experience of Other Developed Countries

United Kingdom

In a survey conducted by Dunning[32], out of 140 U.S affiliates that reported on their costs of production relative to those of the parent, only 21 said that the costs were higher than in U.S. The majority of these firms were producing, using very capital intensive techniques. From the rest of the firms 36 said that the cost was about the same and 83 reported lower costs. In the last group the majority of the firms were using labour intensive techniques. Also 75% of the total sample said that their product range was narrower in the U.K than in the U.S.

In a different study[33] the same author found that out of 50 U.S owned firms only 11 had higher output per worker than the parent. The most common reason given for that was the smaller scale of production. However, the unit cost was lower in all but six cases. The productivity of a selection of U.S firms was 18% above the British competitors. He suggested that this difference reflects superior efficiency rather than industrial composition of the two groups. As he concluded in another study[34], among foreign companies in the U.K only those of U.S origin would seem to record higher rates of return than their U.K competitors. U.S firms do use their resources more efficiently than their domestic competitors, however, there is little doubt about the benefits of potential productive knowledge they introduce.

France

For France, foreign investment has affected both financial and technological aspects of the economy, as well as the competiveness of industries. This is the main observation of Bertin.[35] The effective impact of foreign direct investment has been very important despite the fact that its contribution to domestic savings and investment has been minor. This is due to concentration of foreign investment in industries where there was ample scope for industrial innovation.

The technological contribution which accompanied foreign investment has increased the level of research and development activity and improved the productivity of French industry. On the other hand the deficit due to research and development fees paid to U.S increased from $29.4 million in 1958 to $64.8 million in 1966. The industrial productivity was also helped by the increasing competition introduced by foreign corporations.

Australia

According to Brash[36], the most important single reason given for investing in Australia was a desire to take advantage of the expected growth of the Australian market. Tariff barriers was the most important reason that led firms to invest instead of exporting.

Comparing the physical output per man year of U.S firms with their parents, he found that productivity was lower in Australia than in United States, the main reason being the small volume of production. Out of 82 firms, 23 showed lower unit costs than the parents, 42 almost the same and 47 higher. The low volume of product was the main reason given for the higher costs. For the cases of lower costs the main reason given was lower cost of labour. Production per person for the sample of U.S firms was 36% higher than in Australian industry generally. He suggested that the differences between U.S and Australian firms may reflect in part, a difference in the size of the firms and, in part, the use of modern techniques of management and production in U.S firms, so that labour productivity would be higher even if capital labour ratios were the same.

The impact of foreign investment on the efficiency of the Australian firms was investigated in a study by Caves[37] through its effect on competition. He found that higher shares of foreign firms coincide with higher productivity levels in competing firms. The limitations of this study were mentioned in the previous section.

CHAPTER IV

DATA AND VARIABLES USED

1. Original Variables

Most of the data used in this study are drawn from a recent series of statistical publications[38] on domestic and foreign control of manufacturing establishments in Canada. The data that appear in these publications have been derived from the Annual Census of Manufactures by introducing the country of control characteristic. Thus, every figure that appears in the Annual Census of Manufactures has been broken down into a part that comes from establishments with Canadian origin, another part that comes from establishments with U.S origin and a third part from establishments with foreign origin other than U.S.

The main difference between this body of data and others that relate to foreign control is that it is based on returns of establishments[39] and the others are based on returns relating to companies and enterprises.[40] In the second case the returns must be classified to particular industries as complete entities and cannot be divided into the various different industrial activities in which the companies may be involved in.

Although the figures are tabulated from returns for establishments, whether the establishment is controlled in Canada or another country must be determined at the level of the owning enterprise. The nationality of an enterprise depends on the origin of those that own 50% or more of the shares. This nationality of control then applies to all establishments in the enterprise.[41]

Below we present all the available data in this series of publications.

Labor Inputs

PW Production and related workers (manufacturing activity).[42]

There are also separate figures for male and female production workers.

MH Man hours paid (manufacturing activity).

These are related to the above employees classified as production and related workers.

AE Administrative, office and other non-manufacturing employees (non-manufacturing activity).

In this group we include all the employees that are not included in the manufacturing activity, such as employees in cafeterias or restaurants operated by the establishment, employees in head, administrative, sales or service offices. There are also separate figures for males and females in this group.

WO Working owners and partners.

A very small group which also belongs to non-manufacturing activity.

WG Wages (manufacturing activity).

They refer to gross earnings of production workers before deductions of any kind.

SL Salaries (non-manufacturing activity).

They refer to gross earnings of non-production workers before deductions of any kind.

Commodity Inputs

RM Cost of materials and supplies (manufacturing activity).

It refers to consumption of purchased items only at laid-down costs including transportation and handling charges, duties etc. Includes transfers between units of the same company and work done on contract by others.

CM Cost of materials and supplies and goods for resale (total activity).

This includes the cost of materials and supplies mentioned above and in addition to that includes goods purchased for resale as well as materials and supplies that are not included in RM, such as purchased materials and supplies used for production of any machinery by own labour force for own use, office supplies etc.

FE Cost of fuel and electricity (total activity).

These figures refer to amounts actually used, not to purchases. Any fuel and electricity produced by establishments for their own consumption is not included.

Outputs

SP Shipments (manufacturing activity).

Shipments are the net selling value of goods produced by reporting establishment, or for its own account, from its own materials. Excluded are discount returns, allowances, sales tax, excise taxes and duties, returnable containers, common or contract carriers' charges for outward transportation (but not own carriers' delivery expenses). Included are repair and custom revenue, transfers to reporting units of same firm, all exports, book value of own products shipped the first time on a rental basis. As well consignment shipments to other countries, but domestic consignment shipments are included in inventory until sold.

VA Value added (manufacturing activity).

Value added refers to the value of shipments of goods of own manufacture (SP) plus net change in inventory of goods in process and finished, less cost of materials and supplies used (CM) as well as fuel and electricity (FE).

SR Shipments and other revenues (total activity).

This heading, besides SP, includes selected outputs of the establishment resulting from any non-manufacturing activity, such as purchase and resale of goods, book value of construction of buildings and equipment for own use by own labour force, operation of cafeterias, laboratories etc. Non-operating revenues such as interest or dividends or sales of used fixed assets are excluded.

TV Total value added (total activity).

Total value added consists of value added in manufacturing activity. The latter is calculated by subtracting relevant commodity inputs from non manufacturing revenue or outputs. These commodity inputs are net of the change in inventories of goods purchased for resale. Non-manufacturing revenues include depreciable fixed assets produced by own work force for own use, revenue from product rentals, etc., but exclude non-operating revenue such as real property rentals, dividends, interest.

All the above data are available for each type of ownership within each four-digit SIC[43] industry for the years 1969, 1970, 1972 and 1974. The above represent the only data presently available by country of control.

Data on capital input is not available by country of control. Due to the importance of the problem of creating a capital input series we present it in a separate chapter.

The last group of data deals with prices for the various inputs and outputs and data necessary to create series in cases where they are not directly available. As was mentioned above, price information is not available by country of control. Thus, with the exception of labour, we must assume that all groups of firms face the same input and output prices.

Energy Data

QN1 Quantity of purchased coal and coke

CT1 Cost of purchased coal and coke

QN2 Quantity of purchased gasoline

CT2 Cost of purchased gasoline

QN3 Quantity of purchased fuel oil

CT3 Cost of purchased fuel oil

QN4 Quantity of purchased liquid petroleum gases

CT4 Cost of purchased liquid petroleum gases

QN5 Quantity of purchased natural gas

CT5 Cost of purchased natural gas

QN6 Quantity of purchased electricity

CT6 Cost of purchased electricity

All these data come from the same source[44] and they are available only at the two-digit level for the years 1962-1976.

Other Prices

PQ Price index of gross output

PM Price index of raw materials

PV Price index for value added

Those three indices are available mainly at the two-digit level and for a number of selected four and three-digit industries. They all come from the same source.[45]

2. Derivation of the Main Variables

Output (Q)

Traditionally, economists have expressed a functional relationship between the output and the factor inputs in the form of $V = f(L,K)$, where V is the real value added, K is the quantity of capital services and L the quantity of labour services.

"In Canada, as in many other countries, the method used to calculate value added is the double deflation procedure. Gross output and material inputs are deflated by their respective price indices and the difference in the deflated values is called real value added. The procedure is justified, however, only under very strong separability conditions. If the production technology is additively separable, that is, if $Q = V + M$ then double deflation is justified. In this special instance materials (M) and real value added (V) are perfect substitutes".[46] Thus the use of real value added or the real value of production in place of output in a production function depends on whether the above mentioned conditions are met.

Denny and May[47] have tested the hypothesis that real value added is an acceptable measure of output in Canadian total manufacturing industries. This hypothesis was soundly rejected in this study. Denny and May[48] rejected the same hypothesis at the two and three-digit level in Canadian manufacturing. Finally the validity of the value added specification was also rejected by Berndt and Wood.[49]

From the above it becomes evident that the real value of production is likely the more appropriate measure of output. In our case it is measured as the current value of production divided by the industry selling price index (PQ). The current value of production is calculated as the sum of value added in total activity (TV), the cost of materials and supplies in the total activity (CM), and the cost of fuel and electricity (FE).

Labour (L)

This variable is defined as total man hours in production worker equivalents. It is measured by man hours paid to production workers (MH), plus the contribution of administration and other office employees converted to production workers equivalent. The convertion is done by dividing the salaries of non-production employees (SL) by the wage rate of production workers. The wage rate of production workers is given by the wage bill of production workers (WG) divided by the number of man hours paid to production workers (MH). Thus

$$L = MH + \frac{SL}{WG/MH} = MH(1 + \frac{SL}{WG})$$

This procedure assumes that the differences in wages between production and non-production workers are due to differences in skill. If this assumption is true the use of this variable corrects for quality variations due to a different mix of production and non-production workers.

Raw Materials (M)

The use of materials in the production function is related to the choice between value of output and value added. If value added is used, raw materials are not in the list of inputs. This procedure has received a variety of justifications[50]: (a) it facilitates the comparison of results for different industries with different material use intensities, (b) it facilitates the aggregation of output measures across industries through the reduction of double counting, (c) it reduces the problems of estimation and interpretation by the elimination of one variable, (d) often the use of materials is very closely related with the level of gross output and hence their inclusion as an independent variable in a regression analysis would obscure the relationships of interest, (e) any short run fluctuations in demand can be satisfied by a similar fluctuation in the use of materials only. In this sense, M is more endogenous than L and K and its use as an independent variable is more likely to lead to simultaneity problems.

As we will see later, most of the above reasons do not play an important role in this study. On the other hand there are valid reasons which support the use of raw materials, which implies the use of the value of production in the place of value added. The most important reason is the one given before, that is that the use of value added assumes at the very least that materials are weakly separable from labour and capital in the production process and the existing evidence supports the opposite.

The raw materials variable used in this study is defined as the cost of materials and supplies and goods for resale plus the cost of fuel and electricity, both at constant prices.

Price of Capital Services (r)

The price of capital services has three main components. One is the amount of physical capital that is used up during the period, the second is the opportunity cost of the financial capital tied up in capital goods, and the third is the capital gains. The logic behind the price of capital services defined in this way, which sometimes referred to as the "user cost of capital" and sometimes as the "implicit rental price of capital services", is that the rent on a unit of capital must be such that it just covers the opportunity cost of lending the funds used to buy it (i) plus the economic depreciation per unit (δ) less the expected rate of capital gains per period due to a rise in the unit price of capital goods ($\dot{q}/q$). Thus the basic formula for the user cost of capital (r) is given by

$$r = q(i + \delta - (\dot{q}/q))$$

There has been a number of different versions of this formula which range from the simple one $r = q(i + \delta)$ to very complicated ones which include several economic variables such as tax rates, tax credits, depreciation deductions etc.

In this study the series for the user cost of capital (one for each two-digit industry and for the years 1969, 1970, 1972 and 1974) have been taken from CANDIDE Model 2.0. The derivation of these series has been based on a measure derived mainly by Jorgenson[51], Hall and Jorgenson[52] and others. Assuming that the component based on expected capital gains is zero, this measure is defined as

$$r_j = q_j(i+\delta_j)(1-u_j z_j)(1-k_j)(1/(1-u_j)$$

where q = Investment deflator

i = Discount rate

δ = Economic depreciation rate

u = Effective corporate tax rate

z = Discounted capital cost allowances

k = Effective tax credit rate

j = The specific two-digit industry

Price Index for Energy (PE)

As noted previously the energy input variable available is the consumption of fuel and electricity (FE), which is an aggregate input consisting from six different types of energy (which were presented before p. 43). Thus, the price index of energy should be also an aggregate price index consisting from the price indices of the six different types of energy.

One can imagine the aggregation process as a production process where the inputs are the various energy input prices and the output is the aggregate input price for energy. Diewert[53] has shown that various common indices correspond to specific functional forms. That is the choice of a specific index implicitly assumes a given production function.

In this study the construction of the aggregate price index of energy is done by using the Divisia Index. The use of the Divisia Index implies that the production of the aggregate input, using the six different types of energy, follows a translog form.[54] The advantages of this form are presented later when this form is used for the cost function.

Other Prices

w Hourly wage rate of production workers which is defined as the wage bill divided by the total number of hours paid to production workers.

$w = WG/MH$

v Price index of raw materials

It is defined as $(CM + FE)/M$

CHAPTER V

CAPITAL SERVICES

The measurement of capital services involves more problems than any other variable. If no firm owned its capital then each machine, building etc. would have to be rented. In that case the problem of constructing an index for capital would be the same as it is for labour. Since firms tend to own their own capital these values should be imputed. This is a very difficult process because we have to take into account the effects of many other variables such as the original costs, the capital loss, the rate of depreciation, and the rate of interest. In general, the value of capital services is derived from the amount of capital stock by multiplying the latter with the user cost of capital. The construction of the user cost of capital was discussed in the previous chapter. In this chapter we present the construction of the capital stock figures.

The main difficulty with disaggregated data is with the information on capital stocks. Capital stock figures are not available at the four-digit level; furthermore, they are not available for foreign and domestic groups of firms within each industry. However, capital stock figures are available by Statistics Canada[55] for three-digit Canadian manufacturing industries for the years 1947-1978. The method of construction of these figures is presented in Appendix A. Thus, we need a method that will be used to distribute the capital stock figures at the three-digit level amongst four-digit level industries. Once the capital stock figures have been created at the four-digit level they can be further broken down into foreign and domestic groups of firms using the same method. The consequences of this method on the estimation procedure will be studied in the estimation part of this study.

Regarding the method that should be used we can argue that if capital is related to some variable which is available at the four-digit level and also for foreign and domestic groups of firms, then this variable can be used to break down the capital stock figures. More specifically, within a three-digit industry the shares of this variable can be used to create capital stock figures at the four-digit level. The same method can also be used to create capital stock figures for foreign and domestic groups of firms at any industrial level.

In our case the variable chosen for this purpose is the energy consumption. Energy consumption is available at the four-digit level for foreign and domestic groups of firms. The method by which capital figures were broken down is given by

$$K_j^i = \frac{E_j^i}{\sum_j E_j^i} \sum_j K_j^i \quad \text{or} \quad K_j^i = a_i \, E_j^i$$

$$\text{where } a_i = \frac{\sum_j K_j^i}{\sum_j E_j^i}$$

K_j^i is the capital stock of the j^{th} four-digit industry that belongs to the i^{th} three-digit industry.

E_j^i is the energy consumption of the same industry

$\sum_j K_j^i$ is the total capital stock of the i^{th} industry

$\sum_j E_j^i$ is the total energy consumption of the i^{th} industry

This method involves a number of assumptions which should be mentioned before we procede. First, it assumes that there is an exact relation between energy and capital of a specific form $K_j = a_j \cdot E_j$. This is a hypothesis that will be tested later on. Second, for a given three-digit industry the conversion factor from capital to energy (a_j) is constant. This factor is constant not only for every four-digit industry but also for every group of firms within a given three-digit industry. It is allowed to vary only from one three-digit industry to the other. The meaning of this is that capital stock and, furthermore, capital services from different vintages of capital equipment keep the same relation to energy consumption for every group of firms within a three-digit industry, thus energy-saving technical progress rate is not allowed to vary within a three-digit industry. At the firm level this will imply that if one firm uses capital intensive techniques which at the same time are energy-saving the amount of capital stock of that firm will be underestimated. As long as this is true this measure of capital is subject to error. In this study we deal with groups of firms and not with individual firms. This will decrease this type of error up to a point. If, however, a whole group of firms is characterized by capital-intensive energy-saving techniques this error becomes again important. Besides this error we lose the possibility of examining whether a group of firms that is characterized as capital-intensive is at the same time energy saving.

Apart from these shortcomings the energy consumption has the advantage of having a very strong relation with capital. In order to describe this relationship data for capital for the years 1962-1976 we were initially plotted against energy consumption data for each two-digit industry. From the graphs it was found that the relation between these two variables was very close to linear. The two different types of relations estimated were $K_j = a + bE_j$ and $K_j = bE_j$. The results are shown in Table 14. From this table it does not become clear which type of relation is the most appropriate. In some cases the constrained model (a=0) is significantly different from the unconstrained; in some others it is not and there are a few cases on the border. However, since the second one leads to considerable analytical convenience it was adopted. Besides this evidence for the relation between energy consumption and capital there is also more evidence in the relevant literature.[56] Most of these studies have examined the relation between these two variables in the production process and the majority of them agrees that capital and energy are strong complements. In a recent paper by

Table 14

CAPITAL-ENERGY RELATIONS*

		a	b	R^2	DW	LLF	ρ
1. Food and Beverage	E_q1	-283.0 (-1.341)	32.89 (19.46)	.966	.545	-106.1	
	E_q2		30.77 (50.69)	.962	.383	-106.5	
	E_q3	4220.7 (3.04)	21.05 (8.34)	.993		- 87.8	.963
	E_q4		14.81 (4.42)	.993		- 87.1	1.105
2. Wood	E_q1	-172.8 (-2.87)	28.50 (24.5)	.979	2.13	- 91.0	
	E_q2		25.53 (26.34)	.965	1.105	- 94.1	
3. Paper	E_q1	652.1 (2.25)	15.60 (14.99)	.945	1.459	-114.5	
	E_q2		17.70 (33.5)	.924	1.438	-116.4	
4. Primary Metal	E_q1	247.7 (3.16)	20.52 (51.48)	.995	2.681	- 93.8	
	E_q2		21.67 (101.7)	.991	1.745	- 97.5	
5. Metal Fabricating	E_q1	-155.3 (-2.26)	38.3 (22.8)	.975	1.510	- 90.0	
	E_q2		34.77 (49.71)	.966	.884	- 91.9	
			34.34 (29.57)	.975		- 83.4	
6. Transportation Equipment	E_q1	174.3 (2.11)	42.69 (26.0)	.981	1.666	- 95.8	
	E_q2		45.78 (55.44)	.974	1.427	- 97.5	
7. Electrical Products	E_q1	-158.0 (-4.28)	50.73 (31.3)	.986	1.280	- 80.1	
	E_q2		44.24 (51.55)	.968	.389	- 86.1	
	E_q3	1093.0 (1.83)	33.4 (6.04)	.990		- 72.6	.969
	E_q4		44.03 (27.97)	.988		- 73.1	.759

8. Chemicals	E_q1	400.9 (2.90)	20.45 (20.64)	.970	1.449	-105.2
	E_q2		22.93 (37.02)	.951	1.247	-108.4

*E_q1 is the equation $K = a + bE$

E_q2 is the equation $K = bE$

E_q3 is the E_q1 corrected for autocorrelation

E_q4 is the E_q2 corrected for autocorrelation

B.C. Field and C. Grebenstein[57], where the most important studies on capital-energy relation are summarized, it was found that the substitutability or complementarity between energy and capital depends on the measurement of the cost of capital. If the service price approach is used then energy and capital will show complementarity. In the service price approach the capital cost is computed as the quantity of physical capital multiplied by the service price. This is exactly the method we follow in this study.

In the same study there is also another method of measuring the capital stock which has been also followed in a number of other studies.[58] This is the value-added approach. According to this method the capital cost is obtained by subtracting the cost of labour from the value-added. The cost of capital measured in this way includes not only the cost of physical capital but also the cost of working capital. The main problem of this approach is that it deals with two different types of capital that behave in quite different ways. This difference is shown also in their relation to energy consumption. If capital cost is measured using the value-added approach it shows substitutability with energy.

Although the value-added method was not used as a method of creating the cost of capital in this study it was used as another way to break down the capital figures at the three-digit level. Value added and labour cost are available at the four-digit level and for foreign and domestic groups of firms. Thus, we have two ways to break down capital figures; first, using the shares of energy consumption and second, using the shares of capital cost created with the value-added approach.

Since there is no reason to choose one of them on theoretical grounds, we tested the ability of both to predict capital on a higher level of aggregation where the capital stock figures are known. We took the capital stock figures at the two-digit level and we broke them down to three-digit using both ways. The error of prediction (Table 15) in the case of energy consumption was in the range of 15%-30% in the majority of the cases while in the case of value-added cost of capital was the range of 45%-65%. Although we can not argue that these percentages will necessarily also apply to lower levels of aggregation, they give us one more reason to prefer energy consumption.

Table 15

THE AVERAGE ERROR OF PREDICTION
USING THE ENERGY SHARES AND
THE VALUE-ADDED APPROACHES
(In absolute values)

INDUSTRY	ER(ES)	ER(VA)
1. Food and Beverage	23.4	11.6
2. Wood	22.4	60.2
3. Paper	31.2	80.4
4. Primary Metal	21.6	50.2
5. Metal Fabricating	17.3	14.7
6. Transportation Equipment	19.8	50.6
7. Electrical Products	45.2	49.8
8. Chemicals	29.2	90.2

Note: ER(ES) = Average Error of Prediction
Using the Energy Shares Approach

ER(VA) = Average Error of Prediction
Using the Value Added Approach

CHAPTER VI

THE MODEL

1. Theoretical Background

The main question in this section concerns whether foreign firms effectively employ the same technology as domestic firms. The technological characteristics which can be used to examine this question are: the factor intensities, especially the capital intensity, the elasticities of substitution and the scale elasticity.

The factor intensities, under certain conditions, can tell us something about differences in technology among the different groups of firms. A difference in factor intensities is not necessarily the result of different technologies if the different groups of firms face different input prices and/or there are differences in the scale of production. To be able to see this in more detail we assume for the moment only two groups of firms and two factors of production, capital and labour. We further assume that each firm is a cost minimizer subject to a production function.

The case where a difference in the factor intensities is due to a difference in technologies is drawn in diagram A. In this case both firms (or groups of firms) face the same factor prices and produce the same level of output, however, they have different factor intensities because they use different technologies.

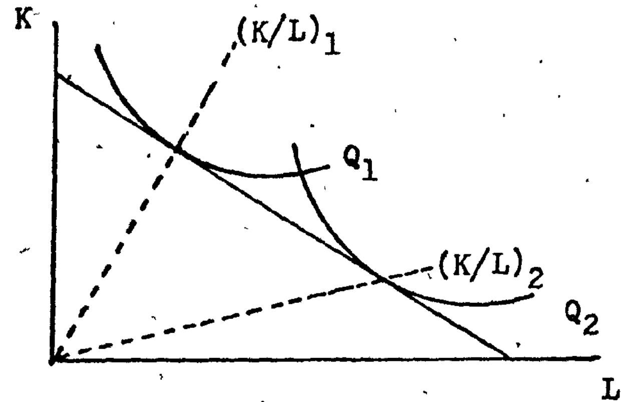

diagram A

The cases where the difference in factor intensities is due to differences in factor prices is given in diagram B. In this case although both firms (or groups of firms) have the same technology and produce the same level of output they have different intensities due to different factor prices that they face.

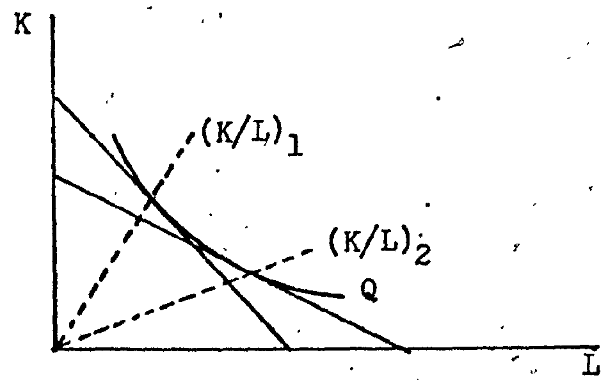

diagram B

Finally, the case where the difference in factor intensities is due to differences in the scale of production is given in diagram C, where factor prices and technology are the same and the only difference is the scale of production.

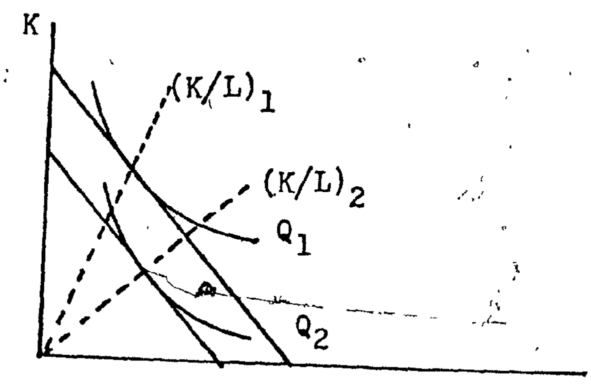

diagram C

These are three clear cases; other cases can also be derived as combinations of them, thus, to be able to infer something about technology from the factor intensities we have to isolate the effects of differences in input prices and scale of production.

Besides factor intensities there are other technological characteristics that will help us decide about the nature of technology. Such characteristics are the elasticities of substitution between the different factors of production which will tell us how easy it is for different groups of firms to respond in changes in factor prices and scale elasticity.

All the above characteristics will be derived through a cost function which will be estimated, wherever possible, for every group of firms (foreign and domestic) within a given industry.

We assume that each firm is a cost minimizer subject to a production function. This assumption is introduced for the main reason that, as opposed to other assumptions (for example, profit maximizing), it is much weaker. For every group of firms within a given industry the exact form of the cost minimization problem is given by:

$$\text{minimize} \quad C = wL + rK + vM \tag{1}$$

$$\text{subject to } F(Q^o, L, K, M) = 0 \tag{2}$$

where C = Cost of production

L = Labour input

K = Capital services

M = Raw materials

w = Price of labour

r = Price of capital

v = Price of raw materials

F = The production function

Q^o = A parametric value of output

The first order conditions for a true minimum point are given by:

$$\begin{aligned} w &= \frac{\partial F}{\partial L} \\ r &= \frac{\partial F}{\partial K} \\ v &= \frac{\partial F}{\partial M} \\ F(Q^o&, L, M, K) = 0 \end{aligned} \tag{3}$$

One way to study the technological characteristics of a given firm or group of firms is through the production function. That is, by estimating the production function (2) or the whole system (3) which consists of the first order conditions for a true minimum cost. The estimation of the entire system has been suggested to be appropriate because it takes into account the relations between factors of production and their prices. The main problem with this method is that the above system usually consists of highly nonlinear equations and the estimation becomes very difficult.

Another way to study the technological characteristics of a given firm or group of firms is through a cost function. This is based on the duality that exists between the cost and the production function. It has been proved[59] that, for well behaved functions, the existence of a production function implies the existence of a unique cost function and vice versa. Thus, all the properties of a production technology can be derived from the properties of the cost function of the firm or group of firms. The main advantage of this approach, as we will see later, is that it allows the estimation of a system of linear equations.

2. Cost Function and Its Properties[60]

Consider a set of production possibilities which yield an output (Q) from inputs of labour services (L), capital services (K) and raw materials (M). If these possibilities can be represented by a production function $F(Q,L,K,M) = 0$

which is increasing and quasi-concave in inputs, then we can define a cost function of the form $C = g(w,r,v,Q^o)$ which represents the minimum cost of producing Q^o, with given input prices.

This cost function possess a number of important properties. It is weakly concave, non decreasing, homogeneous of degree one and at least once differentiable in factor prices. It is continuous and increasing in output, and its derivatives with respect to factor prices equal the unique cost minimizing demands for the respective inputs.

Once we have estimated the cost function we can derive several production characteristics.

The elasticity of the input demand with respect to input prices is given by:

$$E_{ij} = \frac{\partial \ln X_i}{\partial \ln P_j} \tag{4}$$

where $X_i = L,K,M$

$P_j = w,r,v$

From the relation

$$E_{ij} = S_j \, \sigma_{ij} \tag{5}$$

where E_{ij} = the demand elasticity of input i with respect to price of input j

S_j = the cost share of input j

σ_{ij} = the elasticity of substitution between the i^{th} and the j^{th} factor

we can derive the elasticity of substitution

$$\sigma_{ij} = \frac{E_{ij}}{S_j} \tag{6}$$

The scale elasticity is given by:

$$E_{sc} = \frac{AC}{MC} \tag{7}$$

where $MC = \frac{\partial C}{\partial Q}$ (Marginal Cost) (8)

$AC = \frac{C}{Q}$ (Average Cost) (9)

3. The Form of the Cost Function

We now turn to the form of the cost function. In general, the choice of the functional form depends on the application, more specifically on the objectives of the study. There is no single best function for all purposes. In our case the main objective is the comparison of technological characteristics of foreign and domestic firms. Thus the first requirement is that we will be able to derive all the technological characteristics specified in the previous section. This implies that the cost function should be twice differentiable. This requirement is satisfied by most of the known forms. A second requirement is that the cost function should be sufficiently flexible[61] to be considered as a second order approximation to any arbitrary cost function, and will impose a minimum of constraints on the technological characteristics to be estimated. A variety of functional forms satisfy this requirement, including the generalized Leontief, the generalized Cobb-Douglas, the translog cost functions and others. In this study we choose the translog form. The main reason for this choice is that we can more easily test the different hypotheses as constraints on the parameters using the translog form.

For our three input model the cost function takes the form[62]:

$$\begin{aligned} \ln C = {} & c_o + c_w \ln w + c_r \ln r + c_v \ln v + c_Q \ln Q \\ & + \tfrac{1}{2} c_{ww} (\ln w)^2 + \tfrac{1}{2} c_{rr} (\ln r)^2 + \tfrac{1}{2} c_{vv} (\ln v)^2 + \tfrac{1}{2} c_{QQ} (\ln Q)^2 \\ & + c_{wr} \ln w \ln r + c_{wv} \ln w \ln v + c_{wQ} \ln w \ln Q \\ & + c_{rv} \ln r \ln v + c_{rQ} \ln r \ln Q + c_{vQ} \ln v \ln Q \end{aligned} \tag{10}$$

Using Shephard's lemma

$$L = \frac{\partial C}{\partial w} \qquad K = \frac{\partial C}{\partial r} \qquad M = \frac{\partial C}{\partial V}$$

we can derive the cost share equations

$$\begin{aligned} S_L &= \frac{wL}{C} = \frac{w}{C} \frac{\partial C}{\partial w} = \frac{\partial \ln C}{\partial \ln w} \\ &= c_w + c_{ww} \ln w + c_{wr} \ln r + c_{wv} \ln v + c_{wQ} \ln Q \end{aligned} \tag{11}$$

$$\begin{aligned} S_K &= \frac{rK}{C} = \frac{r}{C} \frac{\partial C}{\partial r} = \frac{\partial \ln C}{\partial \ln r} \\ &= c_r + c_{rr} \ln r + c_{wr} \ln w + c_{rv} \ln v + c_{rQ} \ln Q \end{aligned} \tag{12}$$

$$\begin{aligned} S_M &= \frac{vM}{C} = \frac{v}{C} \cdot \frac{\partial C}{\partial v} = \frac{\partial \ln C}{\partial \ln v} \\ &= c_v + c_{vv} \ln v + c_{wv} \ln w + c_{rv} \ln r + c_{vQ} \ln Q \end{aligned} \tag{13}$$

From the definition of cost $C = wL + rK + vM$ we derive the condition $S_L + S_K + S_M = 1$ which imposes the following constraints on the parameters.

$$c_w + c_r + c_v = 1 \tag{14}$$

$$c_{ww} + c_{wr} + c_{wv} = 0$$

$$c_{wr} + c_{rr} + c_{rv} = 0$$

$$c_{wv} + c_{rv} + c_{vv} = 0$$

$$c_{wQ} + c_{vQ} + c_{rQ} = 0$$

These constraints imply that one of the share equations is redundant. That is, the coefficients of one of the share equations can be derived from knowledge of the others. We arbitrarily, and without loss of generality, choose to delete the materials equation. The constraints and the system of equations then take the form:

$$c_v = 1 - c_w - c_r \tag{15}$$

$$c_{wv} = - c_{ww} - c_{wr}$$

$$c_{rv} = - c_{wr} - c_{rr}$$

$$c_{vv} = - c_{wv} - c_{rv} = -(-c_{ww} - c_{wr}) - (-c_{wr} - c_{rr})$$

$$= c_{ww} + c_{rr} + 2c_{wr}$$

$$c_{vQ} = - c_{wQ} - c_{rQ}$$

$$\ln C = c_o + c_w \ln w + c_r \ln r + (1 - c_w - c_r)\ln v + c_Q \ln Q$$
$$+ \tfrac{1}{2}c_{ww}(\ln w)^2 + \tfrac{1}{2}c_{rr}(\ln r)^2 + \tfrac{1}{2}c_{QQ}(\ln Q)^2 \tag{16}$$

$$+ \tfrac{1}{2}(c_{ww} + c_{rr} + 2c_{wr})(\ln v)^2 + c_{wr}\ln w \ln r$$

$$+ (-c_{ww} - c_{wr})\ln w \ln v + c_{wQ}\ln w \ln Q$$

$$+ (-c_{wr} - c_{rr})\ln r \ln v + c_{rQ}\ln r \ln Q$$

$$+ (-c_{wQ} - c_{rQ})\ln v \ln Q$$

$$S_L = c_w + c_{ww}\ln w + c_{wr}\ln r + (-c_{ww} - c_{wr})\ln v + c_{wQ}\ln Q \qquad (17)$$

$$S_K = c_r + c_{wr}\ln w + c_{rr}\ln r + (-c_{wr} - c_{rr})\ln v + c_{rQ}\ln Q \qquad (18)$$

CHAPTER VII

ESTIMATION OF THE MODEL

1. The Estimation Procedure

For the empirical implementation the model should be placed in a stochastic framework. Written in a more general form the system of equations (16), (17), and (18) becomes

$$C = g(w,r,v,Q^0) + \varepsilon_1 \tag{19}$$

$$S_L = S_L(w,r,v,Q^0) + \varepsilon_2 \tag{20}$$

$$S_K = S_K(w,r,v,Q^0) + \varepsilon_3 \tag{21}$$

It was assumed at the outset that each firm was a cost minimizer subject to a production function. Thus, we would expect that each firm (group of firms in our case) will represent a point on the cost function. However, when we come to the estimation part we accept that this is only an approximation. There are many reasons why a given firm is not on the estimated cost function and thus the cost at which the firm operates may not be the "minimum" cost. For example the functional form may not be appropriate or the parameters may differ slightly from one firm to the other. In addition our data may be in error either because they were recorded wrongly or because they do not measure correctly what we would like to measure. In most of the cases even though we realize that all or some of the elements of error is possible to exist we assume that the disturbances behave in a certain way. More specifically we assume that each of the ε's is a random variable distributed normally with mean zero and variance $\sigma_i^2 (i=1,2,3)$. We further assume that εi is not correlated with any of the regressors and that $E(\varepsilon^{ij}\ \varepsilon^{ij+s})$ $= 0$ for $s \neq 0$ and $i = 1,2,3$.

It is clear from equations (16), (17), and (18) that all the parameters of the model can be obtained by just estimating the cost function (16). We introduce the cost share equations (17) and (18) to supplement the estimation for two main reasons. First, given the accuracy of our assumption, the inclusion of these equations will increase the efficiency of the estimation because more information has been added to the estimation process. Second, the multicollinearity which is usually present in a translog cost function estimated from time series can be partially overcome. Finally, we have arbitrarily excluded the materials share equation because a system that includes all the share equations is constrained to have the sum of the dependent variables S_L, S_K, S_M equal to unity by definition. This implies the constraints (13) and the additional constraint that the sum of share equations disturbances is zero at each observation. This implies the disturbance variance co-variance matrix of this system of equations is singular.

Usually the higher the level of disaggregation the more reasonable it becomes to assume that factor prices are exogenous variables. This becomes almost true at the firm level. In our case we are working at a level somewhat more disaggregate than the four-digit level. Since there is no theory to tell us the level of disaggregation below which prices are considered exogenous we assume that the level of disaggregation at which we work allows us to assume that prices are exogenous. This assumption, which involves the possibility of an error (if prices are endogenous), facilitates much of the estimation procedure.

What we have so far is a system of three equations each one having common parameters with the others and a disturbance term with the usual assumptions. However, a more detailed examination of these equations shows that it is possible that it is not only the common parameters that relates these equations, there is one more factor. All three equations refer to the behavior of the same firm, also the share equations are derivatives of the cost equation, which means that if there is some variable which was not included in the cost equation it was also omitted from the other two equations. All these imply that a shock in one of the equations it is possible to be transmitted to other equations as well, which means that the errors across equations are correlated (contemporaneously correlated). In this case the variance covariance matrix of $\varepsilon = (\varepsilon_1, \varepsilon_2, \varepsilon_3)$ is

$$\underline{0} = \begin{bmatrix} E(\varepsilon_1\varepsilon_1') & E(\varepsilon_1\varepsilon_2') & E(\varepsilon_1\varepsilon_3') \\ E(\varepsilon_2\varepsilon_1') & E(\varepsilon_2\varepsilon_2') & E(\varepsilon_2\varepsilon_3') \\ E(\varepsilon_3\varepsilon_1') & E(\varepsilon_3\varepsilon_2') & E(\varepsilon_3\varepsilon_3') \end{bmatrix} = \begin{bmatrix} \sigma_{11}I_n & \sigma_{12}I_n & \sigma_{13}I_n \\ \sigma_{21}I_n & \sigma_{22}I_n & \sigma_{23}I_n \\ \sigma_{31}I_n & \sigma_{32}I_n & \sigma_{33}I_n \end{bmatrix}$$

where I_n is the identity matrix of order n and n is the number of observations.

Thus what we need is an estimation method that will take into account not only the parameter restrictions across equations but also the contemporaneous correlation of the disturbances. Such a method is the Zellner's iterative minimum distance method. According to this method we start by estimating the system of equations using stacked least squares method. This method will take into account only the parameter constraints across equations. Using the residuals from this first step we obtain an estimate of the variance covariance matrix $\hat{\underline{0}}$. Using $\hat{\underline{0}}$ we obtain a second set of parameters using GLS. If we now use the residuals we can obtain a second estimator of $\underline{0}$. This method continues until convergence is achieved. The procedure is declared converged when both of the following are true: the parameter changes are less than some pre-specified value (usually .01) and the product of the inverse of the covariance matrix from the previous iteration and the covariance matrix from the current iteration is close to the unity.[63]

2. Effects of the Use of a Proxy for Capital

The estimation procedure described in the previous section is valid as long as all the assumptions are true. However, as it is also said at the beginning of this study, capital is not available at the level of dissaggregation at which we work, that is at the four-digit level. Instead it is available at the three-digit level and we use energy shares to break it down to the four-digit level and further to foreign and domestic groups of firms. In this part we examine the effect of this method on the estimation procedure.

At this point we must make the distinction between actual and true variables. We assume that the only variable that is measured with error is capital, that is $K \neq K^A$, $L = L^A$ and $M = M^A$ where K^A, L^A, and M^A are the actual variables. Given that $K \neq K^A$ then $C \neq C^A$ and also $S_L \neq S_L^A$ and $S_K \neq S_K^A$.

We assume that $K^A = K + e$ (22)

where e is the error of prediction which has a normal distribution with zero mean and variance σ_e^2. This assumption is also supported by the results in Table 14.

Thus, the model in terms of actual variables has the form:

$$\ln C^A = g(w,r,v,Q^0) + \varepsilon_1 \tag{23}$$

$$S_L^A = S_L(w,r,v,Q^0) + \varepsilon_2 \tag{24}$$

$$S_K^A = S_K(w,r,v,Q^0) + \varepsilon_3 \tag{25}$$

where g is the translog cost function with all the properties mentioned in the previous chapter.

$$\begin{aligned} C^A &= w\,L^A + r\,K^A + v\,M^A \\ &= w\,L + r(K+e) + v\,M \\ &= w\,L + r\,K + v\,M + re \\ &= C + re \end{aligned} \tag{26}$$

$$S_L^A = \frac{wL^A}{C^A} = \frac{wL}{C+re} \tag{27}$$

$$S_K^A = \frac{rK^A}{C^A} = \frac{rK+re}{C+re} \tag{28}$$

If we now express our model in terms of the observable variables we obtain

$$\ln(C+re) = g(w,r,v,Q^0) + \varepsilon_1 \tag{29}$$

$$\frac{w\ L}{C+re} = S_L(w,r,v,Q^0) + \varepsilon_2 \tag{30}$$

$$\frac{rK+re}{C+re} = S_K(w,r,v,Q^0) + \varepsilon_3 \tag{31}$$

Thus, although the assumptions about the error terms were sufficient in order for this model to produce unbiased estimators, the error of measurement in the case of capital destroys this property as we will see below.

To be able to examine the effect of the error of prediction on the error terms of the regression equations we approximate each of the left-hand sides of the equations (29), (30) and (31) with a polynomial of degree n around the point e=0.

The left-hand side term of the equation (29) becomes

$$\ln(C+re) = \ln C + (\tfrac{r}{C})e - \tfrac{1}{2}(\tfrac{r}{C})^2 e^2 + \tfrac{1}{3}(\tfrac{r}{C})^3 e^3 - \ldots + (-1)^{n+1}\tfrac{1}{n}(\tfrac{r}{C})^n e^n \tag{32}$$

The left-hand side term in equation (30) becomes

$$\frac{wL}{C+re} = \frac{wL}{C} - S_L(\frac{r}{c})e + S_L(\frac{r}{c})^2e^2 - S_L(\frac{r}{c})^3e^3 + \ldots. \tag{33}$$
$$\ldots + (-1)^n S_L(\frac{r}{c})^n e^n$$

The same term in equation (31) becomes

$$\frac{rK+re}{C+re} = \frac{rK}{C} + (1-S_K)(\frac{r}{C})e - (1-S_K)(\frac{r}{C})^2e^2 \tag{34}$$
$$+ (1-S_K)(\frac{r}{C})^3e^3 - \ldots. + (-1)^{n+1}(1-S_K)(\frac{r}{C})^n e^n$$

Substituting in equations (29), (30) and (31) and transfering to the right-hand side all the terms that contain the error of prediction we obtain

$$\ln C = g(w,r,v,Q^0) + \varepsilon_1 - (\frac{r}{C})e \quad \frac{1}{2}(\frac{r}{C})^2e^2 - \frac{1}{3}(\frac{r}{C})^3e^3 + \tag{35}$$
$$\ldots. -(-n)^{n+1}\frac{1}{n}(\frac{r}{C})^n e^n$$

$$S_L = S_L(w,r,v,Q^0) + \varepsilon_2 + S_L(\frac{r}{C})e - S_L(\frac{r}{C})^2e^2 + \tag{36}$$
$$+ S_L(\frac{r}{C})^3e^3 - (-1)^n S_L(\frac{r}{C})^n e^n$$

$$S_K = S_K(w,r,v.Q^0) + \varepsilon_3 - (1-S_K)(\frac{r}{C})e + (1-S_K)(\frac{r}{C})^2e^2 \tag{37}$$
$$-(1-S_K)(\frac{r}{C})^3e^3 - \ldots\ldots - (-1)^{n+1}(1-S_K)(\frac{r}{C})^n e^n$$

For unbiased estimators we require

$$E\ \{\varepsilon_1 - (\frac{r}{C})e + \frac{1}{2}(\frac{r}{C})^2 e^2 - \frac{1}{3}(\frac{r}{C})^3 e^3 + \ldots -(-1)^{n+1}\frac{1}{n}(\frac{r}{C})^n e^n\} = E(\varepsilon_1^*) = 0 \qquad (38)$$

$$E\ \{\varepsilon_2 + S_L(\frac{r}{C})e - S_L(\frac{r}{C})^2 e^2 + S_L(\frac{r}{C})^3 e^3 - \ldots -(-1)^n S_L(\frac{r}{C})^n e^n\} = E(\varepsilon_2^*) = 0 \qquad (39)$$

$$E\ \{\varepsilon_3 - (1-S_K)(\frac{r}{C})e + (1-S_K)(\frac{r}{C})^2 e^2 - (1-S_K)(\frac{r}{C})^3 e^3 + \ldots -(-1)^{n+1}(1-S_K)(\frac{r}{C})^n e^n\} = E(\varepsilon_3^*) = 0 \qquad (40)$$

Noting that $E(\varepsilon_i) = 0$ for $i=1,2,3$ and that $E(e^k) = 0$ for every k that is an odd number under normality of errors we obtain

$$E(\varepsilon_1^*) = \frac{1}{2}(\frac{r}{C})E(e^2) + \frac{1}{4}(\frac{r}{C})^4 E(e^4) + \ldots + \frac{1}{q}(\frac{r}{C})^q E(e^q) \qquad (41)$$

where q=n if n is an even number
and q=n-1 if n is an odd number

$$E(\varepsilon_2^*) = - S_L(\frac{r}{C})^2 E(e^2) - S_L(\frac{r}{C})^4 E(e^4) - \ldots - S_L(\frac{r}{C})^q E(e^q) \qquad (42)$$

$$E(\varepsilon_3^*) = (1-S_K)(\frac{r}{C})^2 E(e^2) + (1-S_K)(\frac{r}{C})^4 E(e^4) + \ldots + (1-S_K)(\frac{r}{C})^q E(e^q) \qquad (43)$$

These expressions can not be computed at the four digit level since we do not know the error of prediction and the true variables (C, S_L, S_K). To quantify the potential values of these expressions we use the following method. At the three - digit level, where we know the amount of capital stock for every industry at the total industry level we create capital figures using energy shares. Thus for every industry we have the actual and the predicted capital stock. The error of prediction can be then calculated as well as its variance (σ_e^2). Knowing the prediction error and its variance we can compute the expressions (41), (42), and (43). Using the average cost as an approximation for the true cost, the average price of capital and the average shares as an approximation for the true shares we compute the values of the three first terms of each expression for each two-digit industry.[64] The results are shown in Table 16.

From the results in Table 16 we can notice that the expected values of the error terms in our equations are not any more zero, however, they differ from zero by a very small number. Our hope is that this will create a very small bias in the estimated coefficients.

3. Description of the Sample

Although our intention at the outset was to examine every major industry in Canadian manufacturing, for different reasons such as unavailability of data and confidentiality,

Table 16

THE FIRST THREE TERMS OF EACH OF THE E(ε*) EXPRESSIONS

	ER11		ER12		ER13		ER21		ER22		ER23		ER31		ER32		ER33	
1. Food and Beverage	-10^{-3}	.63	-10^{-5}	.12	-10^{-7}	.51	10^{-3}	.19	10^{-6}	.76	10^{-8}	.48	-10^{-2}	.11	-10^{-5}	.44	-10^{-7}	.28
2. Wood	-10^{-4}	.15	-10^{-9}	.76	-10^{-12}	.80	10^{-5}	.87	10^{-9}	.83	10^{-12}	.13	-10^{-4}	.28	-10^{-8}	.27	-10^{-12}	.43
3. Paper and Allied Industries	-10^{-3}	.66	-10^{-5}	.13	-10^{-7}	.58	10^{-3}	.31	10^{-5}	.12	10^{-8}	.81	-10^{-3}	.98	-10^{-5}	.39	-10^{-7}	.26
4. Primary Metal Industries	-10^{-2}	.15	-10^{-5}	.69	-10^{-6}	.70	10^{-3}	.71	10^{-5}	.65	10^{-7}	.98	-10^{-2}	.23	-10^{-4}	.21	-10^{-6}	.33
5. Metal Fabricating	-10^{-3}	.29	-10^{-6}	.25	-10^{-8}	.50	10^{-3}	.18	10^{-6}	.32	10^{-9}	.96	-10^{-3}	.53	-10^{-6}	.94	-10^{-8}	.27
6. Transportation Equipment	-10^{-4}	.44	-10^{-8}	.60	-10^{-10}	.18	10^{-4}	.14	10^{-8}	.40	10^{-11}	.18	-10^{-4}	.84	-10^{-7}	.22	-10^{-10}	.10
7. Electrical Products	-10^{-3}	.58	-10^{-5}	.10	-10^{-7}	.40	10^{-3}	.34	10^{-5}	.12	10^{-8}	.70	-10^{-2}	.10	-10^{-5}	.38	-10^{-7}	.22
8. Chemicals	-10^{-2}	.32	-10^{-4}	.32	-10^{-5}	.71	10^{-2}	.14	10^{-4}	.28	10^{-6}	.93	-10^{-2}	.52	-10^{-3}	.10	-10^{-5}	.33

*The first three terms of the expression (41) were calculated as

$$ER11 = -\frac{1}{2}\left(\frac{r}{c}\right)^2 E(e^2) = -\frac{1}{2}\left(\frac{r}{c}\right)^2 \sigma_e^2$$

$$ER12 = -\frac{1}{4}\left(\frac{r}{c}\right)^4 E(e^4) = -\frac{1}{4}\left(\frac{r}{c}\right)^4 3\sigma_e^4$$

$$ER13 = -\frac{1}{6}\left(\frac{r}{c}\right)^6 E(e^6) = -\frac{1}{6}\left(\frac{r}{c}\right)^6 15\sigma_e^6$$

The first three terms of the expression (42) were calculated as

$$ER21 = S_L\left(\frac{r}{c}\right)^2 E(e^2) = S_L\left(\frac{r}{c}\right)^2 \sigma_e^2$$

$$ER22 = S_L\left(\frac{r}{c}\right)^4 E(e^4) = S_L\left(\frac{r}{c}\right)^4 3\sigma_e^4$$

$$ER23 = S_L\left(\frac{r}{c}\right)^6 E(e^6) = S_L\left(\frac{r}{c}\right)^6 15\sigma_e^6$$

The first three terms of the expression (43) were calculated as

$$ER31 = -(1-S_k)\left(\frac{r}{c}\right)^2 E(e^2) = -(1-S_k)\left(\frac{r}{c}\right)^2 \sigma_e^2$$

$$ER32 = -(1-S_k)\left(\frac{r}{c}\right)^4 E(e^4) = -(1-S_k)\left(\frac{r}{c}\right)^4 3\sigma_e^4$$

$$ER33 = -(1-S_K)\left(\frac{r}{c}\right)^6 E(e^6) = -(1-S_k)\left(\frac{r}{c}\right)^6 15\sigma_e^6$$

Table 17

SOME CHARACTERISTICS OF THE SAMPLE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Food and beverage	53	31	24	53	69	36.1	17.4
2. Wood	27	16	10	27	46	31.2	4.4
3. Paper and allied industries	16	12	12	16	23	48.5	8.5
4. Primary metal	28	7	7	28	28	23.9	7.9
5. Metal fabricating	39	28	25	39	39	40.7	6.8
6. Transportation equipment	23	8	4	24	37	87.1	14.7
7. Electrical products	29	16	9	30	33	64.8	5.6
8. Chemical	34	25	25	34	40	81.9	5.8

Note: Column (1) gives the number of observations in the group of Canadian firms.

Column (2) shows the number of observations in the U.S group of firms.

Column (3) shows the number of observations in the group of all other foreign firms except U.S firms.

Column (4) shows the number of observations of the foreign firms as a group.

Column (5) shows the number of observations of the whole industry as one group.

Column (6) gives the foreign control by industry.

Column (7) gives the share of each industry in the total manufacturing.

we end up with only eight out of the twenty major manufacturing industries. Some information of these industries are given in Table 17. Despite the fact that we lost twelve industries our sample still represents a large share of the value of manufacturing (71.1%). As well it contains a variety of industries from the point of view of size and from the point of view of the size of foreign control.

There are two reasons why the numbers do not add up in most of the industries. First, observations may not exist. For example, there are cases where in some industry we do not have foreign firms. Second, and most importantly, there are missing observations due to confidentiality.

CHAPTER VIII

THE MAIN RESULTS BY INDUSTRY

1. Introduction

Before starting the presentation of the main results by industry it is necessary to explain what kind of results we present in this section as well as the way they have been derived.

As was noted in Chapter IV, the unit of account is the four-digit industry. At each four-digit industry we have one observation for the domestic groups of firms, one for the U.S group of firms and one for the group of other foreign group of firms. These are our three main groups. Using these three groups we can derive four more groups. First, we can combine all the three of them and make the industry group (in this case the sample size will be the sum of the three sample sizes). Second, we can combine the U.S and the other foreign groups of firms and create the foreign group. Third, we can sum the observations for the three main groups and create the total industry group. Finally, we can create the total foreign group as the sum of U.S and the other foreign group of firms. It should be clear that the difference between industry and total industry is that in the first case the three main groups of firms are recognized as separate sources of information while in the second case they don't. The same difference is true between foreign and total foreign groups.

In general for every two-digit industry we have seven groups. Thus, for each two-digit industry we must estimate seven cost functions. This is the maximum number of groups because there will be cases where the small sample sizes will not allow us to estimate the cost function. In cases like this we present only the sample size.

For each two-digit industry we present eight different tables. In Table (a) for each industry, we present the results of the translog cost function. By construction the translog is a very general form. It is therefore necessary to test for the most simple form which is acceptable. For each group of firms, starting from the translog form, we test several hypotheses, using the likelihood ratio test[65], until we reach the most simple form. The results of the final form are presented in the Table (b) for each industry.

Once we have found the form of the cost function we can derive the technological and other characteristics that will allow us to compare the different groups of firms. In general these characteristics are different from one data point to the other. To avoid long tables which will also be difficult to compare and interpret we compute all these characteristics at the average value of the exogenous variables (w,r,v,Q). The results are presented in Table (c).

Despite the fact that all the groups within a two-digit industry have the same prices of materials and capital services we might observe differences in the averages. This is due to the fact that sometimes some data on four-digit industries are missing due to confidentiality. For example, we might have an observation for domestic firms in a four-digit industry but we might not have separate observations for U.S and other foreign firms due to confidentiality but we have observations for all foreign together. In Table (d) we show results which are based on common averages for v and r.

All the above characteristics and especially the factor intensities, under certain conditions, can tell us whether there are some differences among the different groups of firms. We expect that if two groups of firms employ the same technology under the same input ratios and produce the same level of output they will produce it with the same input ratios. In Table (e) we assume that all firms produce the same level of output (the average output of the total industry group) at the same input prices (the average input prices of the total industry group).[66] The results based on these assumptions can be used to derive conclusions about differences amongst the different groups of firms.

In Tables (c), (d), and (e) we also present results on input ratios that all seem different in all the cases. However, we can not tell whether two input ratios are significantly different unless we know also the confidence intervals for the true input ratios. In Tables (f), (g), and (h) we present 95% confidence intervals for the input ratios corresponding to Tables (c), (d), and (e).

The various technological characteristics that are derived and presented in the tables below are:

SLF The share of labour in the total cost

SKF The share of capital in the total cost

SMF The share of materials in the total cost

K/L The capital-labour ratio

K/M The capital-materials ratio

L/M The labour-materials ratio

ELW The elasticity of demand for labour

EKR The elasticity of demand for capital services

EMV The elasticity of demand for materials

ELR The cross-elasticity of the demand for labour with respect to the price of capital services

ELV The cross-elasticity of the demand for labour with respect to the price of materials

EKV The cross-elasticity of the demand for capital services with respect to the price of materials

SCL The scale elasticity

σ_{LK} The partial elasticity of substitution between capital and labour

σ_{LM} The partial elasticity of substitution between labour and materials

σ_{KM} The partial elasticity of substitution between capital and materials

C The cost of production

All the above variables are computed as fitted variables using the results from the cost function. The method of computation for these variables is presented in Appendix B.

2. Food and Beverage Industry

With respect to size, this is the most important industry in Canadian manufacturing. It represents 17.8% of total industry shipments. It is comprised of more than 5000 establishments, 89.5% of which are Canadian controlled. Measured, however, in terms of total shipments, Canadian control amounts to 64.0% which makes this industry thirtenth among the twenty major manufacturing industries when classified according to the size of foreign control. Finally, 61.7% of this industry's shipments come from the top eight firms in the industry. Among these firms the foreign control is 48.5%.[67]

The results reported in Table 18b suggest that both groups, foreign and domestic, employ technologies that are homogeneous. Domestic firms have linear homogeneous production structures whereas foreign firms do not. Another characteristic of the form of the cost function of these two groups is that in the case of foreign firms it is not significantly different from a simple Cobb-Douglas while the case of domestic firms is somewhat more complicated. An additional important result relates to the similarity of the two foreign groups. Both the U.S and the other foreign groups of firms have not only the same functional form but also their coefficients are very similar. This similarity of these two groups is also evident in the results of the group of foreign firms, where the coefficients and the functional form is very similar to the two individual foreign groups. In the case of total foreign group the results are different. It seems that by adding the observations of the two foreign groups some of the characteristics are destroyed. The same is true for the case of total industry where the function is also not well-behaved. Finally, the results of the industry group prove once more that there are differences in the form of the cost function among foreign and domestic groups of firms.

Now we examine the technological characteristics that are derived from the cost functions. In Tables 18c and 18d, where all these characteristics are computed at the average value of the exogenous variables, we notice that there are no major differences between foreign and domestic groups of firms. Both groups show inelastic demands for factors of production and substitutability among any two of them. The only exception is the demand for labour in the domestic group of firms which is elastic. The major difference between these groups is the scale elasticity. The foreign group shows increasing returns to scale while the domestic group shows constant returns. Another difference is the elasticity of substitution between labour and materials which is higher in the case of domestic firms. The various input-input ratios do not show any major differences as this is also confirmed in Tables 18f and 18g.

In Tables 18e and 18h we isolate the effects of differences in factor prices and in the scale of production and we compute again the technological characteristics. The most important result is the difference in the capital labour ratios which are significantly different in the two groups. Domestic firms are more capital intensive and among the foreign firms there is no significant difference.

Opposite relation to capital intensity shows the cost of production which shows that foreign groups are more efficient and among foreign groups the other foreign group is more efficient. All the other characteristics remain the same as in the other tables.

Thus, as a brief conclusion we can say that domestic firms are more capital intensive, have a higher elasticity of demand for labour and a higher substitutability between labour and materials. On the other hand foreign firms, which are all the same regardless of origin, show higher returns to scale.

The implication of the above characteristics is that there is a strong possibility for increased foreign control in this industry. This results from the fact that foreign firms exhibit increasing returns to scale while domestic firms exhibit constant returns to scale. Thus the incentive for growth is much greater in the foreign firms than in the domestic firms. The existing evidence confirms this theoretical possibility. In Table 13 we note that from 1970 to 1974 the foreign control increased by 3.8% in this industry.

Despite the fact that foreign firms employ a more labour-intensive technology the actual capital-labour ratio used is

Table 18a

FOOD AND BEVERAGE - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-1.54	.661	.526	-.188	1.24	-.159	.153	.141	-.019	.073	.085	-.019	-.227	-.019	.038	.703	204.3	53
	(-1.08)	(5.76)	(4.18)	(-.986)	(5.38)	(-3.90)	(2.49)	(1.33)	(-1.04)	(2.38)	(1.50)	(-2.17)	(-3.18)	(-2.88)	(2.99)			
U.S	3.13	.309	.384	.305	.524	-.037	.040	.231	.030	.114	-.076	.007	-.154	-.029	.021	.821	138.7	31
	(1.47)	(1.98)	(2.86)	(1.33)	(1.44)	(-.613)	(.656)	(2.17)	(.989)	(2.89)	(-1.06)	(.514)	(-2.43)	(-3.02)	(1.13)			
OTHER FOREIGN	.633	.318	.294	.387	.868	.007	.0005	.072	.008	.032	-.039	-.007	-.032	-.022	.029	.701	112.2	24
	(.427)	(1.72)	(2.71)	(1.55)	(2.92)	(.078)	(.014)	(.433)	(.290)	(.876)	(-.321)	(-.498)	(-.576)	(-3.07)	(1.45)			
FOREIGN	-.141	.308	.308	.383	[illegible].04	-.044	.059	.117	-.009	.051	-.006	-.000	-.110	-.015	.015	.749	228.1	55
	(-.135)	(2.78)	(3.07)	(2.36)	(5.66)	(-.918)	(1.23)	(1.23)	(-.576)	(1.76)	(-.102)	(-.000)	(-2.10)	(-2.72)	(1.22)			
TOTAL FOREIGN	-2.96	.315	.357	.327	1.53	-.127	.115	.140	-.050	.076	.051	.010	-.191	-.013	.003	.783	213.9	53
	(-2.11)	(2.09)	(2.94)	(1.60)	(6.46)	(-2.65)	(2.15)	(1.55)	(-2.52)	(2.67)	(.897)	(.843)	(-.230)	(-2.02)	(.237)			
INDUSTRY	.391	.494	.395	.110	.915	-.102	.129	.079	.007	.026	.076	-.015	-.155	-.010	.025	.651	398.9	108
	(487)	(6.40)	(4.49)	(.877)	(6.84)	(-3.61)	(2.92)	(1.08)	(.687)	(1.27)	(1.91)	(-2.57)	(-3.14)	(-2.33)	(2.97)			
TOTAL INDUSTRY	-3.42	.533	.498	-.032	1.51	-.202	.144	.028	-.040	.042	.159	-.007	-.187	-.015	.023	.574	252.4	69
	(-2.30)	(3.22)	(4.47)	(-.140)	(6.63)	(-5.94)	(3.12)	(.413)	(-2.27)	(2.12)	(3.92)	(-.590)	(-3.87)	(-2.39)	(1.36)			

Table 18b

FOOD AND BEVERAGE - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-.163	.363	.099	.536	1	-.229		-.229			.229					.702	197.6	53
	(-7.34)	(10.9)	(12.1)	(14.9)		(-6.34)		(-6.34)			(6.34)							
U.S	.622	.175	.086	.738	.930											.804	133.2	31
	(4.08)	(16.2)	(9.39)	(44.7)	(72.8)													
OTHER FOREIGN	.576	.189	.079	.731	.926											.635	107.4	24
	(3.45)	(13.3)	(9.55)	(36.4)	(62.1)													
FOREIGN	.344	.180	.083	.737	.950											.742	223.0	55
	(2.53)	(20.5)	(13.01)	(57.3)	(82.1)													
TOTAL FOREIGN	-3.29	.430	.183	.385	1.54	-.117		.039	-.050	.078	.039		-.078	-.014	.014	.778	211.4	53
	(-2.33)	(6.51)	(2.25)	(3.79)	(6.45)	(-2.50)		(.508)	(-2.49)	(2.68)	(.678)		(-2.68)	(-2.18)	(2.18)			
INDUSTRY	-.049	.297	.287	.415	1	-.133	.121	-.011			.133		-.121			.648	394.6	108 *
	(-.811)	(11.0)	(3.99)	(5.44)		(-4.88)	(2.74)	(-.216)			(4.88)		(-2.74)					
TOTAL INDUSTRY	-3.18	.371	.343	.284	1.49	-.202	.148	-.054	-.039		.202		-.148			.564	249.0	69 *
	(-2.29)	(9.82)	(4.52)	(3.35)	(6.89)	(-5.91)	(3.13)	(-.917)	(-2.31)		(5.91)		(-3.13)					

Table 18c

FOOD AND BEVERAGE - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	W	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	2.76	.228	1.15	440369	462811	.163	.100	.737	7.40	.685	.092	-2.23	-.900	-.574	.099	2.13	.736	1.00	1.00	2.90	1.00
U.S	3.30	.230	1.18	227850	221342	.175	.086	.738	7.07	.602	.085	-.824	-.913	-.261	.086	.738	.738	1.07	1.00	1.00	1.00
OTHER FOREIGN	3.35	.232	1.18	92896	90414	.189	.079	.732	6.05	.554	.091	-.810	-.920	-.268	.079	.732	.732	1.08	1.00	1.00	1.00
FOREIGN	3.33	.231	1.18	168961	165004	.180	.083	.737	6.63	.579	.087	-.819	-.916	-.263	.083	.736	.736	1.05	1.00	1.00	1.00
TOTAL FOREIGN	3.32	.228	1.15	244447	243362	.178	.083	.738	6.79	.570	.084	-1.48	-.916	-.207	.525	.957	-.209	1.06	6.31	1.29	-.283
INDUSTRY	3.05	.229	1.17	302152	309975	.170	.089	.741	6.99	.615	.088	-1.61	.449	-.274	.089	1.52	-.619	1.00	1.00	2.05	-.835
TOTAL INDUSTRY	3.15	.227	1.14	590913	590602	.164	.103	.732	8.73	.710	.081	-2.06	.542	-.342	.103	1.96	-.707	1.02	1.00	2.68	-.966

Table 18d

FOOD AND BEVERAGE - TECHNOLOGICAL CARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	W	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	2.76	.227	1.14	440369	458125	.160	.100	.740	7.58	.678	.089	-2.26	-.900	-.569	.099	2.16	.739	1.00	1.00	2.93	1.00
U.S	3.30	.227	1.14	227850	214810	.175	.086	.738	7.17	.587	.082	-.824	-.913	-.261	.086	.738	.738	1.04	1.00	1.00	1.00
OTHER FOREIGN	3.35	.227	1.14	92896	87553	.189	.079	.732	6.20	.545	.087	-.810	-.920	-.268	.079	.731	.731	1.08	1.00	1.00	1.00
FOREIGN	3.33	.227	1.14	168961	159969	.180	.083	.737	6.76	.567	.083	-.819	-.916	-.263	.083	.737	.737	1.05	1.00	1.00	1.00
TOTAL FOREIGN	3.32	.227	1.14	244447	240913	.177	.084	.738	6.96	.573	.082	-1.48	-.915	-.207	.529	.959	-.197	1.06	6.28	1.29	-.268
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.15	.227	1.14	590913	590602	.164	.103	.732	8.73	.710	.081	-2.06	.542	-.342	.103	1.96	-.707	1.02	1.00	2.68	-.966

Table 18e

FOOD AND BEVERAGE - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.15	.227	1.14	590913	626459	.130	.100	.760	10.6	.652	.061	-2.62	-.900	-.528	.099	2.52	.769	1.00	1.00	3.27	1.00
U.S	3.15	.227	1.14	590913	516823	.175	.086	.738	6.83	.587	.086	-.824	-.911	-.261	.086	.738	.738	1.07	1.00	1.00	1.00
OTHER FOREIGN	3.15	.227	1.14	590913	480066	.189	.079	.732	5.82	.545	.093	-.810	-.920	-.268	.079	.732	.732	1.08	1.00	1.00	1.00
FOREIGN	3.15	.227	1.14	590913	520931	.180	.083	.737	6.40	.567	.088	-.819	-.916	-.263	.083	.737	.737	1.05	1.00	1.00	1.00
TOTAL FOREIGN	3.15	.227	1.14	590913	537524	.183	.067	.750	5.06	.449	.088	-1.45	-.933	-.197	.496	.962	-.428	1.11	7.41	1.28	-.572
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.15	.227	1.14	590913	590602	.164	.103	.732	8.73	.710	.081	-2.05	.42	-.342	.103	1.96	-.707	1.02	1.00	2.68	-.966

Table 18f

FOOD AND BEVERAGE - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

Table 18g

FOOD AND BEVERAGE - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

Table 18h

FOOD AND BEVERAGE - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	Table 18f K/L	Table 18f K/M	Table 18f L/M	Table 18g K/L	Table 18g K/M	Table 18g L/M	Table 18h K/L	Table 18h K/M	Table 18h L/M
DOMESTIC	6.34 - 8.46	.545 - .826	.077 - .108	6.49 - 8.67	.539 - .816	.074 - .104	8.73 - 12.4	.519 - .784	.048 - .074
U.S	5.60 - 8.54	.448 - .755	.071 - .099	5.68 - 8.66	.437 - .737	.068 - .095	5.41 - 8.25	.437 - .737	.072 - .100
OTHER FOREIGN	4.95 - 7.15	.407 - .700	.072 - .110	5.07 - 7.33	.401 - .689	.069 - .106	4.76 - 6.88	.401 - .689	.074 - .113
FOREIGN	5.69 - 7.58	.473 - .684	.076 - .098	5.80 - 7.73	.463 - .670	.073 - .095	5.48 - 7.31	.463 - .670	.077 - .100
TOTAL FOREIGN	5.65 - 7.93	.464 - .677	.071 - .097	5.79 - 8.12	.467 - .679	.069 - .095	3.47 - 6.64	.292 - .606	.075 - .102
INDUSTRY	6.26 - 7.73	.533 - .697	.078 - .097	-	-	-	-	-	-
TOTAL INDUSTRY	7.63 - 9.82	.588 - .832	.066 - .096	7.63 - 9.82	.588 - .832	.066 - .096	7.63 - 9.82	.588 - .832	.066 - .096

not signficantly different from that of the domestic firms. This is due to higher wages that foreign firms pay, as this is evident in Table 12. From that we can infer that the effect of the expansion of foreign control on employment is not different from what it would have been in the case of an expansion of the domestic control. However, if we take into account the elasticities of the demand for labour. the results change. Domestic firms have an elastic demand while foreign firms have inelastic demand. This together with the downward rigidity of the wages suggests that it is more possible that the expansion of foreign control will bring a higher level of employment than the expansion of domestic control. However, there will be a difference in efficiency as expressed in terms of cost of production. Increased foreign control will bring more efficiency in the industry.

3. Wood Industries

This industry ranks nineth in the classification according to size; it represents 5.0% of total manufacturing shipments. It consists of more than 3000 establishments, 94.5% of which are Canadian controlled. Measured, however, in terms of total shipments the Canadian control is 69.8%. This industry is classified fourteenth if we classify the manufacturing industries according to the size of foreign control. Due to confidentiality we do not have figures for industrial concentration as this is measured by the share of the top eight firms in the industry; however, we know

(Table 11) that the foreign control in the top eight firms is 40.7%.

This is one more industry where the form of the cost function is different between domestic and foreign groups of firms. In the case of foreign firms the Cobb-Douglas with constant returns to scale form is a hypothesis that can not be rejected. In the case of domestic firms the form of the cost function is more complicated as it is shown in Table 18B. Even though we were not able to estimate a cost function for the group of other foreign firms, due to small size of the sample, the results of the U.S group on the one hand and the results of the foreign group of firms as well as the results of the total foreign group on the other, suggests that U.S and other foreign firms are similar. In the case of foreign firms where we have the combination of U.S and other foreign firms, the results do not differ from U.S firms above. The same is true in the case of total foreign group where we have the sum of the observations of the U.S and other foreign groups. The results in the industry group are also similar to foreign groups, something that indicates that probably there is more variation in the foreign sample than in the domestic.

The results in Table 19c, 19d and 19e as well as the results in Tables 19f and 19g and 19h suggest that there are not major differences among foreign and domestic firms in this industry. The difference that exists in the functional form has very minor effects on the technological characteristics. Both major groups (foreign and domestic) employ technologies that are characterized by inelastic demands for factors of production and substitutability among all of them. More specifically, the partial elasticity of substitution among any two factors of production is not significantly different from one. Even though there is some difference in the capital-labour ratio in Table 19e, this is not significant as shown in Table 19h. The only difference exists in the scale elasticity and in the cost of production. Foreign firms and especially U.S firms, which represent about 80% of the foreign control, exhibit higher returns to scale and lower cost of production than domestic firms.

For this industry we can conclude that foreign and domestic firms employ the same technology which is characterized by inelastic demand for factors of production and substitutability with elasticity one between any two inputs. However, foreign firms exhibit increasing returns to scale and have a lower cost of production than domestic firms.

The difference in scale elasticity between foreign and domestic firms suggests that foreign firms will tend to grow faster than domestic firms and increase their share in this industry. The existing evidence (Table 13) shows that from 1970 to 1974 the foreign control increased by 1.1%. The similarities in the input ratios and in the elasticities of demand for inputs suggest that the expansion of foreign control will have the same effect in the input use as the expansion of domestic control. However, the expansion of

Table 19a

WOOD - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	2.02 (2.68)	.570 (7.72)	.236 (1.68)	.193 (1.18)	.612 (4.69)	.033 (.914)	.101 (1.24)	.218 (1.74)	.034 (3.04)	.041 (1.16)	-.074 (-1.38)	-.021 (-4.67)	-.143 (-1.52)	-.001 (-.328)	.023 (3.25)	.898	147.9	27
U.S	.974 (1.75)	.311 (3.98)	.034 (.560)	.654 (6.98)	.764 (6.84)	.062 (1.16)	-.010 (-.298)	.015 (.224)	.022 (2.02)	-.017 (-1.06)	-.044 (-.206)	-.011 (-1.58)	.028 (.662)	.005 (2.06)	.006 (.969)	.823	94.0	16
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
FOREIGN	.864 (1.15)	.264 (2.34)	.079 (.683)	.655 (4.98)	.811 (5.67)	.055 (.806)	-.014 (-.234)	.038 (.391)	.016 (1.20)	-.001 (-.035)	-.053 (-.907)	-.007 (-.788)	.015 (.219)	.0004 (.074)	.006 (.916)	.639	110.2	26
TOTAL FOREIGN	.216 (.471)	.477 (5.92)	.156 (1.50)	.366 (2.93)	.925 (11.0)	.041 (.718)	.068 (1.22)	.226 (2.25)	.005 (.742)	.058 (2.35)	-.099 (-1.52)	-.014 (-1.77)	-.126 (-1.97)	-.002 (-.409)	.017 (1.[illegible]8)	.619	119.6	27
INDUSTRY	.336 (.784)	.459 (6.47)	.105 (1.12)	.434 (4.21)	.896 (11.6)	-.050 (-1.42)	.020 (.401)	.089 (1.29)	.008 (1.15)	.059 (2.81)	-.009 (-.264)	-.003 (-.750)	-.080 (-1.43)	-.003 (-.897)	.006 (1.46)	.740	231.5	53
TOTAL INDUSTRY	.129 (2.69)	.823 (10.3)	.016 (.130)	.160 (1.32)	.699 (9.08)	-.089 (-2.52)	-.027 (-.426)	.254 (3.36)	.023 (3.56)	.186 (6.48)	-.096 (-2.66)	-.013 (-2.29)	-.158 (-2.45)	-.012 (-2.01)	.026 (4.07)	.899	230.1	46

Table 19b

WOOD - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	2.05 (2.75)	.513 (11.0)	.093 (13.1)	.[illegible]92 (8.29)	.592 (4.53)				.036 (3.19)			-.019 (-4.83)			.019 (4.83)	.898	146.4	27
U.S	.131 (1.89)	.288 (19.1)	.084 (16.5)	.626 (51.2)	.961 (156.0)											.795	91.1	16
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
FOREIGN	-.167 ([illegible].69)	.253 (19.1)	.106 (11.8)	.639 (64.4)	1											.619	106.8	26
TOTAL FOREIGN	.138 (1.53)	.277 (21.7)	.086 (9.39)	.636 (49.4)	.964 (138.9)											.614	115.4	27
INDUSTRY	-.053 (-.667)	.270 (33.5)	.100 (17.3)	.628 (82.4)	.987 (139.1)											.734	226.3	53
TOTAL INDUSTRY	1.20 (2.72)	.849 (11.9)		.626 (51.2)	.708 (9.34)	-.091 (-2.56)			.023 ([illegible].65)	.187 (6.76)		-.015 (-2.88)		-.007 (-3.01)		.898	229.6	46

Table 19c

WOOD - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.12	.240	1.20	234443	250292	.271	.093	.636	4.49	.737	.164	-.729	-.906	-.364	.093	.635	.635	.980	1.00	1.00	1.00
U.S	3.82	.238	1.19	121131	128019	.288	.084	.626	4.71	.679	.143	-.711	-.915	-.373	.084	.626	.626	1.04	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.83	.235	1.17	90943	102863	.253	.106	.639	6.83	.833	.121	-.746	-.893	-.360	.106	.639	.639	1.02	1.00	1.00	1.00
TOTAL FOREIGN	3.51	.240	.120	90822	96564	.278	.086	.636	4.53	.676	.149	-.722	-.914	-.363	.085	.636	.636	1.04	1.00	1.00	1.00
INDUSTRY	3.46	.238	1.18	164046	180896	.271	.100	.629	5.40	.797	.147	-.729	-.899	-.371	.100	.628	.629	1.01	1.00	1.00	1.00
TOTAL INDUSTRY	3.12	.236	1.16	207785	215313	.275	.091	.634	4.38	.709	.161	-1.05	-.908	.824	.773	.282	-1.42	1.00	8.41	.444	-2.24

Table 19d

WOOD - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.12	.236	1.16	234443	244364	.270	.094	.636	4.57	.724	.158	-.729	-.906	-.364	.093	.635	.635	.981	1.00	1.00	1.00
U.S	3.82	.236	1.16	121131	125446	.288	.085	.627	4.77	.665	.139	-.711	-.915	-.373	.084	.626	.626	1.04	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.83	.236	1.16	90943	101940	.253	.106	.639	6.83	.821	.120	-.846	-.893	-.260	.106	.639	.639	1.00	1.00	1.00	1.00
TOTAL FOREIGN	3.51	.236	1.16	90822	94254	.278	.086	.636	4.61	.664	.144	-.722	-.914	-.363	.086	.636	.636	1.04	1.00	1.00	1.00
INDUSTRY	3.46	.236	1.16	164046	177928	.271	.100	.629	5.44	.787	.143	-.729	-.899	-.371	.100	.628	.628	1.01	1.00	1.00	1.00
TOTAL INDUSTRY	3.12	.236	1.16	207785	215313	.275	.091	.634	4.38	.709	.161	-1.05	-.908	.824	.733	.282	-1.42	1.00	8.41	.444	-2.24

Table 19e

WOOD - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.12	.236	1.16	207185	215498	.273	.094	.633	4.53	.727	.160	-.726	-.906	-.366	.093	.633	.633	.985	1.00	1.00	1.00
U.S	3.12	.236	1.16	207185	198149	.288	.085	.627	3.89	.665	.171	-.711	-.915	-.373	.085	.626	.626	1.04	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.12	.236	1.16	207185	220431	.253	.106	.639	5.56	.821	.147	-.746	-.839	-.360	.106	.639	.639	1.00	1.00	1.00	1.00
TOTAL FOREIGN	3.12	.236	1.16	207185	202093	.278	.086	.636	4.09	.664	.162	-.722	-.914	-.363	.086	.636	.636	1.04	1.00	1.00	1.00
INDUSTRY	3.12	.236	1.16	207185	207185	.271	.100	.629	4.89	.784	.160	-.729	-.899	-.371	.100	.628	.628	1.01	1.00	1.00	1.00
TOTAL INDUSTRY	3.12	.236	1.16	207185	215313	.275	.091	.634	4.38	.709	.161	-.105	-.908	.824	.773	.282	-1.42	1.00	8.41	.444	-2.24

Table 19f

WOOD - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	3.79 - 5.20	.606 - .868	.151 - .177
U.S	3.69 - 5.74	.599 - .759	.122 - .165
OTHER FOREIGN	-	-	-
FOREIGN	5.07 - 8.59	.686 - .981	.105 - .138
TOTAL FOREIGN	3.32 - 5.73	.516 - .836	.130 - .168
INDUSTRY	4.58 - 6.21	.697 - .896	.135 - .159
TOTAL INDUSTRY	3.33 - 5.43	.551 - .867	.147 - .175

Table 19g

WOOD - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	3.85 - 5.29	.595 - .853	.145 - .171
U.S	3.73 - 5.81	.587 - .744	.118 - .160
OTHER FOREIGN	-	-	-
FOREIGN	5.07 - 8.59	.676 - .966	.104 - .136
TOTAL FOREIGN	3.38 - 5.83	.506 - .821	.125 - .162
INDUSTRY	4.62 - 6.26	.686 - .882	.132 - .155
TOTAL INDUSTRY	3.33 - 5.43	.551 - .867	.147 - .175

Table 19h

WOOD - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	3.82 - 5.24	.598 - .856	.147 - .172
U.S	3.04 - 4.73	.587 - .744	.145 - .196
OTHER FOREIGN	-	-	-
FOREIGN	4.12 - 6.99	.676 - .966	.128 - .167
TOTAL FOREIGN	3.00 - 5.18	.506 - .821	.141 - .183
INDUSTRY	4.16 - 5.63	.686 - .882	.147 - .172
TOTAL INDUSTRY	3.33 - 5.43	.551 - .867	.147 - .175

foreign control will increase the efficiency of the industry. Since both groups use similar technologies but foreign firms pay a higher wage we would expect that the actual capital-labour ratio would be higher in the case of the foreign firms given also that all the partial elasticities are equal to one. This tendency is obvious in Table 18f, however, the difference in the price of labour is not strong enough to produce significant differences in the input ratios.

4. Paper and Allied Industries

With respect to size this industry is one of the most important in the Canadian manufacturing. It ranks third and it represents 7.38% of total manufacturing shipments. There are about 650 establishments in this industry, 70% of which are Canadian controlled. If we measure control in terms of total shipments then Canadian control is 50.5% which makes this industry eleventh in the classification according to the size of foreign control. With respect to industrial concentration, 55.3% of the industry shipments are produced by the top eight firms. The foreign control in these top eight firms is 39.2%.

With respect to the form of the cost function, in Table 20b we notice that in the case of domestic firms it is closer to the full translog. The difference lies in the price of capital terms. In the case of foreign firms the cost function is more simple and closer to the Cobb-Douglas form. Within the foreign group of firms we also notice the difference between U.S and other foreign groups of firms. The cost function of the other foreign group of firms is very similar to the foreign group while the cost function of the U.S group is close to the full translog form. The similarity of other foreign and foreign groups suggests that there maybe more variation in the other foreign sample than in the U.S sample. The results in the total foreign group have characteristics from both foreign groups. Most of the coefficients are similar to the other foreign group, however, the coefficient of the output is the same as in the U.S group. Finally the industry group has a cost function which is not well-behaved while the total industry shows once again what happens when we try to combine groups that are not similar with respect to the form of their cost functions.

Even though foreign and domestic groups have different forms of the cost function, they do not show major differences in the technological characteristics derived from these functions. They both have inelastic demands for inputs and they show substitutability among all the factors of production. More specifically, the elasticity of substitution between any two inputs is one except between capital and materials in the case of domestic firms where is less than one. Another similarity is that they both show decreasing returns to scale.

If we now examine in more detail the foreign group of firms we notice that there are some differences among U.S and other foreign groups. This is shown in Tables 20c and

20d. The results of the other foreign groups are very similar to those of this foreign group while the U.S group shows an elastic demand for labour, a lower scale elasticity and elasticities of substitution different from one. The input-input ratios are a little different in the various groups but the difference is not significantly different from zero as shown in Table 20h. Finally, the difference in the cost of production (Table 20e) is not important.

As a conclusion for this industry we can say that domestic and foreign firms employ similar technologies characterized by decreasing returns to scale, inelastic demands for inputs and substitutability among any two inputs with elasticity of one in most of the cases. Within the foreign group there are some differences which have to do more with the shape of the isoquants than with their positions.

The implication of the above characteristics is that both domestic and foreign firms will tend to grow together. They both exhibit decreasing returns to scale. However, U.S firms have the lowest returns to scale. This suggests that domestic and other foreign firms will increase their share in this industry. In Table 13 we note that the U.S control was decreased by 3.3% from 1970 to 1974 while the domestic control and the other foreign control were increased during the same period by 3.1% and 0.2% respectively.

Looking at the differences that exist in the input

Table 20a

PAPER - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	3.33	.275	-.634	1.35	.354	.025	.124	.069	.061	-.040	.014	-.011	-.084	.080	-.068	.961	114.7	16
	(2.92)	(2.33)	(-.790)	(9.86)	(2.03)	(.271)	(3.34)	(.794)	(4.53)	(-.932)	(.177)	(-.667)	(-2.01)	(9.30)	(-4.45)			
U.S	6.28	.498	-.820	1.32	-.224	-.130	-.060	.172	.107	.182	-.051	.011	-.121	.054	-.654	.939	87.7	12
	(5.30)	(5.22)	(-5.31)	(14.2)	(-1.19)	(-3.48)	(-1.13)	(3.35)	(7.33)	(4.75)	(-1.49)	(1.46)	(-3.10)	(4.60)	(-9.15)			
OTHER FOREIGN	-11.7	.542	-.565	1.02	2.79	.020	.075	.302	-.136	.103	-.123	-.015	-.178	.060	-.045	.511	73.5	12
	(-3.80)	(3.94)	(-3.72)	(8.51)	(5.38)	(.203)	(1.77)	(3.25)	(-3.09)	(2.07)	(-1.42)	(-.811)	(-3.88)	(4.22)	(-2.94)			
FOREIGN	-1.93	.541	-.628	1.08	1.12	.069	-.023	.313	.001	.133	-.203	-.016	-.110	.049	-.032	.719	141.7	24
	(-1.94)	(5.95)	(-5.27)	(10.2)	(7.24)	(1.47)	(-.641)	(3.83)	(.121)	(4.53)	(-3.69)	(-1.93)	(-2.43)	(5.15)	(-3.53)			
TOTAL FOREIGN	4.31	.416	-.880	1.46	.120	-.087	-.038	.025	.080	.075	.011	.001	-.036	.069	-.071	.887	114.0	16
	(4.14)	(4.55)	(-6.17)	(14.8)	(.760)	(-1.81)	(-1.23)	(.507)	(6.51)	(2.37)	(.296)	(.234)	(-1.21)	(6.32)	(-8.69)			
INDUSTRY	-2.99	.588	-.514	.926	1.30	.036	.033	.435	-.015	.182	-.219	-.011	-.216	.041	-.029	.772	229.4	40
	(-3.42)	(8.33)	(-5.79)	(10.5)	(9.60)	(1.05)	(.898)	(6.63)	(-1.41)	(7.03)	(-5.43)	(-1.77)	(-5.07)	(6.23)	(-4.38)			
TOTAL INDUSTRY	-6.24	.339	-.445	1.10	1.82	-.125	.051	.108	-.056	.091	.034	.013	-.143	.042	-.055	.712	143.9	23
	(-7.78)	(3.61)	(-5.06)	(11.6)	(15.5)	(-2.09)	(2.41)	(1.66)	(-6.53)	(3.77)	(.601)	(1.62)	(-4.98)	(6.47)	(-6.94)			

Table 20b

PAPER - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	2.81	.224	-.615	1.39	.440		.107	.107	.053				-.107	.072	-.072	.960	113.9	16
	(2.41)	(29.5)	(-7.61)	(17.1)	(2.47)		(3.28)	(3.28)	(3.94)				(-3.28)	(13.3)	(-13.3)			
U.S	4.76	.529	-.859	1.33		-.089		.192	.093	.140	-.051		-.140	.068	-.068	.919	86.8	12
	(31.9)	(8.19)	(-9.70)	(18.8)		(-2.88)		(4.18)	(63.6)	(5.43)	(-1.75)		(-5.43)	(10.2)	(-10.2)			
OTHER FOREIGN	-6.10	.239	-.642	1.40	1.86				-.060					.068	-.068	.619	69.0	12
	(-2.22)	(23.5)	(-4.51)	(9.87)	(4.05)				(-1.56)					(5.67)	(-5.67)			
FOREIGN	-1.64	.228	-.550	1.32	1.12									.059	-.059	.717	135.6	24
	(-5.00)	(32.1)	(-4.95)	(11.9)	(41.8)									(6.45)	(-6.45)			
TOTAL FOREIGN	5.38	.223	-.719	1.49					.088					.068	-.068	.899	110.6	16
	(41.0)	(31.1)	(-7.65)	(15.9)					(55.5)					(9.27)	(-9.27)			
INDUSTRY	-1.49	.512	-.499	.987	1.08			.390		.195	-.195		-.195	.034	-.034	.786	226.6	40
	(-8.60)	(13.0)	(-8.10)	(13.1)	(74.2)			(7.40)		(7.40)	(-7.40)		(-7.40)	(6.02)	(-6.02)			
TOTAL INDUSTRY	-6.24	.339	-.445	1.10	1.82	-1.25	.051	.108	-.056	.091	.034	.013	-.143	.042	-.055	.712	143.9	23
	(-7.78)	(3.61)	(-5.06)	(11.6)	(15.5)	(-2.09)	(2.41)	(1.66)	(-6.53)	(3.77)	(.601)	(1.62)	(-4.98)	(6.47)	(-6.94)			

Table 20c

PAPER - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	W	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.42	.251	1.09	560842	585232	.224	.191	.584	11.6	1.42	.123	-.775	-.243	-.231	.191	.583	.018	.960	1.00	1.00	1.00
U.S	3.61	.251	1.09	465631	476638	.215	.203	.582	13.5	1.51	.111	-1.19	-.797	-.087	.855	.342	-.112	.895	4.21	.588	-.193
OTHER FOREIGN	3.64	.251	1.09	184320	200410	.239	.190	.571	11.5	1.44	.125	-.760	-.809	-.429	.190	.570	.570	.965	1.00	1.00	1.00
FOREIGN	3.63	.251	1.09	324976	346123	.228	.199	.572	12.6	1.51	.119	-.871	-.800	-.327	.199	.572	.572	.960	1.00	1.00	1.00
TOTAL FOREIGN	3.64	.251	1.09	517719	520692	.224	.186	.590	11.9	1.37	.115	-.776	-.813	-.410	.186	.589	.589	.935	1.00	1.00	1.00
INDUSTRY	3.55	.251	1.09	419322	446779	.225	.179	.595	11.2	1.31	.116	-.774	-.820	.251	1.04	-.269	-.494	.965	5.82	-.453	-.830
TOTAL INDUSTRY	3.47	.252	1.10	795264	869301	.237	.162	.601	9.45	1.17	.124	-1.29	-.519	-.217	.549	.746	-.281	.986	3.38	1.24	-.467

Table 20d

PAPER - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

DOMESTIC	3.42	.252	1.10	560842	587720	.224	.190	.584	11.5	1.42	.123	-.775	-.243	-.230	.190	.584	.018	.960	1.00	1.00	.031
U.S	3.61	.257	1.10	465631	479348	.215	.201	.582	13.4	1.51	.112	-1.19	-.798	-.087	.853	.343	-.115	.895	4.23	.589	-.198
OTHER FOREIGN	3.64	.252	1.10	184320	201526	.239	.190	.571	11.4	1.45	.126	-.760	-.809	-.429	.190	.570	.570	.966	1.00	1.00	1.00
FOREIGN	3.63	.252	1.10	324976	348064	.229	.199	.572	12.5	1.52	.120	-.771	-.800	-.427	.199	.572	.572	.960	1.00	1.00	1.00
TOTAL FOREIGN	3.60	.252	1.10	517719	522911	.223	.186	.589	11.9	1.38	.115	-.776	-.813	-.410	.186	.589	.589	.935	1.00	1.00	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.47	.252	1.10	795264	869301	.237	.162	.601	9.45	1.17	.124	-1.29	-.519	-.217	.549	.746	-.281	.986	3.38	1.24	-.467

Table 20e

PAPER - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.47	.252	1.10	795264	850657	.224	.216	.558	13.2	1.69	.127	-.775	-.284	-.248	.216	.558	.059	.943	1.00	1.00	.106
U.S	3.47	.252	1.10	795264	875146	.219	.232	.548	14.5	1.85	.126	-1.18	-.767	-.100	.873	.312	-.057	.857	3.76	.570	-.105
OTHER FOREIGN	3.47	.252	1.10	795264	848047	.239	.290	.471	16.7	2.69	.161	-.760	-.709	-.529	.290	.470	.470	1.06	1.00	1.00	1.00
FOREIGN	3.47	.252	1.10	795264	874985	.228	.252	.519	15.2	2.11	.139	-.771	-.747	-.480	.252	.519	.519	.960	1.00	1.00	1.00
TOTAL FOREIGN	3.47	.252	1.10	795264	836924	.224	.216	.560	13.2	1.68	.126	-.776	-.783	-.439	.216	.560	.560	.903	1.00	1.00	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.47	.252	1.10	795264	869301	.237	.162	.601	9.45	1.17	.124	.124	-1.29	-.519	-.549	.746	-.281	.986	3.38	1.24	-.467

Table 20f

PAPER - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	10.3 - 12.8	1.28 - 1.56	.110 - .135
U.S	10.6 - 16.4	1.26 - 1.76	.104 - .119
OTHER FOREIGN	9.01 - 14.0	1.15 - 1.73	.110 - .140
FOREIGN	10.5 - 14.7	1.26 - 1.76	.109 - .129
TOTAL FOREIGN	9.66 - 14.2	1.15 - 1.60	.106 - .123
INDUSTRY	-	-	-
TOTAL INDUSTRY	7.88 - 11.0	1.02 - 1.33	.111 - .137

Table 20g

PAPER - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	10.3 - 12.8	1.28 - 1.56	.111 - .135
U.S	10.5 - 16.2	1.25 - 1.76	.105 - .120
OTHER FOREIGN	8.98 - 14.0	1.16 - 1.74	.111 - .141
FOREIGN	10.5 - 14.6	[illegible] - 1.77	.110 - [illegible]
TOTAL FOREIGN	9.63 - 14.2	1.15 - 1.61	.107 - .124
INDUSTRY	-	-	-
TOTAL INDUSTRY	7.88 - 11.0	1.02 - 1.33	.111 - .137

Table 20h

PAPER - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	11.8 - 14.7	1.51 - 1.86	.114 - .140
U.S	11.6 - 17.5	1.52 - 2.17	.117 - .136
OTHER FOREIGN	12.7 - 20.6	1.86 - 3.53	.135 - .187
FOREIGN	12.5 - 17.8	1.67 - 2.56	.125 - .153
TOTAL FOREIGN	10.8 - 15.7	1.39 - 1.97	.117 - .136
INDUSTRY	-	-	-
TOTAL INDUSTRY	7.88 - 11.0	1.02 - 1.33	.111 - .137

ratios and at the elasticities of the demands for inputs we conclude that there will not be any difference between an expansion in the foreign control and an expansion in the domestic control, However, if we look at the more detailed results we note that U.S firms have an elastic demand for labour. This implies that an expansion in the domestic control will bring a higher level of employment than an expansion in the foreign control. This effects is not obvious in the foreign group as a whole because the other foreign group dominates the results.

5. Primary Metal Industries

From the size point of view this industry is fourth in Canadian manufacturing; it represents 7.31% of manufacturing shipments. It consists of about 400 establishments, 76% of which are Canadian controlled. Measured in terms of total shipments Canadian control is 77.1%. With respect to this measure of foreign control it ranks fifteenth. It is also one of the most concentrated industries; 89.9% of its shipments are produced by the top eight firms in the industry. Due to confidentiality we do not have figures for size of foreign control in these top eight firms.

Looking at the cost functions of foreign and domestic groups (Table 21b) we notice that there are some differences. The cost function of the domestic group of firms is more close to the Cobb-Douglas form while the form in the case of foreign firms is very close to the full translog. Unfortunately, the small sample size in both U.S and other foreign groups of firms does not allow us to go into more detail in the foreign group.

Even though there are differences in the cost functions between the foreign and domestic groups of firms, the results in Table 21c and 21d show that the only significant difference is in the scale elasticity and some minor differences in the elasticites of substitution. Both groups have inelastic demands for inputs and show substitutability among any two of them. The elasticity of substitution is one in the case of domestic firms and lower than one in the case of foreign. Also the differences in the input-input ratios do not seem very important in Tables 21c and 21d. However, as we move to Tables 21e and 21h we notice the big changes in the input ratios. The difference in the capital-labour ratio between domestic and foreign firms is not significantly different from zero. In the case of capital-materials ratio there is some common region in the confidence intervals but it is very small. Finally, the cost of production, as a measure of efficiency, shows a big difference in favor of foreign firms.

In summary, foreign and domestic firms employ technologies with common characteristics regarding the inelasticity of input demands and the substitutability among any two inputs. On the other hand foreign firms employ more capital intensive techniques with a higher scale elasticity. It is greater than one in the case of foreign firms and very close but not higher than one in the case of domestic firms.

Table 21a

PRIMARY METAL - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	2.17 (2.54)	.505 (2.70)	-.014 (-.147)	.509 (2.11)	.574 (4.16)	.062 (.526)	.206 (3.57)	.359 (2.00)	.040 (3.60)	.045 (.945)	-.107 (-.775)	-.024 (-1.31)	-.252 (-3.61)	.031 (4.09)	-.006 (-2.90)	.813	131.2	28
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
FOREIGN	-17.6 (-6.24)	-.131 (-1.33)	-1.04 (-2.89)	2.17 (5.27)	4.02 (7.78)	.149 (5.17)	-.158 (-2.04)	-.211 (-1.88)	-.258 (-5.49)	-.101 (-2.58)	-.048 (-.899)	-.0008 (-.091)	.259 (3.26)	.095 (3.02)	-.094 (-3.16)	.670	83.8	14
TOTAL FOREIGN	-1.55 (-.750)	.412 (-1.31)	-1.60 (-5.79)	2.19 (5.31)	.929 (2.99)	.303 (3.19)	-.138 (-2.09)	.473 (2.06)	.029 (1.23)	.154 (2.45)	-.457 (-3.19)	-.457 (-3.19)	-.016 (-.159)	.114 (5.36)	-.083 (-2.51)	.678	115.0	28
INDUSTRY	-.881 (-1.13)	.524 (3.81)	-.460 (-3.33)	.933 (4.50)	1.00 (8.02)	.059 (.781)	-.133 (-1.67)	.286 (1.66)	.033 (.349)	.180 (3.49)	-.239 (-2.26)	-.010 (-.951)	-.047 (-.494)	.014 (1.78)	-.004 (-.258)	.809	171.6	42
TOTAL INDUSTRY	-2.08 (-.558)	.207 (.895)	-.654 (-7.51)	1.44 (5.25)	1.17 (2.09)	.125 (1.06)	.099 (2.64)	.261 (1.45)	-.001 (-.024)	.178 (.443)	-.143 (-1.00)	-.010 (-.492)	-.117 (-2.23)	.070 (10.1)	-.060 (-2.41)	.896	151.4	28

Table 21b

PRIMARY METAL - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	.681 (.782)	.209 (12.3)	-.346 (-5.35)	.811 (5.80)					.019 (1.76)					.037 (7.29)	-.037 (-7.29)	.838	126.1	28
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	-19.1 (-6.09)	1.83 (7.19)	-.839 (-3.28)	1.83 (7.19)	4.31 (7.64)	.125 (4.39)		.069 (.930)	-.285 (-5.57)	-.028 (-1.20)	-.097 (-1.89)		.028 (1.20)	.091 (3.98)	-.091 (-3.98)	.649	80.2	14
TOTAL FOREIGN	-3.35 (-4.66)		-1.63 (-5.35)	2.63 (8.63)	1.26 (21.4)	.158 (13.4)	-.188 (-2.86)	-.029 (-.435)			-.158 (-13.4)		.188 (2.86)	.126 (5.38)	-.126 (-5.38)	.693	112.0	28
INDUSTRY	-.678 (-5.89)	.506 (7.80)	-.377 (-2.96)	.870 (7.12)	1		-.178 (-2.20)	.230 (1.91)		.204 (4.79)	-.204 (-4.79)		-.026 (-.280)			.795	168.5	42
TOTAL INDUSTRY	-1.92 (-9.43)	.203 (14.2)	-.659 (-8.16)	1.45 (17.5)	1.14 (74.1)		.094 (2.58)	.094 (2.58)					-.094 (-2.58)	.071 (14.8)	-.071 (-14.8)	.896	150.9	28

Table 21c

PRIMARY METAL - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.68	.255	1.11	459862	480165	.209	.148	.643	10.2	1.01	.098	-.790	-.851	-.357	.148	.642	.642	.987	1.00	1.00	1.00
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.82	.256	1.14	83522	93525	.193	.158	.648	12.2	1.09	.089	-.156	-.841	-.244	.013	.142	.824	1.06	.087	.220	1.27
TOTAL FOREIGN	3.79	.255	1.11	216795	237729	.201	.203	.596	15.6	1.48	.095	-.010	-1.72	-.454	.202	-.191	1.52	.924	1.00	-.321	2.56
INDUSTRY	3.73	.255	1.12	334415	351289	.204	.131	.665	9.38	.869	.092	-.796	-2.22	.011	1.13	-.335	.465	1.00	8.62	-.505	.700
TOTAL INDUSTRY	3.83	.255	1.11	676657	724275	.204	.166	.630	12.2	1.15	.094	-.796	-.265	-.220	.165	.630	.061	.960	1.00	1.00	.098

Table 21d

PRIMARY METAL - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.68	.255	1.11	459862	477607	.209	.148	.643	10.2	1.00	.098	-.790	-.851	-.357	.148	.642	.642	.986	1.00	1.00	1.00
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.82	.255	1.11	83522	91504	.196	.158	.646	12.0	1.06	.088	-.164	-.842	-.246	.015	.148	.822	1.05	.097	.230	1.27
TOTAL FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.83	.255	1.11	676657	724275	.204	.166	.630	12.2	1.15	.094	-.796	-.265	-.220	.165	.630	.061	.960	1.00	1.00	.098

Table 21e

PRIMARY METAL - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.83	.255	1.11	676657	713127	.209	.163	.628	11.7	1.13	.096	-.790	-.837	-.372	.162	.627	.627	.979	1.00	1.00	1.00
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.83	.255	1.11	676657	356184	.196	.348	.454	26.5	3.33	.125	-.164	-.651	-.392	.205	-.041	.535	2.85	.591	-.090	1.17
TOTAL FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.83	.255	1.11	676657	724275	.204	.166	.630	12.2	1.15	.094	-.796	-.265	-.220	.165	.630	.061	.960	1.00	1.00	.098

Table 21f

PRIMARY METAL - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	8.73 - 11.7	.835 - 1.18	.075 - .122
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	9.42 - 15.0	.723 - 1.46	.077 - .101
TOTAL FOREIGN	12.2 - 19.0	1.13 - 1.83	.074 - .115
INDUSTRY	7.94 - 10.8	.711 - 1.02	.077 - .107
TOTAL INDUSTRY	10.6 - 13.8	1.03 - 1.27	.075 - .112

Table 21g

PRIMARY METAL - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	8.75 - 11.7	.830 - 1.17	.074 - .121
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	9.25 - 14.8	.703 - 1.42	.076 - .100
TOTAL FOREIGN	-	-	-
INDUSTRY	-	-	-
TOTAL INDUSTRY	10.6 - 13.8	1.03 - 1.27	.075 - .112

Table 21h

PRIMARY METAL - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT

	K/L	K/M	L/M
DOMESTIC	9.85 - 13.4	.928 - 1.32	.073 - .119
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	17.6 - 35.5	1.28 - 5.38	.087 - .163
TOTAL FOREIGN	-	-	-
INDUSTRY	-	-	-
TOTAL INDUSTRY	10.6 - 13.8	1.03 - 1.27	.075 - .112

The difference that exists in the scale elasticities between foreign and domestic firms suggests that foreign firms will tend to grow faster than domestic firms and thus increase their share in this industry. It is difficult to examine whether this is confirmed by the existing evidence because of the reclassification of Alcan and INCO from foreign to Canadian in 1972 which caused a major decrease in the percentage of foreign control. In Table 13 the decrease in foreign control from 1970 to 1974 is 22.4%.

This is one of the few industries where the technologies used by the two groups (foreign and domestic) imply different capital-labour ratios. However, the actual capital-labour ratios are not significantly different. Since the input prices are almost the same in both groups, the only factor explaining this similarity is the difference in the scale of production. This similarity in the actual input ratios together with the inelasticity of demand for inputs in both groups suggests that a possible expansion in foreign control will not bring different results from an expansion in the domestic control.

6. <u>Metal Fabricating Industries</u>

This industry ranks fifth in the classification according to size representing 65.2% of manufacturing shipments. It consists of about 4000 establishments, 89% of which are Canadian controlled. Measured, however, in terms of total shipments Canadian control is 59.3%. According to the size of foreign control this industry is classified twelfth. With respect to the industrial concentration 42.2% of industry's shipments is coming from the top eight firms in the industry. The foreign control in these top eight firms is 51.5%.

The results in Table 22b shows that the cost functions of both foreign and domestic firms are close to the Cobb-Douglas form - the difference being the role of output. The role of output in the cost function is also the difference between foreign and domestic. Within the foreign group the U.S group shows a great similarity with the foreign group while the other foreign group has a more complicated form more close to the full translog but it is not well-behaved. These results suggest that there is more variation in the U.S group than in the other foreign group, something that does not change very much when we sum the observations, as this is evident in the total foreign group.

Tables 22c and 22d show that the two main groups of firms, foreign and domestic, have almost the same technological characteristics. They both have inelastic demands for factors of production and they both show substitutability with elasticity one between any two inputs. Furthermore, they both have increasing returns to scale and similar input ratios.

Even though most of these similarities remain, in Table 22e and especially in Table 22h we see that there are also some differences worth noting. In those tables we have isolated the effects of scale and input price differences. The similarity in the input-input ratios is not maintained. Domestic firms use more capital and more labour per unit of materials than foreign firms. This shows that even though domestic firms use a capital-intensive technique this is not a labour-saving at the same time. This is also reflected in the cost of production in Table 22e. Finally, within the foreign group of firms we notice the similarity between U.S and foreign groups, something that we expected from the similarity in the cost functions.

Thus, the only important difference between foreign and domestic firms lies in the level of efficiency. Foreign firms and especially U.S firms use a more efficient technology. Also there is a small difference in the scale elasticity between domestic and U.S firms; domestic firms have higher returns to scale.

The small difference that exists between domestic and U.S firms in the scale elasticity suggests that there is a possibility for domestic firms to increase their share against the U.S firms which represent more than 80% of foreign control in this industry. The existing evidence confirms this possibility. In Table 13 we note that from 1970 to 1974 the domestic control rose by 2.1% while the U.S control decreased by 2.5%.

From the similarity of input ratios and the input demand elasticities in the two groups we can infer that the effects on the input use will be similar under the expansion of foreign or domestic control, the only difference will be

Table 22a

METAL FABRICATING - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-6.63 (-3.46)	.739 (3.48)	.199 (1.35)	.061 (.237)	2.06 (6.5[illegible])	.035 (.271)	-.027 (-.413)	.308 (1.30)	-.093 (-3.57)	.150 (2.71)	-.185 (-1.10)	-.018 (-.995)	-.122 (-1.27)	-.025 (-2.54)	.044 (1.92)	.744	196.9	39
U.S	2.03 (2.78)	.290 (2.07)	.590 (2.85)	.119 (.525)	.635 (5.02)	.189 (2.99)	.151 (1.30)	.315 (2.23)	.030 (2.66)	-.012 (-.324)	-.176 (-2.50)	-.020 (-2.59)	-.139 (-1.18)	-.022 (-4.15)	.042 (4.53)	.779	135.9	28
OTHER FOREIGN	-4.72 (-4.14)	.886 (6.08)	.357 (2.57)	-.243 (-1.22)	1.88 (8.50)	.007 (.096)	.049 (.718)	.382 (2.83)	-.091 (-4.19)	.162 (4.22)	-.170 (-1.80)	-.036 (-3.50)	-.212 (-2.80)	-.037 (-4.74)	.073 (5.09)	.593	132.7	25
FOREIGN	-.246 (-.405)	.443 (4.78)	.331 (2.27)	.225 (1.36)	1.02 (9.46)	.153 (3.01)	.083 (.982)	.423 (3.43)	-.005 (-.586)	.092 (2.78)	-.246 (-3.73)	-.017 (-2.87)	-.176 (-1.98)	-.029 (-4.49)	.038 (4.58)	.691	243.3	53
TOTAL FOREIGN	-.780 (-1.56)	.436 (3.66)	.509 (2.50)	.053 (.247)	1.13 (13.5)	.178 (2.92)	.099 (.798)	.371 (2.33)	-.014 (-1.89)	.046 (1.04)	-.225 (-3.17)	-.024 (-3.96)	-.145 (-1.11)	-.027 (-4.81)	.052 (6.43)	.781	175.6	39
INDUSTRY	-1.15 (-2.43)	.390 (4.34)	.185 (1.82)	.424 (3.15)	1.15 (13.9)	.116 (2.11)	.053 (.913)	.405 (3.89)	-.016 (-2.27)	-.117 (-4.47)	-.234 (-3.48)	-.003 (-.645)	-.171 (-2.66)	-.013 (-3.55)	.016 (2.22)	.603	402.6	92
TOTAL INDUSTRY	-1.76 (-1.04)	.900 (4.89)	.353 (2.30)	-.253 (-1.05)	1.25 (4.78)	.092 (1.05)	-.001 (-.020)	.356 (2.22)	-.024 (-1.18)	.132 (3.47)	-.224 (-2.04)	-.039 (-2.58)	-.131 (-.163)	-.032 (-3.38)	.071 (3.90)	.770	201.1	39

Table 22b

METAL FABRICATING - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-8.46 (-3.83)	.330 (27.8)	.100 (16.7)	.562 (41.0)	2.38 (6.51)				-.117 (-3.90)							.731	191.3	39
U.S	-.128 (-.531)	.550 (5.66)	.332 (5.31)	.117 (1.07)	.972 (46.0)							-.020 (-2.44)		-.020 (-3.74)	.041 (4.33)	.716	131.6	28
OTHER FOREIGN	-4.73 (-4.20)	.900 (7.47)	.281 (3.05)	-.181 (-1.22)	1.86 (8.51)			.331 (4.33)	-.090 (-4.17)	.165 (4.33)	-.165 (-4.33)	-.036 (-3.51)	-.165 (-4.33)	-.037 (-4.70)	.073 (5.11)	.586	132.4	25 *
FOREIGN	.063 (.407)	.452 (6.21)	.292 (5.93)	.255 (2.62)	.957 (66.6)							-.014 (-2.12)		-.018 (-4.04)	.032 (3.64)	.708	238.0	53
TOTAL FOREIGN	-.010 (-.063)	.360 (3.83)	.469 (6.43)	.229 (2.07)	.978 (65.5)	.188 (3.09)		.188 (3.09)			-.188 (-3.09)	-.025 (-4.01)		-.026 (-4.76)	.052 (6.39)	.790	173.6	39
INDUSTRY	-1.24 (-2.68)	.469 (12.0)	.114 (2.32)	.415 (9.43)	1.15 (14.1)			.213 (4.18)	-.017 (-2.34)		-.106 (-4.18)		-.106 (-4.18)	-.012 (-3.47)	.012 (3.47)	.609	400.6	92 *
TOTAL INDUSTRY	3.17 (.824)	.730 (3.90)	.409 (4.00)	-.140 (-6.38)	.944 (30.9)							-.032 (-2.19)		-.024 (-3.05)	.057 (3.29)	.800	197.6	39

Table 22c

METAL FABRICATING - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.53	.249	1.09	232958	227987	.330	.100	.569	4.29	.769	.179	-.669	-.899	-.430	.100	.569	.569	1.07	1.00	1.00	1.00
U.S	3.87	.250	1.09	157146	140055	.301	.086	.612	4.46	.618	.138	-.698	-.913	-.387	.086	.612	.612	1.03	1.00	1.00	1.00
OTHER FOREIGN	3.50	.252	1.10	37895	36511	.272	.081	.646	4.12	.549	.133	-.727	-.918	.160	.690	.037	-1.40	1.08	8.51	.057	-2.16
FOREIGN	3.69	.251	1.09	100896	91508	.289	.082	.629	4.17	.569	.136	-.711	-.918	-.370	.082	.629	.629	1.03	1.00	1.00	1.00
TOTAL FOREIGN	3.77	.249	1.09	153401	139227	.291	.089	.619	4.63	.632	.136	-.062	-.910	-.076	.089	-.026	.619	1.01	1.00	-.043	1.00
INDUSTRY	3.62	.250	1.09	156879	147485	.312	.090	.597	4.18	.660	.157	-.687	-.909	-.044	.432	.255	-.586	1.03	4.79	.426	-.981
TOTAL INDUSTRY	3.62	.249	1.09	386446	360803	.312	.091	.596	4.25	.671	.157	-.687	-.908	-.403	.091	.596	.596	1.06	1.00	1.00	1.00

Table 22d

METAL FABRICATING - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.53	.249	1.09	232958	227712	.330	.100	.569	4.30	.770	.178	-.669	-.899	-.430	.100	.569	.569	1.01	1.00	1.00	1.00
U.S	3.87	.249	1.09	157146	139814	.301	.086	.612	4.77	.619	.138	-.698	-.913	-.387	.086	.612	.612	1.03	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.69	.249	1.09	100896	90979	.289	.082	.629	4.21	.570	.135	-.711	-.918	-.370	.082	.629	.629	1.03	1.00	1.00	1.00
TOTAL FOREIGN	3.77	.249	1.09	153401	139048	.291	.089	.618	4.64	.633	.136	-.063	-.910	-.070	.099	-.026	.618	1.01	1.00	-.042	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.62	.249	1.09	386446	360803	.312	.091	.596	4.25	.671	.157	-.687	-.908	-.403	.091	.596	.596	1.06	1.00	1.00	1.00

Table 22e

METAL FABRICATING - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.62	.249	1.09	386446	361966	.330	.100	.569	4.41	.770	.174	-.669	-.899	-.430	.100	.509	.569	1.15	1.00	1.00	1.00
U.S	3.62	.249	1.09	386446	330230	.282	.068	.649	3.50	.459	.130	-.717	-.931	-.350	.068	.649	.649	1.02	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.62	.249	1.09	386446	331662	.269	.057	.672	3.09	.373	.120	-.730	-.942	-.327	.057	.672	.672	1.03	1.00	[illegible]	1.00
TOTAL FOREIGN	3.62	.249	1.09	386446	342203	.260	.064	.674	3.61	.420	.116	-.055	-.935	-.066	.064	-.026	.674	1.01	1.00	-.030	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.62	.249	1.09	386446	360803	.312	.091	.596	4.25	.671	.157	-.687	-.908	-.403	.091	.596	.596	1.06	1.00	1.00	1.00

Table 22f

METAL FABRICATING - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	3.72 - 4.86	.652 - .887	.158 - .200
U.S	3.52 - 5.39	.489 - .747	.121 - .155
OTHER FOREIGN	3.42 - 4.82	.438 - .659	.119 - .146
FOREIGN	3.54 - 4.80	.465 - .673	.122 - .150
TOTAL FOREIGN	3.61 - 5.66	.483 - .780	.122 - .150
INDUSTRY	3.72 - 4.65	.575 - .745	.146 - .169
TOTAL INDUSTRY	3.63 - 4.86	.565 - .778	.140 - .175

Table 22g

METAL FABRICATING - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	3.73 - 4.87	.652 - .887	.157 - .200
U.S	3.54 - 5.41	.490 - .748	.121 - .155
OTHER FOREIGN	-	-	-
FOREIGN	3.57 - 4.85	.465 - .674	.121 - .148
TOTAL FOREIGN	3.61 - 5.67	.484 - .781	.122 - .150
INDUSTRY	-	-	-
TOTAL INDUSTRY	3.63 - 4.86	.565 - .778	.140 - .175

Table 22h

METAL FABRICATING - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	3.82 - 5.00	.652 - .887	.153 - .195
U.S	2.23 - 4.78	.294 - .623	.107 - .153
OTHER FOREIGN	-	-	-
FOREIGN	1.96 - 4.21	.217 - .529	.099 - .141
TOTAL FOREIGN	2.14 - 5.07	.243 - .596	.098 - .134
INDUSTRY	-	-	-
TOTAL INDUSTRY	3.63 - 4.86	.565 - .778	.140 - .175

the level of efficiency.

7. Transportation Equipment Industries

This is the second most important industry in Canadian manufacturing. It represents 14.77% of total manufacturing shipments. This industry consists of about 1000 establishments, 80% of which are Canadian controlled. If we measure control in terms of total shipments Canadian control amounts to 12.9%.

This industry is thus second in the classification according to size of foreign control. With respect to industrial concentration, 86% of industry's shipments is produced by the top eight firms. Among these firms the foreign control is 90.9%.

In Table 23b we notice that while the cost function of the foreign group of firms is of the Cobb-Douglas type, the cost function of the domestic group is not well-behaved. This is due to positive elasticities of the demands for labour and materials. Since we do not have a cost function of the domestic group we can not compare this with the foreign group. From the results in Table 23c we can describe the foreign firms as firms that exhibit increasing returns to scale, inelastic demands for inputs and show substitutability among any two inputs with elasticity one.

8. Electrical Products Industries

This industry is seventh when classified according to size. It represents 5.99% of manufacturing shipments. It consists of about 800 establishments, 59% of which are

Table 23a

TRANSPORTATION EQUIPMENT - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	3.52 (1.52)	.297 (1.17)	1.02 (3.98)	-.325 (-1.12)	.540 (1.35)	.320 (3.19)	.181 (1.44)	.925 (5.73)	.024 (.702)	.211 (4.89)	-.532 (-5.77)	-.003 (-.130)	-.393 (-2.98)	-.074 (-4.56)	-.077 (-3.61)	.472	109.6	23
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
FOREIGN	-.118 (-.175)	.018 (.079)	.075 (.240)	.906 (2.28)	1.05 (10.4)	.585 (2.63)	-.055 (-.307)	.792 (2.35)	-.009 (-1.12)	.131 (1.78)	-.716 (-3.16)	-.019 (-.891)	-.075 (-.356)	-.017 (-1.18)	.036 (1.41)	.486	59.3	12
TOTAL FOREIGN	.373 (.538)	.347 (1.94)	.335 (1.36)	.317 (1.09)	.954 (9.05)	.251 (1.97)	.185 (1.20)	.755 (3.38)	.0006 (.072)	.159 (3.45)	-.410 (-3.22)	-.010 (-.696)	-.344 (-2.04)	-.010 (-1.32)	.021 (1.39)	.202	94.7	24
INDUSTRY	.527 (.673)	.156 (1.00)	.683 (2.82)	.159 (.606)	1.01 (8.04)	.327 (4.07)	.191 (1.35)	.744 (4.21)	-.010 (-.996)	.112 (2.69)	-.440 (-5.32)	-.004 (-.301)	-.304 (-2.05)	-.034 (-3.20)	.038 (2.56)	.485	154.5	35
TOTAL INDUSTRY	2.55 (4.12)	.714 (4.45)	.489 (2.74)	-.203 (-.858)	.614 (6.92)	.181 (1.64)	.101 (.945)	.469 (3.02)	.026 (3.85)	.093 (2.72)	-.274 (-2.61)	-.042 (-2.63)	-.195 (-1.73)	-.027 (-3.73)	.069 (4.11)	.584	158.4	37

Table 23b

TRANSPORTATION EQUIPMENT - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	1.80 (3.76)	.276 (2.03)	.776 (4.56)	-.053 (-.276)	.812 (20.2)	.312 (3.50)		.742 (7.10)			-.527 (-6.04)		-.214 (-5.00)	-.076 (-5.06)	.076 (5.06)	.482	108.6	23
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
FOREIGN	.239 (2.39)	.349 (14.4)	.125 (7.79)	.525 (22.4)	.956 (130.1)											.400	54.9	12
TOTAL FOREIGN	.214 (2.21)	.287 (13.)	.132 (11.7)	.580 (25.6)	.965 (123.8)											.200	88.2	24
INDUSTRY	1.07 (3.59)		.406 (3.56)	.593 (5.21)	.904 (35.3)	.273 (27.2)		.273 (27.2)			-.273 (-27.2)			-.023 (-2.39)	.023 (2.39)	.478	149.1	35
TOTAL INDUSTRY	2.25 (3.82)	.407 (7.31)	.355 (4.31)	.236 (2.35)	.674 (7.99)			.206 (3.16)	.018 (2.90)	.103 (3.16)	-.103 (-3.16)		-.103 (3.16)	-.029 (-4.04)	.029 (4.04)	590	155.0	37

Table 23c

TRANSPORTATION EQUIPMENT - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLP	SKP	SMP	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.23	.237	1.03	129206	124924	.316	.126	.557	5.44	.991	.181	.305	-.873	.888	.804	-1.11	-1.14	.108	6.37	-1.99	-2.04
U.S.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.97	.253	1.02	325633	319350	.349	.125	.525	5.83	1.05	.180	-.650	-.874	-.474	.125	.525	.525	1.04	1.00	1.00	1.00
TOTAL FOREIGN	3.62	.236	1.03	379721	366284	.287	.132	.580	7.05	.969	.141	-.712	-.867	-.419	.132	.580	.580	1.04	1.00	1.00	1.00
INDUSTRY	3.42	.235	1.03	196552	189212	.327	.122	.550	5.42	.971	.179	.161	-.877	.046	.122	-.283	.550	1.06	1.00	-.515	1.00
TOTAL INDUSTRY	3.65	.239	1.04	1028590	941226	.256	.081	.662	4.85	.535	.110	-.743	-.918	-.026	.483	.259	-.601	1.03	5.92	.329	-.908

Table 23d

TRANSPORTATION EQUIPMENT - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLP	SKP	SMP	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.23	.237	1.03	127206	124924	.316	.126	.557	5.44	.991	.181	.305	-.873	.888	.804	-1.11	-1.14	1.08	6.37	-1.99	-2.04
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.79	.237	1.03	325633	320383	.349	.125	.525	5.74	1.03	.180	-.650	-.874	-.474	.125	.525	.525	1.04	1.00	1.00	1.00
TOTAL FOREIGN	3.62	.234	1.03	379721	365629	.287	.132	.580	7.03	.989	.140	-.712	-.867	-.419	.132	.580	.580	1.04	1.00	1.00	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 23e

TRANSPORTATION EQUIPMENT - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	W	r	V	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.23	.237	1.03	129206	124924	.316	.126	.557	5.44	.991	.181	.305	-.873	.888	.804	-1.11	-1.14	1.08	6.37	-1.99	-2.04
U.S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.23	.237	1.03	129206	125127	.349	.125	.525	4.88	1.03	.212	-.650	-.874	-.474	.125	.525	.525	1.04	1.00	1.00	1.00
TOTAL FOREIGN	3.23	.237	1.03	129206	124985	.287	.132	.580	6.27	.989	.157	-.712	-.867	-.419	.132	.580	.580	1.04	1.00	1.00	1.00
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 23f

TRANSPORTATION EQUIPMENT - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	4.08 - 6.81	.780 - 1.20	.157 - .206
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	3.70 - 7.96	.713 - 1.39	.137 - .222
TOTAL FOREIGN	5.22 - 8.89	.783 - 1.20	.108 - .173
INDUSTRY	-	-	-
TOTAL INDUSTRY	-	-	-

Table 23g

TRANSPORTATION EQUIPMENT - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	4.08 - 6.81	.780 - 1.20	.157 - .206
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	3.64 - 7.84	.704 - 1.37	.138 - .222
TOTAL FOREIGN	5.20 - 8.87	.777 - 1.20	.107 - .173
INDUSTRY	-	-	-
TOTAL INDUSTRY	-	-	-

Table 23h

TRANSPORTATION EQUIPMENT - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	4.08 - 6.81	.780 - 1.20	.157 - .206
U.S	-	-	-
OTHER FOREIGN	-	-	-
FOREIGN	3.10 - 6.67	.704 - 1.37	.162 - .262
TOTAL FOREIGN	4.64 - 7.90	.777 - 1.20	.127 - .194
INDUSTRY	-	-	-
TOTAL INDUSTRY	-	-	-

Canadian controlled. Measured, however, in terms of total shipments Canadian control represents 35.2%. In terms of the size of foreign control this industry is classified seventh among the twenty major manufacturing industries. It is also one of the most concentrated industries, 75.6% of industry's shipments is produced by the top eight firms. The foreign control in these top eight firms is 67.8%.

Looking at the cost functions of foreign and domestic firms (Table 24b) we notice that the foreign group of firms has a function which is characterized by linear homogeneity while the domestic group has a more complicated form which is more close to the full translog. Within the foreign group the U.S firms have a function of the Cobb-Douglas form with constant returns to scale. Due to the small size of the sample we do not have results for the other foreign group of firms. However, the results for the foreign group compared with those of the U.S group suggest that there might be some differences between U.S and other foreign groups.

Even though there are differences in the functional form of the cost functions, there are no important differences in the technological characteristics as presented in Tables 24c, 24d, 24e, 24f, 24g, and 24h. More specifically, both groups of firms have inelastic demands for factors of production; they both have very high substitutability between labour and capital and low substitutability between labour and materials. They differ in the elasticity of scale where domestic firms show increasing returns to scale while

Table 24a

ELECTRICAL PRODUCTS - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-1.03	.332	-.072	.740	1.13	.071	-1.30	.242	-.016	.150	-.222	.006	-.019	-.017	.010	.804	169.2	29
	(-3.60)	(3.47)	(-.761)	(5.24)	(21.6)	(1.19)	(-2.28)	(2.26)	(-3.38)	(6.28)	(-3.04)	(.841)	(-.328)	(-.510)	(1.05)			
U.S	5.01	.037	-.173	1.13	.072	-.021	-.050	.091	.075	.081	-.060	.030	-.031	.005	-.036	.825	96.7	16
	(2.02)	(.224)	(-1.32)	(4.69)	(.176)	(-.168)	(-.708)	(.397)	(2.20)	(1.59)	(-.370)	(2.21)	(-.314)	(.920)	(-2.01)			
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
FOREIGN	.098	.300	-.158	.857	.887	.257	-.084	.490	.009	.158	-.416	-.007	-.073	-.006	.014	.831	138.4	25
	(.142)	(1.86)	(-1.78)	(4.38)	(7.48)	(2.50)	(-1.76)	(3.37)	(.886)	(5.45)	(-3.55)	(-.019)	(-1.33)	(-1.69)	(.972)			
TOTAL FOREIGN	6.73	.193	-.154	.961	-.209	.127	-.074	.381	.098	.164	-.291	.012	-.089	-.005	-.007	.686	160.2	30
	(2.41)	(1.11)	(-1.32)	(4.16)	(-.459)	(1.29)	(-1.22)	(2.29)	(2.64)	(4.32)	(-2.39)	(.864)	(-1.25)	(-.878)	(-.387)			
INDUSTRY	-.897	.310	-.081	.771	1.09	.160	-.104	.368	-.012	.156	-.317	.001	-.051	-.014	.013	.736	289.6	54
	(-3.07)	(3.68)	(-1.18)	(6.74)	(21.4)	(3.15)	(-2.60)	(4.59)	(-2.60)	(9.07)	(-5.42)	(.141)	(-1.20)	(-5.19)	(1.57)			
TOTAL INDUSTRY	1.86	.202	-.098	.095	.624	.111	-.085	.354	.028	.164	-.275	.013	-.079	-.010	-.002	.802	187.3	33
	(1.00)	(1.22)	(-.851)	(4.09)	(2.12)	(1.26)	(-1.36)	(2.53)	(1.20)	(4.91)	(-2.69)	(.924)	(-1.12)	(-1.75)	(-.161)			

Table 24b

ELECTRICAL PRODUCTS - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-1.10	.460		.539	1.14		-.104	.170	-.108	.137	-.137		-.032	-.019	.019	.800	167.7	29
	(-4.17)	(13.7)		(16.0)	(22.4)		(-4.92)	(3.16)	(-3.77)	(6.42)	(-6.42)		(-.942)	(-7.10)	(7.10)			
U.S	-.424	.271	.059	.669	1											.753	90.7	16
	(-29.7)	(19.8)	(11.3)	(39.0)														
OTHER FOREIGN	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	-.610	.458	-.073	.615	1			.249		.124	-.124		-.124			.823	132.3	25
	(-11.7)	(10.1)	(-2.21)	(32.5)				(4.34)		(4.34)	(-4.34)		(-4.34)					
TOTAL FOREIGN	5.46	.338		.661				.119	.083	.059	-.059		-.059			.687	155.6	30
	(60.6)	(23.1)		(45.1)				(15.5)	(71.7)	(15.5)	(-15.5)		(-15.5)					
INDUSTRY	-.807	.316		.683	.109	.159	-.061	.402	-.011	.152	-.311		-.090	-.015	.015	.735	289.0	54*
	(-2.85)	(6.01)		(12.90)	(21.2)	(3.32)	(-3.42)	(5.61)	(-2.56)	(9.11)	(-5 75)		(-3.25)	(-6.81)	(6.81)			
TOTAL INDUSTRY	-.450	.345		.654	1			.128		.064	-.064		-.064			.788	180.6	33
	(-36.9)	(27.4)		(51.8)				(17.6)		(17.6)	(-17.6)		(-17.6)					

Table 24c

ELECTRICAL PRODUCTS - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.01	.255	1.08	141934	131841	.262	.062	.676	2.79	.389	.139	-.738	-2.62	-.071	.587	.150	.146	1.04	9.46	.222	.216
U.S	3.47	.260	1.10	297119	268378	.271	.059	.670	2.91	.374	.128	-.728	-.940	-.330	.059	.669	.669	1.00	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.56	.261	1.10	216522	200615	.277	.072	.651	3.52	.467	.132	-.722	-.928	.034	.521	.200	-1.08	1.00	7.26	.308	-1.67
TOTAL FOREIGN	3.27	.255	1.08	288197	256257	.253	.066	.681	3.34	.410	.122	-.747	-.933	-.144	.301	.445	-.221	.947	4.56	.654	-.324
INDUSTRY	3.26	.258	1.09	176466	162991	.271	.065	.664	3.02	.412	.137	-.119	-.935	.372	.627	-.508	-1.69	1.03	9.70	-.765	-2.55
TOTAL INDUSTRY	3.17	.253	1.07	416616	375270	.252	.070	.678	3.45	.435	.126	-.747	-.930	-.132	.324	.423	-.245	1.00	4.65	.624	-.362

Table 24d

ELECTRICAL PRODUCTS - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.01	.261	1.10	141934	133452	.263	.059	.678	2.60	.368	.141	-.737	-2.70	-.070	.583	.154	.122	1.04	9.84	.227	.180
U.S	3.47	.261	1.10	297119	268171	.271	.059	.670	2.90	.372	.128	-.728	-.940	-.330	.059	.669	.669	1.00	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.56	.261	1.10	216522	200615	.277	.072	.651	3.52	.467	.132	-.722	-.928	.034	.521	.200	-1.08	1.00	7.26	.308	-1.67
TOTAL FOREIGN	3.27	.261	1.10	288197	259885	.253	.065	.682	3.21	.401	.125	-.746	-.935	-.143	.300	.446	-.235	.947	4.62	.655	-.345
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.17	.261	1.10	416616	382072	.253	.068	.679	3.27	.423	.129	-.746	-.931	-.131	.322	.424	-.264	1.00	4.72	.625	-.390

Table 24e

ELECTRICAL PRODUCTS - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.56	.261	1.10	216522	208782	.262	.074	.664	3.84	.470	.122	-.737	-2.34	-.079	.597	.139	.219	1.05	8.07	.210	.330
U.S	3.56	.261	1.10	216522	196749	.271	.059	.669	2.97	.373	.125	-.728	-.940	-.330	.059	.669	.669	1.00	1.00	1.00	1.00
OTHER FOREIGN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREIGN	3.56	.261	1.10	216522	200615	.277	.072	.651	3.52	.467	.132	-.722	-.928	.034	.521	.200	-1.08	1.00	7.26	.308	-1.67
TOTAL FOREIGN	3.56	.261	1.10	216522	197017	.253	.070	.677	3.76	.453	.115	-.746	-.930	-.147	.305	.441	-.174	.969	4.36	.652	-.258
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.56	.261	1.10	216522	204409	.253	.075	.672	4.07	.474	.116	-.746	-.924	-.137	.329	.417	-.180	1.00	4.36	.621	-.268

Table 24f

ELECTRICAL PRODUCTS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	2.42 - 3.17	.318 - .461	.122 - .156
U.S	2.46 - 3.36	.288 - .460	.107 - .149
OTHER FOREIGN	-	-	-
FOREIGN	3.05 - 3.98	.392 - .543	.111 - .153
TOTAL FOREIGN	2.93 - 3.75	.344 - .476	.106 - .138
INDUSTRY	2.68 - 3.35	.357 - .467	.124 - .149
TOTAL INDUSTRY	3.01 - 3.88	.375 - .495	.111 - .141

Table 24g

ELECTRICAL PRODUCTS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	K/L	K/M	L/M
DOMESTIC	2.22 - 2.97	.297 - .438	.124 - .158
U.S	2.45 - 3.35	.287 - .458	.107 - .148
OTHER FOREIGN	-	-	-
FOREIGN	3.05 - 3.98	.392 - .543	.111 - .153
TOTAL FOREIGN	2.81 - 3.60	.336 - .465	.108 - .141
INDUSTRY	-	-	-
TOTAL INDUSTRY	2.86 - 3.68	.365 - .481	.114 - .144

Table 24h

ELECTRICAL PRODUCTS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	3.27 - 4.41	.378 - .563	.107 - .137
U.S	2.51 - 3.43	.287 - .458	.105 - .145
OTHER FOREIGN	-	-	-
FOREIGN	3.05 - 3.98	.392 - .543	.111 - .153
TOTAL FOREIGN	3.30 - 4.23	.364 - .506	.100 - .130
INDUSTRY	-	-	-
TOTAL INDUSTRY	3.55 - 4.58	.408 - .540	.102 - .130

foreign firms show constant returns to scale. They also differ in the elasticity of substitution between capital and materials where in the case of domestic firms is positive and less than one while in the case of foreign firms is negative.

As it is evident in Tables 24e and 24h there are no important differences in the input ratios as well as in the cost of production.

Thus, in this industry the important differences between foreign and domestic firms are the scale elasticity and the elasticities of demand for capital services and materials.

The implication of the first difference is that domestic firms will tend to grow faster than foreign firms and thus increase their share. The evidence (Table 13) shows that from 1970 to 1974 the domestic control increased by 3.1%.

The implication of the second difference, especially in the elasticity of the demand for capital, is that an expansion of domestic control will be accompanied by a higher level of employment than an expansion of foreign control.

9. <u>Chemical and Chemical Products Industries</u>

This industry is classified sixth in terms of size. It represents 5.63% of manufacturing shipments. It consists of about 1200 establishments, 52% of which are Canadian controlled. Measured in terms of total shipments, Canadian control is only 18.2%. This makes this industry third in terms of the size of foreign control. With respect to industrial concentration, 64.7% of industry's shipments are produced by the top eight firms. The foreign control in these top eight firms is 90.9%.

The cost functions of both foreign and domestic group of firms are characterized by homogeneity. However, the degree of homogeneity is higher than one in the case of domestic firms and not different from one in the case of foreign firms. Among their main differences is the coefficient of the price of capital which is negative in the case of domestic firms but not different from zero in the case of foreign group. Similar to the function form of the foreign group is the form of the other foreign group while the cost function of the U.S group is different.

Comparing now the technological characteristics derived from the above functions (Tables 25c, 25d and 25e) we notice that there are a few differences between the two groups of firms. Even though they both have inelastic demands for materials this is not true for the case of the other two inputs. Domestic firms have an elastic demand for capital while foreign firms have an elastic demand for labour. Another difference is in the elasticities of substitution. Despite the fact that both groups show high substitutability between labour and materials while foreign firms show no substitutability between capital and materials. On the other hand they both have decreasing returns to scale and similar factor intensities. The similarity of the factor intensities as well as the efficiency of the two groups, as measured by the cost of production, are evident in Tables 25e and 25h.

Within the foreign group there are also some differences. The other foreign group is very similar to this foreign group while the U.S. group shows increasing returns to scale, substitutability between capital and materials, lower substitutability between labour and capital and a lower cost of production.

Thus, while the difference between foreign and domestic firms is in the shape of their isoquants the difference between U.S and other foreign groups is also in the position of the isoquants.

From the difference in the returns to scale we expect that the share of U.S control may increase. The existing evidence (Table 13) shows that from 1970 to 1974 the U.S control increased, however, by a small percentage of 0.3%.

The differences in the input demand elasticities suggest that, given the downward rigidity of the input prices, a possible expansion of the domestic control will bring more employment than an expansion in the foreign control. However, the expansion of foreign control will bring a higher level of efficiency in the industry. This is true only for U.S firms.

Table 25a

CHEMICALS - TRANSLOG COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	.189	.186	-.255	1.06	.887	-.010	-.219	.148	.006	.189	-.178	.029	.030	-.012	-.016	.644	135.6	34
	(.154)	(1.10)	(-1.15)	(4.05)	(4.05)	(-.186)	(-2.58)	(.961)	(.301)	(4.74)	(-2.16)	(1.97)	(.314)	(-.734)	(-.788)			
U.S	-5.09	-.150	.508	.641	2.05	-.045	.011	.312	-.112	.173	-.127	.057	-.184	-.044	-.012	.609	96.1	25
	(-1.53)	(-.743)	(1.45)	(1.76)	(3.71)	(-1.21)	(.085)	(1.56)	(-2.38)	(3.77)	(-1.75)	(3.69)	(-1.20)	(-1.96)	(-.571)			
OTHER FOREIGN	4.00	.812	-.353	.540	.026	-.145	-.098	.175	.097	.209	-.064	-.008	-.111	.011	-.002	.544	88.0	25
	(.830)	(4.00)	(-1.04)	(1.97)	(.031)	(-3.15)	(-.635)	(1.06)	(1.24)	(3.45)	(-1.06)	(-.547)	(-.744)	(.504)	(-.163)			
FOREIGN	-3.34	.432	.105	.462	1.54	-.073	-.002	.276	-.052	.176	-.102	.012	-.173	-.013	.0005	.501	168.5	50
	(-1.24)	(3.04)	(.449)	(2.15)	(3.33)	(-2.16)	(-.028)	(2.11)	(-1.30)	(4.47)	(-2.05)	(1.18)	(-1.57)	(-.945)	(.050)			
TOTAL FOREIGN	5.96	.023	.382	.593	.117	-.083	-.006	.139	.057	.115	-.031	.037	-.108	-.030	-.007	.501	133.8	34
	(2.28)	(.136)	(1.27)	(2.32)	(.278)	(-2.56)	(-.055)	(.879)	(1.62)	(2.63)	(-.551)	(2.82)	(-.831)	(-1.46)	(-.436)			
INDUSTRY	-2.03	.397	-.105	.707	1.33	-.077	-.088	.296	-.037	.231	-.153	.022	-.142	-.012	-.010	.496	269.8	84
	(-1.48)	(3.98)	(-.627)	(4.11)	(5.50)	(-2.51)	(-1.01)	(2.62)	(-1.75)	(7.16)	(-3.40)	(2.90)	(-1.53)	(-1.24)	(-1.09)			
TOTAL INDUSTRY	11.1	.240	-.091	.850	-.873	-.070	-.048	.225	.148	.172	-.101	.025	-.123	-.001	-.023	.514	152.2	40
	(3.61)	(1.59)	(-.342)	(3.63)	(-1.74)	(-2.34)	(-.464)	(1.58)	(3.63)	(4.34)	(-2.00)	(2.17)	(-1.06)	(-.107)	(-1.65)			

Table 25b

CHEMICALS - COST FUNCTIONS

	c_0	c_w	c_r	c_v	c_Q	c_{ww}	c_{rr}	c_{vv}	c_{QQ}	c_{wr}	c_{wv}	c_{wQ}	c_{rv}	c_{rQ}	c_{vQ}	R^2	LLF	N
DOMESTIC	-1.03	.491	-.362	.871	1.03		-.200	.177		.189	-.189		.011			.615	133.7	34
	(-6.08)	(9.09)	(-2.84)	(6.79)	(103.3)		(-2.47)	(1.64)		(5.80)	(-5.80)		(.132)					
U.S	-4.76	-.366	.165	1.20	1.92	-.093		-.093	-.091		.093	.057			-.057	.594	91.4	25
	(-1.56)	(-2.11)	(8.06)	(6.90)	(3.66)	(-2.33)		(-2.33)	(-2.02)		(2.33)	(4.00)			(-4.00)			
OTHER FOREIGN	-1.12	.600		.399	1.05	-.129		.162		.146	-.016		-.146			.522	86.9	25
	(-3.66)	(10.9)		(7.30)	(38.4)	(-3.01)		(3.23)		(9.77)	(-.369)		(-9.77)					
FOREIGN	-.586	.515		.484	1.00	-.065		.221		.143	-.028		-.143			.481	166.6	50
	(-3.18)	(12.2)		(11.5)	(64.9)	(-1.92)		(5.52)		(13.6)	(-2.19)		(-13.6)					
TOTAL FOREIGN	1.04		.077	.922	.882	-.082		.057		.070	.012	.034	-.070		-.034	.494	131.1	34
	(5.51)		(1.61)	(19.2)	(48.8)	(-2.33)		(.665)		(1.87)	(.231)	(6.10)	(-1.87)		(-6.10)			
INDUSTRY	-1.99	.406		.593	1.33	-.077		.383	-.037	.230	-.153	.022	-.230	-.009	-.012	.496	269.2	84
	(-1.49)	(4.45)		(6.49)	(5.52)	(-2.52)		(5.37)	(-1.72)	(7.20)	(-3.42)	(3.03)	(-7.20)	(-2.79)	(-1.62)			
TOTAL INDUSTRY	10.7	.191		.808	-.775	-.071		.210	.140	.140	-.069	.025	-.140		-.025	.513	151.8	40
	(3.56)	(1.78)		(7.52)	(-1.57)	(-2.32)		(5.30)	(3.47)	(12.1)	(-2.07)	(2.85)	(-12.1)		(-2.85)			

Table 25c

CHEMICALS - TECHNOLOGICAL CHARACTERISTICS (USING THE AVERAGE INPUT PRICES AND OUTPUT OF EACH GROUP)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.17	.241	1.10	50746	51538	.204	.141	.655	9.12	.990	.108	-.795	-2.27	-.075	1.06	-.272	.737	.963	7.53	-.416	1.12
U.S	3.67	.244	1.12	192852	175474	.226	.166	.608	10.9	1.25	.114	-1.18	-.834	-.545	.165	1.01	.608	1.13	1.00	1.67	1.00
OTHER FOREIGN	3.72	.244	1.12	82468	78303	.221	.175	.604	12.0	1.33	.111	-1.36	-.825	-.126	.834	.529	-.233	.950	4.77	.877	-.387
FOREIGN	3.70	.244	1.12	137660	126890	.218	.170	.612	11.8	1.28	.109	-1.08	-.829	-.025	.827	.252	-.231	.993	4.85	.413	-.387
TOTAL FOREIGN	3.65	.241	1.10	246748	220931	.217	.161	.622	11.2	1.18	.105	-1.16	-.838	-.285	.483	.679	.186	1.08	3.00	1.09	.299
INDUSTRY	3.48	.243	1.12	102480	97069	.221	.154	.624	10.0	1.13	.113	-1.13	-.845	.239	1.19	-.067	-.871	1.06	7.76	-.108	-1.39
TOTAL INDUSTRY	3.65	.242	1.11	315369	290751	.210	.167	.622	12.0	1.23	.103	-1.12	-.832	-.040	.839	.292	-.217	.965	4.99	.469	-.349

Table 25d

CHEMICALS - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.17	.242	1.11	50746	51741	.203	.141	.656	9.12	.990	.108	-.796	-2.27	-.074	1.07	-.274	.738	.963	7.56	-.418	1.12
U.S	3.67	.242	1.11	192852	173240	.224	.166	.610	11.2	1.24	.111	-1.19	-.854	-.543	.165	1.02	.609	1.13	1.00	1.68	1.00
OTHER FOREIGN	3.72	.242	1.11	82468	77301	.220	.177	.603	12.4	1.35	.108	-1.36	-.822	-.127	.841	.528	-.222	.950	4.74	.876	-.369
FOREIGN	3.70	.242	1.11	137660	125259	.218	.173	.609	12.1	1.30	.107	-1.08	-.827	-.026	.830	.249	-.221	.993	4.80	.410	-.363
TOTAL FOREIGN	3.65	.242	1.11	246748	221697	.217	.161	.622	11.2	1.18	.106	-1.16	-.839	-.285	.483	.679	.185	1.08	3.00	1.09	.298
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.65	.242	1.11	315369	290751	.210	.167	.622	12.0	1.23	.103	-1.12	-.832	-.040	.839	.292	-.217	.965	4.99	.469	-.349

Table 25e

CHEMICALS - TECHNOLOGICAL CHARACTERISTICS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	w	r	v	Q	C	SLF	SKF	SMF	K/L	K/M	L/M	ELW	EKR	EMV	ELR	ELV	EKV	SCL	σLK	σLM	σKM
DOMESTIC	3.65	.242	1.11	315369	354729	.203	.168	.629	12.4	1.22	.098	-.796	-2.02	-.089	1.09	-.300	.699	.963	6.53	-.478	1.11
U.S	3.65	.242	1.11	315369	263539	.253	.165	.580	9.86	1.30	.132	-1.11	-.834	-.579	.165	.948	.580	1.20	1.00	1.63	1.00
OTHER FOREIGN	3.65	.242	1.11	315369	315516	.223	.174	.603	11.8	1.32	.112	-1.35	-.825	-.127	.829	.529	-.237	.950	4.76	.878	-.393
FOREIGN	3.65	.242	1.11	315369	287661	.219	.171	.610	11.7	1.28	.109	-1.07	-.829	-.026	.826	.252	-.229	.993	4.83	.413	-.376
TOTAL FOREIGN	3.65	.242	1.11	315369	278044	.226	.161	.613	10.7	1.20	.111	-1.14	-.839	-.292	.471	.669	.177	1.08	2.93	1.09	.288
INDUSTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL INDUSTRY	3.65	.242	1.11	315369	290751	.210	.167	.622	12.0	1.23	.103	-1.12	-.832	-.040	.839	.292	-.217	.965	4.99	.469	-.349

Table 25f

CHEMICALS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE AVERAGE INPUT PRICES AND OUTPUT FOR EACH GROUP)

	K/L	K/M	L/M
DOMESTIC	6.79 - 11.4	.753 - 1.22	.090 - .126
U.S	7.57 - 14.4	.863 - 1.65	.098 - .130
OTHER FOREIGN	8.31 - 15.6	1.01 - 1.65	.097 - .125
FOREIGN	9.27 - 14.2	1.06 - 1.50	.097 - .120
TOTAL FOREIGN	7.98 - 14.4	.897 - 1.47	.094 - .117
INDUSTRY	8.33 - 11.6	.969 - 1.30	.103 - .124
TOTAL INDUSTRY	9.23 - 14.7	.995 - 1.47	.092 - .112

Table 25g

CHEMICALS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE PRICE OF LABOUR AND CAPITAL SERVICES

	K/L	K/M	L/M
DOMESTIC	6.78 - 11.4	.753 - 1.22	.090 - .126
U.S	7.72 - 14.6	.856 - 1.63	.095 - .127
OTHER FOREIGN	8.59 - 16.2	1.02 - 1.67	.095 - .122
FOREIGN	9.54 - 14.7	1.07 - 1.52	.096 - .118
TOTAL FOREIGN	7.94 - 14.3	.897 - 1.47	.094 - .117
INDUSTRY	-	-	-
TOTAL INDUSTRY	9.23 - 14.7	.995 - 1.47	.092 - .112

Table 25h

CHEMICALS - 95% CONFIDENCE INTERVALS FOR INPUT RATIOS (USING THE TOTAL INDUSTRY'S AVERAGE INPUT PRICES AND OUTPUT)

	K/L	K/M	L/M
DOMESTIC	9.62 - 15.3	.953 - 1.49	.081 - .115
U.S	6.76 - 12.9	.893 - 1.72	.109 - .155
OTHER FOREIGN	8.17 - 15.3	1.00 - 1.64	.098 - .126
FOREIGN	9.27 - 14.2	1.06 - 1.50	.098 - 1.20
TOTAL FOREIGN	7.64 - 13.8	.909 - 1.49	.099 - .124
INDUSTRY	-	-	-
TOTAL INDUSTRY	9.23 - 14.7	.995 - 1.46	.092 - .112

CHAPTER IX

SUMMARY RESULTS AND CONCLUSION

In this chapter we summarize the results of the previous chapter and present the conclusions and policy implications derived from them. Also the results of this study are compared with the results of other studies that have examined the technological characteristics of Canadian manufacturing.

Concerning the form of the cost function, the idea of obtaining more flexible forms as a characterization of technology in Canadian manufacturing has been justified to a great extent from our results. Looking at the results of domestic, U.S, other foreign and foreign groups of firms (Table 26) we notice that even though the full translog form

Table 26

THE FORM OF THE COST FUNCTION BY INDUSTRY AND BY COUNTRY OF CONTROL

Industry	Domestic	U.S	Other Foreign	Foreign
1. Food and Beverage		CD	CD	CD
2. Wood		CD		CD-CRTS
3. Paper				
4. Primary Metal	CD			
5. Metal Fabricating	CD			
6. Transportation Equipment				
7. Electrical Products	CD-CRTS			
8. Chemicals				

Note: CD = Cobb-Douglas
CRTS = Constant Returns to Scale

has not been accepted in any case, more flexible than the usual popular forms cannot be rejected. In twenty-six cost functions the Cobb-Douglas form cannot be rejected in nine cases. The rest of the seventeen show more flexibility.

With respect to technological characteristics, the actual capital-labour ratio is higher in the foreign firms in the majority of the industries. If, however, we isolate the effects of differences in the input prices and in the scale of production, we notice that the capital-labor ratio is significantly different in only two industries (Food and Beverages and in Primary Metals). Also, for the few cases that we have results, U.S firms and other foreign firms show similar input ratios in the majority of the cases.

The evidence that we have and which is presented in Chapter II that foreign firms, in general, pay higher wages and are much larger than domestic firms, confirms our conclusion that foreign firms actually employ more capital intensive techniques, not because they have more capital intensive technologies, but due to differences in input prices, more specifically in the price of labour and in the scale of production.

Concerning the demands for factors of production we notice that in most of the cases we have inelastic input demands. In the case of demand for labour we notice (Table 27) that in two industries foreign groups show elasticities higher than one and in one case domestic firms show elasticity higher than one. We also notice that in the majority of the cases domestic firms have lower elasticities. Thus, in general the expansion of foreign control will ceteris paribus bring a lower level of employment than a similar expansion of domestic control. Also, the inelasticity of labour demand, which is lower in the case of domestic groups, implies that large changes in wage rates will be necessary to induce increases in the quantity of labour demand sufficient to reduce unemployment. Since wages are flexible, perhaps only in an upward direction, inelastic demands could help to retain the existing level of unemployment.

Table 27

ELASTICITIES OF DEMAND FOR LABOUR BY INDUSTRY AND BY COUNTRY OF CONTROL

Industry	Domestic	U.S	Other Foreign	Foreign
1. Food and Beverage	-2.23	- .824	- .810	- .819
2. Wood	- .729	- .711	-	- .846
3. Paper	- .775	-1.19	- .760	- .871
4. Primary Metal	- .790	-	-	- .156
5. Metal Fabricating	- .660	- .698	- .727	- .711
6. Transportation Equipment	.305	-	-	- .650
7. Electrical Products	- .737	- .728	-	- .722
8. Chemicals	- .795	-1.18	-1.36	-1.08

The partial elasticities of substitution show an elasticity of one or close to one in most of the cases (Table 28). In the remaining cases we have elasticities higher than one and very few cases where the elasticity is less than or equal to zero.

Table 28

PARTIAL ELASTICITIES OF SUBSTITUTION BY INDUSTRY AND BY COUNTRY OF CONTROL

	σLK				σLM				σKM			
Industry	Domestic	U.S	Other Foreign	Foreign	Domestic	U.S	Other Foreign	Foreign	Domestic	U.S	Other Foreign	Foreign
1. Food and Beverage	1.0	1.0	1.0	1.0	2.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2. Wood	1.0	1.0	-	1.0	1.0	1.0	-	1.0	1.0	1.0	-	1.0
3. Paper	1.0	4.2	1.0	1.0	1.0	.58	1.0	1.0	.03	-.19	1.0	1.0
4. Primary Metal	1.0	-	-	.08	1.0	-	-	.22	1.0	-	-	1.2
5. Metal Fabricating	1.0	1.0	8.5	1.0	1.0	1.0	.05	1.0	1.0	1.0	-2.1	1.0
6. Trans-portation Equipment	6.3	-	-	1.0	-1.9	-	-	1.0	-2.0	-	-	1.0
7. Electrical Products	9.4	1.0	-	7.2	.22	1.0	-	.30	.21	-	-	-1.6
8. Chemicals	7.5	1.0	4.7	4.8	-.41	1.6	.87	.41	1.12	1.0	-3.8	.29

This substitutability among all inputs suggests that the results are related mostly to the long run which means that the cross section part of our data may have had a greater effect on our results than the time-series part. This is something that we expected since the time-series part consists of the years 1969, 1970, 1972 and 1974. Most of the variation in our data comes from the cross-section changes.

Finally, concerning returns to scale, we notice that in five out of the eight industries foreign firms have higher returns to scale (Table 29). In the same vein foreign firms show a lower cost of production. Even though there are cases with increasing returns to scale those are not very High. Most of the cost elasticities are very close to one.

Table 29

SCALE ELASTICITIES BY INDUSTRY*
AND BY COUNTRY OF CONTROL

Industry	Domestic	U.S	Other Foreign	Foreign
1. Food and Beverage	1.00	1.07	1.08	1.05
2. Wood	.98	1.04	-	1.02
3. Paper	.96	.89	.96	.96
4. Primary Metal	.98	-	-	1.06
5. Metal Fabricating	1.01	1.03	1.08	1.03
6. Transportation Equipment	1.08	-	-	1.04
7. Electrical Products	1.04	1.00	-	1.00
8. Chemicals	.96	1.13	.95	.993

*Care must be taken in interpreting differences in the scale elasticities between foreign and domestic firms. Although there is some systematic pattern, the differences are so small that policy conclusions must be carefully drawn.

From all the above we can conclude that even though there are differences between foreign and domestic firms, arising in the industry by industry analysis, they are not systematic so that they can be generalized for the whole manufacturing. The only thing that is clear from this study is that foreign firms actually employ more capital intensive techniques mostly due to higher price of labour that they pay and to differences in the scale of production and much less due to differences in technology.

There have been several studies in the past that attempted to estimate the technological characteristics in Canadian manufacturing industries, without, however, separating foreign and domestic firms. Three of them[68] have attempted this estimation for every two-digit manufacturing industry. The common characteristic of these studies is that they estimated elasticities of substitution between capital and labour and scale elasticities using a CES production function. However, they differ in the estimation procedure and in the data base. Tsurumi and Corbo and Peeterssen agree that there is strong evidence for increasing returns to scale, especially in the high technology industries. They differ in the elasticities of substitution. Tsurumi found elasticities of substitution lower than one in the majority of industries and in that agrees with Kotowitz. On the other hand Corbo and Peeterssen found that there are industries with elasticities of substitution higher than one and also higher than two in a few cases.

Comparing these results with ours we notice that even though we agree with findings that show elasticities of substitution close to one or higher than one in some cases, we disagree that there is strong evidence for strong increasing returns to scale.

There are also two studies where technological characteristics have been estimated using more flexible than the CES forms for the whole of manufacturing and not for individual industries.

Woodland[69] used a generalized Leontief cost function and data for the period 1946-69, while Denny and May[70] used a translog cost function and data for the period 1950-70. They both agree that there is an inelastic demand for labour. However, they differ in the magnitude of the elasticity. In the second study the elasticity is higher. Our result in that respect agrees mostly with the second study.

Both of the above studies found that there is substitutability between capital and labour with elasticity lower than one. This differs from our results where in most of the cases we have elasticities very close to and often higher than one. This is something that one might expect since cross section studies are usually more close to long run results than time series.

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APPENDIX A

CAPITAL STOCK FIGURES AT THE THREE-DIGIT LEVEL FOR THE MANUFACTURING SECTOR

In this section we present the technique that was used by Statistics Canada[71] to derive the capital stock figures at the three-digit level for the manufacturing sector. This procedure is presented at the beginning of the document which, as was said before, is an unpublished document and the data are experimental.

This measurement procedure underlying the capital stock estimates is a modified version of the "Perpetual Inventory" method. Briefly, this method involves the derivation of a firm estimate of an initial capital stock by industry within each province, and accumulation over the following years of investment expenditures which together with the initial estimate give the capital stock in any given year.

The basic ingredients required are:

(a) Initial capital stock estimates by industry and province;

(b) Annual investment series in current dollars by industry and category of expenditure;

(c) Price deflators relating to the investment series;

(d) Estimates of average economic lives of the assets used in the various industries.

As an aid to understanding the mechanics of this method, an illustration of the computing process is given. Assume that the capital assets in a particular industry remain in production 10 years before they are retired. We start with a firm capital stock estimate and add to it, adjusting for prices, the annual investment expenditures pertaining to the types of assets considered in the estimation, while discarding gradually in equal annual amounts the initial stock over the life of the asset. For each year a measure of the gross stock of this industry's capital asset is obtained. In the eleventh year we deduct from the capital stock the investment expenditures of the first year while the purchases of capital assets of the new year are added. We proceed in the same manner for all subsequent years.

In the "Gross Capital Stocks" capital assets are included at their full value during the entire time they remain in the capital stock. In other words, the deductions from gross investment are due to the fact that the assets in question have ceased to exist. An alternative set of measures of capital stocks is derived by adjusting the value of the assets in existence for the wear and tear and obsolescence they undergo during their service life. These estimates are known as "Net Capital Stocks". Calculations of net capital stocks are made by applying a straight line depreciation formula to the gross stock estimates.

The technique for the estimation of the initial stock was, to a certain extent, dictated by data constraints. No provincial capital stocks by industry are available in any form. The approach, therefore, was to start with the national level of industrial activities and assume a production relationship of the Cobb-Douglas form between shipments (output) and factor inputs (labour, capital) within each major manufacturing group. A set of regression coefficients was derived using time series data by a major group for the period 1946-69. Provincial data on employment and shipments by industry classified according to the 1948 Standard Industrial Classification (SIC) were reworked and adjusted to conform to the 1970 SIC. Assuming that each province has access to the same technology, capital stocks by industry were derived by applying the regression coefficients to the provincial data on employment and shipments and solving for capital stocks.

Briefly, for each major manufacturing group at the total Canada level a production relationship was estimated of the form:

$$Y = c\ L^{a}\ K^{b} \tag{1}$$

where Y = shipments

L = Labour input

K = Capital stock

c = A constant

a,b = Coefficients of elasticity of shipments with respect to labour and capital respectively.

An inverted version of equation (1) was used for each industry at the three-digit level within each province in order to derive the capital stock. This version is as follows:

$$K = (c^{-1}\ Y\ L^{-a})^{1/b}$$

where K = Provincial capital stock by industry

Y = Provincial shipments by industry

L = Provincial employment data by industry

c = The constant from equation (1)

a,b = The coefficients from equation (1)

Equation (1) was estimated by means of a generalized least-squares technique. In pursuing this approach it was thought that it will be able to circumvent the dependence between successive values of the stochastic term in each industry. The twenty production functions, one for each major group, were estimated simultaneously viewed formally as a single equation regression.

Gross provincial investment expenditures were obtained by processing a considerable amount of historical data. The data from the annual records of capital and repair expenditures of the private and public investment survey were assempled reworked and rearranged on the basis of the 1970 SIC for the period 1947-71. The categories of expenditure used in the estimation are: construction, and machinery and equipment (including capital items charged to operating expenses).

These expenditures were deflated by the respective deflators used in the national stocks series. For the estimates of the average economic lives the study relied on the information used in the national series.

The derivation of the three-digit national series in the manufacturing sector was done by a simple aggregation of the provincial data.

APPENDIX B

1. Derivation of the Cost Function

The cost minimization problem is given by

$$\text{minimize } C = wL + rK + vM \tag{1}$$

$$\text{subject to } f(L,K,M) = Q^0 \tag{2}$$

For the solution of this problem we form the Lagrangian function:

$$\mathcal{L} = wL + rK + vM + \lambda\,(Q^0 - f(L,K,M)) \tag{3}$$

The first order conditions for an interior solution are given by:

$$\mathcal{L}_L = \frac{\partial \mathcal{L}}{\partial L} = w - \lambda f_L \tag{4}$$

$$\mathcal{L}_K = \frac{\partial \mathcal{L}}{\partial K} = r - \lambda f_K \tag{5}$$

$$\mathcal{L}_M = \frac{\partial \mathcal{L}}{\partial M} = v - \lambda f_M \tag{6}$$

$$\mathcal{L}_\lambda = \frac{\partial \mathcal{L}}{\partial K} = Q^0 - f(L,K,M) = 0 \tag{7}$$

where $f_L = \frac{\partial f}{\partial L}$, $f_K = \frac{\partial f}{\partial K}$, $f_M = \frac{\partial f}{\partial M}$

The second order conditions require that the following matrix is positive definite.

$$H = \begin{bmatrix} \mathcal{L}_{LL} & \mathcal{L}_{LK} & \mathcal{L}_{LM} & \mathcal{L}_{L\lambda} \\ \mathcal{L}_{KL} & \mathcal{L}_{KK} & \mathcal{L}_{KM} & \mathcal{L}_{K\lambda} \\ \mathcal{L}_{ML} & \mathcal{L}_{MK} & \mathcal{L}_{MM} & \mathcal{L}_{M\lambda} \\ \mathcal{L}_{\lambda L} & \mathcal{L}_{\lambda K} & \mathcal{L}_{\lambda M} & \mathcal{L}_{\lambda\lambda} \end{bmatrix} = \begin{bmatrix} -\lambda f_{LL} & -\lambda f_{LK} & -\lambda f_{LM} & -f_L \\ -\lambda f_{KL} & -\lambda f_{KK} & -\lambda f_{KM} & -f_K \\ -\lambda f_{ML} & -\lambda f_{MK} & -\lambda f_{MM} & -f_M \\ -f_L & -f_K & -f_M & 0 \end{bmatrix}$$

The matrix H is positive definite if all the determinants of the successive principal minors are negative, that is

$$|H_1| = \begin{vmatrix} -\lambda f_{MM} & -f_M \\ -f_M & 0 \end{vmatrix} = -(f_M^2) \text{ which is always negative}$$

$$|H_2| = \begin{vmatrix} -\lambda f_{KK} & -\lambda f_{KM} & -f_K \\ -\lambda f_{KM} & -\lambda f_{MM} & -f_M \\ -f_K & -f_M & 0 \end{vmatrix} = \begin{vmatrix} f_{KK} & f_{KM} & f_K \\ f_{KM} & f_{MM} & f_M \\ f_K & f_M & 0 \end{vmatrix} \quad (-\frac{1}{\lambda}) < 0$$

$$|H_3| = \begin{vmatrix} -\lambda f_{LL} & -\lambda f_{LK} & -\lambda f_{LM} & -f_L \\ -\lambda f_{LK} & -\lambda f_{KK} & -\lambda f_{KM} & -f_K \\ -\lambda f_{LM} & -\lambda f_{KM} & -\lambda f_{MM} & -f_M \\ -f_L & -f_K & -f_M & 0 \end{vmatrix} = \begin{vmatrix} f_{LL} & f_{LK} & f_{LM} & f_L \\ f_{LK} & f_{KK} & f_{KM} & f_K \\ f_{LM} & f_{KM} & f_{MM} & f_M \\ f_L & f_K & f_M & 0 \end{vmatrix} \quad (\frac{1}{\lambda^2}) < 0$$

Since λ is the change in the value of the objective function per unit change in the constraint, that is the marginal cost, which is always positive, the second order conditions can be written as

$$\begin{vmatrix} f_{KK} & f_{KM} & f_K \\ f_{KM} & f_{MM} & f_M \\ f_K & f_M & 0 \end{vmatrix} > 0 \qquad \begin{vmatrix} f_{LL} & f_{LK} & f_{LM} & f_L \\ f_{LK} & f_{KK} & f_{KM} & f_K \\ f_{LM} & f_{KM} & f_{MM} & f_M \\ f_L & f_K & f_M & 0 \end{vmatrix} < 0$$

which is equivalent to the strict quasi-concavity of the production function. Thus for an interior solution the production function has to be at least strictly quasi-concave.

The strict quasi-concavity of the production function guarantees also that if we want to solve the system of equations (4), (5), (6) and (7) for L, K, M and λ this solution exists. The requirement for the solution to exist is $|H| \neq 0$. Solving those equations we obtain

$$L = L^*(w, r, v, Q^0) \text{ demand for labor services} \tag{8}$$

$$K = K^*(w, r, v, Q^0) \text{ demand for capital services} \tag{9}$$

$$M = M^*(w, r, v, Q^0) \text{ demand for raw materials} \tag{10}$$

$$\lambda = \lambda^*(w, r, v, Q^0) \text{ marginal cost function} \tag{11}$$

Substituting L^*, K^*, M^* in the cost equation we obtain the cost function $C = g(w, r, v, Q^0)$.

2. Properties of the Cost Function

Shephard's Lemma

$$C = g(w, r, v, Q^0) = wL^*(w, r, v, Q^0) + rK^*(w, r, v, Q^0) + vM^*(w, r, v, Q^0)$$

$$\frac{\partial C}{\partial w} = L^* + w\frac{\partial L^*}{\partial w} + r\frac{\partial K^*}{\partial w} + v\frac{\partial M^*}{\partial w}$$

$$\frac{\partial C}{\partial w} = L^* + \lambda f_L\frac{\partial L^*}{\partial w} + \lambda f_K\frac{\partial K^*}{\partial w} + \lambda f_M\frac{\partial M^*}{\partial w}$$

$$\frac{\partial C}{\partial w} = L^* + \lambda\left(f_L\frac{\partial L^*}{\partial w} + f_K\frac{\partial K^*}{\partial w} + f_M\frac{\partial M^*}{\partial w}\right)$$

$$\frac{\partial C}{\partial w} = L^* + \lambda\frac{\partial Q^0}{\partial w}$$

since $\frac{\partial Q^0}{\partial w} = 0$ then $\frac{\partial C}{\partial w} = L^*$

This is true for every input price

$$\frac{\partial C}{\partial w} = L^*(w,\ r,\ v,\ Q^0),\ \frac{\partial C}{\partial r} = K^*(w,\ r,\ v,\ Q^0),\ \frac{\partial C}{\partial v} = M^*(w,\ r,\ v,\ Q^0)$$

The quasi-concavity of the production function also implies that the above demand curves are negatively sloped.

Homogeneity of the Cost Function with Respect to Factor Prices

Assume that each input price is multiplied by t, then the cost minimization problem takes the form

$$\text{Minimize} \quad C = (tw)L + (tr)K + (tv)M$$

$$\text{Subject to} \quad f(L,\ K,\ M) = Q^0$$

First order conditions:

$$tw = \lambda f_L$$

$$tr = \lambda f_K$$

$$tv = \lambda f_M$$

$$f(L,\ K,\ M) = Q^0$$

The first three conditions can also be written as

$$\frac{tw}{tv} = \frac{w}{v} = \frac{f_L}{f_K}$$

$$\frac{tr}{tv} = \frac{r}{v} = \frac{f_K}{f_M}$$

Thus, there is no effect on the demand functions for inputs. The demand functions are homogeneous of degree zero in factor prices. The cost function then becomes

$$C' = (tw)L^* + (tr)K^* + (tv)M^*$$
$$t(wL^* + rK^* + vM^*)$$
$$tC$$

Thus, the cost function is homogeneous of degree one in factor prices.

Degree of Homogeneity of the Production Function

If the production is homogeneous of some degree $k > 0$, by Euler's theorem

$$f_L\, L + f_K\, K + f_M\, M = k\, Q$$

or $$\lambda f_L\, L + \lambda f_K\, K + \lambda f_M\, M = \lambda k Q$$

At the optimum point $\lambda f_L = w \quad \lambda f_K = r \quad \lambda f_M = v$

and $w\, L^* + r\, K^* + v\, M^* = \lambda^* k\, Q$

$$C = \lambda^* k\, Q$$

where $$\lambda^* = \frac{\partial C}{\partial Q}$$

thus $k = \dfrac{C/Q}{\partial C/\partial Q} = \dfrac{AC}{MC}$

Thus, the degree of homogeneity of the production function is given by AC/MC.

Relations Between Elasticities of Substitution and Input Demand Elasticities

From Shephard's lemma $C_w = \dfrac{\partial C}{\partial w} = L^*(w, r, v, Q^0)$

$$\frac{\partial L^*}{\partial r} = \frac{\partial C^2}{\partial w\, \partial r} = C_{wr}$$

$$\frac{\partial L^*}{\partial r}\,\frac{r}{L} = C_{wr}\,\frac{r}{L}$$

$$E_{Lr} = C_{wr} \frac{r}{L} \frac{K}{K} \frac{C}{C} = (C_{wr} \frac{C}{KL}) \frac{rK}{C}$$

$$E_{Lr} = (\frac{C_{wr} C}{C_r C_w}) S_K$$

Uzawa[72] has showed that $C_{wr} C/C_w \cdot C_r = \sigma_{LK}$ where σ_{LK} is the elasticity of substitution between labour and capital.

Thus, $E_{LR} = \sigma_{LK} S_K$

This result can also be generalized to other factors of production.

Well-Behavedness of the Cost Function

One of the main conditions that the cost function must satisfy in order to be the dual of some real unique production function, is the concavity in factor prices. The cost function is concave if the following Hessian matrix is negative semidefinite at each data point.

$$H = \begin{bmatrix} C_{ww} & C_{wr} & C_{wv} \\ C_{wr} & C_{rr} & C_{rv} \\ C_{wv} & C_{rv} & C_{vv} \end{bmatrix} \qquad \text{where } C_{wr} = \frac{\partial C}{\partial w \; \partial r}$$

Concavity of the cost function requires that the following conditions are satisfied:[73]

$$C_{ww} < 0 \qquad C_{rr} < 0 \qquad C_{vv} < 0$$

$$H_{wr} = \begin{vmatrix} C_{ww} & C_{wr} \\ C_{wr} & C_{rr} \end{vmatrix} > 0$$

$$H_{wv} = \begin{vmatrix} C_{ww} & C_{wv} \\ C_{wv} & C_{vv} \end{vmatrix} > 0$$

$$H_{rv} = \begin{vmatrix} C_{rr} & C_{rv} \\ C_{rv} & C_{vv} \end{vmatrix} > 0$$

From the property of homogeneity of degree zero in factor prices of the demand for inputs we have

$$C_{ww}\, w + C_{wr}\, r + C_{wv}\, v = 0$$

$$C_{wr}\, w + C_{rr}\, r + C_{rv}\, v = 0$$

$$C_{wv}\, w + C_{rv}\, r + C_{vv}\, v = 0$$

This implies that $|H| = 0$ and thus the cost function cannot be strongly concave but only a weakly concave function.

FOOTNOTES

1. J.H. Dunning, "International Investment", (Harmondsworth, Middx: Penguin, 1972).

2. A detailed history of capital movements is presented in J.H. Dunning (ed), "Studies in International Investment", (London, George Allen and Unwin, 1970).

3. A review of these theories is given in S. Lall and P. Streeten, "Foreign Investment Transnationals and Developing Countries", (London, Macmillan Press, 1977), Chapter 2.

4. Ibid., p. 71.

5. Government of Canada, "Foreign Direct Investment in Canada", (Ottawa, Information Canada, 1972), p. 5.

6. Y. Kotowitz, "Capital-Labour Substitution in Canadian Manufacturing 1926-39 and 1946-61", Canadian Journal of Economics, (August 1968), pp. 619-632; H. Tsurumi, "Nonlinear Two-Stage Least Squares Estimation of CES Production Functions Applied to the Canadian Manufacturing Industries, 1926-1939, 1946-1967", Review of Economics and Statistics, Vol. 52 (1970), pp. 200-207; V. Corbo and A. Van Peeterssen, "Production Functions in Canadian Manufacturing: Some Preliminary Results", Concordia University Working Paper, No. 11 (May 1974); A.D. Woodland, "Substitution of Structures, Equipments and Labour in Canadian Production", International Economic Review (February 1975), pp. 171-187; M. Denny and D. May, "A Representation of Canadian Manufacturing Technology", Applied Economics, Vol. 10 (1978), pp. 305-317.

7. Statistics Canada, "Domestic and Foreign Control of Manufacturing Establishments in Canada, 1969 and 1970", (Ottawa, 1976), Cat. 31-401; Statistics Canada, "Domestic and Foreign Control of Manufacturing Establishments in Canada, 1972", (Ottawa, 1977), Cat. 31-401; Statistics Canada, "Domestic and Foreign Control of Manufacturing Mining and Logging Establishments in Canada, 1974", (Ottawa, 1979), Cat. 31-401.

8. Ibid.

9. J. Fayerweather, "Foreign Investment in Canada: Prospects for National Policy", (New York, International Arts and Sciences Press Inc., 1973).

10. I.A. Litvak and C.J. Maule, "Foreign Investment in Canada", in I.A. Litvak and C.J. Maule (ed), "Foreign Investment: The Experience of Host Countries", (New York, Praeger Publishers, 1970), p. 94.

11. Government of Canada, Foreign Direct Investment in Canada, p. 32.

12. T. Horst, "The Industrial Composition of U.S Exports and Subsidiary Sales to the Canadian Market", American Economic Review, (March 1972), p. 37.

13. H.G. Bauman, "The Industrial Composition of U.S Exports and Subsidiary Sales to the Canadian Market: Note", American Economic Review, (December 1973), p. 1009.

14. R.E. Caves, "Causes of Direct Investment: Foreign Firms' Shares in Canadian and U.K Manufacturing Industries", Review of Economic Studies, (August 1974).

15. H.G. Bauman, "Merger Theory, Property Rights and the Pattern of U.S Investment in Canada", Weltwirtschaftliches Archiv, (1975), p. 676.

16. J.C. Pattison, "Financial Markets and Foreign Ownership", Ontario Economic Council, Occasional Paper 8, (Ontario, 1978).

17. Statistics Canada, Domestic and Foreign Control 1969 and 1970, p. 33.

18. Statistics Canada, "Structural Aspects of Domestic and Foreign Control in the Manufacture Mining and Forestry Industries 1970-1972", (Ottawa, February 1978), Cat. 31-523.

19. By "Other foreign firms" we mean all foreign firms except those of U.S origin.

20. A.E. Rosenbluth, "The Relation Between Foreign Control and Concentration in Canadian Industry", Canadian Journal of Economics, (No. 3, 1970), p. 14.

21. These results are taken from: Statistics Canada, Domestic and Foreign Control 1977, p. VIII and Statistics Canada, Domestic and Foreign Control 1974, p. X. They were derived using the Rosenbluth method.

22. A.E. Safarian, "The Performance of Foreign Owned Firms in Canada", (Montreal, National Planning Association U.S.A and Private Planning Association of Canada, 1969).

23. Firms with assets in excess of $25 million.

24. Dunning, Studies in International Investment

25. This is another name for the study: Government of Canada, Foreign Investment in Canada.

26. H.C. Eastman and S. Stycolt, "The Tariff and Competition in Canada", (Toronto, MacMillan, 1967), pp. 96-100.

27. R.E. Caves, "Multinational Firms, Competition and Productivity in Host-Country Markets", Economica, (May 1974), p. 176.

28. If the new foreign firms are very large in size as compared with the existing firms in the industry, or if the share of foreign firms increased through take-overs we cannot take their presence as an indication of higher competition.

29. P.K. Gorecki, "The Determinants of Entry by Domestic and Foreign Enterprises in Canadian Manufacturing Industries: Some Comments and Empirical Results", The Review of Economics and Statistics, (October 1976).

30. Caves, Multinational Firms, Competition Productivity.

31. S. Globerman, "Foreign Direct Investment and Spillover Efficiency Benefits in Canadian Manufacturing Industries", Canadian Journal of Economics, (February 1979), p. 42.

32. J.H. Dunning, "American Investment in British Manufacturing", (London, George Allen and Unwin, 1958).

33. J.H. Dunning, "The Role of American Investment in the British Economy", (London, Political and Economic Planning, 1969).

34. Dunning, Studies in International Investment.

35. G.Y. Bertin, "Foreign Investment in France", in I.A. Litvak and G.J. Maule (ed), "Foreign Investment: The Experience of Host Countries", (New York, Praeger Publishers, 1970).

36. D.T. Brash, "American Investment in Australian Industry", (Canberra, Australian University Press, 1966).

37. Caves, Multinational Firms, Competition, Productivity.

38. Statistics Canada, Domestic and Foreign Control 1969 and 1970; Statistics Canada, Domestic and Foreign Control 1972; Statistics Canada, Domestic and Foreign Control 1974.

39. Establishment is the smallest operating unit capable of reporting certain specified input and output data, usually a plant or a mill.

40. An enterprise is a company or a family of companies which, as a result of common ownership, are controlled or managed by the same interests.

41. Statistics Canada, Domestic and Foreign Control 1969 and 1970, p. 33

42. Since many manufacturing establishments are engaged in non-manufacturing activities in addition to their manufacturing activities, the figures are also broken down to a part that comes from the manufacturing activity and a part that comes from the non-manufacturing activity. Total activity is the sum of the two activities.

43. Standard Industrial Classification.

44. Statistics Canada, "Consumption of Purchased Fuel and Electricity by the Manufacturing, Mining and Electric Power Industries 1967-1974", (Ottawa, December 1977). Statistics Canada, "Consumption of Purchased Fuel and Electricity by the Manufacturing, Mining and Electric Power Industries" (Annual), Cat. 57-208.

45. Statistics Canada, "Real Domestic Product by Industry 1961-1971 (1961 100)", (Ottawa, 1971), Cat. 61-516. Statistics Canada, "Real Domestic Product by Industry 1971-1978 (1971 100)", (Ottawa, 1979), Cat. 61-213.

46. M. Denny and D. May, "The Existence of a Real Value-Added Function in the Canadian Manufacturing Sector", Journal of Econometrics, No. 5 (1977).

47. Ibid.

48. M. Denny and D. May, "The Structure of Production in Canadian Manufacturing at the Three-Digit Level", 1979 (Mimeographed).

49. R.E. Berndt and D. Wood, "Technology, Prices and the Derived Demand for Energy", The Review of Economics and Statistics, (August 1975), pp. 259-268.

50. Z. Griliches and V. Ringstad, "Economies of Scale and the Form of the Production Function", (Amsterdam, North Holland, 1971).

51. D.W. Jorgenson, "Anticipation and Investment Behavior", in J.S. Duesenberry, G. Framing, L.R. Klein, and E. Kuh (eds), "The Brooking Quarterly Model of the United States", (Amsterdam, North Holland, 1965).

52. R.E. Hall and D.W. Jorgenson, "Application of the Theory of Optimal Capital Accumulation", in G. Fromm (ed), "Tax Incentives and Capital Spending", (Brookings Institution, 1971).

53. W.E. Diewert, "Exact and Superlative Index Numbers", Journal of Econometrics, (May 1976), pp. 115-146.

54. This is true for the continuous case. For discrete data we use a discrete approximation of the Divisia Index, the Tornqvits Index.

55. Statistics Canada, "Capital Stock Figures at the Three-Digit Level for the Manufacturing Sector", October 1979 (Unpublished Document).

56. D.W. Jorgenson and Z. Griliches, "The Explanation of Productivity Change", Review of Economic Studies, Vol. 34 (1967), pp. 249-283; Corbo and Peeterssen, Production Functions in Canadian Manufacturing; Berndt and Wood, Technology, Prices and the Derived Demand for Energy; J.R. Magnus, "Substitution Between Energy and Non-Energy Inputs in the Netherlands 1950-1976", International Economic Review, Vol. 20, No. 2, 1979, pp. 465-484.

57. B.C. Field and C. Grebenstein, "Capital-Energy Substitution in U.S Manufacturing", The Review of Economics and Statistics, (May 1980), pp. 207-212.

58. J.M. Griffin and P.R. Gregory, "An Intercountry Translog Model of Energy Substitution Responses", American Economic Review, Vol. 66, 1976, pp. 845-857; M. Fuss, "The Demand for Energy in Canadian Manufacturing. An Example of the Estimation of Production Structures with Many Inputs", Journal of Econometrics, (January 1977), p. 89; R.S. Pindyk, "Interfuel Substitution and the Industrial Demand for Energy: An International Comparison", M.I.T. Energy Laboratory, Working Paper M.I.T. EL 77-026 WP.

59. R.W. Shephard, "Theory of Cost and Production Functions", (Princeton, Princeton University Press, 1970); W.E. Diewert, "An Application of the Shephard Duality Theorem: A Generalized Leontief Production Function", Journal of Political Economy, Vol. 79, (May/June 1971), pp. 481-507.

60. All the proofs and derivations for this section are presented in the Appendix B.

61. By choosing a flexible form the results are stronger and not as dependent on the functional form. Thus, in a case that some hypothesis is rejected, the possibility that it is the functional form that should be rejected is smaller.

62. This form assumes symmetry.

63. B.H. Hall and R.E. Hall, "Time Series Processor - Users Manual (Version 3.4)", Adapted to C.D.C. by J.A. Breslaw, Concordia University, (June 1980), p. 44.

64. The three first terms in each expression are enough to show us the magnitude of the error and also whether the successive terms grow or decline.

65.
$$\lambda = \frac{L(\text{constrained})}{L(\text{unconstrained})}$$

and $-2 \ n\lambda \sim x_k^2$ is true asymptotically

where k is the number of restrictions.

66. In some cases where one of our main groups (foreign and domestic) does not have a well-behaved function and thus we cannot adjust its input ratios, we use the average prices and output of this group instead of total industry's averages. A function that is not well-behaved is marked with an asterisk in Table 6.

67. All the percentages presented in this and in the other industries below concerning the share of the industry in manufacturing, the number of establishments, the foreign control in terms of number of establishments, the foreign control in terms of total shipments, the concentration in the top 8 firms and the foreign control in these top 8 firms refer to year 1972. This is because the industry concentration data are available only for 1972. For consistency, we present the other characteristics also for 1972 and not for 1974 which is the most recent year at which these data are available. The changes from 1972 to 1974 are very small, thus the picture we get for the industry from those characteristics remains almost the same for 1974.

68. Kotowitz, Capital Labour Substitution; Tsurum, Non-linear CES Production Functions; Corbo, Peeterssen, Production Function in Canadian Manufacturing.

69. Woodland, Substitution in Structures.

70. Denny and May, Representation of Canadian Manufacturing Technology.

71. Statistics Canada, Capital Stock Figures at the Three-Digit Level.

72. H. Uzawa, "Production Functions with Constant Elasticities of Substitution", Review of Economic Studies, Vol. 29 (1962), pp. 291-99.

73. A. Takayama, "Mathematical Economics", (Hinsdale, Illinois, The Dryden Press, 1974).

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TABLE 1 : Statistics Canada, "Canada'a International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 66-67.

TABLE 2 : Statistics Canada, "Canada's International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 70-71.

TABLE 3 : Statistics Canada, "Canada's International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 68-69.

TABLE 4 : Statistics Canada, "Canada's International Investment Position", (Ottawa, December 1971), Cat. 67-202, pp. 130-131;

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TABLE 5 : Statistics Canada, "Canada's International Investment Position", (Ottawa, December 1971), Cat. 67-202, pp. 128-129;

Statistics Canada, "Canada's International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 82-83.

TABLE 6 : J.C. Pattison, "Financial Markets and Foreign Ownership", Ontario Economic Council, Occasional Paper 8, (1979).

TABLE 7 : Statistics Canada, "Canada's International Investment Position", (Ottawa, December 1971), Cat. 67-202, pp. 130-131.

Statistics Canada, "Canada's International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 84-85.

TABLE 8 : Statistics Canada, "Canada's International Investment Position", (Ottawa, December 1971), Cat. 67-202, pp. 128-129.

Statistics Canada, "Canada's International Investment Position", (Ottawa, February 1978), Cat. 67-202, pp. 82-83.

TABLE 9 : Statistics Canada, "Domestic and Foreign Control of Manufacturing, Mining and Logging Establishments in Canada, 1974", (Ottawa, January 1979), Cat. 31-401, pp. 6-11.

TABLE 10: Statistics Canada, "Domestic and Foreign Control of Manufacturing, Mining and Logging Establishments in Canada, 1974", (Ottawa, January 1979), Cat. 31-401, p. 6-11.

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TABLE 12: Statistics Canada, "Domestic and Foreign Control of Manufacturing, Mining and Logging Establishments in Canada, 1974", (Ottawa, January 1979), Cat. 31-401, pp. 6-11.

TABLE 13: Statistics Canada, "Doméstic and Foreign Control of Manufacturing Establishments in Canada 1969-1970", (Ottawa, March 1976), Cat. 31-401, pp. 42-45.

Statistics Canada, "Domestic and Foreign Control of Manufacturing Establishments in Canada, 1974", (Ottawa, January 1979), Cat. 31-401, pp. 6-11.