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DISCUSSION PAPER NO. 232

Trade, Tariffs and Relative Plant Scale in Canadian Manufacturing Industries: 1970-1979

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RÉSUMÉ

La productivité industrielle au Canada continue, encore aujourd'hui comme par le passé, à être moins élevée qu'aux États-Unis. On invoque souvent comme l'une des causes de cette disparité la petite taille des usines au Canada. À l'aide d'une base de données spécialement conçue à cet effet par Statistique Canada, les auteurs du présent document examinent les répercussions des changements survenus dans les échanges et les tarifs douaniers au cours des années 70 - à la suite du Kennedy Round - sur la taille des usines au Canada. Ils établissent une comparaison en particulier entre la taille des grandes usines canadiennes et celle des grandes usines américaines, la dernière mesure étant considérée comme un indicateur de la taille minimale efficace, soit la plus petite taille permettant à une usine de minimiser les coûts unitaires de production.

Au sujet de la taille relative des usines, les auteurs constatent que le coefficient des grandes usines canadiennes par rapport aux grandes usines américaines était en moyenne de 0,691 en 1970 et de 0,736 en 1979. Les moyennes pondérées correspondantes - mesurées à l'aide des pondérations de l'emploi - étaient respectivement de 0,762 et de 0,818. Ces moyennes donnent à penser qu'il existe un problème d'échelle et que celui-ci est plus important dans les petites industries que dans les grandes.

En utilisant de tels coefficients moyens pour mesurer la sous-optimalité globale, on suppose implicitement que les cas où la taille des usines est supérieure à la taille minimale efficace compensent dans une certaine mesure les cas où c'est l'inverse. Cependant, si la courbe des coûts a la forme d'un "L", on n'a pas raison d'attribuer à la variable de la taille relative des usines une valeur supérieure à l'unité, étant donné que les coûts supérieurs à ceux d'une usine de taille moyenne efficace sont présumés être constants. La taille relative des usines a donc été réévaluée en attribuant une valeur égale à l'unité à toutes les usines canadiennes plus grandes que la taille minimale efficace. Les coefficients moyens pondérés ainsi obtenus étaient de 0,560 et de 0,605 pour 1970 et 1979 respectivement, alors que les moyennes pondérées correspondantes étaient de 0,608 et de 0,641. Il s'ensuit que le manque d'échelle est beaucoup plus important que ne le laissent entendre les moyennes simples. Il ressort de l'ensemble de ces constatations que la taille sous-optimale des usines revêt une importance beaucoup plus grande que celle que lui accorde les ouvrages récents.

La portée de ce document du point de vue des politiques à mettre en oeuvre a trait aux effets de la libéralisation des échanges sur la taille relative des usines. Les plus ardents défenseurs du libre-échange soutiennent que la libéralisation multilatérale du commerce favorisera de plus grandes usines. Mais d'autres estiment que durant le processus provisoire d'adaptation, la taille des usines sera réduite dans le secteur de l'économie exposé à la concurrence des importations. Or, il ressort du présent document que les deux conclusions sont justes.

D'une part, les auteurs démontrent que l'augmentation de la taille du marché a conduit à un accroissement de la taille relative des usines, ce qui laisse supposer qu'une zone canado-américaine de libre-échange apporterait d'autres avantages. L'industrie canadienne a tiré parti des secteurs dans lesquels elle détient un avantage comparatif, ce qui l'a amenée à y agrandir ses usines; en même temps, la réduction des tarifs douaniers dans les industries à forte concentration et à tarifs élevés - lesquelles ont beaucoup à souffrir d'une échelle trop réduite - a eu pour effet d'accroître la taille relative des usines. Ces constatations viennent corroborer l'opinion de ceux qui font valoir les avantages de la libéralisation des échanges.

D'autre part, les auteurs constatent que les importations suscitent aussi des effets négatifs sur la taille relative des usines. Ils avancent plusieurs explications à ce sujet. D'un côté, le fait peut être le signe d'une adaptation réussie qui se manifeste par un changement de caractère de l'industrie, tel que le passage à l'assemblage ou à la fabrication de produits finis, ou l'occupation de créneaux commerciaux spécialisés. D'autre part, ce résultat peut raffermir l'opinion de ceux qui craignent que l'aide gouvernementale aux entreprises en difficulté n'ait ralenti le processus d'adaptation. De plus, le mécanisme d'adaptation normalement facile du commerce intra-sectoriel n'a eu aucun effet sur la taille relative des usines. Cette situation s'explique, cependant, par le fait que le commerce intra-sectoriel influe sur les séries de production plutôt que sur la taille des usines.

Somme toute, les conclusions de l'étude viennent appuyer les tenants d'une plus grande libéralisation des échanges et font ressortir les problèmes et les inefficacités du maintien de tarifs élevés, particulièrement dans les industries à forte concentration. Il est difficile, néanmoins, à partir des données disponibles, de discerner si les importations favorisent la rationalisation et le processus d'adaptation.

ABSTRACT

Canadian industrial productivity has and continues to lag behind that of the United States. One of the causes of this disparity is commonly considered to be the small size of plants in Canada. This paper, using a specially created database at Statistics Canada, examines the impact of trade and tariff changes in the 1970's -- following upon the Kennedy Round -- on the size distribution of plants in Canada. In particular it focuses attention upon the size of larger Canadian plants relative to larger U.S. plants, since the latter measure is then taken to be the indicator of minimum efficient size -- the smallest size of plant that minimizes unit production costs.

Our findings on relative plant scale -- the ratio of larger Canadian to larger U.S. plants -- show that, on average, this ratio was 0.691 in 1970 and 0.736 in 1979. The corresponding weighted averages -- using employment weights -- were 0.762 and 0.818. These averages suggest that there is a scale problem, and that the problem of scale is more important in small rather than large industries.

The use of average ratios such as these to measure aggregate sub-optimality implicitly assumes that instances where plants are larger than MES somehow offset instances where the converse is the case. However, if the cost curve is "L" shaped then there is no

sense in letting the relative plant scale variable take on a value above unity, since costs above MES are assumed to be constant. Hence, relative plant scale was re-estimated with all instances in which Canadian plants are greater than MES set equal to unity. The resulting unweighted averages were 0.560 and 0.605 in 1970 and 1979, respectively, while the corresponding weighted averages were 0.608 and 0.641. This suggests that lack of appropriate scale is of much more significance than simple averages suggest. Taken together these findings suggest sub-optimal plant size is much more important than much of the recent literature suggests.

The policy implications of the paper relate to the debate over the impact of trade liberalization upon relative plant scale. The most forceful advocates of free trade have argued that larger plant scale will result from multilateral trade liberalization. Others, however, have suggested that at least during an interim adjustment process, plant size in the import-competing sector of the economy could be reduced. The evidence provided by this paper suggests both are correct.

This paper demonstrates that increases in market size have led to increases in relative plant size, suggesting further gains for a U.S./Canada free trade area. Canadian industry has taken advantage of areas in which it has a comparative advantage, leading to larger plant sizes; while tariff reductions in high tariff/high concentration industries -- which suffer considerably from small scale -- resulted in increased relative plant scale.

These findings are consistent with those who proclaim the benefit of trade liberalization.

In contrast, this study also found that imports had a negative impact upon relative plant scale. Several explanations were put forward. On the one hand, this may indicate successful adaptation which resulted in a change in the character of the industry --a switch to finishing and assembling and/or to serving specialized market niches. On the other hand, this result is also consistent with the suggestion that government assistance to ailing firms may have slowed the adaptation process. In addition, the potentially easy adjustment mechanism of intra-industry trade had no impact upon relative plant scale. However, that may be because intra-industry trade impacts upon production runs rather than plant size.

On balance then our research finds much to support those who advocate freer trade and points out the problems and inefficiencies of the maintenance of high tariffs especially in high concentration industries. Nevertheless it is difficult to judge from the available evidence whether imports are resulting in rationalization and successful adaptation.

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1. INTRODUCTION

This paper is one of a set that examines the impact of trade and tariff changes that occurred in the late 1960's and 1970's upon efficiency and productivity in Canadian manufacturing industries. The measure of efficiency used here is the degree of sub-optimal plant scale -- as measured by the ratio of average Canadian plant size (for the top half of the size distribution) relative to an estimate of the minimum efficient size (MES) of plant. The comparable U.S. industry is used to estimate the MES. The U.S. is chosen as a benchmark since productivity comparisons so frequently focus on Canada's position relative to the United States (e.g., Frank 1979, Saunders 1980, West 1971).

While the measure of efficiency used here is an indirect one, it is one factor that is often said to determine Canada's productivity differences with the U.S. Canadian economists have long claimed that the inefficiency that resulted from the tariff structure went beyond the static welfare losses from incomplete or incorrect specialization. Not only was it argued that tariffs led to an expansion of sectors where Canada had a comparative disadvantage but it was also suggested that those industries that received tariff protection did not operate as efficiently as they could have. Eastman and Stykolt (1967), in their pioneering study of the degree of sub-optimality in Canadian plant size, focused on the tariff as one of the chief determinants of inefficiency. Their conclusion was:

> The evidence in this study points to the detrimental effect of excessive tariff protection that permits firms to operate plants of sub-optimal scale in Canada. The frequency with which industries are found with a number of plants of inefficiently small size existing side by side in national or regional markets in Canada indicates that the height of the Canadian tariff is greater than necessary to preserve those industries in Canada. (Eastman and Stykolt, 1967, p. 106)

Some ten years later, the Royal Commission on Corporate Concentration (RCCC) reiterated what had become a common theme. Canadian plant scale was too small and this was a result of tariff protection.

> The small and dispersed Canadian market, combined with a policy of economic nationalism designed to aid the manufacturing and skilled labour sectors, has led to an economy whose firms and plants in many industries tend to be relatively small and unspecialized by international standards. (RCCC, 1978, p. 45)

The prescription for resolution of this problem has been a reduction in tariffs. Indeed, in 1967, after the Kennedy Round of trade negotiations had been completed, the Economic Council of Canada predicted that the upcoming reduction in tariffs would decrease the amount of inefficiency in Canadian industry:

> The recently concluded Kennedy Round of trade negotiations under the General Agreement on Tariffs and Trade has resulted in the largest and most wide-ranging programme of tariff reductions on industrial products achieved since the Second World War...[it] will help to provide a basis for greater scale and specialization in Canadian manufacturing...[it] will offer opportunities for more efficient use of resources, important gains in productivity, and reductions in various types of unit costs and prices. (Economic Council of Canada, 1967, p. 168).

In 1975, the Economic Council of Canada, in a study recommending continued movement to freer trade, once again listed improvements in plant scale as one of the benefits to be expected (Economic Council of Canada, 1975, pp. 32-33).

While economists have long pointed to the problem the tariff created and predicted benefits should tariffs be reduced, empirical studies of the phenomenon have been relatively few. While two recent studies (Caves et al, 1980 and Saunders, 1980) have found that the existence of sub-optimal sized plants affects relative Canadian/U.S. productivity, the extent to which sub-optimal plant size depends upon the tariff has not been well documented. Moreover, those few studies that have attempted to do so have not made much of a case that sub-optimality is a problem. One reason for this view is that a rough comparison of average size in Canada and the United States suggested differences were not dramatic. Rosenbluth (1957, pp. 82-85) noted that the average size of Canadian companies differed little from American companies. The Economic Council of Canada (1967, p. 153) using a comparison of 50 matching Canadian and U.S. industries concluded,

> ...for all but a few of the industries examined thus far, while the average size of firms may be larger in the United States, the average size of plant or establishment [where size is measured in terms of employees] is actually larger in Canada.

(However, the average size measure used in the Council study probably overstated Canadian plant size relative to the U.S.)[1] Similarly the RCCC (1978, p. 52) quoted one of its background studies as showing that the average size (measured in value added) of manufacturing establishment in Canada does not differ greatly from that for U.S. industry.

The shortcoming inherent in comparisons of averages such as these is that they do not recognize the variations that exist in relative plant size across industries or attempt to explain these differences. Substantial differences can exist across the sample even if the average is much the same. Gorecki (1976, Table 2.1, p. 12) compared the average plant size (measured by employment) for 123 Canadian and United States manufacturing industries as of 1963. For those 50 industries where the U.S./Canada plant size ratio is less than unity, the average value of the ratio is .76. It is greater than unity in 60 industries where the average value of the ratio is 1.61.

A second shortcoming in the use of simple averages to infer the existence of sub-optimal scale is that such an approach implicitly assumes the problem of inefficient plant scale to be a general one, rather than one limited to industries with relatively high tariffs and small market size relative to MES. Several studies have overcome this by concentrating on a small subset of industries. They have attempted to explain the variance within the sample chosen of average plant size to MES. Eastman and Stykolt (1967) examined 16 Canadian industries; Gorecki (1976) looks at 17 Canadian industries; and Scherer _et al_ (1975), following in Bain's

(1966) tradition, look at 12 industries across 6 countries, one of which was Canada. Each tries to explain the ratio of plant size to MES or some variant in a regression framework. However, the results suffer since the data set in each case covers so few industries. Because of this, it is unclear from these studies how general the problem of sub-optimal plant scale might be.

Another shortcoming of these studies is that they are relatively unsuccessful in actually incorporating trade variables. This is undoubtedly related to the paucity of observations in most of the studies. The sample of Eastman and Stykolt (1967) generally did not include industries which either exported or imported. Gorecki (1976) did not include anything other than an effective tariff rate and the ratio of exports to domestic production. Scherer et al, (1975) used exports, imports and nominal tariffs as explanatory variables but did not have effective tariff rates.

The most extensive analysis (Caves et al, 1980, p. 64) of Canadian suboptimal plant sizes attempted to overcome the data problems outlined above by using a matching sample of 84 Canadian and U.S. industries aggregated to the 3-digit SIC level for 1969. The dependent variable chosen is the ratio of the average size (shipments) of the largest establishments accounting for half of the industries employment in Canada divided by the industry shipments in Canada to the same variable for the U.S. counterpart industry. The results shed very little light on the extent to which Canadian plant sub-optimality depends upon industry characteristics and trade flows since the estimated equation was not significant.

This lack of significance is the result of two factors. First, the Caves study had to estimate missing observations for part of the 84 3-digit industry sample used (see Caves et al, 1977, Appendix A, Table A.3 pp. A-39 - A-41) and this may have introduced substantial errors in observations. These missing observations occur primarily in high concentration industries because of data reporting practices followed by Statistics Canada. But as subsequent sections argue these are precisely those observations where it is expected that inefficiency due to trade restrictions may be greatest. Second, the dependent variable does not measure relative plant scale; because it also includes relative market size, it is a peculiar hybrid. Indeed, it is more appropriately described as a relative concentration variable - though it measures only that part of concentration due to large plant size and not due to multiplant operation.

This paper attempts to overcome the problems that have beset other studies in this area and to extend previous analysis. First, it uses an extensive data base for 1970 and 1979 on the 167 4-digit industries into which the Canadian manufacturing sector is divided. These industries vary considerably in terms of their characteristics. Thus, it permits a more comprehensive analysis than has previously been done. Second, this paper attempts to estimate the effects of a set of variables that include the trade and tariff effects that have been so frequently discussed but rarely examined in detail. Third, it uses a data base that does not suffer in the same degree from missing observations. All the regression equations, correlation coefficients, means and standard deviations estimated and presented below draw upon all observations of the 167 industries even though (say) concentration ratios may not be published for particular industries because of confidentiality requirements. Hence, although much of the underlying data base is confidential the summary statistics and regression coefficients are not. Fourth, by having two cross-sections separated by a decade, this study tests the stability of the determinants of sub-optimal plant scale. The usual assumption associated with cross-sectional regression, that of long-run equilibrium, is not always appropriate. Where tariffs are in the process of change, as they were in the late 1960's for Caves' study, the cross-sectional relationship may reflect an inordinate amount of transitory or short-run effects. Finally, the analysis examines not only changes in relative plant scale but also examines changes that occurred in tariff rates and thus helps to explain the change that has occurred in the cross-sectional relationship over time.

Our discussion of the degree of sub-optimal plant scale is divided into several sections. The specification of the method of measuring minimum efficient plant size (MES) is presented in Section 2, together with various proxies of the size distribution of plants. From this are developed a series of measures that indicate the degree to which Canadian plant sizes approximate MES. The next section, 3, specifies the independent variables used to "explain" the indices of relative plant scale in 1970 and 1979. A separate section, 4, is devoted to the empirical results. The penultimate section , 5, concentrates on the determinants of changes in relative plant scale over the 1970-1979 decade. The discussion concludes in section 6 with a brief summary of the findings.

2. RELATIVE PLANT SCALE

Measuring Plant Scale and Efficient Plant Scale

MES plant represents the smallest size of plant at which unit costs are minimized - OE in Figure 1. At output levels of less than MES, costs are assumed to be higher; while for plants larger than MES, costs are either constant ('L' shaped cost curve, solid line in Figure 1) or eventually rise ('U' shaped cost curve, dotted line in Figure 1). In estimating the costs of a plant size distribution, which includes sub-optimum (i.e., less than OE) and supra-optimum (i.e., greater than OF in 'U' shaped cost curve) plants, several pieces of information are required: the MES plant and unit cost levels; and the size and cost levels for all plants.

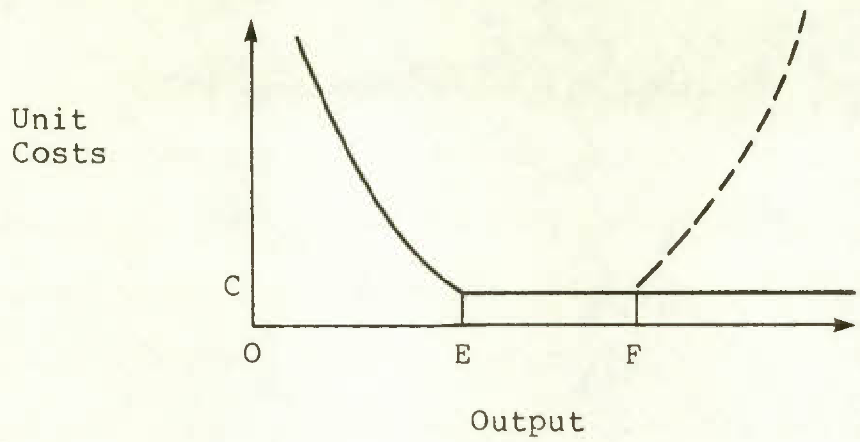


Figure 1

Such a data set would permit calculation of several indicators of the plant size distribution in relation to MES: the percentage of industry output accounted for by plants of less than MES;[2] and the increase in total industry costs because of the presence of sub-optimal capacity. While these estimates will be examined subsequently, this paper concentrates only on the ratio of average plant size to MES as a proxy for inefficiency.

MES can be measured in a number of different ways -- using the engineering technique, the statistical cost approach, the survivor technique, and variants of the survivor methodology that utilize either summary statistics on plant size distributions or data on the average size of firms that become multiplant operations. The first technique concentrates directly on costs in trying to find the smallest average size of plant that minimizes production costs. The others are indirect approaches in that they infer "optimal" plant from firm behaviour and take into account not only production costs but also other factors such as market size and transportation costs. Each has certain theoretical shortcomings that have been discussed elsewhere (Gorecki, 1976, pp. 19-23, Scherer, 1980, pp. 91-98). They also imply somewhat different concepts of optimality. This study omits use of engineering and survivor estimates primarily because of the limited number of observations that can be produced in each case, particularly the former. Statistical cost estimates will be dealt with in an accompanying paper.

For the purpose of this investigation the measure of MES selected was that originally used by Comanor and Wilson (1967) and subsequently by many others, including Caves et al (1980). It is the average size of the smallest number of the largest plants accounting for 50 per cent of industry size. Estimating the MES in this manner assumes: (1) that larger firms have the option of building large or small plants and that taking into account transportation costs, market size and factor input costs, these firms build plants of "optimal" scale; and (2) the mean size of these plants is highly correlated (across industries) with the smallest output at which production plant economies of scale are exhausted. The available evidence is consistent with this latter point. (Masson and Shaanan, 1982, p. 418, Scherer et al, 1975, pp. 182-183, and Weiss, 1976, pp. 132-136).

U.S. data were used to derive an estimate of MES using the top 50 per cent measure, since the U.S. market, because of its size and competitiveness, is not subject to the same constraints that result in Canada's scale and specialization problems. At the same time its geographical closeness combined with similar tastes, a common language, and significant U.S. ownership of Canadian industry ensure the experience of the U.S. is relevant to Canada. It therefore serves as the closest we are likely to come to a controlled laboratory experiment.

Even though the MES measure selected here is correlated with the smallest output at which production economies are exhausted, this correlation is less than one. This raises the question of whether the top 50 per cent measure may be biased upwards to the extent the long run cost curve is L-shaped and plants of very large U.S. firms substantially exceed MES. There is evidence that this is the case.[3] However, in the subsequent analysis, this problem is reduced since the measure of relative plant scale used is the ratio of the top 50 per cent measure in Canada to the top 50 per cent measure in the corresponding U.S. industry. To the extent the same bias occurs in Canada, our measure of relative size goes some way to correct for this distortion.

An often repeated criticism levied against indirect measures of MES such as those used here is that they measure "what is" rather than "what should be". This is less of a problem for this paper because the U.S. standard is being used as a basis for comparison. While the U.S. average firm size may not represent optimality, it nevertheless seems to provide a respectable standard for comparison and one frequently used by Canadians in a wide array of policy areas.

Relative Plant Scale: 1970 and 1979

The U.S. MES, defined as the average size (measured in terms of shipments) of the smallest number of the largest plants accounting for 50 per cent of industry employment, is available for 1972 and 1977. In a number of instances several U.S. industries had to be combined to form the corresponding Canadian industry. (See Appendix A for details.) Since the estimates of MES are in U.S. dollars, they are converted to Canadian dollars for each year, using the exchange rate in existence for that year (i.e., 1972 and 1977). Since plant sizes for Canada were available for 1970 and 1979 on our data base, the U.S. estimates, now in 1972 and 1977 Canadian dollars, are converted to 1970 and 1979 Canadian dollars, respectively. These two estimates will be referred to as USMES70 and USMES79, respectively.

The actual Canadian plant size distribution is captured by three measures:

Average Plant Size, All Plants	AVSZ70, 79	=	average plant size, measured in terms of shipments, for 1970 and 1979.
Average Plant Size, Large Plants	AVSZT70, 79	=	average size (measured in shipments) of the smallest number of the largest plants accounting for 50 per cent of industry employment, for 1970 and 1979.
Average Plant Size, Small Plants	AVSZB70	=	average size measured in shipments) of the largest number of the smallest plants accounting for 50 per cent of industry employment, for 1970 and 1979.

All the Canadian average measures were calculated directly from the actual size distribution of plants, not the frequency distributions typically presented in Statistics Canada publications. AVSZT70 is the top 50 per cent measure, discussed above, for Canada, while USMES70 refers to the U.S.

The relative plant scale measures or indices designed to capture the degree to which actual plant sizes are equal to MES are defined as follows for 1970;

EFF170 = AVSZ70/USMESS70, relative average size, total industry,

EFF1T70 = AVSZT70/USMESS70, relative average size, top half,

EFF1B70 = AVSZB70/USMESS70, relative average size, bottom half,

and similarly for 1979. As can readily be observed the measures consist of the ratio of actual average Canadian plant size for various samples of plants in the industry (total, bottom half, top half) to the estimate of MES.

Table 1 presents for 125 manufacturing industries the average levels and changes of the three relative plant scale measures defined above for 1970 and 1979 as well as the average plant size measures defined above. The sample of 125 industries is drawn from the universe of 167 4-digit Canadian manufacturing industries (using the 1970 Standard Industrial Classification) in the following manner: 26 industries were omitted because they were

Table 1

Average Plant Size and Relative Plant Scale Indices
for 125 Canadian Manufacturing Industries
1970 and 1979

Relative Plant Scale Index[a]	Year 1970	Year 1979	Plant Index	Year 1970	Year 1979
	Average[b]			Average[b] (000000's)[c]	
EFF1	0.171 (0.157)	0.203 (0.211)	AVSZ	5.9 (18.1)	8.6 (34.6)
EFF1T	0.691 (0.589)	0.736 (0.631)	AVSZT	31.0 (111.9)	40.4 (177.9)
EFF1B	0.096 (0.092)	0.117 (0.131)	AVSZB	3.1 (9.2)	4.3 (12.8)

	Change 1979-1970[d]			
	Average	Standard Deviation	Range Minimum	Range Maximum
EFF1	0.032	0.110	-0.269	0.567
EFF1T	0.046	0.489	-2.503	2.347
EFF1B	0.021	0.065	-0.102	0.286

a See text for definitions, relative plant scale measures expressed as a ratio.

b Standard deviation in parenthesis.

c Measured in constant (1971) Canadian dollars.

d Estimated using EFF1, as an example, EFF179-EFF170.

Note: USMES70 = $48.6 million, USMES79 = $61.0 million, where Canadian (1971) dollars are used. The standard deviation of these measures is 92.0 and 126.0, respectively.

Source: Statistics Canada. See Appendix A for details. (Vol. 6).

miscellaneous; and a further 16 were neglected because the U.S. data was not available primarily because of differences in U.S./ Canada industry classification systems. Industries which fell into this latter category included several in the Clothing (4), Textile (2) and Wood (3) Industry Groups, with no other 2-digit industry group accounting for more than one industry. The 125 industry sample accounted for 73 per cent of the manufacturing sector's sales in 1970 and 1979, but only 64-66 per cent of employment. Full details may be found in Appendix A.

The table suggests that the average size of all Canadian plants (EFF1) was smaller than MES, with this being, particularly the case for the bottom half (small plants) of the distribution (EFF1B). However, for the top half (large plants) of the distribution (EFF1T), plant sizes are much more comparable to MES, -- approximately 70 per cent. The large difference between the top and bottom half is partly a reflection of large number of small plants: in 1970, for example, on average, it took 13.0 of the largest plants to account for 50 per cent of industry employment, with the other half accounted for by 130.1 plants. In 1979 the corresponding numbers were 14.3 and 139.6, respectively.[4]

An attempt was made to measure the ratio of the average size of all plants, these in the top half (large plants) as well as the bottom half (small plants) of the plant size distribution in Canada to MES using employment rather than shipments. (See Appendix B for details). The results are broadly similar to those recorded here for shipments, with the employment based measures usually exceeding the shipments indices.

Table 2 presents the correlation matrix of the levels and changes in relative plant scale. Several points are worth noting. There is a high degree of correlation among the relative plant scale indices for a particular year or over time, especially between the whole industry and the bottom half. For example, EFF1B70 and EFF170 have a correlation of 0.969. A given measure of relative plant scale for 1970 is quite highly correlated with its counterpart in 1979. Industries with high relative plant scale in 1970 tended to record high values in 1979. Nevertheless, there is a weak negative correlation between the level of relative plant scale in 1970 and the change over the period 1970-1979 for plants in the top half of the distribution. The reverse occurs for the bottom half. Hence there is something of a centripetal tendency. Finally, there is quite a strong correlation between relative plant scale indices for 1979 and the change over the period 1970-1979. These correlations have some implications for regression analysis: relative plant scale indices based on the industry and the bottom half of the distribution are likely to yield similar results; some stability might be expected over time in the determinants of the level of relative plant scale; and determinants of changes in relative plant scale are much more likely to be more closely related to factors that led to sub-optimality in 1979 than 1970.

Table 2

Correlation Matrix Among Levels and First Difference Measures of Relative Plant Scale for 125 Canadian Manufacturing Industries: 1970-1979.

	EFF1T70	EFF170	EFF1B70	EFF1T79	EFF179	EFF1B79	EFF1T	EFF1	EFF1B
EFF1T70	1.000	0.708	0.611	0.681	0.484	0.415	-0.327	-0.081	-0.033
EFF170		1.000	0.969	0.735	0.863	0.838	0.094	0.233	0.310
EFF1B70			1.000	0.702	0.887	0.887	0.169	0.323	0.364
EFF1T79				1.000	0.812	0.697	0.470	0.514	0.406
EFF179					1.000	0.975	0.465	0.692	0.703
EFF1B79						1.000	0.399	0.681	0.753
EFF1T							1.000	0.761	0.564
EFF1								1.000	0.912
EFF1B									1.000

Source: Statistics Canada. See Appendix A for details. (Vol. 6)

The Dependent Variable

In our regression analysis the index of relative plant scale selected is EFF1T. Only for this measure are we comparing like with like -- the ratio of average size of plants in the top half of the distribution (large plants) in Canada to the U.S. We therefore supplement our general discussion of relative plant scale measures, presented above, with closer attention to the selected indicator used in the regression analysis.

The introduction to the paper made two important points with respect to U.S./Canada plant sizes: that differences are not dramatic; and that studying averages can be misleading. The results contained in Table 1 for EFF1T suggest that Canadian plant sizes in the top half of the distribution are substantially less, perhaps not dramatically so, than their U.S. counterparts; and a substantial variation exists. It is to this latter area that our attention turns.

Of critical importance to the interpretation of the meaning of EFF1T is our notion of the shape of the industry cost curve. If, for a given industry, EFF1T has a value less than unity, Canadian average plant size is less than MES. Hence Canadian plants would suffer some cost disadvantage, compared to MES plants. The cost disadvantage will vary directly with distance from unity; on the other hand, if EFF1T is greater than unity and the cost curve is "L" shaped, Canadian plants, although larger than MES, operate along the horizontal portion of the average cost curve without any cost advantage compare MES plants. When the cost curve is "L" shaped, no matter how much larger than MES a plant may be, unit cost levels are constant. Hence, it may be inappropriate to treat values of EFFIT above and below unity as symmetrical with respect to the implication for unit cost. If so, a simple average of EFFIT is a misleading indicator of the degree of "suboptimality".

Taking unity as the dividing line EFF1T is distributed as follows:

	EFF1T > 1		EFF1T < 1	
	# Industries	Mean	# Industries	Mean
EFF1T70	23	1.710	102	.461
EFF1T79	26	1.630	99	.541

Approximately 18-21 per cent of the 125 industries had values of EFF1T greater than unity. However, the 80 per cent of the industries where plant size is less than MES, EFF1T is indeed not only substantially but dramatically below unity. Indeed, if we set all instances where EFF1T > 1 equal to unity then the average value of EFF1T is 0.560 in 1970 and 0.637 in 1979 for the 125 industry sample. If this modified average of EFF1T is used, plant sizes in Canada are, on average, well below the MES.

As we shall see below, the size of market is positively related to relative plant scale. This implies that the unweighted mean of EFF1T70 and EFF1T79 will be lower than the weighted mean. In the

Table 3

Relative Plant Scale for 125
Canadian Manufacturing Industries Grouped
by 2-Digit Industry: 1970-1979

2-Digit Industry		Index of Relative Plant Scale[b]		
Number of Constituent 4-digit industries[a]	Title	EFF1T70	EFF1T79	EFF1T
17	Food & beverages	0.526	0.573	0.047
2	Tobacco products	0.273	1.004	0.731
0	Rubber and plastics	-	-	-
4	Leather	0.757	0.857	0.099
13	Textiles	0.578	0.580	0.002
2	Knitting mills	0.416	0.314	-0.102
5	Clothing	0.558	0.799	0.241
6	Wood industries	0.994	1.004	0.010
2	Furniture & fixtures	0.241	0.195	-0.046
5	Paper & allied industries	1.033	1.050	0.017
2	Printing & Publishing	0.567	0.558	-0.009
5	Primary metal	0.927	0.863	-0.064
8	Metal fabricating	1.175	0.973	-0.202
3	Machinery	1.255	0.472	-0.782
8	Transportation equipment	0.541	0.773	0.232
8	Electrical Products	0.597	0.415	-0.181
11	Nonmetallic mineral products	0.965	1.324	0.359
2	Petroleum & chemical products	1.389	0.977	-0.412
8	Chemical & chemical products	0.574	0.764	0.109
14	Miscellaneous manufacturing	0.360	0.448	0.087
125	All industries	0.691	0.736	0.046

a There are a total of 167 4-digit Canadian manufacturing industries. Data is available on relative plant scale for only 125.

b For each 2-digit industry relative plant scale consists of the unweighted average of the constituent 4-digit industries.

Source: Statistics Canada. See Appendix A for details. (Vol. 10).

unweighted mean, small industries with low values of relative plant scale are given equal weight with large industries with high values of relative plant scale. The weighted mean values of EFF1T70 and EFF1T are 0.762 and 0.818 in 1970 and 1979, respectively, where the weights are total industry employees in each year. These averages are several percentage points -- 7 to 8 -- above the unweighted means reported in Table 1. Nevertheless, it could be argued that such a weighted mean could seriously understate the problem of small plant scale because, as discussed above, some values of EFF1T are above unity. We therefore re-estimated the weighted average but with EFF1T constrained to have a maximum unity (i.e., for all instances in which EFF1T was greater than unity, unity was substituted). The resulting weighted averages were .608 in 1970 and .641 in 1979, compared to unweighted means of .560 and .605, respectively.[5] Hence, weighting does not appear to be as important as at first sight.

It is useful to ask whether a pattern can be discerned in the values of relative plant scale across industries. Table 3 attempts to fill this void by presenting EFF1T70, EFF1T79 and EFF1 for the twenty 2-digit industries or major groups into which the manufacturing sector is divided. The results are difficult to interpret on an industry by industry basis. Nevertheless, some regularities do emerge. Sectors often considered weak in terms of international competition -- Leather, Textiles, Knitting Mills, Clothing, Furniture and Fixtures, Electrical Products -- tend to come out at the low end of the spectrum. On the other hand, sectors where Canada is often thought to do well -- Wood industries, Paper and allied industries, Primary metal, and Transportation Equipment (in 1979 at least) -- score highly using the relative plant scale index. Hence, the results in Table 3 seem to coincide with *a priori* views of where problems exist in Canada's manufacturing sector.

3. THE DETERMINANTS OF THE LEVEL OF RELATIVE PLANT SCALE

Specification of the determinants of relative plant scale should be based on a model of the process that generates the distribution of plant sizes. Traditionally, industrial organization has concentrated on systematic differences in market characteristics that cause concentration to differ across industries. While this literature can be used to infer the determinants of large firm average size, it alone does not permit direct inference of differences in the plant size distribution across countries. For example, economies of scale per se do not suggest that Canadian average plant size will be smaller than U.S. -- only that there will be fewer Canadian plants. In order to draw a connection to the entire plant size distribution, reference could be made to the effect of concentration on competition and thus on the extent to which the performance in some markets may result in prices being held above costs thereby engendering a fringe of smaller firms. The end result then (of non-competitive behaviour) is for such markets to generate firms of smaller average size.

Even with this extension, the traditional literature must look elsewhere for an explanation of average plant size where market size relative to minimum efficient sized plant is large. For in these circumstances, the number of firms is sufficiently large to argue that changes in concentration and changes in competition stemming therefrom are not likely to contribute significantly to smaller average plant size in one country compared to another.[6] Several explanations are found in the traditional literature that might be used to explain the extent of sub-optimal plant scale for this set of industries. First, the fact that optimal plant size depends upon transportation and distribution costs as well as production costs means that small firms should exist side by side with large plants where there are separate and different sizes of regional markets operating side by side. (Scherer, et al, 1975) Second, it has been argued that there are alternative but equally effective strategies that permit different size firms/plants to exist side by side. (Caves and Porter, 1977, Porter, 1979). The latter approach has focussed on delineating those factors that permit a broad range of sizes to coexist. (Newman, 1978, Caves and Pugel, 1980). In each of the cases mentioned, Canadian average plant size is smaller than that in the U.S. simply because the distribution of plant sizes is truncated in its upper tail by the market available in Canada.

Thus a traditional model would focus both on the set of variables that generally influence the size distribution of plants as well as those factors, both technological and behavioural, that in special circumstances could lead to sub-optimality. The latter set includes those factors that truncate the upper tail or extend the lower tail of the Canadian size distribution relative to that in the United States -- since the dependent variable has been defined in the present context as the ratio of Canadian average plant size relative to MES, where the latter is measured as the size of the top 50 per cent in the comparable U.S. industry.

The market size variable, expressed in terms of number of units of MES plants, is meant to capture the truncation of the upper tail of the size distribution. Plant size is bounded above when markets are small and the upper tail of large plants is cut off in these small markets. Thus average Canadian plant size, relative to American, will be smaller.

A set of variables is included to capture the forces that permit suboptimality by extending the lower tail of the distribution of plant sizes. These variables measure the extent to which certain factors prevent competitive forces from producing optimality. Variables that capture these influences include protection from trade (tariffs and the level of exports and imports), protection from competition (concentration, and the regional character of an industry), and, finally, the extent of foreign ownership in an industry. It is the combination of the trade, concentration, and foreign ownership variables that the miniature replica hypothesis emphasizes as one of the primary determinants of suboptimal scale and excessive product differentiation in Canada. In addition to the above, the cost penalty of plant achieving MES plant is included because the power of these variables to affect average plant size should be reduced where the cost penalty of so doing is high.

Finally, there are those technical factors that permit a relatively large variance in plant sizes. A large variance in plant sizes implies that large and small firms can subsist side by side. These factors are important since the larger the variance, the greater should be the effect of truncation of the upper tail of the distribution on Canadian average plant size relative to U.S. Truncation of the upper tail of two distributions of the same class (such as the normal, or lognormal) having identical means but different variances will decrease the mean more for the distribution with the larger variance. Alternatively, it could be argued that where small and large plants coexist and this is not the result of imperfect competition, the cost pressures to achieve large plant size are less and thus the average Canadian plant size will tend to be lower relative to that for the United States.[7] Variables that are meant to catch the factors tending to increase variance include the regional character of an industry; the extent of product differentiation; the variance of margins/sales ratios across firms; and the cost disadvantage ratio of small as opposed to large plants.

Instead of relying upon the traditional industrial organization literature stemming from the structure-conduct-performance paradigm to explain relative plant scale, an alternative model may be utilized. The determinants of the concentration of firms can be derived from stochastic models of firm size distribution. These models (Simon and Bonini, 1958, Ijiri and Simon, 1964) use as a basis for their analysis some form of "Gibrat's Law".[8] Using the basic assumption that period-to-period firm growth rates are generated by probability distributions that are independent of firm size, they show that the distribution of firm sizes will approach a lognormal or similar type of distribution. When entry is permitted in these models, the distribution will be determined by two variables -- the average growth rate per firm and that portion of growth of the industry attributable to new firms. Thus, it is the determinants of entry that this approach would lead us to include. The variables that have been shown to determine entry (Baldwin and Gorecki, 1983) are growth, market size, entry barriers, and profitability. Except for profitability, these are the same variables that the more traditional literature suggested. Profitability is excluded from this analysis because Marshallian quasi-surplus measures are essentially short term phenomena that should not be relevant to the long run equilibrium of the stochastic process.

The determinants of relative plant scale can be divided into two basic groups: those that relate to the <u>level</u> of relative plant scale in any particular year (e.g., EFF1T79) and those that relate to the <u>change</u> in relative plant scale (e.g., EFF1T) over the 1970's. We discuss determinants of levels in this section, deferring to Section 5 consideration of changes.

Market Size. We would expect that size of market would be an important factor affecting plant efficiency. If the industry can accomodate a large number of MES plants then the cost of a new plant is likely to be lower, other things equal, and price effects much less compared to a situation where the industry is characterized by conditions of fewness. We therefore define the following variable,

MESMSD ratio of domestic disappearance (i.e., domestic production + imports - exports) to minimum efficient sized plant.

where minimum efficient plant size is measured using the U.S. top 50 per cent measure. This variable should be positively related to relative plant scale.

Trade Variables. Imports and exports are likely to influence the degree to which an industry reaches efficient scale. In those instances in which the industry exports a considerable percentage of output, this is likely to be indicative of a comparative advantage. In such instances it is to be expected that actual plant size will be close to or exceed efficient plant size. Turning to the other side of the trade balance, imports are likely to have two different impacts, making it difficult to specify *a priori* the direction. On the one hand, imports may spur Canadian firms to build plants of efficient size to meet or beat the competition. On the other hand, imports may indicate areas in which Canada has little or no comparative advantage and Canadian plants may be modified little to meet foreign competition but gradually wound down as capital is not replaced.

A number of different variables are used in the regression equations to capture the effects of trade:

EXP = the proportion of domestic production that is exported.

INTRA = ((XT+IM) - (absolute value (XT-IM))/(XT+IM)) where XT = exports and IMP = imports -- a variable often referred to as measuring intra-industry trade.

IMP = imports as a proportion of domestic disappearance, where the latter is domestic production minus exports plus imports.

CA = (exports minus imports divided by the sum of exports plus imports) +1 -- a variable often referred to as measuring comparative advantage.

INTRA will vary between 1 (imports = exports) and 0 (imports = 0, exports > 0, or exports = 0, imports > 0) while the addition of 1 in CA scales the variable so that it varies between 0 (imports > 0, exports = 0) and 2 (exports > 0, imports = 0).

Each of the four trade variables is designed to capture a separate aspect of the way trade may affect relative plant scale. The use of IMP and EXP implicitly assumes that it is imports and exports (divided by domestic disappearance and production, respectively) per se that impact upon relative plant scale -- the more you export, other things equal, the greater the plant size in relation to MES. INTRA, which measures intra industry trade, essentially assumes that greater is the amount of trade that is of a two way nature (the greater is the amount of export or import overlap), the more likely will an industry be efficient. Finally, the use of CA, a measure of comparative advantage, assumes that it is not exports or imports per se that matter but the extent to which an industry specializes in one or the other that matters. All the trade measures are expected to be positively related to relative scale except IMP which is ambiguous.

Tariffs. An important attribute of Canadian manufacturing industries is the level of tariff protection. An extensive literature following Eastman and Stykolt (1967) has postulated the existence of inefficient plant scale as a response to excessive product differentiation and tariff protection. Although the impact of foreign competition should be caught with the previously discussed trade variables, there may be a residual effect caught by the tariff variables. We specify two measures of tariff protection:

NRP = nominal tariff protection, defined as the actual duties collected divided by total imports less duties.

ERP = effective tariff protection, defined to take into account export intensiveness and indirect taxes and subsidies as suggested by Wilkinson and Norrie (1975, pp. 5-20).

Both measures of protection are used in the regression equations, although ERP is probably more appropriate since it takes into account the whole structure of tariffs not just that on the output of the industry concerned (i.e., NRP). However, ERP embodies a number of important assumptions, such as pricing up to the tariff, which do not always appear to be valid (Hazledine, 1980). A negative relationship between tariff levels and relative plant scale is predicted.

Eastman and Stykolt (1967) and Bloch (1974), both suggest that the level of costs (and hence, indirectly, relative plant scale) may not be inversely related to tariffs. Rather it may be only in industries with high concentration that high tariffs have an impact on efficiency. In such industries the protection afforded the firm, combined with oligopolistic interdependence (implied by high concentration) and the weak Canadian competition law results in a competitive environment in which plant sizes are less than required to minimize unit costs. The profit evidence presented by Bloch (1974, Table 3, p. 607), albeit based on a small sample of industries, is consistent with this line of reasoning. Hence NRP and ERP alone may bear little, if any, relationship to relative plant scale.

In order to capture the interdependence between tariffs and market structure, the following variables were specified:

HVTRHCR a dummy variable which takes the value 1 when both concentration and effective tariff protection are greater than their respective means, 0 otherwise.

EASTV = HVTRHCR · MESMSD -- the ratio of domestic disappearance to MES where both concentration and effective tariff protection are greater than their respective means.

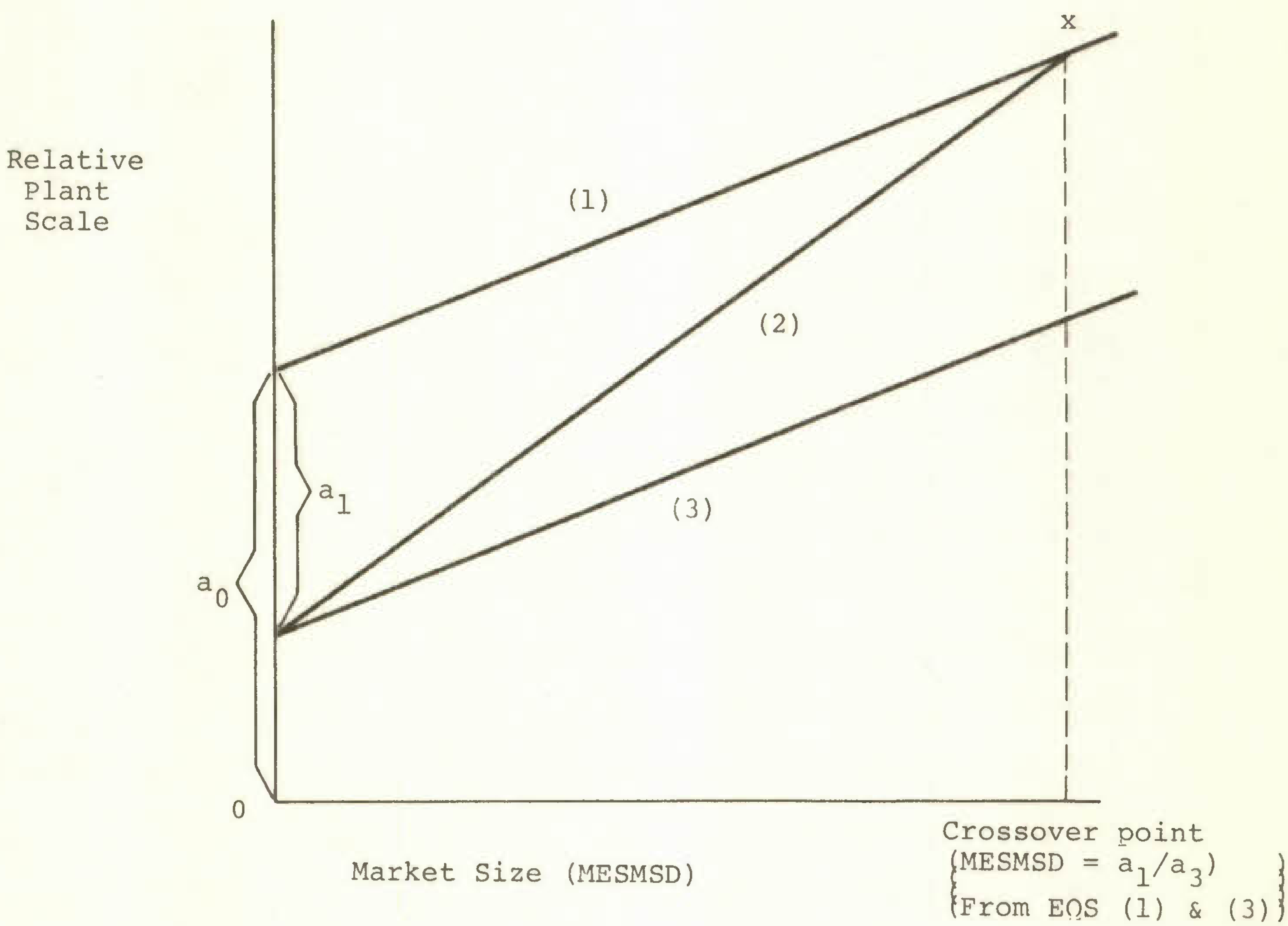
These two variables can be defined in analogous fashion for nominal tariffs. When this is done EASTV becomes EASTN and HVTRHCR becomes HNTRHCR.

The variable HVTRHCR captures the effect of high tariffs in highly concentrated industries. It is expected to have a negative sign. The variable EASTV is introduced to reflect the view that the effect of tariffs varies within the set of concentrated industries. It is hypothesized that as plant economies become less important (i.e., as MESMSD increases), the influence of tariffs will be reduced.

The effect of tariffs is represented in two dimensions in Figure 2 while the relationship between relative plant scale and market size divided by MES (an inverse measure of concentration) is graphed. The relative plant scale function that does not consider tariffs is represented by relationship (1). It is expected to shift downward by the coefficient a_1 in highly concentrated industries where there are high tariffs. However, the slope of the relationship between relative plant scale and market size is expected to differ for high tariff, high concentration industries because eventually the effect of larger market size offsets the

Figure 2

Testing the Eastman/Stykolt Hypothesis



(1) Relative plant scale = $a_0 + a_2$ MESMSD

(2) Relative plant scale = $a_0 + a_1$ HVTRHCR $+ a_2$ MESMSD

where HVTRHCR = 1

(3) Relative plant scale = $a_0 + a_1$ HVTRHCR $+ a_2$ MESMSD

$+ a_3$ EASTV

where HVTRHCR = 1

$a_3 > 0$

Source: See text.

effects of high tariffs and returns the relationship to the original level. In Figure 2, this is represented by a higher slope for relationship (2). At X, the "crossover" point with relationship (1), the market size is sufficiently large that there is no measurable effects of tariffs.

The importance of the Eastman/Stykolt effect depends on the relationship between the mean value of MESMSD for high concentration, high tariff industries and the crossover point X. Should the cross-over point be considerably above the mean, then most of the highly concentrated industries would suffer from the Eastman/Stykolt effect. Should the reverse occur, then the Eastman/Stykolt effect would have to be considered relatively unimportant. Therefore subsequent analyses will concentrate not only on the coefficients attached to HVTRHCR(HNTRHCR) and EASTV(EASTN) but also on the relationship between the mean of MESMSD for high tariff, high concentration industries and the "crossover" point.

The mean values[9] used in estimating HVTRHCR and HNTRHCR were as follows:

	1970	1979
Concentration	0.539	0.529
Nominal Tariff	0.120	0.102
Effective Tariff	0.138	0.124

In Bloch (1974, p. 600), which referred to the early 1960's, the cut-off point for concentration was 0.50 and for nominal tariffs 0.15. Hence, the level of concentration used here is comparable to Bloch, that for the tariff is somewhat lower. However, there has been a decline in overall tariffs because of the Kennedy Round in the late 1960's. Thus the lower level of tariffs used here may not be as inconsistent with Bloch as it first appears. The number of industries falling in the high tariff/high concentration categories was as follows:[10]

	1970	1979
HVTRHCR = 1	19	22
HNTRHCR = 1	14	17

In other words, approximately 16-18 per cent of the industry sample fell in the high tariff/high concentration category when effective tariffs were used and 12-14 per cent when nominal tariffs were used. The average and standard deviation of MESMSD was as follows for high concentration/high tariff industries.

	1970		1979	
	MEAN	S.D.	MEAN	S.D.
MESMSD for HVTRHCR = 1	6.7	5.0	7.1	4.7
MESMSD for HNTRHCR = 1	5.5	4.6	6.5	4.9

The mean and standard deviation of MESMSD for high tariff/high concentration industries is substantially lower than that for all industries in the sample. (See Table 4 below for mean and standard deviations for the sample).[11]

Concentration. We would expect that, other things equal, the greater the degree of concentration the more probable it is that an efficient sized plant is built. In other words, a firm with

60 per cent of the market is much more likely to be able to build an MES plant than are with 2 per cent of the market. We therefore define:

CON the proportion of industry shipments accounted for by the four largest enterprises.

It is expected to have a positive sign.

Several comments about the effect of CON are in order. First, it might be argued that causation runs from plant scale to concentration and not vice versa. However, a variety of factors determine concentration. Moreover, the effect of plant scale has already been captured in the market size (MESMSD) variable. Thus inclusion of the concentration variable catches those factors other than large plant size that determine concentration -- multiplant operations or economies in such inputs as advertising, research and development or management. It seems sensible to presuppose the direction of causation runs from these factors to relative plant scale and not vice versa. For instance, Scherer et al (1975, pp. 112-115) argue the case for causation in the direction suggested here.

Second, it was argued earlier that high concentration when combined with high tariffs and high MES leads to inefficient plant size decisions. Bloch (1974) in his work on tariffs, concentration, prices and profits found that concentration exerted an independent influence in several instances. The addition of CON enables us to test whether concentration exerts any separate effect that is independent of the tariff level.

Cost Disadvantage Ratio. The firm considering whether to build a plant at or below MES will be influenced by the cost of operating at less than MES compared to MES. The steeper the cost curve the greater the pressure on the firm to build a plant of MES, other things equal. Previous studies (Gorecki, 1976, Table 5-6, p. 56 and Scherer, et al, 1975, pp. 103-111), which have measured the cost disadvantage of smaller plants using the engineering technique, have found that it is an important determinant of relative plant scale. Unfortunately, we do not have such a variable and use a variant of the approximation first suggested by Caves et al (1975).

CDR the ratio of value added per manhour of the smallest plants accounting for 50 per cent of industry employment divided by the value added per manhour of the largest plants accounting for 50 per cent of industry employment.

This variable should be negatively related to the relative plant scale index, since the lower the value of CDR the greater the disadvantage of smaller plants and the greater the probability an MES plant will be built.

One potential problem with CDR is what Caves et al (1980) refer to as the truncation effect -- in Canada the most disadvantaged plants will not be observed because of the smallness of market and openness to trade; but in the U.S., which is a much larger market, there are likely to be many opportunities and niches for such plants to survive. Some doubt is thrown on this explanation because Table 1 shows, on average, small Canadian plants (i.e., EFF1B) are substantially less than MES -- approximately 10 per cent in 1970 and 1979. Previous studies which estimated the cost disadvantage of smaller plants on the basis of the engineering technique (Pratten, 1977, and Scherer et al, 1975), used costs for plants one-third or one-half of MES in order to estimate a cost disadvantage ratio. Hence, the percentages cited above should reach far enough back into the distribution to provide estimates of the cost disadvantage ratio comparable to that calculated by others.

Nevertheless, to overcome the possibility of a truncation problem, the cost disadvantage ratio from the U.S. was used in several regression estimates. In the U.S. market, the forces making for truncation are likely to be less than in Canada,[12] while the production processes are approximately the same, thereby making the U.S. cost disadvantage ratio a good proxy for the Canadian. Hence, we include:

USCDR = for the U.S., value added per worker in the smallest establishments accounting for half the employment in the industry divided by value added per worker in the larger plants accounting for the balance.

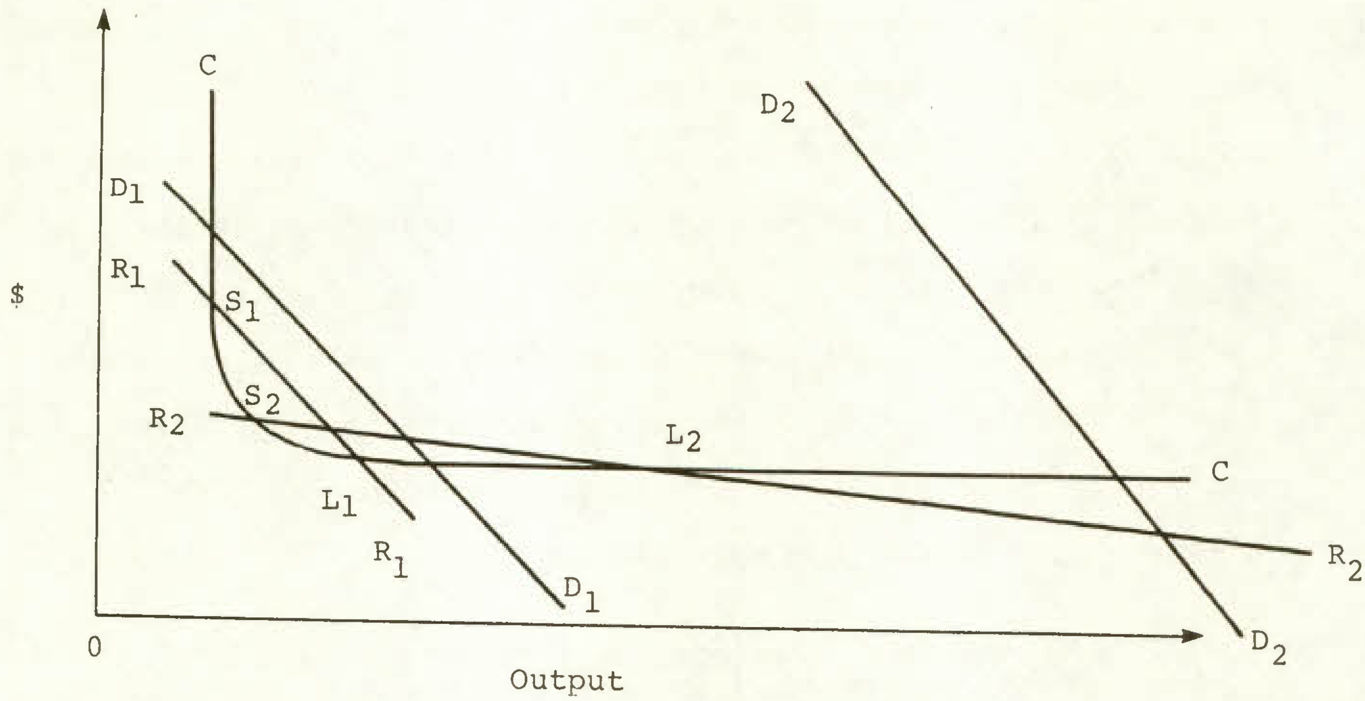
USCDR should be negatively related to the relative plant scale index.

A second and potentially more serious problem is that the measurement obtained for CDR depends not just on the cost disadvantage incurred by small firms from operating sub-MES plants but also on the firm size distribution. In particular, it is expected that in large markets, there may be very little measured cost disadvantage for small firms. This phenomenon is illustrated in Figure 3. Two markets, one small (represented by the demand curve, D_1) and one large (represented by demand curve, D_2), both share the same cost curve (C). R_1 joins the average cost for smaller firms (S_1) to that of larger firms (L_1) in the small market, while R_2 performs the same function in the large market. R_1 exhibits a much higher cost disadvantage ratio than R_2 even though the underlying cost curve is the same for the two markets.

The result depicted in Figure 3 arises because it is assumed that in markets where MESMSD (i.e., the ratio of domestic disappearance to MES) is large most firms will have plants of MES or larger. These are the markets where, because there is room for numerous MES sized plants, competition will be stronger thereby forcing price toward long run average cost (the flat section of the curve) and eliminating the fringe that otherwise might have been located on the negatively sloped section of the average cost curve. Thus, most plants will be located along the flat portion of the cost curve and the cost disadvantage ratio is relatively

Figure 3

The Relationship Between the Cost Disadvantage Ratio and The Size of the Market



D_1D_1 -- demand curve in market 1

D_2D_2 -- demand curve in market 2

CC -- cost curve for both market 1 and market 2

S_1 -- average cost for smaller plants in market 1

S_2 -- average cost for smaller plants in market 2

L_1 -- average cost for larger plants in market 1

L_2 -- average cost for larger plants in market 2

Source: See text

meaningless as an estimate of the slope of the cost curve below MES. Moreover, since the relative plant scale measure will be high when most plants are greater than MES, CDR should be positively related to the efficiency measure in large markets - exactly the opposite relationship hypothesized to exist between the slope of the cost curve below MES and the relative plant scale efficiency measure.

In contrast, when markets are relatively small compared to MES (as with D_1 in Figure 3), the cost disadvantage ratio will better reflect the steepness of the cost curve to the left of MES plant. Contrary to the case of large markets, it is likely that in small markets, plants will be more equally distributed both below and above MES plant size. The concentrated nature of these markets reduces competition and leaves price above the long run average cost of MES plant, thereby providing an umbrella under which smaller plants can survive. Therefore the following cost disadvantage variable was created.

CDR1 where MESMSD is less than its median[13]
CDR1 is set equal to CDR, 0 otherwise.

Providing that the tendency of more steeply sloped cost curves does not so skew the distribution that measured cost disadvantage decreases (or its inverse, CDR1 increases) as median plant size increases, CDR1 should be negatively related to the plant scale efficiency variable - since the lower the value of CDR1, the greater the disadvantage of smaller plants and the greater the probability that an MES plant will be built.

In order to test whether the cost disadvantage ratio indeed has a different relationship to relative plant scale in markets which are large relative to MES, several additional variables are specified. These are:

CDR2	where MESMSD is greater than its median, CDR2 is set equal to CDR, 0 otherwise,
CDR3	where the industry is national (REG = 0) and MESMSD is greater than its median, CDR3 set equal to CDR, 0 otherwise.
CDR4	where the level of imports (IMP) is less than its mean and MESMSD is greater than its median, CDR4 set equal to CDR, 0 otherwise.

We would expect CDR2 to be positively related to relative plant scale, since in such instances we are dealing with large numbers of MES plants consistent with the domestic market. Hence few sub-optimal plants should exist. CDR3 and CDR4 are included to test to see whether different characteristics of markets change the significance of the results. CDR3 is the cost disavantage ratio for large markets that are national as opposed to regional. Other things equal, national markets should be more competitive markets. CDR4 is the cost disadvantage ratio for large markets with low imports. Other things equal, these should be less competitive markets. If neither of the coefficients on these variables differ from the effect of CDR2, it may be concluded that the effect of the cost disadvantage ratio in large markets does not depend upon the degree to which such markets are protected from competition.

Product Differentiation. Advertising permits the firm to produce a rent yielding asset which results in the firm commanding a price premium. This may be used to offset the disadvantages of operating at a small scale. We therefore define:

ADVDM	the advertising sales ratio for consumer - non-durable goods industries, 0 otherwise.

This should be negatively related to relative plant scale efficiency index.

Research and Development. Expenditures on research and development work in a similar way to advertising in that an advantage is created that can be used to offset the cost disadvantage of small scale. The variable used to account for R&D is:

RD	the ratio of research and development personnel to all wage and salary earners.

This should be negatively related to a relative plant scale.

Foreign Ownership. Foreign ownership is postulated to have a negative effect on relative plant scale. The foreign firm, because of its market advantage created through advertising and RD, has been characterised as being able to command considerable brand loyalty that allows it to carve a niche in the market at lower cost than domestic firms. This combined with the relatively small cost of adapting its market advantage to Canadian conditions permits the foreign firm to offset the disadvantages of small scale and yet, at the same time, earn at least a normal rate of return. The Canadian industry thus becomes, in certain instances, a smaller version of the U.S. industry, with all U.S. leading firms present. This is sometimes referred to as the miniature replica effect (Eastman and Stykolt, 1967, and English, 1964) and is held to provide evidence of the cost of foreign ownership. Although advertising and RD are included, foreign ownership is added separately to capture the remaining influence that permits these firms to carve out small market segments.

Reinforcing the above tendencies are several other facets of the operation of foreign firms. First, technology transfers may be much more rapid via a parent-subsidiary relationship than via arm's-length transactions. This will result in higher productivity for Canadian subsidiaries of multinational enterprises in Canada, but its impact on relative plant scale in Canada relative to the U.S. cannot be specified a priori. Second, the foreign firm sources, to a considerable extent, its input and components from its base country. As a result scale economies may be realized at smaller plant size and the final product may use fewer resources than would otherwise be the case. In other words, the foreign owned subsidiary in Canada may have a smaller MES than the Canadian-owned firm in the same industry. Third, when product differentiation is important, foreign firms may specialize in one product line in Canada, while importing the remainder. Canadian-owned plants may be larger than foreign because more product lines are packed into one plant in order to obtain the volume economies of scale. These three explanations for smaller foreign firm size do not imply the inefficiency results from foreign ownership. Thus caution should be shown in interpreting a negative coeficient on the foreign ownership variable as an indicator of inefficiency in industries dominated by multinationals.

In order to capture the impact of foreign ownership we specify three variables:

FOR	the proportion of industry shipments accounted for by foreign owned firms.
HVTRCRF	a dummy variable which takes the value of 1 when concentration, effective tariffs and foreign ownership are high, defined as greater than their respective means.
EASTFV	HVTRCRF • MESMSD -- the ratio of domestic disappearance to MES where concentration, tariffs and foreign ownership are greater than their respective means.

The latter two variables can be defined in an analogous fashion for nominal tariffs, such that EASTFV becomes EASTFN and HVTRCRF becomes HNTRCRF.

The mean value used for foreign ownership is 0.44 of industry shipments in 1970 and 0.41 in 1979. The same cut-off points for high concentration and high tariffs are used as was the case with

HVTRHCR and HNTRHCR above. The number of industries falling into the high tariff/high concentration/high foreign ownership category are as follows:

	1970	1979
HVTRCRF = 1	12	11
HNTRCRF = 1	7	9

The addition of the constraint of high foreign ownership to high concentration and high tariffs reduces the number of industries in the subsample by approximately one half.

The expected relationship between HVTRCRF,EASTFV and relative plant scale is exactly analogous to that discussed above with respect to HVTRHCR and EASTV, illustrated with Figure 2. The average and standard deviation of MESMSD in high concentration/-high tariff/high foreign ownership industries is as follows:

	1970		1979	
	MEAN	S.D.	MEAN	S.D.
MESMSD for HVTRCRF = 1	5.6	5.0	6.4	4.3
MESMSD for HNTRCRF = 1	2.7	1.6	5.1	3.7

These means and standard deviations are lower than the corresponding set for the high tariff/high concentration industries.

Finally, FOR is introduced as a separate variable to test whether foreign ownership exerts an influence independent of high concentration and high tariffs. The predicted sign for this variable is negative.

Variance in Margins. Another variable that should be related to the ability of small and large firms to coexist side by side is the extent to which there is a large variation in the earnings ratios (margins/sales) within an industry throughout the decade. This variable is

MARCVA the average of the coefficients of variation of margins/sales ratios for all firms in the industry, 1970 and 1979.

Where this is consistently large, the industry is able to support firms of considerable variation in margins/sales ratios. These ratios can vary substantially if capital/sales ratios differ. Thus the coefficient of variation is another proxy for market segmentation. Small firms may have found a different level of capital intensity that allows them to survive. It may also represent the effect of umbrella pricing and catch the imperfect competition effect. Thus MARCV should be negatively related to relative plant size.

Regional Industries. There are a number of reasons to postulate that relative plant scale may be affected by whether the industry is regional or national. Regional industries offer smaller markets and hence, by the reasoning offered above, may be expected to have a greater degree of suboptimal plant size. Tastes may also be regional hence providing a rent which can be used to offset smaller size. We use the following specification for regional industries.

REG a regional dummy variable taking on the value 1 when the industry is regional, 0 otherwise.

This should be negatively related to relative plant scale efficiency.

4. THE REGRESSION RESULTS: 1970 and 1979

Some Preliminaries

We have defined a relatively large number of independent variables that are determinants of the degree of relative plant scale, measured in three ways. In order to make the task of estimation and presentation manageable it was decided to proceed in the following manner.

First, rather than estimate regressions relating to the determinants of EFF1, EFF1B and EFF1T for 1970 and 1979 we estimate and present regresssions relating to EFF1T70 and EFF1T79. Only for EFF1T are we comparing like with like - the ratio of average size of plants in the top half of the distribution (large plants) in Canada to the U.S. For EFF1 and EFF1B we are not comparing Canada with the corresponding U.S. statistics but rather USMES. In future work it is expected that it will be possible to compare the ratio of the average size of plants in the bottom half of the distribution (small plant) for Canada to the U.S.

Second, in our discussion of the independent variables a number of groups of variables were specified in order to develop more fully certain aspects of the determinants of relative plant scale. Rather than estimate, present and discuss regression equations for all of the independent variables, we begin by discussing the impact of tariffs, concentration and foreign ownership , the truncation effect and, finally, the trade variables. In each instance we do not present all the regression results but only the most significant, summarizing the remainder.

The independent variables, together with their means, standard deviations, and expected signs are presented in Table 4 for 120 industries, since for INTRA and CA the sample size is 120 because imports = exports = 0 in five industries, leaving both trade variables undefined. Earlier we defined an independent variable without reference to the year. If it is measured for 1970 the suffix 70 or 0 is added, while for 1979, 79 or 9 is added. In a number of instances, however, data for a year close to 1970 or 1979 had to be used. These are:

Variable	Actual Year Used
NRP79	1978
ERP79	1978
ADVDM79	1977
INTRA70	1971
EXP70	1971

Table 4

Means and Standard Deviations of Independent Variables
Across 120 Canadian Manufacturing Industries.
1970 and 1979

Variable	Mean	Standard Deviation	Variable	Mean	Standard Deviation	Expected Sign
CON70	0.560	0.220	CON79	0.553	0.222	+
REG	0.267	0.444	REG	0.267	0.444	-
RD70	0.008	0.015	RD79	0.008	0.018	-
ADVDM70	0.008	0.022	ADVDM79	0.006	0.017	-
HVTRHCR0	0.158	0.367	HVTRHCR9	0.183	0.389	-
HNTRHCR0	0.117	0.322	HNTRHCR9	0.142	0.350	-
HVTRCRF0	0.100	0.301	HVTRCRF9	0.092	0.290	-
HNTRCRF0	0.058	0.235	HNTRCRF9	0.075	0.264	-
EASTV70	1.054	3.119	EASTV79	1.297	3.395	+
EASTN70	0.647	2.349	EASTN79	0.923	2.914	+
EASTFV70	0.564	2.269	EASTFV79	0.588	2.232	+
EASTFN70	0.157	0.733	EASTFN79	0.386	1.672	+
FOR70	0.473	0.303	FOR79	0.440	0.293	-
IMP70	0.212	0.195	IMP79	0.256	0.222	?
CA70	0.661	0.572	CA79	0.676	0.592	+
INTRA70	0.408	0.301	INTRA79	0.395	0.295	+
EXP70	0.129	0.188	EXP79	0.154	0.196	+
NRP70	0.122	0.163	NRP79	0.102	0.090	-
ERP70	0.143	0.166	ERP79	0.126	0.351	-
MARCVA	0.858	0.354	MARCVA	0.858	0.354	-
MESMSD70	15.257	19.077	MESMSD79	18.411	21.525	+
CDR70	0.917	0.229	CDR79	0.903	0.293	-
USCDR70	1.014	0.207	USCDR79	1.004	0.203	-
CDR170	0.458	0.496	CDR179	0.482	0.535	-
CDR270	0.459	0.480	CDR279	0.421	0.457	+
CDR370	0.293	0.456	CDR379	0.268	0.421	+
CDR470	0.295	0.437	CDR479	0.245	0.404	+

Source: Statistics Canada. See Appendix A for details. (Vol. 5).

IMP70	1971
CA70	1971
USCDR70	1972
USCDR79	1977
RD70	1975

In these cases the assumption is made that the missing value of a particular variable for 1970 and for 1979 is highly correlated with the actual value used. The instance where this is most likely to be seriously remiss is for RD70 since the value is for a year five years away (1975). However, RD for 1975 is highly correlated with RD for 1979 (.970) suggesting that even here the problem is not that serious. For the trade variables for 1970 the estimates of XT and IM related to 1971 the earliest year for which data were tabulated on an industry basis.

The independent variables are defined over the 120 industry sample, mentioned earlier, which, in turn, is derived from the universe of 167 4-digit Canadian manufacturing industries. However, in a small number of instances data was available not at the 4-digit level but at a somewhat more aggregate level of industry classification, thus necessitating prorating or spreading. Nominal and effective tariffs and advertising variables were based on a 122 industry division of the manufacturing sector, while RD statistics were available at the 3-digit level, which divides the manufacturing sector into 112 industries. Finally, the trade data (i.e. imports and exports used to derive INTRA, EXP, IMP, CA) needed some minor prorating for 21 4-digit industries. Appendix A provides details on the database and sources.

Table 5

Correlation Matrix Among Independent Variables Across
120 Canadian Manufacturing Industries: 1970

Variable	CON70	REG	RD70	ADVDM70	HVTRHCR0	HNTRHCR0	HVTRCRF0	HNTRCRF0	EASTV70	EASTN70	EASTFV70	EASTFN70	FOR70
CON70	1.000	-0.266	0.217	0.068	0.451	0.376	0.396	0.319	0.331	0.235	0.283	0.222	0.448
REG		1.000	-0.118	0.128	-0.055	-0.102	-0.075	-0.150	-0.029	-0.034	-0.047	-0.130	-0.261
RD70			1.000	0.082	0.054	-0.106	0.141	-0.049	0.118	-0.095	0.246	-0.046	0.401
ADVDM70				1.000	0.252	0.141	0.182	0.033	0.088	0.019	0.090	-0.036	0.163
HVTRHCR0					1.000	0.838	0.769	0.574	0.782	0.638	0.575	0.496	0.102
HNTRHCR0						1.000	0.485	0.685	0.526	0.762	0.126	0.591	0.003
HVTRCRF0							1.000	0.747	0.492	0.131	0.748	0.645	0.277
HNTRCRF0								1.000	0.131	0.217	0.234	0.864	0.199
EASTV70									1.000	0.717	0.688	0.173	0.017
EASTN70										1.000	0.037	0.267	-0.139
EASTFV70											1.000	0.285	0.205
EASTFN70												1.000	0.117
FOR70													1.000
IMP70													
CA70													
INTRA70													
EXP70													
NRP70													
ERP70													
MARCVA													
MESMSD70													
CDR70													
USCDR70													
CDR370													
CDR270													
CDR470													
CDR170													

Source: Statistics Canada. See Appendix A for details. (Vol. 5).

Variable	IMP70	CA70	INTRA70	EXP70	NRP70	ERP70	MARCVA	MESMSD70	CDR70	USCDR70	CDR370	CDR270	CDR470	CDR170
CON70	0.210	0.219	-0.011	0.208	0.085	0.121	-0.088	-0.501	-0.042	0.081	-0.275	-0.499	-0.466	0.463
REG	-0.355	0.055	0.040	-0.145	-0.108	-0.047	0.059	0.363	-0.151	0.064	-0.390	0.204	0.414	-0.267
RD70	0.186	0.033	0.116	0.160	-0.116	-0.077	0.106	-0.184	0.002	0.118	-0.126	-0.231	-0.231	0.224
ADVDM70	-0.215	0.109	0.008	-0.113	0.224	0.129	-0.173	-0.046	-0.249	0.013	-0.218	-0.223	-0.115	-0.101
HVTRHCR0	-0.159	0.163	-0.063	-0.069	0.366	0.523	-0.133	-0.196	-0.054	0.038	-0.064	-0.161	-0.118	0.131
HNTRHCR0	-0.095	0.120	-0.092	-0.046	0.444	0.476	-0.124	-0.186	0.020	-0.005	-0.063	-0.128	-0.101	0.133
HVTRCRF0	-0.163	0.172	-0.099	-0.061	0.101	0.469	0.015	-0.169	-0.068	0.040	-0.136	-0.245	-0.168	0.206
HNTRCRF0	-0.091	0.129	-0.154	-0.034	0.168	0.436	0.057	-0.165	0.024	-0.015	-0.161	-0.239	-0.168	0.242
EASTV70	-0.115	0.032	-0.004	-0.108	0.159	0.304	-0.112	-0.090	-0.116	0.069	0.084	-0.032	-0.015	0.084
EASTN70	-0.074	0.011	0.019	-0.077	0.252	0.220	-0.159	-0.090	0.008	-0.008	0.083	-0.076	-0.007	0.069
EASTFV70	-0.110	0.060	-0.036	-0.086	-0.008	0.260	0.003	-0.074	-0.174	0.091	-0.016	-0.101	-0.075	0.018
EASTFN70	-0.089	0.085	-0.069	-0.056	0.107	0.216	0.021	-0.132	-0.018	-0.036	-0.139	-0.206	-0.145	0.191
FOR70	0.318	0.027	0.044	0.214	-0.121	0.022	-0.059	-0.347	-0.147	-0.005	-0.294	-0.480	-0.378	0.396
IMP70	1.000	-0.307	-0.017	0.504	-0.104	-0.247	-0.052	-0.355	-0.108	-0.030	-0.007	-0.233	-0.504	0.175
CA70		1.000	0.393	0.470	0.122	0.136	0.138	0.036	0.114	0.098	0.064	0.016	0.154	-0.068
INTRA70			1.000	0.250	-0.122	-0.177	0.092	0.025	0.012	0.133	0.002	0.018	0.028	-0.012
EXP70				1.000	0.050	-0.115	0.109	-0.213	0.010	0.025	-0.036	-0.132	-0.170	0.132
NRP70					1.000	0.448	-0.158	-0.102	-0.054	0.017	0.009	-0.061	-0.069	0.035
ERP70						1.000	0.259	-0.067	0.143	0.073	0.014	-0.044	-0.066	0.108
MARCVA							1.000	0.056	0.308	0.236	0.030	0.142	0.086	0.005
MESMSD70								1.000	-0.177	0.022	0.174	0.482	0.500	-0.548
CDR70									1.000	0.035	0.222	-0.164	-0.062	0.302
USCDR70										1.000	-0.078	0.028	0.071	-0.011
CDR370											1.000	0.726	0.249	-0.600
CDR270												1.000	0.679	-0.891
CDR470													1.000	-0.627
CDR170														1.000

Although miscellaneous industries have been excluded it was recognized that some of the remaining industries might be extremely diverse or for some other reason not fit the estimated relationship well. Therefore several additional regressions were run using different criterion for excluding "aberrant" observations. (Appendix C provides full details). The result of excluding outliers may be summarized as follows: IMP generally becomes more significant; CA is only weakly significant in 1979; the constant term in 1979 becomes insignificant; and, finally, the difference in adjusted R^2 between 1970 and 1979 narrows considerably. Thus, it may be concluded that exclusion of outliers serves to strengthen our results, since most conclusions remain intact and, at the same time, outliers explain some of the more puzzling differences between 1970 and 1979 reported below.

The variables means presented in Table 4 change very little between 1970 and 1979. As expected tariffs, both nominal and effective, fall over time while imports and exports both increase. MESMSD increases between 1970 and 1979 from 15.3 to 18.4. As recorded in Table 1, USMES increases, in constant 1970 Canadian dollars, from $48.6 million to $61.0 million while the annual growth in Canadian domestic disappearance, was, on average 2.56 per cent, over the period 1970 to 1979. Since the latter exceeded the former, MESMSD increased. An indication of the relative importance of these two factors can be gained by estimating MESMSD79, but using USMES70, expressed in 1979 dollars, as the denominator, instead of USMES79. The result is 20.9 compared to

Table 6

Correlation Matrix Among Independent Variables Across
120 Canadian Manufacturing Industries: 1979

Variable	CON79	REG	RD79	ADVDM79	HVTRHCR9	HNTRHCR9	HVTRCRF9	HNTRCRF9	EASTV79	EASTN79	EASTFV79	EASTFN79	FOR79
CON79	1.000	-0.306	0.148	0.056	0.485	0.447	0.296	0.294	0.400	0.356	0.207	0.181	0.459
REG		1.000	-0.137	0.133	-0.091	-0.137	-0.061	-0.172	-0.080	-0.109	-0.038	-0.140	-0.256
RD79			1.000	0.060	0.051	-0.096	0.112	-0.039	0.053	-0.099	0.165	-0.060	0.276
ADVDM79				1.000	0.110	0.101	0.060	0.009	-0.008	-0.010	-0.024	-0.065	0.217
HVTRHCR9					1.000	0.796	0.670	0.519	0.810	0.641	0.559	0.438	0.076
HNTRHCR9						1.000	0.533	0.701	0.599	0.783	0.348	0.571	0.077
HVTRCRF9							1.000	0.787	0.481	0.320	0.833	0.661	0.314
HNTRCRF9								1.000	0.287	0.415	0.527	0.814	0.258
EASTV79									1.000	0.810	0.602	0.407	-0.014
EASTN79										1.000	0.348	0.531	-0.051
EASTFV79											1.000	0.692	0.233
EASTFN79												1.000	0.146
FOR79													1.000
IMP79													
CA79													
INTRA79													
EXP79													
NRP79													
ERP79													
MARCVA													
MESMSD79													
CDR79													
USCDR79													
CDR379													
CDR279													
CDR479													
CDR179													

Source: Statistics Canada. See Appendix A for details. (Vol. 5).

Variable	IMP79	CA79	INTRA79	EXP79	NRP79	ERP79	MARCVA	MESMSD79	CDR79	USCDR79	CDR379	CDR279	CDR479	CDR179
CON79	0.210	0.207	0.006	0.176	0.017	-0.043	-0.094	-0.451	0.210	0.039	-0.121	-0.365	-0.344	0.427
REG	-0.377	0.085	0.068	-0.194	-0.107	0.065	0.059	0.330	-0.096	0.076	-0.385	0.205	0.364	-0.228
RD79	0.286	0.045	0.104	0.285	-0.180	0.172	0.119	-0.171	-0.019	0.027	-0.041	-0.078	-0.184	0.056
ADVDM79	-0.205	0.156	-0.104	-0.134	0.171	0.025	-0.171	-0.079	-0.062	0.080	-0.215	-0.182	-0.077	0.121
HVTRHCR9	-0.088	0.145	-0.124	-0.040	0.343	0.351	-0.202	-0.251	0.146	-0.001	-0.062	-0.217	-0.183	0.265
HNTRHCR9	-0.069	0.071	-0.119	-0.064	0.473	0.131	-0.291	-0.226	-0.003	-0.017	-0.091	-0.221	-0.130	0.190
HVTRCRF9	-0.036	0.004	-0.182	-0.112	0.136	0.372	-0.142	-0.178	-0.110	-0.041	-0.084	-0.185	-0.125	0.098
HNTRCRF9	0.010	-0.090	-0.123	-0.132	0.215	0.077	-0.145	-0.176	-0.118	-0.016	-0.110	-0.198	-0.099	0.104
EASTV79	-0.057	0.017	-0.053	-0.105	0.181	0.370	-0.145	-0.149	0.103	-0.045	-0.154	-0.013	-0.063	0.046
EASTN79	-0.060	0.014	0.015	-0.111	0.300	0.090	-0.209	-0.124	0.009	-0.043	-0.114	-0.002	-0.005	0.007
EASTFV79	-0.012	-0.036	-0.115	-0.092	0.029	0.467	-0.043	-0.116	-0.080	-0.040	-0.043	-0.050	-0.041	0.001
EASTFN79	0.035	-0.114	-0.039	-0.097	0.141	0.046	-0.090	-0.117	-0.092	0.003	-0.006	-0.073	-0.019	0.012
FOR79	0.278	0.082	0.070	0.178	-0.112	-0.046	-0.094	-0.294	-0.084	-0.071	-0.092	-0.274	-0.236	0.187
IMP79	1.000	-0.394	0.009	0.502	-0.107	-0.068	0.017	-0.360	0.042	-0.130	-0.038	-0.207	-0.508	0.199
CA79		1.000	0.352	0.413	0.016	-0.090	0.073	0.035	0.094	0.150	0.008	0.014	0.201	-0.040
INTRA79			1.000	0.298	-0.174	-0.108	0.089	0.127	0.070	0.093	-0.064	0.132	0.118	-0.074
EXP79				1.000	-0.069	-0.228	0.117	-0.224	0.147	-0.007	-0.079	-0.040	-0.148	0.115
NRP79					1.000	0.139	-0.197	-0.106	0.008	-0.092	0.025	-0.072	-0.097	0.065
ERP79						1.000	-0.401	-0.012	0.063	-0.117	0.086	-0.044	-0.030	0.003
MARCVA							1.000	0.096	-0.108	0.250	0.053	0.157	0.118	-0.193
MESMSD79								1.000	-0.176	-0.000	0.210	0.537	0.570	-0.555
CDR79									1.000	0.140	-0.046	-0.030	-0.009	0.523
USCDR79										1.000	-0.076	0.022	0.082	-0.058
CDR379											1.000	-0.706	0.215	-0.577
CDR279												1.000	0.650	-0.837
CDR479													1.000	-0.549
CDR179														1.000

18.4. Hence, changes in MESMSD appear to be accounted for by both increases in market size and MES.

Tables 5 and 6 present the simple correlations among the independent variables for 1970 and 1979, respectively. Rather than discuss the correlations here, this will be left to the discussion below. In presenting the regression results all the variables discussed above are included in the estimated regression equations presented with the significance levels given in each table. These significance levels are the levels that would have to be adopted in order to reject the null hypothesis that the paramenter is zero when a one-tailed test is used. In the following discussion, a variable is referred to as significant when the significance level is 10 per cent or less. Weakly significant variables are those between 10 and approximately 20 per cent. This standard was chosen because in each run all variables are usually included and exclusion of insignificant variables increased the significance levels substantially.

Concentration, Tariffs and Foreign Investment: Testing the Eastman and Stykolt Hypothesis

Tables 7 and 8 present the results of regressions that test the Eastman/Stykolt hypothesis for relative plant scale. Table 7 uses effective tariff variables (EASTV, EASTFV, etc.) and Table 8 uses nominal tariffs (EASTN, EASTFN, etc). This division reflects the high correlation detailed in Tables 5 and 6 between the same nominal and effective tariff variables. Because of the

Table 7

Concentration, Effective Tariffs,[1] Truncation, Foreign Ownership and Relative Plant Scale: Regression Results Across 120 Canadian Manufacturing Industries, 1970 and 1979

	EFF1T70								EFF1T79							
Equation #	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Coeff	Sign	Coeff	Sign	Coeff	Sign	Coeff	Sign	Coeff	Sign	Coeff	Sign	Coeff	Sign	Coeff	Sign
Constant	-0.085	.71	-0.117	.62	-0.087	.70	-0.564	.03	-0.354	.18	-0.510	.05	-0.487	.07	-0.688	.01
Trade and Tariffs																
IMP	-0.392	.18	-0.413	.16	-0.388	.19	-0.307	.30	-0.443	.10	-0.431	.10	-0.436	.11	-0.440	.10
CA	0.057	.50	0.058	.51	0.056	.52	0.044	.62	0.149	.09	0.189	.03	0.185	.04	0.176	.04
NRP	0.344	.31	0.392	.25	0.381	.30	0.461	.18	0.267	.62	0.640	.25	0.657	.25	0.669	.23
ERP	-0.486	.20	-0.444	.26	-0.443	.26	0.497	.21	0.002	.99	0.076	.62	0.043	.80	0.063	.68
Barriers to Entry																
MESMSD	0.008	.01	0.009	.01	0.008	.01	0.010	.01	0.014	.0000	0.014	.0000	0.014	.0000	0.014	.0000
ADVDM	-1.869	.40	-1.518	.51	-1.730	.45	-0.497	.83	-4.896	.09	-4.486	.12	-4.403	.13	-4.252	.14
RD	1.489	.65	2.723	.42	1.564	.64	2.304	.49	-1.992	.49	-1.760	.54	-1.764	.54	-1.662	.56
CON	1.207	.0000	1.231	.0001	1.251	.0000	1.285	.0000	1.371	.0000	1.515	.0000	1.542	.0000	1.471	.0000
Truncation																
CDR1	-0.403	.001	-0.407	.001	-0.410	.001	-	-	-0.246	.02	-0.179	.10	-0.185	.10	-	-
CDR2	-	-	-	-	-	-	0.420	.001	-	-	-	-	-	-	0.220	.07
Eastman/Stykolt																
EASTV	-	-	0.058	.03	0.001	.99	0.064	.01	-	-	0.043	.08	0.033	.30	0.042	.09
HVTRHCR	-	-	-0.424	.11	-0.110	.82	-0.460	.08	-	-	-0.652	.01	-0.595	.07	-0.639	.01
EASTFV	0.099	.001	-	-	0.099	.05	-	-	0.054	.17	-	-	0.027	.58	-	-
HVTRHCRF	-0.528	.05	-	-	-0.448	.37	-	-	-0.618	.04	-	-	-0.148	.71	-	-
Other																
REG	-0.039	.73	-0.036	.75	-0.035	.76	0.001	.99	-0.007	.95	0.017	.88	0.016	.88	0.022	.84
FOR	-0.046	.81	-0.073	.71	-0.024	.90	0.137	.48	0.223	.25	0.138	.46	0.117	.57	0.186	.31
MARCVA	0.229	.11	0.221	.14	0.214	.15	0.168	.27	0.163	.28	0.200	.17	0.176	.24	0.209	.14
$\bar{R}^2$	0.3399	.0000	0.3067	.0000	0.3283	.0000	0.3061	.0000	0.4372	.0000	0.4555	.0000	0.4467	.0000	0.4577	.0000

Note: For each variable the table presents its estimated regression coefficient (Coeff) and level of statistical significance (Sign). The tests of significance are one-tailed.

1 Effective tariffs used to delimit Eastman/Stykolt hypothesis.

Source: Statistics Canada. See Appendix A for details. (Vol. 1 and 2).

substantial collinearity between the terms presenting high concentration/high tariffs (HVTRHCR, EASTV, for effective tariffs) and high concentration/high tariffs/high foreign ownership (HVTRCRF and EASTV, for effective tariffs) three estimated regressions are presented in Tables 7 and 8 -- one regression equation with each set of interaction terms entered separately (Equations 1, 2, 5 and 6) and a third where both sets of interaction terms are entered (Equations 3 and 7). It should be noted that Tables 7 and 8 use the 120 industry sample -- the 125 industry sample less the five industries for which CA is not defined.

The tables show that market size (MESMSD) has the expected positive impact on relative plant scale. The impact is fairly stable over time, differing little whether the interaction terms representing the Eastman/Stykolt hypothesis are specified using nominal or effective tariffs, and is always statistically significant.[14] A quadrupling of market size would, other things equal, raise the mean level of EFF1T in both 1970 and 1979, to unity -- i.e. on average Canadian plant sizes would be equal to MES. This is the sort of magnitude of increased market size that Ontario and Quebec plants would gain access to if there was free trade with the United States. (Wonnacott and Wonnacott, 1982, p. 416). The importance of market size in determining relative plant scale accords with the work of Scherer <u>et al</u> (1975, p. 103) as well as Eastman and Stykolt (1967, p. 79).[15]

Table 8

Concentration, Nominal Tariffs,[1] Truncation, Foreign Ownership and Relative Plant Scale: Regression Results Across 120 Canadian Manufacturing Industries, 1970 and 1979

Equation #	EFF1T70 (1) Coeff	Sign	(2) Coeff	Sign	(3) Coeff	Sign	(4) Coeff	Sign	EFF1T79 (5) Coeff	Sign	(6) Coeff	Sign	(7) Coeff	Sign	(8) Coeff	Sign
Constant	-0.157	.51	-0.115	.63	-0.159	.51	-0.636	.01	-0.361	.16	-0.437	.09	-0.441	.09	-0.655	.01
Trade and Tariffs																
IMP	-0.479	.11	-0.463	.12	-0.469	.12	-0.345	.25	-0.481	.07	-0.458	.08	-0.470	.08	-0.461	.08
CA	0.030	.73	0.029	.74	0.026	.77	0.010	.91	0.122	.17	0.155	.07	0.152	.09	0.143	.10
NRP	0.239	.48	0.416	.24	-0.293	.44	0.491	.16	0.331	.54	0.901	.13	0.912	.13	0.879	.14
ERP	-0.184	.63	-0.262	.48	0.109	.78	-0.310	.41	0.002	.999	0.0001	.9996	-0.001	.996	-0.012	.93
Barriers to Entry																
MESMSD	0.009	.01	0.009	.008	0.009	.01	0.010	.001	0.014	.0000	0.014	.0000	0.014	.0000	0.014	.0000
ADVDM	-2.160	.35	-1.949	.39	-2.032	.39	-0.828	.72	-5.252	.07	-4.891	.08	-4.821	.09	-4.681	.10
RD	3.294	.32	3.583	.28	3.312	.32	3.263	.33	-2.128	.46	-2.133	.45	-2.054	.47	-1.976	.49
CON	1.410	.0000	1.456	.0000	1.494	.0000	1.539	.0000	1.424	.0000	1.609	.0000	1.640	.0000	1.504	.0000
Truncation																
CDR1	-0.473	.0001	-0.479	.0001	-0.489	.0001	-	-	-0.255	.01	-0.240	.02	-0.242	.02	-	-
CDR2	-	-	-	-	-	-	0.489	.002	-	-	-	-	-	-	0.249	.04
Eastman/Stykolt																
EASTN	-	-	0.020	.53	0.009	.84	0.021	.52	-	-	0.033	.19	0.025	.45	0.033	.20
HNTRHCR	-	-	-0.429	.12	-0.115	.81	-0.447	.11	-	-	-0.689	.004	-0.650	.08	-0.644	.01
EASTFN	0.130	.33	-	-	0.151	.28	-	-	0.044	.33	-	-	0.028	.61	-	-
HNTRHCRF	-0.774	.09	-	-	-0.732	.24	-	-	-0.640	.04	-	-	-0.137	.75	-	-
Other																
REG	-0.061	.60	-0.050	.67	-0.057	.62	-0.006	.96	-0.015	.89	-0.007	.95	-0.007	.95	0.014	.90
FOR	-0.087	.65	-0.014	.94	-0.045	.82	-0.077	.70	0.238	.21	0.142	.44	0.135	.50	0.208	.26
MARCVA	0.221	.13	0.182	.22	-0.197	.19	0.115	.44	0.176	.23	0.119	.41	0.114	.44	0.145	.32
$\bar{R}^2$	0.2992	.0000	0.2944	.0000	0.2908	.0000	0.2863	.0000	0.4429	.0000	0.4625	.0000	0.4536	.0000	0.4576	.0000

Note: For each variable the table presents its estimated regression coefficient (Coeff) and level of statistical significance (Sign). The tests of significance are one-tailed.

1 Nominal tariffs used to delimit Eastman/Stykolt hypothesis.

Source: Statistics Canada. See Appendix A for details. (Vol. 1 and 2)

The Eastman/Stykolt hypothesis is couched in terms of the combined influence of high tariffs and small market oligopoly behaviour. In the regression equation, this is captured by EASTV and HVTRHCR in Table 7 (Equations 2 and 6) and EASTN and HNTRHCR in Table 8 (Equations 2 and 6). In all instances the result accord with expectations: the coefficient attached to HVTRHCR is negative, while the influence of EASTV is, as expected, positive. A similar finding applies to nominal tariffs. Furthermore these terms are always statistically significant at .12 or less, except for EASTN (.53) in 1970 and (.19) in 1979. Hence we find strong support for Eastman/Stykolt hypothesis.

The fact that support for the plant scale variant of the Eastman/Stykolt hypothesis has been found does not mean all of the industries in the high tariff/high competition sample are of a size where their relative efficiency is detrimentally affected - that is, they fall to the left of the "crossover point" as is shown at point x in Figure 2. It is possible to estimate the market size (MESMSD) at which the impact of high concentration and high tariffs on plant size is zero and the number of industries which fall to the left of the crossover point. Table 9 presents the crossover MESMSD (column 2) the mean MESMSD (column 3) for high tariff/high concentration industries and the number of industries where MESMSD is less than the crossover MESMSD (column 4). The majority of industries were to the left of the crossover point in both years, no matter whether nominal or effective tariffs were used. The mean value of MESMSD is

Table 9

Testing the Impact of Eastman/Stykolt Hypothesis

Category[a]	Mean Value of MESMSD for Category	Crossover MESMSD[b]	Number of Industries to left of Crossover Point to Total Number in Category	The Percentage Effect[d]
(1)	(2)	(3)	(4)	(5)
HVTRHCR0 = 1	6.7	7.3	13/19	-5.1
HVTRHCR9 = 1	7.1	15.2	21/22	-53.5
HNTRHCR0 = 1	5.5	21.5[c]	14/14	-43.8
HNTRHCR9 = 1	6.5	20.9[c]	17/17	-56.2
HVTRCRF0 = 1	5.6	5.3	6/12[e]	4.4
HVTRCRF9 = 1	6.4	11.4	9/11	-46.9
HNTRCRF0 = 1	2.7	6.0[c]	7/7	-68.5
HNTRCRF9 = 1	5.1	14.5[c]	9/9	-38.0

a These categories refer to

HVTRHCR0 - High effective tariffs, high concentration, 1970
HVTRHCR9 - High effective tariffs, high concentration, 1979
HNTRHCR0 - High nominal tariffs, high concentration, 1970
HNTRHCR9 - High nominal tariffs, high concentration, 1979
HVTRCRF0 - High effective tariffs, high concentration, high foreign ownership, 1970
HVTRCRF9 - High effective tariffs, high concentration, high foreign ownership, 1979
HNTRCRF0 - High nominal tariffs, high concentration, high foreign ownership, 1970
HNTRCRF9 - High nominal tariffs, high concentration, high foreign ownership, 1979

b The crossover point is defined with reference to Figure 2 above as point of the value of equation (1) = equation (3). For this to hold MESMSD = a_1/a_3. Equations 1, 2, 5 and 6 of Tables 7 and 8 were used to derive the crossover point value of MESMSD.

c Coefficient on slope term (EASTFN, EASTN) either just weakly significant or insignificant.

d See text for explanation.

e For one high concentration/high tariff/high foreign ownership industry MESMSD is exactly the same as the crossover point. This is not included in the numerator of 6/12.

Source: Statistics Canada. See Appendix A for details.

substantially below the crossover point in both years when nominal tariffs are used, but only in 1979 when effective tariffs are used.

Tables 7 and 8 contain several regressions (Equations 1, 3, 5, and 7) that were estimated to test whether foreign ownership, when combined with high tariffs and high concentration, exacerbates the extent of sub-optimal sized plant. If collinearity was not severe, the additional effect of foreign ownership would be revealed in the significance of EASTFV, (EASTFN) and HVTRCRF (HNTRCRF) when included with the corresponding high tariff/high concentration terms. However, the degree of collinearity between the two is so high that even though each set -- high tariffs/high concentration versus high tariff/high concentration/high foreign ownership -- is generally significant on its own (Equations 1 and 2 and 5 and 6), neither set is consistently significant when included together. Thus the additional effects of foreign ownership must be inferred from a comparison of equations 1 and 2 for 1970 and 5 and 6 for 1979.

For 1970, the results of both equations 1 and 2 are very similar -- whether effective or nominal tariff rates are used. In the first place, the percentage of industries in the sample to the left of the crossover point is about the same (Table 8, column 4). Second, the intercept term (HVTRCRF,HNTRCRF) is lower but the slope coefficient on market size (EASTFV,EASTFN) is higher than that for the alternative that just uses high tariffs and high concentration. Hence, in 1970, high foreign ownership might be said to have exacerbated the impact of high tariffs and high concentration, but only in the most concentrated (smallest MESMSD) markets.

For 1979 the intercept shift term that includes high foreign ownership is either higher (HVTRCRF) or approximately the same (HNTRCRF) while the slope coefficient (EASTFV and EASTFN) is higher than for the alternative that just uses high tariffs and high concentration. The percentage of plants to the left of the crossover point in 1979 is less when foreign ownership is included where effective tariffs are considered (line 6 versus line 2 in Table 9) but no different for nominal tariffs (line 8 versus line 4 in Table 9). Thus by 1979 foreign ownership tends to reduce the extent of sub-optimality brought about by tariff protection of oligopolistic markets, particularly using effective tariffs.

The qualitative results demonstrate that foreign ownership, per se, does not exacerbate the degree of sub-optimality. It implies that high foreign ownership probably has a different effect in different industries. In an accompanying paper on tariff structure, it is reported that tariffs fell more where foreign ownership was highest. The two results then suggest that tariffs were reduced in industries where foreign ownership was high, but so too was the degree of plant sub-optimality.

A measure of the importance of the inefficiencies that were exhibited in 1970 and 1979 can be obtained by calculating the percentage reduction in relative plant scale that is expected at the mean value of MESMSD in highly concentrated industries compared to the prediction that the regression equation yields for that value of MESMSD had there been no Eastman/Stykolt effect. In order to calculate the predicted value, the mean value of all the independent variables for the 120 industry sample are used, except, of course, for MESMSD. Table 9 presents these results. The impact on efficiency for the effective tariff categories in 1970 is, on average, slightly negative or positive, but for high tariff/high concentration/high foreign ownership and high tariff/ high concentration in 1979 there is a considerable reduction in relative plant scale. The reduction for the nominal tariff categories is always substantial, never falling below 38.0 per cent. Although sub-optimal scale is limited to a few industries in the model used in this analysis, the percentage effect is considerable for nominal tariffs in both years, but only for effective tariffs in 1979.

One of the most noticeable results to emerge from the analysis of the Eastman/Stykolt hypothesis is the difference between the terms employing effective and nominal tariffs. The impact using effective tariffs, judging from Table 9, is much greater in 1979 than 1970, while for nominal tariffs there is, by comparison, little change. Furthermore while the slope and intercept terms are always at least weakly significant for effective tariffs, the slope coefficient for nominal tariffs (EASTN, EASTFN) is, except for one case, insignificant. These differences may be a reflection of the fact that effective tariffs represent the whole structure of protection while nominal tariffs refer to only one level. Hence adjustment to the tariff changes of the late 1960's may be much more gradual for effective tariffs than nominal. In other words, full adjustment to the Kennedy Round changes of 1966-1970 were complete by 1979, while adjustment was incomplete by 1970.

A second explanation of the difference between the significance of the relative plant scale effect in 1970 and 1979 lies in the changing pattern of effective tariff protection during the decade. In a separate study we have investigated the determinants of tariffs using the same set of data as for this paper. Effective tariffs declined more where the cost disadvantage of small plants in 1970 (CDR) was lower. Moreover, this variable exerted a weak positive influence on effective tariffs in 1970 but had a negative and very significant coefficient in 1979. In other words, effective tariffs were generally higher in 1970 and were reduced more during this decade where small plants did not have much disadvantage so that by the end of the period this variable had no significant effect. But it is in these industries that relative plant scale should be less affected by high tariffs. Thus in 1970, amongst high effective tariff industries, there are a relatively large number of industries where the Eastman/Stykolt effect should not be felt; however, by 1979, this would no longer be the case.

Tables 7 and 8 also shed some light on the issue of whether tariffs, concentration and/or foreign ownership have any influence independent of the high tariff/high concentration/high foreign ownership terms just discussed. In the case of effective tariffs the answer is unequivocally no, while for nominal tariffs there is a weak positive relationship in some of the regression equations for 1979. This lack of significance for tariffs is consistent with earlier studies of the Eastman/Stykolt hypothesis (Muller, 1972).[16] Foreign ownership changes sign over the decade from negative in 1970 to positive in 1979, but is never highly significant (Equation 5, Table 7). Earlier work shows contradictory impacts concerning foreign ownership, so these results reflect that ambivalence (Muller, 1982). However, concentration exerts a very powerful force in addition to MESMSD leading to increased relative plant scale, irrespective of the level of tariffs and/or foreign ownership.[17] This is consistent with Bloch (1974), who, as noted above, found that concentration had an influence on profits independent of level of tariffs, and not vice versa. Our analysis confirms that this relationship between concentration and relative plant scale. The result on concentration is also consistent with the earlier finding of Scherer et al (1975, esp. pp. 112-115). However, Scherer did not attempt to test the impact of high tariff/ high concentration, but entered concentration separately only.

Truncation Effect

The cost disadvantage ratio attempts to capture the impact of operating at scales of less than minimum efficient size. The greater the disadvantage --the greater the cost penalty of operating at less than MES -- the smaller the value of CDR and the higher the probability that plants will be of MES. A negative relationship was expected between CDR and relative plant scale. As was previously argued, the effect should be greatest where market size relative to MES is smallest. Tables 7 and 8 show that the cost disadvantage ratio for these industries (CDR1) was always negative -- whether nominal or effective tariffs were used to test the Eastman/Stykolt hypothesis -- and highly significant in both 1970 and 1979.

In an attempt to extend our understanding of the cost disadvantage ratio and its relationship to relative plant scale two extensions of the earlier results were derived. First, the U.S. cost disadvantage ratio -- USCDR -- was used to try and correct for distortions that may exist in the Canadian ratio as a result of truncation effects. Secondly, the cost disadvantage ratio for large markets only -- CDR2, CDR3, or CDR4 -- was added to test for non-linearities in the effect of this variable that were hypothesized earlier. The estimated regression results are not reported in detail, but only summarised briefly.[18]

When the influence of operating plants of less than MES is captured by the cost disadvantage ratio derived from the U.S. size distribution of plants (USCDR), the results very weakly agree with expectations -- the coefficient is always negative but highly insignificant (levels of significance, .43 to .54 in 1970 and .78 to .81 in 1979). It must, however, be remembered that USCDR is included for the whole sample of industries and not just for those where the market size was small. When the Canadian cost disadvantage ratio (CDR) is entered for all industries it also takes on a negative and insignificant sign -- .49 to .81 in 1970 and .48 to .88 in 1979. As Tables 5 and 6 show, USCDR and CDR are only very weakly correlated, a finding that agrees with Caves et al, (1980, pp. 57-58). Hence U.S. data does not seem to provide a significantly better proxy for the cost of operating plants of less than MES across the whole sample. This justifies our use of CDR only where market size (as measured by MESMSD) is small.

The regression results presented in equations 4 and 8 of Tables 7 and 8 show that the coefficients on CDR2 are always positive and statistically significant in both 1970 and 1979 although the coefficients drop in value. If CDR3 and CDR4 are each substituted for CDR2, in equations 4 and 8 the results are very similar to those recorded for CDR2, except for CDR4 - which has a negative and insignificant sign in 1979.[19] Thus where large markets are competitive (CDR2, CDR3), the cost disadvantage ratio is positively related to relative efficient scale; but where large markets are likely to be less competitive because of low import levels -- signifying natural barriers such as transportation or artificial barriers such as tariffs -- there is evidence that the cost disadvantage ratio, as measured by CDR4, has little impact upon relative plant scale in 1979 compared with 1970. This suggests that even in large markets, the lack of import competition may cause sub-optimal plants to exist.

Several inferences can be drawn from the examination of the relationship between the costs of operating small as opposed to large plants and relative plant scale. First, the cost disadvantage ratio estimated from the actual size distribution of Canadian plants is a reasonable approximation of the steepness of the long run average cost curve where markets are small. In large markets the cost disadvantage ratio more accurately reflects the ability of plants and firms to adjust to MES scale plant. In other words, across the sample of industries, one would not expect very high correlation between the cost disadvantage ratio estimated from actual plant size distribution and that derived from the engineering technique. This, in all probability, accounts for the general lack of significance CDR has had in previous studies addressing the same issues as at stake here (Muller, 1982). Second, the truncation effect as hypothesized by Caves et al (1980) does not appear to hold. Third, the relationship between the cost disadvantage ratio and relative plant scale does appear with one exception to be constant over time.

Trade Effects

In Tables 7 and 8, the impact of trade on relative plant scale was represented by the proportion of domestic disappearance accounted for by imports (IMP) and a measure of comparative advantage (CA). As predicted, a positive relationship is found between comparative advantage and relative plant scale, with the coefficients on CA insignificant in 1970 but significant in 1979.[20] The positive relationship between CA and relative plant scale is consistent with earlier work of Owen (1976) who examined relative plant scale in the context increased intra European Economic Community trade in the early 1960's. Imports, for which no *a priori* sign was specified, had a consistently negative impact upon relative plant scale in the 1970's, with the level of significance increasing between 1970 and 1979. This may be a reflection that as imports increase the industry in Canada consists of much smaller scale plants assembling and finishing the semi-finished products imported. For example, in the drug industry much of the bulk active ingredient, where there are significant scale economies, is imported, while dosage preparation, much smaller in scale, is conducted in Canada. Alternatively, these small scale plants may represent specialist firms filling particular niches in the market that may cater to Canadian tastes.

Evidence in Baldwin and Gorecki (1982) accords with this interpretation of imports and relative plant scale. First, the number of firms in an industry and the number of entrants are a positive function of import share. In other words, the distribution of firm size is skewed to the left for industries with large import shares thereby suggesting on average smaller firm size therein. Second, exits are negatively not positively related to import growth. Thus there are relatively fewer exits where import growth was high. While there were also fewer entrants, the net effect of import growth on exits minus entrants was negative. This too suggests imports negatively affected average firm size. Moreover, it explains why the effect of imports on the relative plant scale variable increased between 1970 and 1979 both in terms of the size of the estimated coefficient and its significance. This may be the fault of the adjustment process or of government policies which may have protected those industries most which suffered from the greatest import competition.

The analysis of the trade effects was taken a step further by the inclusion, in the regression analysis, of INTRA, a measure of intra-industry trade, and EXP the proportion of domestic production exported.[21] Intra-industry trade has the expected positive impact upon relative plant scale in 1970, but not 1979; however, this variable is statistically insignificant in both 1970 and 1979. This does not mean, however, that intra-industry trade has no impact upon the efficiency with which production is conducted. Much of the discussion of the impact of trade liberalization and intra-industry trade in Canada[22] refers to individual plants specializing in particular products, resulting in increased production runs and thus lower per unit costs. Hence if the dependent variable were some index of plant produced heterogeneity then a relationship with intra-industry trade may be observed. In future work on product diversity this issue will be examined.

Exports as a proportion of domestic production have a statistically insignificant impact upon relative plant scale in 1970. In 1979, however, EXP is weakly significant[23] with the predicted sign. Exports per se, only have a very weak influence on relative plant scale. Combined with the earlier results with CA, this suggests it is in industries in which Canada has a comparative advantage that exports have a significant influence.

The analysis conducted so far in this paper on the impact of trade on relative plant scale has utilized variables widely accepted in the examination of questions relating to trade, industrial structure and efficiency. Nevertheless in the course of the analysis conducted here it became apparent that these variables suffered a number of shortcomings for the purposes at hand. First, the intra-industry trade variable does not take into account the significance of trade flows relative to the size of the domestic market. For example, INTRA can equal 1 (i.e., imports = exports) yet this is consistent with imports accounting for 1 per cent or 60 per cent of the domestic market. We would expect that the impact upon relative plant scale would be much greater in the latter than in the former instance. Second, the impact of imports and exports is likely to be felt most strongly in import and export intensive industries. In other words, if imports are 20 per cent of the domestic market, the impact might be significantly less if exports are 30 per cent of domestic production rate than 2 per cent. To some extent, of course, CA captures these influences.

In order to investigate further the relationship between trade and relative plant scale we divided our sample of industries into three parts, depending upon whether the industry was export or import intensive or the trade flows were approximately equalized. The variables are defined as follows:

IMPDUM		set equal to one where CA is between 0 and 0.7, 0 otherwise.
INTRADUM		set equal to one where CA is between 0.7 and 1.3, 0 otherwise.
EXPDUM		set equal to one where CA is between 1.3 and 2.0, 0 otherwise.
IMPINT	=	IMP.IMPDUM -- imports as a share of domestic disappearance in industries which are import intensive.
INTRAINT	=	MATCH.INTRADUM -- trade where a high degree of intra-industry trade takes place, i.e., exports and imports are about the same.
EXPINT	=	EXPD.EXPDUM -- export as a share of domestic disappearance in industries where Canada has a comparative advantage.

where MATCH is set equal to twice the level of matched imports and exports in an industry[24] divided by the domestic market, while EXPD is the level of exports divided by domestic market. The common base or denominator, the domestic market, is used for the last three variables so that coefficients can be compared.

Using the classification outlined above to group industries on the basis of their import or export orientation, the 120 industry sample breaks down as follows:

Category	Number of Industries 1970	1979
IMPDUM = 1	73 (.254)	74 (.326)
INTRADUM = 1	27 (.341)	23 (.350)
EXPDUM = 1	20 (.546)	24 (.459)

where the numbers in parentheses represent the mean value of IMP, MATCH and EXPD for the import, intra-industry and export intensive industry categories, respectively. As can readily be observed, most industries are classified as import intensive (61-62 per cent) with the remainder split approximately equally between export and intra-industry intensive. Not surprisingly, the mean of IMP for import intensive industries and EXPD for export intensive industries substantially exceeds the mean for the sample.[25] For example, the mean value of IMP for industries where imports are significant is .254 in 1970 and .326 in 1979, but for the sample as a whole, the corresponding proportions are .212 and .256 (Table 4), respectively.

Turning now to our regression results these can be summarized as follows.[26] Imports (i.e., IMPDUM and IMPINT) had a negative impact upon relative plant scale that was weakly significant in

1970 but significant in 1979.[27] This result is consistent with that reported in Tables 7 and 8 for IMP. Exports -- as captured by EXPDUM and EXPINT -- was statistically insignificant in 1970 but in 1979 EXPDUM had a positive impact which was statistically significant.[28] Given our earlier results we may therefore hypothesize that exports matter particularly in industries where Canada has a comparative advantage, but less elsewhere. Finally, our results for intra-industry trade reveal that it matters little, consistent with our earlier finding. Indeed, it was weakly negative in 1970, contrary to expectations.[29] The significance of imports and exports in 1979, but not 1970 is consistent with our earlier suggestion that some sort of disequilibrium process was at work in 1970 that may have obscured long term relationships.

The results show certain similarities and differences with previous work in the same general area (Muller, 1982). Imports had no significant impact in these studies, which generally referred to the 1960's. Hence import competition appears to have a measurable impact in the 1970's, particularly the late 1970's, but not previously. Exports, by contrast, had a significant positive impact in some studies for the 1960's, but in others no impact. Exports here as indicated by EXP had a weakly positive impact in 1979, but comparative advantage, CA, and exports in those industries in which Canada had a comparative advantage (EXPDUM) had a strong positive impact in 1979. Previous studies tended to use EXP, although one used CA. Hence, exports matter, but particularly where Canada has a comparative advantage, rather than across the board. No previous work has been reported using INTRA, although given its insignificance perhaps this was an unreported result. The main advances in our understanding respecting trade are threefold: a better understanding of the way exports impact upon relative plant scale; the impact of imports which appears to be a development of the 1970's; and the lack of impact of intra-industry trade.

Other Variables

Although our interest has centred around questions of the relationship between relative plant scale and foreign ownership, trade tariffs and size of market, the regression analysis presented so far has included a number of variables that were thought to be, potentially at least, important determinants of relative plant scale. These variables were RD and ADVDM -- two variables traditionally used as barriers to entry; REG, a dummy variable --with a value of 1 for regional industries; and MARCVA, which is meant to capture the ability of large and small plants to coexist. These variables generally perform badly: REG is never remotely significant; MARCVA is usually wrongly signed (positive) and weakly significant; ADVDM while usually correctly signed (negative) is only significant in 1979; and RD is not significant in 1970 or 1979.

5. REGRESSION RESULTS: CHANGES IN THE 1970's

Introduction

In this section of the paper our primary focus is on the relationship between changes in relative plant scale and the independent variables introduced and discussed above. A number of issues need to be resolved before regression analysis can be conducted. These are discussed in the next part of the paper.

Some Methodological Issues

In this section we discuss three issues. The first is the correct specification of the dependent variable -- percentage point change (i.e., EFF1T79-EFF1T70), percentage changes (i.e., (EFF1T79-EFF1T70)/(EFF1T70)), and closing the gap between actual relative plant scale and that attainable (i.e., (EFF1T79-EFF1T70)/(1-EFF1T70)) -- and the independent variables --levels, percentage point changes, percentage changes and interactions between levels and changes. The second issue is the appropriate specification of the relationship of the determinants of changes in relative plant scale. The third issue is the set of the variables that should be included in the regression analysis.

The dependent variable employed here is the percentage point change in the level of relative plant scale over the period 1970 to 1979. More formally we define:

EFF1T = EFF1T79 - EFF1T70

The dependent variable is specified in this form because of our concern with the degree to which trade, tariffs and other variables have led to improvements in relative plant scale. Implicit in this view is that moving from a relative plant scale index of .10 to .20 is as important as a movement from .90 to 1.00 over the same period. In contrast, if the percentage change in EFF1T or the closing of the gap between actual and "ideal" levels of relative plant scale is used as the dependent variable, then these two examples will result in different values for changes in relative plant scale.

The independent variables will be defined in an analogous manner to EFF1T, as the first difference of the 1979 and 1970 values. Several of the independent variables are defined in such a way that they experience no change over the period 1970 to 1979 -- REG, MARCVA --and hence will not be included in the analysis of the determinants of changes in relative plant scale. In terms of notation the letters DIF or DF will replace the year to indicate the first difference. Hence, for example, IMP70 is replaced by IMPDIF. Since the results in the previous section were broadly similar for the effective and nominal tariff rate versions and, furthermore, since we believe, *a priori*, it is more sensible to use effective tariffs, only the latter will be used in the first difference equations.

The specification of the appropriate relationship for the determinants of relative plant scale is straightforward in light of the estimating equations chosen for the previous regressions and the adoption of changes in the efficiency variable EFF1T as the dependent variable. The appropriate specification is:

$$EFF1T = b_0 + b_1 \Delta X$$

where X is a vector of first differences of the variables that were previously found to be significant. The earlier results did show a certain non-linearity -- at least with respect to the Eastman/Stykolt hypothesis. Therefore, it is postulated that the effect of changes in some independent variables -- market size, tariffs, foreign ownership and concentration -- will depend upon whether the industry initially fell into that subset where the Eastman/Stykolt effect was most relevant. Thus the estimating equation becomes:

$$EFF1T = b_0 + b_1 \Delta X + b_2 H + b_3 \Delta X \cdot H$$

where H is a dummy variable set equal to 1 when the industry falls in the high concentration/high tariff or high concentration/high tariff/high foreign ownership category in 1970.

The independent variables selected for the regression analysis were those that were significant in either 1970 or 1979 and exhibited a change between these years. The first differences of variables previously included in our analysis are shown in Table 10 together with their means, standard deviations and expected signs. Concentration and advertizing showed, not surprisingly, little change, with all the trade variables showing much more movement. However, CONDIF showed substantial variation about its mean as did IMPDIF. The remaining variables in Table 10 require more explanation.

Our discussion of the cost disadvantage ratio suggested that this variable only had an influence on relative plant scale in those industries with MESMSD less than its mean. Hence, we define,

CDR1DIF	where MESMSD70 is less than its mean, CDR1DIF is set equal to CDR79-CDR70, 0 otherwise.

All other variables introduced to capture the cost disadvantage ratio, whether based on Canadian or U.S. data have been eliminated since they added little to the previous analysis. CDR1DIF shows very little change, on average, but has a very high standard deviation relative to its mean.

The testing of the Eastman/Stykolt hypothesis in the first difference form requires the creation of several new variables. First, a group of variables are introduced to reflect the previous finding that the effect of market size depended upon whether an

Table 10

Means and Standard Deviations of Independent Variables Across 120 Canadian Manufacturing Industries Used in Analysis of Changes in Relative Plant Scale: 1970-1979.

VARIABLE	MEAN	STD DEV	EXPECTED SIGN
CONDlF	-.007	.083	+
ADVDMDF	-.002	.005	-
IMPDIF	.043	.079	-
CADIF	.014	.289	+
INTRADF	-.014	.218	+
MESMSDlF	3.154	7.883	+
CDRlDlF	.006	.288	-
EASTFVDF	.112	.707	+
EASTVDlF	.170	.955	+
EHCFDF	-.010	.405	-
EHCDF	-.012	.405	-
FORHCVDF	.000	.036	+
CONFCVDF	-.000	.028	-
CONHCVDF	.000	.032	-

Source: Statistics Canada. See Appendix A for details. (Vol. 9).

industry was protected by high tariffs and was highly concentrated:

EASTFVDF = HVTRCRFO · MESMSDIF -- market size change for high effective tariffs/high foreign ownership/ high concentration industries.

EASTVDIF = HVTRHCRO · MESMSDIF -- market size change for high effective tariff/high concentration industries.

Table 10 shows that in all cases MESMSD increased over the time period 1970 to 1979 for high tariff/high concentration/high foreign ownership industries. If we confine our attention solely to such industries (i.e., HVTRCRFO = HVTRHCRO = 1) then the mean value of MESMSDIF is as follows (with standard deviation in parenthesis):

Mean Value of MESMSDIF

Category	Tariffs Effective
high tariff/high concentration	1.575 (1.717)
high tariff/high concentration/ high foreign ownership	1.123 (2.044)

The values are much lower than for the 120 industry sample (Table 10). This is not surprising since it would require a much greater percentage increase in the size of the industry for concentrated industries to yield the same change in MESMSD as was found in unconcentrated industries. A positive relationship is expected to be found with EFF1T.

Our earlier results also suggested that effective tariffs had little impact outside industries characterized by both high tariffs and high concentration or high concentration/high foreign ownership. Hence, we define,

EHCFDF = ERPDIF · HVTRCRFO -- effective tariff rate change for high effective tariff/high concentration/high foreign ownership industries.

EHCDF = ERPDIF · HVTRHCRO -- effective tariff rate change for high effective tariff/high concentration industries.

Table 10 shows such industries experienced declines in tariffs in the decade of the 1970's. If we confine our attention solely to the high tariff/high concentration/high foreign ownership industries, then the mean of ERPDIF is as follows (with standard deviation in parenthesis):

Mean Value for Tariff Changes

Category	Tariffs Effective
high tariff/high concentration	-.076 (1.039)
high tariff/high concentration/ high foreign ownership	-.104 (1.327)

Since the average value of ERPDIF across the 120 industry sample was -.017 it can be seen that these industries experienced substantially higher declines in tariffs. In general we would expect a negative relationship between changes in tariffs in the high tariff/high concentration/ high foreign ownership industries and in EFF1T.

The results presented above also suggested that foreign ownership had little influence outside industries characterised by both high foreign ownership and high tariffs/high concentration. Hence we define:

FORHCVDF = FORDIF · HVTRCRFO -- foreign ownership changes in high effective tariff/high concentration/high foreign ownership industries.

As Table 10 shows, such industries experienced an increase in the share of foreign ownership during the 1970's, while the average value of FORDIF across the 120 industry sample declined slightly -.033. If we confine our attention only to those industries characterized by high concentration/high foreign ownership/high tariffs, then FORDIF is on average .003 (.119) where the standard deviation is in parenthesis. We would expect a positive relationship with EFF1T in light of our earlier results.

Finally, our earlier results suggested that concentration had a positive impact on relative plant scale, but that when high con-

Table 11

Correlation Matrix Of Independent Variables Across
120 Canadian Manufacturing Industries: 1970-79

	CONDIF	ADVDMDIF	EASTFVDF	CDR1DIF	MESMSDIF	IMPDIF	CADIF	EASTVDIF	EHCFDF	EHCDF	FORHCVDF	CONFCVDF	CONHCVDF	HVTRHCRO	HVTRCRFO
CONDIF	1.000	0.021	-0.028	-0.125	0.167	0.179	-0.268	0.045	-0.025	-0.022	0.141	0.338	0.385	0.042	0.013
ADVDMDIF		1.000	-0.061	-0.035	0.092	0.029	-0.084	-0.073	0.016	0.023	-0.147	0.110	0.053	-0.243	-0.150
EASTFVDF0			1.000	-0.135	0.028	0.019	0.077	0.732	-0.399	-0.398	-0.055	0.044	0.036	0.367	0.478
CDR1DIF				1.000	-0.056	-0.100	-0.044	-0.093	0.229	0.224	0.021	0.063	0.004	-0.078	-0.143
MESMSDIF					1.000	-0.180	-0.039	0.053	-0.026	-0.023	-0.009	0.009	0.007	-0.115	-0.086
IMPDIF						1.000	-0.190	0.052	-0.001	-0.001	0.060	0.195	0.154	-0.031	-0.045
CADIF							1.000	-0.018	0.136	0.134	-0.186	-0.331	-0.266	0.029	0.086
EASTVDIF								1.000	-0.294	-0.287	-0.041	0.033	0.077	0.413	0.334
EHCFDF									1.000	0.999	-0.398	-0.069	-0.061	-0.060	-0.078
EHCDF										1.000	-0.397	-0.069	-0.052	-0.069	-0.076
FORHCVDF											1.000	0.412	0.364	0.022	0.029
CONFCVDF												1.000	0.883	-0.030	-0.039
CONHCVDF													1.000	0.012	-0.040
HVTRHCRO														1.000	0.769
HVTRCRFO															1.000

Source: Statistics Canada. See Appendix A for details. (Vol. 9).

centration was combined with high tariffs or high tariff/high foreign ownership, the relationship was negative. In order to capture this we introduce:

CONFCVDF = CONDIF · HVTRCRF0 -- change in concentration in high concentration/high foreign ownership/high effective tariff industries.

CONHCVDF = CONDIF · HVTRHCR0 -- change in concentration in high concentration/high effective tariff industries.

A negative relationship is expected between these variables and EFF1T. Table 10 shows that concentration in such industries changes very little. Indeed, if we confine our attention to such industries, the average value of CONDIF (with the standard deviation in parenthesis) is as follows:

Mean Value for Concentration Change

Category	Tariffs Effective
high tariff/high concentration	.001 (.082)
high tariffs/high concentration/ high foreign ownership	-.004 (.092)

Regression Results

Table 11 presents the correlation matrix among the independent variables while Table 12 presents the regression results. Our initial attention will be confined to equations 1 and 2 of the

Table 12

Concentration, Effective Tariffs,[1] Foreign Ownership and Changes in Relative Plant Scale: Regression Results Across 120 Canadian Manufacturing Industries, 1970 - 1979

Equation #	Coeff (1)	Sign (1)	Coeff (2)	Sign (2)	Coeff (3)	Sign (3)	Coeff (4)	Sign (4)	Coeff (5)	Sign (5)	Coeff (6)	Sign (6)	Coeff (7)	Sign (7)
Constant	0.080	0.10	0.024	0.67	0.059	0.17	0.056	0.20	0.058	0.18	0.057	0.19	0.057	0.18
Trade														
IMPDIF	-1.778	0.0002	-1.900	0.0001	-1.697	0.002	-1.713	0.0002	-1.709	0.0002	-1.710	0.0002	-1.707	0.0002
CADIF	0.267	0.04	0.221	0.09	0.271	0.03	0.261	0.04	0.267	0.04	0.266	0.03	0.268	0.03
Barriers to Entry														
MESMSDF	0.023	0.0000	0.023	0.0000	0.024	0.000	0.024	0.000	0.024	0.0000	0.024	0.0000	0.024	0.0000
ADVDMDIF	3.907	0.60	4.794	0.51	-	-	-	-	-	-	-	-	-	-
CONDIF	2.233	0.0000	2.289	0.0000	2.268	0.000	2.260	0.0000	2.248	0.0000	2.236	0.0000	2.243	0.0000
Truncation														
CDR1DIF	-0.091	0.47	-0.092	0.45	-	-	-	-	-	-	-	-	-	-
Eastman/Stykolt														
EASTFVDF	0.015	0.82	-	-	-0.020	0.70	-	-	-	-	-	-	-	-
CONFCVDF	-0.221	0.88	-	-	-	-	-	-	-0.133	0.92	-	-	-	-
EHCFDF	-0.312	0.007	-	-	-0.368	0.0001	-	-	-0.353	0.0000	-	-	-0.341	0.0003
FORHCVDF	0.697	0.58	-	-	-	-	-	-	-	-	-	-	0.353	0.73
HVTRCRFO	-0.112	0.41	-	-	-	-	-	-	-	-	-	-	-	-
EASTVDIF	-	-	0.023	0.57	-	-	0.010	0.78	-	-	-	-	-	-
CONHCVDF	-	-	-0.002	0.99	-	-	-	-	-	-	0.211	0.86	-	-
EHCDF	-	-	-0.308	0.0001	-	-	-0.342	0.0002	-	-	-0.349	0.0001	-	-
HVTRHCRO	-	-	-0.110	0.30	-	-	-	-	-	-	-	-	-	-
$\bar{R}^2$	.4444	0.0000	.4593	0.0000	.4616	0.0000	.4595	0.0000	.4610	0.0000	.4593	0.0000	.4615	0.0000

Note: For each variable the table presents its estimated regression coefficient (Coeff) and level of statistical significance (Sign). The tests of significance are one-tailed.

1 Effective tariffs used to delimit Eastman/Stykolt hypothesis.

Source: Statistics Canada. See Appendix A for details (Vol. 9).

last two tables. As with our earlier discussions, we present the results with the Eastman/Stykolt terms specified using only effective tariffs (Table 12). The high tariff/high concentration (equation 2) and high tariff/high concentration/high foreign ownership (equation 1) specifications of the Eastman/Stykolt relationship were entered separately because of the high correlation between the terms noted in Table 10.

Table 12 confirms the earlier result that market size is an important determinant of relative plant scale. The coefficient attached to MESMSDIF is positive and highly significant with a value substantially above that obtained in cross section results reported earlier. If MESMSDIF is the only independent variable in the regression equation then the adjusted R^2 is 0.2308. Hence, market size is the most important determinant of changes in relative plant scale.

The differential impact of MESMSDIF in high tariff/high concentration and high tariff/high concentration/high foreign ownership industries is measured by the introduction of terms such as EASTFVDF. The predicted sign, positive, is always observed but the coefficient is statistically insignificant, when entered with all the independent variables (Equations 1 and 2 of Tables 12). Part of the reason may be the correlation between EASTFVDF and several of the explanatory variables.[30] Equations 3 and 4 test for this possibility by excluding the insignificant variables in equations 1 and 2 but retaining EASTFVDF, EASTDIF etc. The results suggest that changes in market size in high tariff/high concentration and high tariff/high concentration/high foreign ownership, although usually correctly signed is rarely significant.

Lower effective tariffs in high tariff/high concentration and high tariff/high concentration/high foreign ownership industries lead to an increase in relative plant scale. Furthermore the coefficient is statistically significant for both EHCDF and EHCFDF (Equations 1 and 2 of Table 13). Hence, in high tariff/high concentration industries the impact of tariff reductions is, generally, to increase relative plant scale.

One of the assumptions made in specifying the equations in Table 12 was that effective tariffs had no impact outside high tariff/high concentration and high tariff/high concentration/high foreign ownership industries. This assumption was based upon an earlier finding concerning the cross-section regression results. In view of the significance of tariffs to our work, we decided to see if this assumption is indeed verified in first difference form. In general the results in the first difference form were consistent with our assumption.[31]

Increases in concentration (CONDIF) exert the expected positive response on relative plant scale, which is always highly statistically significant. In high concentration/high tariff and high concentration/high tariff/high foreign ownership industries decreases in concentration exert the expected positive influence on relative plant scale. However, the coefficient is insignificant (Equations 1 and 2 of Table 12). Inspection of the correlation matrix in Table 10 and equations 5 and 6 of Table 12 suggest that collinearity does not provide an explanation for the insignificance. In summary, changes in the concentration variable has the expected positive impact upon relative plant scale but there is no strong evidence that in high concentration/ high tariff/high foreign ownership industries a change in concentration has a significant impact.

The final variable capturing the influence of the Eastman/ Stykolt hypothesis is the change in foreign ownership in high concentration/high tariff/high foreign ownership industries. Equation 1 (Table 12) shows a positive relationship with respect to foreign ownership, but it is not statistically significant. Removing the insignificant variables except FORHCVDF still leaves foreign ownership insignificant (equation 7 Table 12). Hence our results suggest that foreign ownership has an impact in addition to high tariffs and high concentration that results in increased relative plant scale, but the relationship is not very significant. Finally, our earlier assumption, derived from the cross-section results, that changes in foreign ownership had no impact outside industries for which HVTRCRFO = 1 was confirmed -- although FORDIF was usually positive it was insignificant.[32]

In summary, increases in market size and concentration, across the whole sample, lead to increases in relative plant scale. In high concentration/high tariff industries, only decreases in effective tariff protection significantly improved relative plant scale efficiency. Changes in concentration or market size had negative and positive effects as expected but they were not significant. Thus tariff policy offers the most efficacious method of overcoming sub-optimal scale problems in concentrated industries. Increases in foreign ownership had a positive, but insignificant impact on relative plant scale in high concentration/high tariff/ high foreign ownership industries (but no impact outside these industries, as predicted).

The final set of variables are those capturing the impact of trade upon relative plant scale. In Table 12 two such variables are introduced -- changes in the level of imports (IMPDIF) and changes in comparative advantage (CADIF). In both instances the sign of the coefficients attached to those variables are consistent with the cross-section results -- increases in imports result in a fall in relative plant scale while the converse applies to comparative advantage. Given the importance of trade to our analysis we examined some of the variables which, a priori, should be significant but in the cross-section were not. The results can be summarized as follows: if INTRADIF is included instead of IMPDIF and CADIF in equations 1 and 2 of Table 12, it is highly insignificant; and, EXPDIF had a positive impact upon relative plant scale which was highly insignificant.

6. SUMMARY AND CONCLUSIONS

Canadian productivity in manufacturing industries has and continues to lag behind that of the U.S. One of the causes of this disparity is commonly considered to be the small size of plants in Canada. However, much recent literature suggests that the plant size problem is not that important because U.S./Canadian plants seem of fairly equal size. Yet policy suggestions continue as to how Canadian plant sizes can be increased thus realising reductions in per unit cost because of scale economies: government assistance to encourage merger and rationalization; increased protection to enable scale economies to be captured while imports are kept at bay -- the infant industry argument; and, finally, continued multilateral reduction in tariffs which will increase competition and provide access to larger markets.

This paper has attempted to extend our understanding of the impact of trade and tariff changes in the 1970's -- following upon the Kennedy Round -- upon the size distribution of plants in Canada. In particular our attention was concentrated upon the size of larger Canadian plants relative to larger U.S. plants.[33] The U.S. large plant size was taken to be the indicator of minimum efficient size -- the smallest size of plant that minimizes unit production costs.

The paper has several advantages over previous work which make its findings of particular interest: the sample of industries, 120, is much larger than used in earlier work; problems of confidentiality that plagued these studies were not present because access to such data was provided by special arrangement with Statistics Canada; and since data for two years -- 1970 and 1979 -- were used, the stability of relationships could be examined. The confidentiality problem is likely to be of particular importance because it is in precisely the high concentration industries that inefficiency is likely to be of importance, and it is these industries that have been lacking data in the past.

Our findings on relative plant scale -- the ratio of larger Canadian to larger U.S. plants -- showed that, on average, this ratio was 0.691 in 1970 and 0.736 in 1979. The corresponding weighted averages -- using employment weights -- were 0.762 and 0.818. These averages suggest, contrary to recent literature, that there is a scale problem and that is more important in small rather than large industries.

One problem with average ratios -- whether weighted or unweighted -- is that the implicit assumption is being made that plants larger than MES somehow offset instances where the converse is the case. However, if the cost curve is "L" shaped then placing equal weights on values of relative plant scale that are above and below unity by calculating the average ratio is inappropriate, since costs above MES are assumed to be constant. Hence, relative plant scale was re-estimated, but set in all instances in which Canadian plants were greater than MES, equal to unity. The resulting unweighted averages are 0.560 and 0.605 in 1970 and 1979, respectively, while the corresponding weighted averages are 0.608 and 0.641. This suggests that lack of appropriate scale is of much more significance than simple averages suggest.

One of the major determinants of relative plant scale in 1970, 1979 and over time, is the size of the Canadian market. The larger the market the greater the value of relative plant scale. The coefficient attached to the market size variable implies that if Canada were to enter a bilateral free trade area with the U.S. the size of the market adjacent to Quebec and Ontario would raise the mean value of the relative plant scale index to unity.

Much of the literature on the Canadian manufacturing sector has devoted itself to the impact of tariffs and trade on productivity and efficiency. In particular the Eastman/Stykolt model postulates in high tariff/high concentration industries relative plant scale will be adversely affected. Our results are generally consistent with this model. However, outside these industries tariffs usually have little or no impact, while concentration exerts an independent influence resulting in increased relative plant scale.

Turning now to trade we find that exports per se had only a weak positive impact upon relative plant scale, which was particularly significant in industries for which Canada has a comparative advantage. Indeed, a positive association is found between comparative advantage and relative plant scale. Imports have a negative impact upon relative plant scale -- the more of the Canadian market accounted for by imports the lower relative plant scale. This may be the result of Canadian plants operating in small specialized niches, government aid and assistance slowing the adjustment process and/or a change in the nature of industry to more of a finishing or assembly operation. Intra-industry trade had no measurable impact, a somewhat surprising result. This may be because intra-industry trade impacts mostly on production runs, a topic we intend to investigate in future work.

Our final area of research concerned the impact of foreign ownership. Outside of high tariff/high concentration/high foreign ownership industries the impact of foreign ownership is not statistically significant, although it does change in sign from negative to positive between 1970 and 1979. In such industries -- high tariffs/high foreign ownership/high concentration -- foreign ownership seems to exert a negative influence in 1970 in small markets (i.e., the most concentrated), but by 1979 foreign ownership reduced the extent of sub-optimality brought about by tariff protection of oligopolistic markets. In sum, foreign ownership per se does not exacerbate the degree of sub-optimal plant size.

The policy implications of the paper can be related to the debate over the impact of trade liberalization upon relative plant scale -- are the benefits proclaimed by the free trade advocates realised or have the fears of these who suggest much more caution about trade liberalization been correct. Unfortunately, we are not able to answer these issues unequivocally. Nevertheless our evidence does suggest that some light can be thrown on the debate.

On the one hand; increases in market size lead to substantial increases in relative plant size, suggesting substantial gains for a U.S./Canada free trade area; Canadian industry takes advantage of areas in which it has a comparative advantage leading to larger plant sizes; while tariff reductions in high tariff/high concentration industries -- which suffer considerably from small size -- results in increased relative plant scale. These findings are consistent with those who preach the benefit of trade liberalization.

However, to be set against these advantages are the results we have found of increasing imports. In particular imports had a negative impact upon relative plant scale. Several explanations were put forward. Some suggest successful adaption which indicate a change in the character of the industry -- a switch to finishing and assembling in order to serve market niches -- while others suggest that government assistance to ailing firms may have slowed the adaption process. At this stage in the research it is not possible to distinquish between the three explanations, although clearly all three are likely to have an impact. Nevertheless the consistently negative sign may force us to reconsider the impact of imports. In addition the much vaunted easy adjustment mechanism of intra-industry had no impact. However, that may be because intra-industry trade impacts upon production runs rather than plant size.

On balance, then, our research supports those who advocate freer trade and points out the problems and inefficiencies of a continuation of high tariffs combined with high concentration. Nevertheless the import results suggest that the process may not be proceeding to increase relative plant size everywhere.

Appendix A

Data Base: Sources and Definitions

The study of relative plant scale draws upon two basic data sources: Statistics Canada and the U.S. Bureau of the Census. Statistics Canada assembled a special data base which drew together many series from different parts of the organization. Several features should be noted of the resultant data base. First, several of the series are unpublished and, available, for only a limited number of years. Second, the data base consisted of all observations for a given variable, no matter whether the particular observation is confidential within the meaning of the Statistics Act or not. For example, if there were only two firms in an industry, Statistics Canada would not publish concentration ratios for such industries. (However, as noted in the text, although the authors had access to such a data base all the material presented in this discussion paper was vetted carefully for confidentiality disclosure). The U.S. data were supplied by R. Caves of Harvard University.

In comparing U.S. and Canadian variables, industry definitions had to be made compatible. The Canadian classification system used was at the 4-digit level based on the 1970 Standard Industrial Classification. The U.S. system of classification was somewhat finer than the Canadian. Hence in a number of instances several U.S. industries had to be combined to form the corresponding Canadian industry. An important source in this exercise was Department of Industry, Trade and Commerce (1971). Table A-1 provides the concordance between the two classification systems as well as the weights that could be applied to generate U.S. industry variables for the Canadian definition. Four different weights are shown -- sales, assets, employment and value added. The size dimension selected was sales. Causal inspection of the different weights suggests that they are, on the whole, very similar. For example, Canadian industry 1011, Slaughtering and Meat Processors consisted of three U.S. industries, 2011, 2013 and 2077 of which 2011, Meat Packing Plants, was by far the most significant. Although the Canadian 4-digit SIC system divides the manufacturing sector into 167 industries concordance between U.S. and Canadian definitions was possible in only 125 instances.

Although the Statistics Canada data are based upon the 1970 4-digit SIC, in a number of instances, series were provided at a more aggregative level of classification. Two systems were used. First, data series derived from input-output tables used a classification system that divided the manufacturing sector into 122 industries. Second, in a number of instances, such as the R&D statistics, the 3-digit level of classification, which divides the manufacturing sector into 112 industries, was used. Typically all the 4-digit constituent industries of a given input/output or 3-digit industry are assumed to have an equal value for the data series provided, which are typically ratios. Exceptions are noted in the text. Table A-2 provides the three levels of industry classification and a concordance.

The remainder of the appendix consists of a detailed description and definition of the variables used in the paper. Since, in many instances, the series are not published we refer to the unit or division within Statistics Canada from where the data was derived. Unless otherwise stated the variable is defined at the 4-digit level of classification and is available for 1970 and 1979.

ADVDM — is the advertising/sales ratio for consumer non-durable goods industries, 0 otherwise. The advertising/sales ratio was provided by the Structural Analysis Division of Statistics Canada, from the Input/Output tables (i.e., the industry classification used in Col. (3) in Table A-2). The underlying data for the ratio on advertising have been collected at the company[1] level by a 1974 Survey. If the company produced output in only one industry then the advertising expenditures were attributed to that industry, otherwise, they were split among the various industries in which the company produced. Modification of this ratio, from information provided by CALURA (Corporation and Labour Union Returns Act) and Business Finance Data, were applied to other years. Data were available for ADVDM for 1975 rather than 1970.

AVSZ — average plant size measured in terms of total activity value of shipments. Data provided by Manufacturing and Primary Industries Division. See VS for further details.

AVSZT — average size (measured in total activity value shipments) of the smallest number of the largest plants accounting for 50 per cent of industry employment. Data provided by

Manufacturing and Primary Industries Division. See VS for further details.

AVSZB — average size (measured in total activity value of shipments) of the largest number of the smallest plants accounting for 50 per cent of industry employment. Data provided by Manufacturing and Primary Industries Division. See VS for further details.

CA — is one plus (exports minus imports divided by the sum of exports plus imports). The import and export data was provided by the External Trade Division, Trade of Canada, Statistics Canada. The import data is collected by Canadian Customs. The Custom's values are identical to the selling prices for most transactions, with exceptions occuring for transactions among company affiliates where adjustments are made such that the Custom's value may exceed company transfer prices. Imports are measured free on board (f.o.b.) which is the price as exported from the home base and does not include transportation costs. Some imports from the U.S., however, are purchased on a delivered basis and their prices will reflect an allowance for transportation. Exports are recorded at the values declared on export documents which reflects the actual selling price (and in the case of non-arms length transactions at the transfer price used for company accounting purposes). Most exports are valued at the place in Canada where they are loaded onto a carrier for export.

The trade data are collected at the commodity level and were aggregated to the 4-digit SIC (industry) classification by the External Trade Division. Typically a commodity is allocated completely to the industry to which it is primary.

A number of approximations or adjustments had to be made to the data supplied by External trade. First, in a number of cases, the data for a given 4-digit SIC was not presented in the raw data supplied. This required different sorts of approximations, depending on the nature of the "missing" data. For the 21 industries concerned the details are as follows:

SIC	APPROXIMATION	SIC	APPROXIMATION
1831	A	3241	C
1832	A	3242	C
1871	B	3243	C
1872	B	3511	C
1880	B	3512	C
2391	A	3541	B
2392	A	3542	B
2611	B	3549	B
2619	B	3791	C
3031	C	3799	C
3039	C		

A = Prorating 3-digit trade data to 4-digit level on basis of 4-digit industry sales (e.g., data supplied for 1830, which then used was to generate observations for 1831 and 1832).

B = Data provided at 3-digit level and for some of constituent 4-digit industries. The 3-digit trade is prorated in the same way as A (e.g., data was provided for 1870 and 1871. The 1870 data was then prorated to 1871 and 1872).

C = Same as B except data were provided for all of constituent 4-digit industries, within a 3-digit industry. In other words the residual that could not be allocated to particular 4-digit industries is prorated from the 3-digit industry as in A.

In the case of approximation C (9 of 21) the prorating was often minor because it is only the unallocated residual at the 3-digit level which is a problem. In other words, apart from 4 type A approximations and 8 type B, which may be somewhat crude, the data set should be a close match at the 4-digit.

Second, for one industry exports exceeded domestic production by such a margin (180 per per cent in 1971) to suggest that the classification of export commodities to that 4-digit industry was incorrect. Further investigation suggested one commodity should be relocated. This was confirmed in conversations with responsible persons within Statistics Canada.

The import and export data were available for 1971 rather than 1970. In estimating IMP and EXP the 1971 data was converted to 1970 dollars using the gross output price index. See GPINX for further details.

CDR	is the ratio of value-added per man hour of the smallest plants accounting for 50 per cent of industry employment divided by the value added per man hour for the largest plants accounting for 50 per cent of industry employment. It was derived directly from data supplied on the size distribution of plants by the Manufacturing and Primary Industries Division.
CDR1	where MESMSD is less than its median, CDR1 is set equal to CDR, 0 otherwise. See MESMSD and CDR for further details.
CDR2	where MESMSD is greater than its median, CDR2 is set equal to CDR, 0 otherwise. See CDR and MESMSD for further details.
CDR3	where the industry is national (REG = 0) and MESMSD is greater than its median, CDR3 is set equal to CDR, 0 otherwise. See CDR, MESMSD and REG for further details.
CDR4	where the level of imports (IMP) is less than its mean and MESMSD is greater than its median, CDR4 is set equal to CDR, 0 otherwise. See CDR, IMP and MESMSD for further details.
CON	is the proportion of industry shipments accounted for by the four largest enterprises. This was provided by the Manufacturing and Primary Industries Division.
EASTFN	HNTRCRF•MESMSD. See HNTRCRF and MESMSD for further details.
EASTFV	HVTRCRF•MESMSD. See HVTRCRF and MESMSD for further details.
EASTN	HNTRHCR•MESMSD. See HNTRHCR and MESMSD for further details.
EASTV	HVTRHCR•MESMSD. See HVTRHCR and MESMSD for further details.

EFF1 AVSZ/USMES. See AVSZ and USMES for further details.

EFF1B AVSZB/USMES. See AVSZB and USMES for further details.

EFF1T AVSZT/USMES. See AVSZT and USMES for further details.

ERP is the effective tariff in an industry. The variable was estimated by the Structural Analysis Division from input/output data (i.e., industry classification used in col. (3) in Table A-2) and 1978 is the latest year for which the variable is available. The variable is calculated to take into account exports, indirect taxes and subsidies in an industry. It was estimated using the Wilkinson and Norrie (1968) definition of effective tariff protection. More specifically the basic equation is:

$$G_j = \frac{V_j' - V_j}{V_j'}$$

where V_j' is the value-added/unit of output under protection and V_j is the value-added/unit of output after protection has been removed.

The equation estimated was:

$$\frac{(1-\sum_{i=1}^{n} a_{ij}) - \left[(\frac{1+b_j t_j}{1+t_j}) - (\sum_{i=1}^{n-2} \frac{a_{ij}}{1+ti}) \right]}{1 - \sum_{i=1}^{n} a_{ij}}$$

where: a_{ij} (the input coefficient) is the value of the ith input into the jth industry as a proportion of the value of the jth industry's output, at protected prices; t_i is the nominal tariff rate of the commodity; t_j is the nominal tariff rate of the jth industry; and b_j is the proportion of industry output exported.

To account for the impact of indirect taxes and subsidies the input coefficients from the input/output tables are summed from 1 to n-2. In the Wilkinson and Norrie study the tobacco and alcohol industries were excluded because import duties and excise taxes could not be separated. The data used here excluded all excise taxes and hence these industries are included.

In the input/output tables imports are defined to be the producers values which excludes costs, insurance, freight and import duties at the Canadian border. Because imports are measured f.o.b. it was necessary for the effective rate of protection to calculate estimates of transportation and insurance charges. Exports are valued at producer prices and all values in the input/output tables are measured at current prices. The producer price is the selling price at the boundary of the producing establishment excluding taxes.

EXP — is the proportion of domestic production (i.e., VS) that is exported. See CA for further details.

FOR — is the proportion of industry shipments (i.e., VS) accounted for by foreign owned enterprises. An enterprise is defined as foreign controlled if there is effective foreign control, although the percentage of stock owned by a foreign corporation may be less than 50 per cent. The data was supplied by Multinational Enterprise Division.

GPINX — The Gross Output Price Index for an industry was provided by the Industry Product Division of Statistics Canada and is estimated from the data provided in the Census of Manufacturers from shipments of commodities from an industry and from the industry selling price index that is available for most commodities. The commodities without a selling price index are grouped with 'similar' commodities to provide an estimated price index. The Gross Output Price Index is computed for the majority of the industries at the 4-digit level.

HNTRCRF — is a dummy variable that is equal to one when concentration (CON), nominal tariff protection (NRP) and foreign ownership (FOR) are high (where these variables are greater than their respective means), 0 otherwise. See NRP, CON and FOR for further details.

HNTRHCR — is a dummy variable that is equal to one when both concentration (CON) and nominal tariff protection (NRP) are greater than their respective means, 0 otherwise. See CON and NRP for further details.

HVTRHCRF — is a dummy variable that is equal to one when concentration (CON), effective tariff protection (ERP) and foreign ownership (FOR) are high (where these variables are greater than their respective means), 0 otherwise. See CON and ERP for further details.

HVTRHCR — is a dummy variable which is equal to one when both concentration (CON) and effective tariff protection (ERP) are greater than their respective means and 0 otherwise. (See CON and ERP).

IMP — is imports as a proportion of domestic disappearance, where the latter is domestic production (i.e., VS) minus exports plus imports. See CA for discussion of source of export and import data.

VINTRA — ((XT + IM) - absolute value (XT - IM))/(XT + IM). See CA for discussion of source of XT and IM.

MARCVA — is the average of the coefficient of variation of the margin/sales ratio for all firms in the industry. That is $\frac{TVA-VWS}{VS}$ where where TVA is defined as total-activity value-added, VWS is the total activity value of wages and salaries and VS is the total activity value of shipments. Total activity refers to both manufacturing and non-manufacturing activity, and value-added is a measure of gross output less those purchased inputs which have been embodied in the value of the product. Value-added is census value-added which does not measure net purchases of services or indirect taxes, and in manufacturing they subtract the costs of materials and supplies used in manufacturing activity and the cost of purchased fuel and electricity used. The data was supplied by the Manufacturing and Primary Industries Division.

MESMSD is the ratio of domestic disappearance to USMES. Domestic disappearance is calculated as the total activity value of shipments (i.e., VS) plus total imports minus total exports. Statistics Canada (1979, pp.38-39) suggests total activity is most appropriate when comparing Canada (the numerator) with the U.S. (the denominator) census data. Note that the denominator is defined for 1972 and 1977, rather than 1970 and 1979. See USMES and VS for further details.

NRP is nominal tariff protection which is defined as the actual duties collected divided by the value of total imports less duties. The data was provided by the Structural Analysis Division, Statistics Canada at the input/output level of aggregation (i.e., column (2) of Table A-2) and for 1978 rather than 1979.

RD is the ratio of research and development personnel to all wage and salary earners. Data are collected at the company level[2] and aggregated to the 3-digit SIC levels by attributing one hundred per cent of the expenditure to the industry of the company's principle product. It was provided by the Science Statistics Division, Statistics Canada. Data was available for RD for 1975 rather than 1970.

REG is a regional dummy taking on a value of 1 when the industry was classified regional and 0 otherwise. The industries were classified as regional using Department of Consumer and Corporate Affairs (1971) concentration study with a small number of additions.

USCDR is the U.S. value-added per worker in the smallest establishments accounting for half the employment in the industry divided by the U.S. value-added per worker in the larger plants accounting for the balance. It is based on U.S. Bureau of Census data supplied by R. Caves of Harvard University and is available for 1972 and 1977.

USMES — is the average shipments of the largest U.S. plants which account for the top 50 per cent of industry shipments. It is based upon U.S. census data for 1972 and 1977, supplied by R. Caves of Harvard University. Conversion to Canadian currency was via the average noon spot rates for 1972 and 1977 as published by the Bank of Canada, while the price index used to convert these data to 1970 and 1979 respectively was GPINX. See GPINX for further details.

VS — is total activity value of shipments which encompasses manufacturing and non-manufacturing activities. It is the net selling values at the reporting establishments and excludes discounts, returns, allowances, sales taxes, excise duties and transportation charges by common carriers. The unsold portion at year end of consignment shipments in Canada is treated as inventory and not as shipments, but all shipments to foreign countries for which the form B13 "Customs Export Entry" has been completed are treated as shipments. Resale is included in the total value of shipments and is classified as non-manufacturing activity. The data is taken from the Manufacturing and Primary Industries Division.

Table A-1

Concordance Between 4-digit Standard Industrial Classification for 1972 and Canadian Standard Industrial Classification System for 1970[a]

Industry Code	Name	Percentages of Sales	Assets	Emplmt	Val Add
2011	Meat packing plants	81.00	63.58	69.32	68.00
2013	Sausages & other prepared meat products	16.31	25.14	25.57	25.20
2077	Animal and marine fats and oils	2.69	11.28	5.11	6.80
1011	Slaughtering and Meat Processors	100.00	100.00	100.00	100.00
2016	Poultry dressing plants	84.69	82.47	84.16	81.13
2017	Poultry and egg processing	15.31	17.53	15.84	18.87
1012	Poultry Processors	100.00	100.00	100.00	100.00
2091	Canned and cured fish and seafoods	42.75	45.62	39.02	44.59
2092	Fresh or frozen packaged fish & seafoods	57.25	54.38	60.98	55.41
102	Fish Products	100.00	100.00	100.00	100.00
2032	Canned specialties	24.39	23.67	19.13	26.25
2033	Canned fruits, vegetables, preserves	52.56	55.35	59.04	52.37
2034	Dried fruits, vegetables, and soup mixes	7.89	8.87	8.15	7.59
2035	Pickled fruits&vegs, sauces, salad dress	15.16	12.11	13.68	13.79
1031	Fruit & Vegetable Canners and Preservers	100.00	100.00	100.00	100.00
2037	Frozen fruits, juices, vegetables	100.00	100.00	100.00	100.00
1032	Frozen Fruit & Vegetable Processors	100.00	100.00	100.00	100.00
2021	Creamery butter	4.96	2.93	2.12	2.03
2022	Cheese, natural and processed	19.59	14.64	13.35	12.14
2023	Condensed and evaporated milk	10.22	10.66	6.52	11.53
2024	Ice cream and frozen desserts	7.63	14.12	11.18	11.34
2026	Fluid milk	57.60	57.65	66.83	62.96
104	Dairy Products	100.00	100.00	100.00	100.00
2041	Flour and other grain mill products	56.53	47.82	43.63	33.87
2043	Cereal breakfast foods	26.73	36.04	34.96	45.74
2045	Blended and prepared flour	16.74	16.14	21.41	20.39
105	Flour and Breakfast Cereal Products	100.00	100.00	100.00	100.00
2047	Dog, cat and other pet food	21.77	28.98	24.53	35.80
2048	Prepared animal and fowl feed, NEC	78.23	71.02	75.47	64.20
106	Feed Industry	100.00	100.00	100.00	100.00
2052	Cookies and crackers	100.00	100.00	100.00	100.00
1071	Biscuit Manufacturers	100.00	100.00	100.00	100.00
2051	Bread and other bakery products	100.00	100.00	100.00	100.00
1072	Bakeries	100.00	100.00	100.00	100.00
2065	Candy and other confectionery products	68.86	64.16	78.22	68.59
2066	Chocolate and cocoa products	20.48	21.89	12.89	17.37
2067	Chewing gum	10.66	13.95	8.89	14.04
1081	Confectionery	100.00	100.00	100.00	100.00

Industry Code	Name	Percentages of Sales	Assets	Emplmt	Val Add
2061	Cane sugar, except refining only	13.42	31.41	24.07	17.93
2062	Cane sugar refining	57.52	33.02	36.95	45.37
2063	Beet sugar	29.06	35.57	38.98	36.70
1082	Cane and Beet Sugar	100.00	100.00	100.00	100.00
2075	Soybean oil mills	93.01	93.41	89.22	89.06
2076	Other vegetable oil mills, exc. corn	6.99	6.59	10.78	10.94
1083	Vegetable Oil Mills	100.00	100.00	100.00	100.00
2038	Frozen specialties	14.29	13.03	23.14	13.21
2044	Rice milling	5.03	2.96	2.42	2.74
2046	Wet corn milling	6.15	21.62	7.31	6.11
2079	Other edible fats and oils, NEC	15.27	12.50	7.79	9.45
2083	Malt	1.67	2.78	1.03	1.01
2087	Flavoring extracts & sirups, NEC	10.87	6.65	6.10	16.08
2095	Roasted coffee	17.20	11.31	7.79	15.23
2098	Macaroni, spaghetti, vermicelli, noodles	2.57	2.67	4.41	2.87
2099	Food preparations, not elsewhere class.	26.95	26.48	40.01	33.30
1089	Miscellaneous Food Processors, NES	100.00	100.00	100.00	100.00
2086	Bottled&canned soft drinks&carb. waters	100.00	100.00	100.00	100.00
1091	Soft Drinks	100.00	100.00	100.00	100.00
2085	Distilled, rectified and blended liquors	100.00	100.00	100.00	100.00
1092	Distilleries	100.00	100.00	100.00	100.00
2082	Malt beverages	100.00	100.00	100.00	100.00
1093	Breweries	100.00	100.00	100.00	100.00
2084	Wines, brandy, brandy spirits	100.00	100.00	100.00	100.00
1094	Wineries	100.00	100.00	100.00	100.00
2141	Tobacco stemming and redrying	100.00	100.00	100.00	100.00
151	Leaf Tobacco Processors	100.00	100.00	100.00	100.00
2111	Cigarettes	87.83	82.53	69.40	88.11
2121	Cigars	7.94	10.94	24.59	7.73
2131	Tobacco (chewing and smoking) and snuff	4.23	6.53	6.01	4.16
153	Tobacco Products	100.00	100.00	100.00	100.00
3011	Tires and inner tubes	56.19	63.66	39.69	54.36
3021	Rubber and plastics footwear	5.87	3.81	11.66	6.56
3031	Reclaimed rubber	0.29	0.52	0.33	0.28
3041	Rubber and plastics hose and belting	9.97	10.50	11.78	10.95
3069	Fabricated rubber products, NEC	27.68	21.51	36.54	27.85
162	Rubber Products	100.00	100.00	100.00	100.00
3079	Miscellaneous plastics products	100.00	100.00	100.00	100.00
165	Plastics Fabricating, NES	100.00	100.00	100.00	100.00
3111	Leather tanning and finishing	100.00	100.00	100.00	100.00
172	Leather Tanneries	100.00	100.00	100.00	100.00

Industry Code	Name	Percentages of Sales	Assets	Emplmt	Val Add
3142	House slippers	4.63	5.57	4.83	4.77
3143	Men's footwear, except athletic	39.39	33.45	34.92	37.55
3144	Women's footwear, except athletic	41.13	41.50	43.95	42.51
3149	Footwear, except rubber, NEC	14.85	19.48	16.30	15.17
174	Shoe Factories	100.00	100.00	100.00	100.00
3151	Leather gloves and mittens	100.00	100.00	100.00	100.00
175	Leather Glove Factories	100.00	100.00	100.00	100.00
3131	Boot and shoe cut stock and findings	100.00	100.00	100.00	100.00
1792	Boot and Shoe Findings	100.00	100.00	100.00	100.00
3161	Luggage	32.17	40.58	29.48	31.13
3171	Women's handbags and purses	32.21	24.29	38.28	32.31
3172	Other personal leather goods	21.38	21.12	19.83	23.04
3199	Leather goods, not elsewhere classified	14.24	14.01	12.41	13.52
1799	Luggage, Handbag & Misc.Leather Products	100.00	100.00	100.00	100.00
2211	Broad woven fabric mills, cotton	26.10	27.65	30.43	28.34
2221	Broad woven fabric, manmade fiber & silk	37.83	38.21	37.56	41.32
2281	Yarn spinning mills: cotton, silk, fiber	22.06	22.59	22.48	19.56
2282	Yarn texturizing, throwing, twisting	14.01	11.55	9.53	10.78
181	Cotton&Spun Yarn, Throwsters&Cloth Mills	100.00	100.00	100.00	100.00
2231	Broad woven fabric, wool (incl. finish)	67.03	73.24	70.04	72.09
2283	Wool yarn mills, including carpet & rug	32.97	26.76	29.96	27.91
182	Wool Yarn and Cloth Mills	100.00	100.00	100.00	100.00
2296	Tire cord and fabric	13.94	4.00	9.50	6.00
2823	Cellulosic man-made fibers	12.00	12.30	16.24	10.02
2824	Synthetic organic fibers, exc cellulosic	74.06	83.70	74.26	83.98
1831	Fibre and Filament Yarn Manufacturers	100.00	100.00	100.00	100.00
2298	Cordage and twine	100.00	100.00	100.00	100.00
184	Cordage and Twine	100.00	100.00	100.00	100.00
2293	Paddings and upholstery filling	50.15	56.12	55.00	55.89
2294	Processed waste & recovered fibers	49.85	43.88	45.00	44.11
1851	Fibre Processing Mills	100.00	100.00	100.00	100.00
2291	Felt goods, except woven felts and hats	100.00	100.00	100.00	100.00
1852	Pressed and Punched Felt Mills	100.00	100.00	100.00	100.00
2271	Woven carpets and rugs	6.75	11.15	10.87	8.66
2272	Tufted carpets and rugs	88.23	83.23	83.78	86.14
2279	Carpets & rugs, not elsewhere classified	5.02	5.62	5.35	5.20
186	Carpet, Mat and Rug	100.00	100.00	100.00	100.00
2393	Textile bags	100.00	100.00	100.00	100.00
1871	Cotton and Jute Bags	100.00	100.00	100.00	100.00
2394	Canvas and related products	100.00	100.00	100.00	100.00
1872	Canvas Products	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Percentages of Assets	Percentages of Emplmt	Percentages of Val Add
2284	Thread mills	100.00	100.00	100.00	100.00
1891	Thread Mills	100.00	100.00	100.00	100.00
2241	Narrow fabrics & other smallwares mills	100.00	100.00	100.00	100.00
1892	Narrow Fabric Mills	100.00	100.00	100.00	100.00
2395	Pleating, novelty stitching, tucking	71.89	47.17	75.23	69.96
2397	Schiffli machine embroideries	28.11	52.83	24.77	30.04
1893	Embroidery, Pleating and Hemstitching	100.00	100.00	100.00	100.00
2261	Finishers of cotton broad woven fabric	23.74	30.01	32.37	28.91
2262	Finishers of manmade fiber & silk fabric	51.99	51.32	44.33	46.81
2269	Finishers of textiles, NEC	24.27	18.67	23.30	24.28
1894	Textile Dyeing and Finishing Plants	100.00	100.00	100.00	100.00
2292	Lace goods	0.98	2.03	1.76	1.43
2297	Nonwoven fabrics	8.29	17.96	6.54	9.30
2299	Textile goods, not elsewhere classified	4.42	12.87	5.02	5.22
2391	Curtains and draperies	15.74	8.78	20.52	14.66
2392	Other housefurnishings	31.84	26.02	30.44	28.36
2396	Automotive trimmings, apparel findings	23.62	18.67	16.71	25.73
2399	Fabricated textile products, NEC	15.11	13.67	19.01	15.30
1899	Miscellaneous Textile Industries, NES	100.00	100.00	100.00	100.00
2251	Women's full & knee length hosiery	62.11	67.57	60.29	59.78
2252	Other hosiery	37.89	32.43	39.71	40.22
231	Hosiery Mills	100.00	100.00	100.00	100.00
2257	Circular knit fabric mills	73.98	77.15	75.58	76.53
2258	Warp knit fabric mills	26.02	22.85	24.42	23.47
2391	Knitted Fabric Manufacturers	100.00	100.00	100.00	100.00
2253	Knit outerwear mills	73.39	75.00	71.33	73.16
2254	Knit underwear mills	23.46	21.10	24.93	23.01
2259	Knitting mills, not elsewhere classified	3.15	3.90	3.74	3.83
2392	Other Knitted Mills	100.00	100.00	100.00	100.00
2311	Men's & boys' suits, coats, & overcoats	12.22	11.28	12.11	13.79
2321	Men's and boys' shirts and nightwear	10.73	12.13	11.00	10.32
2322	Men's, youths' and boys' underwear	1.22	1.28	1.55	1.34
2323	Men's, youths' and boys' neckwear	1.50	1.55	1.08	1.47
2327	Men's, youths' & boys' separate trousers	8.89	11.33	8.86	8.06
2328	Men's, youths' and boys' work clothing	8.86	7.97	8.69	8.06
2329	Men's, youths' and boys' clothing, NEC	3.99	3.55	4.07	4.04
2331	Women's&juniors' blouses, waists&shirts	6.40	4.82	6.11	6.08
2335	Women's, misses' and juniors' dresses	18.25	19.48	20.54	19.40
2337	Womens' & juniors' suits, skirts & coats	9.20	8.54	7.36	8.62
2339	Women's & juniors' outerwear, NEC	8.35	6.81	7.97	8.02
2341	Women's & children's underwear&nightwear	6.79	8.08	7.52	7.28
2384	Robes and dressing gowns	1.03	0.94	0.97	0.95
2385	Raincoats and other waterproof garments	1.69	1.77	1.49	1.73
2386	Leather and sheep lined clothing	0.88	0.47	0.68	0.84
243+4	Men's and Women's Clothing	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
2361	Girls' dresses, blouses, waists & shirts	46.08	57.37	47.39	47.35
2363	Girls' and infants' coats and suits	13.26	6.60	12.32	12.75
2369	Girls' and infants' outerwear, NEC	40.66	36.03	40.29	39.90
245	Children's Clothing	100.00	100.00	100.00	100.00
2371	Fur goods	100.00	100.00	100.00	100.00
246	Fur Goods	100.00	100.00	100.00	100.00
2342	Brassieres, girdles and allied garments	100.00	100.00	100.00	100.00
248	Foundation Garments	100.00	100.00	100.00	100.00
2381	Dress & work gloves, exc. knit & leather	100.00	100.00	100.00	100.00
2491	Fabric Glove Manufacturers	100.00	100.00	100.00	100.00
2351	Millinery	25.36	11.64	22.07	24.89
2352	Hats and caps, except millinery	74.64	88.36	77.93	75.11
2492	Hat and Cap Industry	100.00	100.00	100.00	100.00
2387	Apparel belts	68.80	63.41	58.52	68.94
2389	Apparel and accessories, NEC	31.20	36.59	41.48	31.06
2499	Miscellaneous Clothing Industries	100.00	100.00	100.00	100.00
2421	Sawmills and planing mills, general	97.29	97.89	96.30	97.31
2429	Special product sawmills, NEC	2.71	2.11	3.70	2.69
251	Sawmills, Planing Mills & Shingle Mills	100.00	100.00	100.00	100.00
2435	Hardwood veneer and plywood	31.19	9.75	36.48	26.70
2436	Softwood veneer and plywood	68.81	90.25	63.52	73.30
252	Veneer and Plywood Mills	100.00	100.00	100.00	100.00
2426	Hardwood dimension and flooring mills	19.26	31.69	30.88	22.04
2431	Millwork	80.74	68.31	69.12	77.96
2541	Sash, Door, Millwork, Hardwood Flooring	100.00	100.00	100.00	100.00
2439	Structural wood members, NEC	30.36	31.76	33.33	28.57
2452	Prefab wood buildings and components	69.64	68.24	66.67	71.43
2543	Pre-Fabricated Buildings (Woodframe)	100.00	100.00	100.00	100.00
2434	Wood kitchen cabinets	100.00	100.00	100.00	100.00
2544	Wooden Kitchen Cabinets	100.00	100.00	100.00	100.00
2441	Nailed and lock corner wood boxes	30.76	27.02	29.00	28.93
2448	Wood pallets and skids	38.19	38.35	38.75	39.27
2449	Wood containers not elsewhere classified	31.05	34.63	32.25	31.80
256	Wooden Box Factories	100.00	100.00	100.00	100.00
3995	Burial caskets	100.00	100.00	100.00	100.00
258	Coffin and Casket	100.00	100.00	100.00	100.00
2491	Wood preserving	100.00	100.00	100.00	100.00
2591	Wood Preservation Industry	100.00	100.00	100.00	100.00

Industry Code	Name	Percentages of Sales	Assets	Emplmt	Val Add
2492	Particleboard	100.00	100.00	100.00	100.00
2593	Manufacturers of Particle Board	100.00	100.00	100.00	100.00
2499	Wood products, not elsewhere classified	100.00	100.00	100.00	100.00
2599	Miscellaneous Wood Industries	100.00	100.00	100.00	100.00
2511	Wood household furniture not upholstered	45.07	55.44	46.78	46.05
2512	Wood household furniture, upholstered	33.05	23.35	32.17	32.66
2514	Metal household furniture	13.98	12.03	12.03	13.23
2517	Wood TV, radio, phonograph, sew cabinets	5.19	5.87	6.61	5.23
2519	Household furniture, NEC	2.71	3.31	2.41	2.83
2619	Household Furniture	100.00	100.00	100.00	100.00
2521	Wood office furniture	22.47	19.83	29.26	22.23
2522	Metal office furniture	77.53	80.17	70.74	77.77
264	Office Furniture	100.00	100.00	100.00	100.00
2515	Mattresses and bedsprings	27.12	23.86	22.95	23.33
2531	Public building and related furniture	13.94	15.81	15.64	14.39
2541	Wood partitions, shelving, fixtures	20.65	16.91	22.81	22.30
2542	Metal partitions, shelving, fixtures	19.12	26.16	19.15	20.05
2591	Drapery hardware, window blinds, shades	9.49	9.27	8.85	9.64
2599	Furniture and fixtures, NEC	9.68	7.99	10.60	10.29
266	Miscellaneous Furniture and Fixtures	100.00	100.00	100.00	100.00
3645	Residential electric lighting fixtures	100.00	100.00	100.00	100.00
268	Electric Lamp and Shade	100.00	100.00	100.00	100.00
2611	Pulp mills	6.07	8.23	4.81	5.62
2621	Paper mills, except building paper mills	54.54	54.35	58.88	53.31
2631	Paperboard mills	35.49	35.03	31.05	36.55
2661	Building paper and building board mills	3.90	2.39	5.26	4.52
271	Pulp and Paper Mills	100.00	100.00	100.00	100.00
2952	Asphalt felts and coatings	100.00	100.00	100.00	100.00
272	Asphalt Roofing	100.00	100.00	100.00	100.00
2651	Folding paperboard boxes	82.23	83.27	71.45	79.06
2652	Set-up paperboard boxes	17.77	16.73	28.55	20.94
2731	Folding Carton and Set-Up Box	100.00	100.00	100.00	100.00
2653	Corrugated and solid fiber boxes	100.00	100.00	100.00	100.00
2732	Corrugated Boxes	100.00	100.00	100.00	100.00
2643	Bags, except textile bags	100.00	100.00	100.00	100.00
2733	Paper and Plastic Bags	100.00	100.00	100.00	100.00
2641	Paper coating and glazing	22.84	25.13	19.29	24.04
2642	Envelopes	7.26	6.67	11.87	8.48
2645	Die-cut paper, paperboard and cardboard	7.91	5.84	7.88	7.37
2646	Pressed and molded pulp goods	1.90	5.55	3.16	2.46
2647	Sanitary paper products	24.21	20.38	13.63	21.56
2648	Stationery, tablets and related products	5.27	4.12	7.62	5.51
2649	Converted paper,paperboard products, NEC	7.37	6.17	9.38	7.95

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
2654	Sanitary food containers	16.60	19.90	18.20	16.12
2655	Fiber cans, tubes, drums, similar prods	6.64	6.24	8.97	6.51
274	Other Paper Converters	100.00	100.00	100.00	100.00
2732	Book printing	7.64	9.20	9.35	8.06
2751	Commercial printing, letterpress&screen	26.94	27.57	29.83	26.88
2752	Commercial printing, lithographic	41.77	39.41	42.06	42.09
2754	Commercial printing, gravure	5.69	8.27	4.57	4.96
2761	Manifold business forms	11.65	10.27	8.82	10.98
2771	Greeting card publishing	6.31	5.28	5.37	7.03
286	Commercial Printing	100.00	100.00	100.00	100.00
2753	Engraving and plate printing	12.72	1.23	11.82	11.91
2789	Bookbinding and related work	23.80	93.42	30.91	23.14
2791	Typesetting	30.46	2.58	32.03	33.28
2793	Photoengraving	14.49	1.30	12.19	14.98
2794	Electrotyping and stereotyping	2.32	0.23	2.09	2.23
2795	Lithographic platemaking&related servics	16.21	1.24	10.96	14.46
287	Platemaking, Typesetting, Trade Bindery	100.00	100.00	100.00	100.00
2711	Newspapers: publishing and printing	52.62	73.36	68.21	56.33
2721	Periodicals: publishing and printing	22.36	11.85	13.02	19.11
2731	Books: publishing and printing	18.20	10.32	11.18	17.53
2741	Miscellaneous printing	6.82	4.47	7.59	7.03
288+9	Publishing Only + Publishing & Printing	100.00	100.00	100.00	100.00
3312	Blast furnaces,steel works,rolling mills	87.20	93.08	84.28	86.54
3313	Electrometallurgical products	2.00	1.95	1.71	1.82
3316	Cold rolled steel sheet, strip, and bars	5.96	2.16	3.61	4.24
3324	Steel investment foundries	0.95	0.43	2.01	1.47
3325	Steel foundries,not elsewhere classified	3.89	2.38	8.39	5.93
291	Iron and Steel Mills	100.00	100.00	100.00	100.00
3317	Steel pipe and tubes	100.00	100.00	100.00	100.00
292	Steel Pipe and Tube Mills	100.00	100.00	100.00	100.00
3321	Gray iron foundries	88.42	88.64	86.02	86.82
3322	Malleable iron foundries	11.58	11.36	13.98	13.18
294	Iron Foundries	100.00	100.00	100.00	100.00
3331	Primary smelting and refining of copper	46.46	19.61	29.35	28.60
3332	Primary smelting and refining of lead	7.73	3.11	4.78	7.55
3333	Primary smelting and refining of zinc	6.31	5.91	10.75	7.13
3334	Primary production of aluminum	32.86	63.07	43.69	47.84
3339	Nonferrous metals primary refining, NEC	6.64	8.30	11.43	8.88
295	Smelting and Refining	100.00	100.00	100.00	100.00
3353	Aluminum sheet, plate, and foil	49.94	61.83	28.64	36.52
3354	Aluminum extruded products	20.05	15.87	25.34	22.56
3355	Aluminum rolling and drawing, NEC	6.39	5.17	4.21	3.02
3361	Aluminum foundries (castings)	23.62	17.13	41.81	37.90
296	Aluminum Rolling, Casting and Extruding	100.00	100.00	100.00	100.00

Industry Code	Name	Percentages of Sales	Assets	Emplmt	Val Add
3351	Rolling, drawing and extruding of copper	86.94	86.31	71.05	77.16
3362	Brass, bronze, copper, copper-base alloy	13.06	13.69	28.95	22.84
297	Copper&Alloy Rolling, Casting, Extruding	100.00	100.00	100.00	100.00
3341	Secondary smelt&refin nonferrous metals	49.79	31.89	28.90	33.53
3356	Other nonferrous rolling, drawing, extr.	29.55	45.28	29.38	30.53
3369	Nonferrous foundries (castings), NEC	13.97	14.98	32.95	25.62
3497	Metal foil and leaf	6.69	7.85	8.77	10.32
298	Metal Rolling, Casting & Extruding, NES	100.00	100.00	100.00	100.00
3443	Fabricated plate work (boiler shops)	100.00	100.00	100.00	100.00
301	Boiler and Plate Works	100.00	100.00	100.00	100.00
3441	Fabricated structural metal	100.00	100.00	100.00	100.00
302	Fabricated Structural Metal	100.00	100.00	100.00	100.00
3442	Metal doors, sash, frames, molding, trim	100.00	100.00	100.00	100.00
3031	Metal Door and Window	100.00	100.00	100.00	100.00
3446	Architectural and ornamental metal work	48.51	57.00	62.57	53.05
3448	Prefabricated metal buildings&components	51.49	43.00	37.43	46.95
3039	Ornamental and Architectural Metal, NES	100.00	100.00	100.00	100.00
3471	Electroplating,polishing,anodizing,color	59.58	64.38	66.42	66.15
3479	Coating, engraving, allied services, NEC	40.42	35.62	33.58	33.85
3041	Metal Coating	100.00	100.00	100.00	100.00
3411	Metal cans	42.22	48.87	27.10	36.81
3412	Metal shipping barrels,drums,kegs,pails	4.32	4.71	4.03	3.83
3444	Sheet metal work	25.08	15.97	29.27	26.36
3466	Crowns and closures	3.21	3.78	3.20	3.38
3469	Metal stampings,not elsewhere classified	25.17	26.67	36.40	29.62
3042	Metal Stamping and Pressing	100.00	100.00	100.00	100.00
3315	Steel wire drawing, steel nails & spikes	20.84	20.03	16.27	17.82
3451	Screw machine products	18.06	19.06	21.53	19.81
3452	Bolts, nuts, screws, rivets, and washers	34.42	38.37	31.95	36.55
3495	Wire springs	10.39	7.97	12.60	10.41
3496	Miscellaneous fabricated wire products	16.29	14.57	17.65	15.41
305	Wire and Wire Products	100.00	100.00	100.00	100.00
3421	Cutlery	8.39	9.50	8.42	9.91
3423	Hand&edge tools,exc mach tools,hand saws	24.21	19.94	24.69	23.97
3425	Hand saws and saw blades	3.82	4.01	4.15	3.92
3429	Hardware, not elsewhere classified	63.58	66.55	62.74	62.20
306	Hardware, Tool and Cutlery	100.00	100.00	100.00	100.00
3433	Heating equip,exc. electric&air furnaces	100.00	100.00	100.00	100.00
307	Heating Equipment	100.00	100.00	100.00	100.00
3398	Metal heat treating	4.26	7.84	5.22	5.23
3431	Enameled iron and metal sanitary ware	3.38	4.07	3.40	3.50
3432	Plumbing fixture fittings & trim (brass)	6.46	4.65	5.65	6.09
3449	Miscellaneous metal work	8.94	5.52	5.92	6.09

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
3462	Iron and steel forgings	12.91	15.03	10.41	11.14
3463	Nonferrous forgings	2.03	3.17	1.76	1.75
3484	Small arms	3.59	3.84	4.89	4.69
3489	Ordnance and accessories, NEC	4.36	4.10	7.47	5.80
3493	Steel springs, except wire	3.02	2.59	2.58	2.52
3494	Valves&pipe fittings,exc plumbers' brass	26.95	28.29	28.63	29.46
3498	Fabricated pipe and pipe fittings	6.42	4.54	5.31	6.11
3499	Fabricated metal products, NEC	17.68	16.36	18.76	17.62
309	Miscellaneous Metal Fabricating	100.00	100.00	100.00	100.00
3523	Farm machinery and equipment	81.06	84.97	83.48	83.22
3524	Garden tractors, lawn & garden equipment	18.94	15.03	16.52	16.78
311	Agricultural Implements	100.00	100.00	100.00	100.00
3585	Air condition,air heating,refrigeration	100.00	100.00	100.00	100.00
316	Commercial Refrigeration&AirConditioning	100.00	100.00	100.00	100.00
3573	Typewriters, electronic computing equip	72.48	70.11	66.13	68.75
3574	Other calculating & accounting machines	7.13	7.58	10.27	8.00
3576	Scales and balances, except laboratory	2.24	1.77	3.06	2.55
3579	Office machines,not elsewhere classified	14.52	17.25	15.75	17.10
3581	Automatic merchandising machines	3.63	3.29	4.79	3.60
318	Office and Store Machinery	100.00	100.00	100.00	100.00
3721	Aircraft	56.82	45.69	52.83	55.71
3724	Aircraft engines and engine parts	23.56	32.17	23.87	21.83
3728	Aircraft parts & auxiliary equipment,NEC	19.62	22.14	23.30	22.46
321	Aircraft and Aircraft Parts	100.00	100.00	100.00	100.00
3711	Motor vehicles and passenger car bodies	100.00	100.00	100.00	100.00
323	Motor Vehicles	100.00	100.00	100.00	100.00
3713	Truck and bus bodies	100.00	100.00	100.00	100.00
3241	Truck Body Manufacturers	100.00	100.00	100.00	100.00
2451	Mobile homes	70.73	64.69	65.96	68.30
3792	Travel trailers and campers	29.27	35.31	34.04	31.70
3242	Non-Commercial Trailer Manufacturers	100.00	100.00	100.00	100.00
3715	Truck trailers	100.00	100.00	100.00	100.00
3243	Commercial Trailer Manufacturers	100.00	100.00	100.00	100.00
3465	Automotive stampings	19.65	22.60	19.81	19.25
3592	Carburetors, pistons, rings, valves	2.77	2.46	4.29	3.61
3647	Vehicular lighting equipment	1.86	1.63	2.19	2.17
3694	Electrical equipment for engines	7.57	5.31	9.30	8.76
3714	Motor vehicle parts and accessories	68.15	68.00	64.41	66.21
325	Motor Vehicle Parts and Accessories	100.00	100.00	100.00	100.00
3743	Railroad equipment	100.00	100.00	100.00	100.00
326	Railway Rolling Stock	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
3731	Ship building and repairing	100.00	100.00	100.00	100.00
327	Shipbuilding and Repair	100.00	100.00	100.00	100.00
3732	Boat building and repairing	100.00	100.00	100.00	100.00
328	Boatbuilding and Repair	100.00	100.00	100.00	100.00
3799	Transportation equipment, NEC	100.00	100.00	100.00	100.00
329	Miscellaneous Vehicles	100.00	100.00	100.00	100.00
3634	Electric housewares and fans	77.54	73.96	82.14	75.24
3635	Household vacuum cleaners	22.46	26.04	17.86	24.76
331	Small Electrical Appliances	100.00	100.00	100.00	100.00
3631	Household cooking equipment	22.51	25.95	27.00	20.48
3632	House refrigerators, home&farm freezers	41.18	30.96	39.51	39.30
3633	Household laundry equipment	32.49	34.24	27.35	34.03
3636	Sewing machines	3.82	8.85	6.14	6.19
332	Major Appliances (Electric&Non-Electric)	100.00	100.00	100.00	100.00
3646	Commercial, industrial lighting fixtures	60.64	49.23	59.68	57.95
3648	Lighting equipment, NEC	39.36	50.77	40.32	42.05
333	Lighting Fixtures	100.00	100.00	100.00	100.00
3651	Radio and television receiving sets	100.00	100.00	100.00	100.00
334	Household Radio and T.V. Receivers	100.00	100.00	100.00	100.00
3661	Telephone and telegraph apparatus	18.86	20.45	15.95	17.93
3662	Radio&TV transmit,signaling,detection	38.10	30.97	37.90	39.26
3671	Radio and TV receiving electron tubes	0.96	1.26	1.35	1.18
3672	Cathode ray television picture tubes	2.90	3.16	1.80	2.34
3673	Transmit,industrial,specl electron tubes	2.00	2.99	2.43	2.32
3674	Semiconductors and related devices	11.28	17.19	11.58	11.74
3675	Electronic capacitors	1.86	1.80	3.28	2.02
3676	Resistors for electronic applications	1.55	1.65	2.43	1.78
3677	Electronic coils,transformers,inductors	1.48	1.23	2.84	1.45
3678	Connectors for electronic applications	2.02	1.80	2.15	2.34
3679	Electronic components, NEC	12.76	12.30	12.01	10.74
3825	Electrical signal testing instruments	6.23	5.20	6.28	6.90
335	Communication Equipment	100.00	100.00	100.00	100.00
3612	Power,distribution,specialty transformrs	16.98	18.68	15.98	14.96
3613	Switchgear and switchboard apparatus	24.66	18.90	23.63	25.75
3621	Motors and generators	29.22	33.45	30.95	29.30
3622	Industrial controls	16.26	17.60	17.25	17.67
3623	Welding apparatus, electric	7.66	6.46	5.29	6.98
3629	Electrical industrial apparatus, NEC	5.22	4.91	6.90	5.34
336	Electrical Industrial Equipment	100.00	100.00	100.00	100.00
3357	Drawing & insulating of nonferrous wire	100.00	100.00	100.00	100.00
338	Electric Wire and Cable	100.00	100.00	100.00	100.00
3691	Storage batteries	73.56	72.56	72.46	68.32
3692	Primary batteries, dry and wet	26.44	27.44	27.54	31.68
3391	Battery Manufacturers	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
3624	Carbon and graphite products	8.31	20.36	7.60	7.81
3641	Electric lamps	24.14	25.44	21.18	26.01
3643	Current-carrying wiring devices	26.81	20.03	32.48	27.53
3644	Noncurrent-carrying wiring devices	19.53	15.38	17.28	17.62
3693	X-ray,electromedical,therapeutic apparat	9.77	10.09	8.14	11.18
3699	Electrical machinery,equip,supplies,NEC	11.44	8.70	13.32	9.85
3399	Miscellaneous Electrical Products, NES	100.00	100.00	100.00	100.00
3251	Brick and structural clay tile	59.01	61.03	59.36	59.18
3253	Ceramic wall and floor tile	20.20	18.48	20.44	19.75
3259	Structural clay products, NEC	20.79	20.49	20.20	21.07
3511	Clay Product Mfacturers (domestic clays)	100.00	100.00	100.00	100.00
3261	Vitreous china plumbing fixtures	32.34	29.49	21.43	31.10
3262	Vitreous china table & kitchen articles	9.81	7.01	13.17	11.22
3263	Fine earthenware table&kitchen articles	8.90	8.89	15.18	9.36
3264	Porcelain electrical supplies	32.90	43.38	29.91	31.69
3269	Pottery products, NEC	16.05	11.23	20.31	16.63
3512	Clay Product Mfacturers (imported clays)	100.00	100.00	100.00	100.00
3241	Cement, hydraulic	100.00	100.00	100.00	100.00
352	Cement Manufacturers	100.00	100.00	100.00	100.00
3281	Cut stone and stone products	100.00	100.00	100.00	100.00
353	Stone Products	100.00	100.00	100.00	100.00
3271	Concrete block and brick	100.00	100.00	100.00	100.00
3542	Mfacturers of Structural Concrete Prods	100.00	100.00	100.00	100.00
3272	Concrete products except block and brick	100.00	100.00	100.00	100.00
3549	Concrete Products Manufacturers, NES	100.00	100.00	100.00	100.00
3273	Ready-mixed concrete	100.00	100.00	100.00	100.00
355	Ready-Mix Concrete	100.00	100.00	100.00	100.00
3211	Flat glass	30.59	42.18	22.28	32.11
3221	Glass containers	69.41	57.82	77.72	67.89
3561	Glass Manufacturers	100.00	100.00	100.00	100.00
3229	Pressed & blown glass and glassware, NEC	48.79	65.64	57.66	58.46
3231	Glass products made of purchased glass	51.21	34.36	42.34	41.54
3562	Glass Products	100.00	100.00	100.00	100.00
3291	Abrasive products	100.00	100.00	100.00	100.00
357	Abrasives	100.00	100.00	100.00	100.00
3274	Lime	100.00	100.00	100.00	100.00
358	Lime Manufacturers	100.00	100.00	100.00	100.00
3255	Clay refractories	49.44	49.03	58.03	51.40
3297	Nonclay refractories	50.56	50.97	41.97	48.60
3591	Refractories	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Percentages of Assets	Percentages of Emplmt	Percentages of Val Add
3275	Gypsum products	18.82	24.52	11.95	16.56
3292	Asbestos products	22.43	19.91	22.41	21.71
3293	Gaskets, packing, and sealing devices	19.55	12.45	29.57	21.83
3295	Minerals and earths, ground and treated	12.11	15.92	10.14	12.08
3296	Mineral wool	22.20	23.00	19.21	22.49
3299	Nonmetallic mineral products, NEC	4.89	4.20	6.72	5.33
3599	Misc. Non-Metallic Mineral Products	100.00	100.00	100.00	100.00
2911	Petroleum refining	100.00	100.00	100.00	100.00
3651	Petroleum Refining	100.00	100.00	100.00	100.00
2992	Lubricating oils and greases	100.00	100.00	100.00	100.00
3652	Lubricating Oils and Greases	100.00	100.00	100.00	100.00
2951	Paving mixtures and blocks	87.02	86.01	92.67	87.74
2999	Products of petroleum and coal, NEC	12.98	13.99	7.33	12.26
369	Miscellaneous Petroleum & Coal Products	100.00	100.00	100.00	100.00
2875	Fertilizers, mixing only	100.00	100.00	100.00	100.00
372	Mixed Fertilizers	100.00	100.00	100.00	100.00
2821	Plastics materials, synthetic resins	100.00	100.00	100.00	100.00
373	Plastics and Synthetic Resins	100.00	100.00	100.00	100.00
2831	Biological products	4.49	5.92	7.78	3.77
2833	Medicinal chemicals & botanical products	6.35	12.26	6.00	4.24
2834	Pharmaceutical preparations	89.16	81.82	86.22	91.99
374	Pharmaceuticals and Medicines	100.00	100.00	100.00	100.00
2851	Paints, varnishes, lacquers, enamels	100.00	100.00	100.00	100.00
375	Paint and Varnish	100.00	100.00	100.00	100.00
2841	Soap & other detergents, exc specialty	59.30	62.85	49.60	60.57
2842	Specialty cleaning, polishing preps	32.62	23.37	39.53	33.21
2843	Surface active agents, sulfonated oils	8.08	13.78	10.87	6.22
376	Soap and Cleaning Compounds	100.00	100.00	100.00	100.00
2844	Perfumes, cosmetics, toilet preparations	100.00	100.00	100.00	100.00
377	Toilet Preparations	100.00	100.00	100.00	100.00
2816	Inorganic pigments	28.00	22.18	31.22	29.15
2865	Cyclic crudes, intermediates, dyes	72.00	77.82	68.78	70.85
3781	Manufacturers of Pigments and Dry Colors	100.00	100.00	100.00	100.00
2812	Alkalies and chlorine	10.92	17.36	11.68	11.47
2813	Industrial gases	9.01	15.93	8.43	11.75
2819	Industrial inorganic chemicals, NEC	50.83	34.18	56.01	51.32
2873	Nitrogenous fertilizers	10.60	18.71	8.25	11.27
2874	Phosphatic fertilizers	15.63	10.29	13.08	10.73
2895	Carbon black	3.01	3.53	2.55	3.46
3782	Industrial Chemicals (Inorganic, NES)	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
2822	Synthetic rubber(vulcanizabl elastomers)	10.23	7.18	9.83	8.73
2861	Gum and wood chemicals	3.12	1.83	4.91	2.76
2869	Industrial organic chemicals, NEC	86.65	90.99	85.26	88.51
3783	Industrial Chemicals (Organic, NES)	100.00	100.00	100.00	100.00
2893	Printing ink	100.00	100.00	100.00	100.00
3791	Manufacturers of Printing Inks	100.00	100.00	100.00	100.00
2879	Pesticides & agricultural chemicals, NEC	17.44	20.13	8.05	18.06
2891	Adhesives and sealants	14.06	14.06	9.83	12.86
2892	Explosives	6.10	5.98	12.27	8.50
2899	Chemicals and chemical preparations, NEC	33.37	36.53	24.47	33.92
3482	Small arms ammunition	6.64	11.81	9.17	6.89
3483	Ammunition, except for small arms, NEC	22.39	11.49	36.21	19.77
3799	Miscellaneous Chemicals Industries, NES	100.00	100.00	100.00	100.00
3811	Scientific instruments and equipment	9.77	7.12	13.05	9.09
3822	Automatic controls, environ & appliances	6.83	5.10	10.71	6.84
3823	Process control instruments & related	8.50	8.21	13.54	8.44
3824	Totalizing fluid meters&counting devices	2.68	2.67	3.07	2.42
3829	Measuring and controlling devices, NEC	5.42	4.11	7.54	5.07
3832	Optical instruments and lenses	5.05	5.07	6.56	5.13
3841	Surgical & medical instruments&apparatus	9.02	8.29	12.04	8.41
3861	Photographic equipment and supplies	52.73	59.43	33.49	54.60
3911	Instruments and Related Products	100.00	100.00	100.00	100.00
3873	Watches, clocks, clockwork devices&parts	100.00	100.00	100.00	100.00
3912	Clock and Watch	100.00	100.00	100.00	100.00
3842	Orthopedic,prosthetic,surgical appliance	100.00	100.00	100.00	100.00
3913	Orthopaedic & Surgical Appliances	100.00	100.00	100.00	100.00
3851	Ophthalmic goods	100.00	100.00	100.00	100.00
3914	Ophthalmic Goods	100.00	100.00	100.00	100.00
3843	Dental equipment and supplies	100.00	100.00	100.00	100.00
3915	Dental Laboratories	100.00	100.00	100.00	100.00
3911	Jewelry, precious metal	49.23	34.37	43.70	47.58
3914	Silverware, plated ware, stainless ware	15.97	28.62	16.89	17.62
3915	Jewelers' findings & materials, lapidary	14.15	15.30	10.72	10.33
3961	Costume jewelry & novelties, nonprecious	20.65	21.71	28.69	24.47
392	Jewellery and Silverware	100.00	100.00	100.00	100.00
3949	Sporting and athletic goods, NEC	100.00	100.00	100.00	100.00
3931	Sporting Goods	100.00	100.00	100.00	100.00
3942	Dolls	10.30	6.72	14.23	9.11
3944	Games, toys, childrens' vehicles	89.70	93.28	85.77	90.89
3932	Toys and Games	100.00	100.00	100.00	100.00
3993	Signs and advertising displays	100.00	100.00	100.00	100.00
397	Signs and Displays	100.00	100.00	100.00	100.00

Industry Code	Industry Name	Percentages of Sales	Assets	Emplmt	Val Add
3991	Brooms and brushes	100.00	100.00	100.00	100.00
3991	Broom, Brush and Mop	100.00	100.00	100.00	100.00
3963	Buttons	14.02	11.71	16.53	13.41
3964	Needles,pins,hooks&eyes,similar notions	85.98	88.29	83.47	86.59
3992	Button, Buckle and Fastener	100.00	100.00	100.00	100.00
2295	Coated fabrics, not rubberized	71.67	62.22	75.63	64.33
3996	Linoleum,other hard floor coverings,NEC	28.33	37.78	24.37	35.67
3993	Floor Tile, Linoleum and Coated Fabrics	100.00	100.00	100.00	100.00
3652	Phonograph records and prerecorded tape	47.90	52.68	45.31	52.54
3931	Musical instruments	52.10	47.32	54.69	47.46
3994	Sound Recording and Musical Instruments	100.00	100.00	100.00	100.00
3951	Pens, mechanical pencils, and parts	60.97	59.34	60.56	66.39
3952	Lead pencils, crayons&artists' materials	39.03	40.66	39.44	33.61
3996	Pens and Pencils	100.00	100.00	100.00	100.00
3953	Marking devices	8.73	10.71	9.68	10.21
3955	Carbon paper and inked ribbons	11.52	8.41	6.81	9.53
3962	Feathers,plumes,artificial trees&flowers	5.27	5.00	5.73	4.83
3999	Manufacturing industries, NEC	74.48	75.88	77.78	75.43
3999	Fur Dressing&Dyeing+Other Misc Mfactures	100.00	100.00	100.00	100.00

a. The Table should be read as follows: for each Canadian 4-digit industry (represented by the last row of any grouping) the corresponding U.S. industry (or industries) are listed directly above. The SIC code and name are those used in the respective U.S. and Canadian classification systems in 1972 and 1970, respectively.

Source: Statistics Canada and U.S. Bureau of Census.

Table A-2

Concordance Between 4-digit Standard Industrial Classification, 3-digit SIC and Input/Output Classification.

4-DIGIT S.I.C. CODE (1970)	Manufacturing Industries	INPUT/ OUTPUT	3-DIGIT S.I.C.
(1)	(2)	(3)	(4)
	1 - FOOD AND BEVERAGE INDUSTRIES		
1011	Slaughtering and meat processors	016	101
1012	Poultry processors	017	101
1020	Fish Products industry	019	102
1031	Fruit and Vegetable canners and preservers	020	103
1032	Frozen fruit and vegetable processors	020	103
104	Dairy products industry	018	104
105	Flour and breakfast cereal products industry	022	105
106	Feed industry	021	106
1071	Biscuit manufacturers	023	107
1072	Bakery Products	024	107
1081	Confectionary manufacturers	025	108
1082	Cane and beet sugar processors	026	108
1083	Vegetable oil mills	027	108
1089	Miscellaneous food processors, n.e.s.	028	108
1091	Soft drink manufacturers	029	109
1092	Distilleries	030	109
1093	Breweries	031	109
1094	Wineries	032	109
	2 - TOBACCO PRODUCTS INDUSTRIES		
151	Leaf tobacco processors	033	151
153	Tobacco products manufacturers	034	153
	3 - RUBBER AND PLASTICS PRODUCTS INDUSTRIES		
162	Rubber products industries	036	162
1623a	Tire and tube manufacturers	036	162
1624a	Rubber footwear manufacturers	035	162
1629a	Miscellaneous rubber products manufacturers	037	162
165	Plastics fabricating industry, n.e.s.	038	165
	4 - LEATHER INDUSTRIES		
172	Leather tanneries	039	172
174	Shoe factories	040	174
175	Leather glove factories	041	175
1792	Boot and shoe findings manufacturers	042	179
1799	Miscellaneous leather products manufacturers	042	179

5 - TEXTILE INDUSTRIES

181	Cotton yarn and cloth mills	043	181
182	Wool yarn and cloth mills	044	182
1831	Fibre and filament yarn manufacturers	045	183
1832	Throwster, spun yarn & cloth mills	045	183
184	Cordage and twine industry	048	184
1851	Fibre processing mills	046	185
1852	Pressed and punched felt mills	050	185
186	Carpet, mat and rug industry	051	186
1871	Cotton & jute bags manufacturers	054	187
1872	Canvas products manufacturers	053	187
188	Automobile fabric accessories industry	055	188
1891	Thread mills	047	189
1892	Narrow fabric mills	049	189
1893	Embroidery, pleating & hemstitching manufacturers	055	189
1894	Textile dyeing and finishing plants	052	189
1899	Miscellaneous textile industries, n.e.s.	055	189

6 - KNITTING MILLS

231	Hosiery mills	056	231
2391	Knitted fabric manufacturers	057	239
2392	Other knitting mills	057	239

7 - CLOTHING INDUSTRIES

2431	Men's clothing factories	058	243
2432	Men's clothing contractors	058	243
2441	Women's clothing factories	058	244
2442	Women's clothing contractors	058	244
245	Children's clothing industry	058	245
246	Fur goods industry	058	246
248	Foundation garment industry	058	248
2491	Fabric glove manufacturers	058	249
2492	Hat and cap industry	058	249
2499	Miscellaneous clothing industries, n.e.s.	058	249

8 - WOOD INDUSTRIES

2511	Shingle mills	059	251
2513	Sawmills and planing mills	059	251
252	Veneer and plywood mills	060	252
2541	Sash, door & other millwork plants, n.e.s.	061	254
2542b	Hardwood flooring plants	061	254
2543	Manufacturers of pre-fabricated buildings (woodframe construction)	061	254
256	Wooden box factories	062	256
258	Coffin and casket industry	063	258
2591	Wood preservation industry	064	259
2592	Wood handles and turning industry	064	259
2593	Manufacturers of particle board	064	259
2599	Miscellaneous wood industries, n.e.s.	064	259

	9 - FURNITURE AND FIXTURE INDUSTRIES		
2611	Furniture re-upholstery & repair shops	065	261
2619	Household furniture manufacturers, n.e.s.	065	261
264	Office furniture manufacturers	066	264
266	Miscellaneous furniture & fixtures manufacturers	067	266
268	Electric lamp and shade manufacturers	068	268
	10 - PAPER AND ALLIED INDUSTRIES		
271	Pulp and paper mills	069	271
272	Asphalt roofing manufacturers	070	272
2731	Folding carton & set-up box manufacturers	071	273
2732	Corrugated box manufacturers	071	273
2733	Paper & plastic bag manufacturers	071	273
274	Miscellaneous paper converters	072	274
	11 - PRINTING, PUBLISHING AND ALLIED INDUSTRIES		
286	Commercial printing	073	286
287	Platemaking, typesetting & trade bindery industry	074	287
288	Publishing only	073	288
289	Publishing & printing	073	289
	12 - PRIMARY METAL INDUSTRIES		
291	Iron & steel mills	075	291
292	Steel pipe & tube mills	076	292
294	Iron foundries	077	294
295	Smelting & refining	078	295
296	Aluminum roll, casting and extruding	080	296
297	Copper & copper alloy rolling, casting and extruding	081	297
298	Metal rolling, casting & extruding, n.e.s.	082	298
	13 - METAL FABRICATING INDUSTRIES (EXCEPT MACHINERY AND TRANSPORTATION EQUIPMENT INDUSTRIES)		
301	Boiler and plate works	083	301
302	Fabricated structural metal industry	084	302
3031	Metal door and window manufacturers	085	303
3039	Ornamental & architectural metal industry, n.e.s.	085	303
3041	Metal coating industry	086	304
3042	Metal stamping & pressing industry	086	304
305	Wire & wire products manufacturers	087	305
306	Hardware, tool & cutlery manufacturers	088	306
307	Heating equipment manufacturers	089	307
308	Machine shops	090	308
309	Miscellaneous metal fabricating industries	091	309

	14 - MACHINERY INDUSTRIES (EXCEPT ELECTRICAL MACHINERY)		
311	Agricultural implement industry	092	311
315	Miscellaneous machinery & equipment manufacturers	093	315
316	Commercial refrigeration & air conditioning equipment manufacturers	094	316
318	Office & store machinery manufacturers	095	318
	15 - TRANSPORTATION EQUIPMENT INDUSTRIES		
321	Aircraft & aircraft parts manufacturers	096	321
323	Motor vehicle manufacturers	097	323
3241	Truck body manufacturers	098	324
3242	Non-commercial trailer manufacturers	098	324
3243	Commercial trailer manufacturers	098	324
325	Motor vehicle parts & accessories manufacturers	099	325
326	Railroad rolling stock industry	100	326
327	Shipbuilding & repair	101	327
328	Boatbuilding & repair	102	328
329	Miscellaneous vehicle manufacturers	102	329
	16 - ELECTRICAL PRODUCTS INDUSTRIES		
331	Manufacturers of small electrical appliances	103	331
332	Manufacturers of major appliances (electric & non-electric)	104	332
333	Manufacturers of lighting fixtures	110	333
334	Manufacturers of household radio and television receivers	105	334
335	Communications equipment manufacturers	106	335
336	Manufacturers of electrical industrial equipment	107	336
338	Manufacturers of electric wire & cable	108	338
3391	Battery manufacturers	109	339
3399	Manufacturers of miscellaneous electrical products, n.e.s.	110	339
	17 - NON-METALLIC MINERAL PRODUCTS INDUSTRIES		
3511	Clay products manufacturers (from domestic clays)	115	351
3512	Clay products manufacturers (from imported clays)	115	351
352	Cement manufacturers	111	352
353	Stone products manufacturers	117	353
3541	Concrete pipe manufacturers	113	354
3542	Manufacturers of structural concrete products	113	354
355	Ready-mix concrete manufacturers	114	355
3561	Glass manufacturers	119	356

3562	Glass products manufacturers	119	356
357	Abrasives manufacturers	120	357
358	Lime manufacturers	112	358
3591	Refractories manufacturers	116	359
3599	Miscellaneous non-metallic mineral products industries, n.e.s.	118	359
	18 - PETROLEUM AND COAL PRODUCTS INDUSTRIES		
3651	Petroleum refining	121	365
3652	Manufacturers of lubricating oils & greases	121	365
369	Miscellaneous petroleum & coal products industries	122	369
	19 - CHEMICAL AND CHEMICAL PRODUCTS INDUSTRIES		
372	Manufacturers of mixed fertilizers	123	372
373	Manufacturers of plastics & synthetic resins	124	373
374	Manufacturers of pharmaceuticals & medicines	125	374
375	Paint & varnish manufacturers	126	375
376	Manufacturers of soap & cleaning compounds	127	376
377	Manufacturers of toilet preparations	128	377
3781	Manufacturers of pigments & dry colours	129	378
3782	Manufacturers of industrial chemicals (inorganic), n.e.s.	129	378
3783	Manufacturers of industrial chemicals (organic), n.e.s.	129	378
3791	Manufacturers of printing inks	130	379
3799	Miscellaneous chemical industries, n.e.s.	130	379
	20 - MISCELLANEOUS MANUFACTURING INDUSTRIES		
3911	Instrument & related products manufacturers	131	391
3912	Clock & watch manufacturers	131	391
3913	Orthepaedic & surgical appliance manufacturers	131	391
3914	Ophthalmic goods manufacturers	131	391
3915	Dental laboratories	131	391
392	Jewellry & silverware industry	132	392
3931	Sporting goods manufacturers	134	393
3932	Toys & games manufacturers	134	393
397	Signs & display industry	136	397
3991	Broom, brush & mop manufacturers	133	399
3992	Button, buckle & fastener manufacturers	137	399
3993	Floor tile, linoleum & coated fabrics manufacturers	135	399
3994	Sound recording & musical instrument manufacturers	137	399
3995c	Stamp & stencil (rubber & metal) manufacturers	137	399
3996	Pen & pencil manufacturers	137	399
3997c	Typewriter supplies manufacturers	137	399

3998	Fur dressing & dyeing	137	399
3999	Other miscellaneous manufacturing industries	137	399
167	Totals[g,h]	122	112

a) These three 4-digit industries are grouped into 162.

b) Included with 2541.

c) Included with 3999.

g) Net of duplicated codes

h) Takes into account footnotes a to c.

<u>Source</u>: Statistic Canada.

Annually goes back to <u>1977.</u>

Here 1985 – 1987 include 2-digit - Ontario

Appendix B

Relative Plant Scale Using Employment as the Size Dimension

The only estimate of the smallest number of the largest plants accounting for 50 per cent of U.S. industry size -- the proxy for MES in this study -- uses sales as the size dimension. No direct estimate using employment was readily available. However, by the use of the industry employment/shipments ratio the sales estimate of MES can be converted to employment. More formally for 1970:

USMESE70 = (I70/S70) · USMES70
where I = U.S. industry employment in 1972
S = U.S. industry sales for 1972, expressed in U.S. dollars
USMES = U.S. estimate of minimum efficient size for 1972 expressed in U.S. dollars.

(USMESE79 is defined in an exactly analogous manner with 1977 U.S. data used to approximate 1979).

The actual Canadian plant size distribution, using employment as the size dimension, is captured by three measures,

AVSZE70, 79 = average plant size, measured in terms of employment, for 1970 and 1979.

AVSZTE70, 79 = average size (measured in employment) of the smallest number of the largest plants accounting for 50 per cent of industry employment, for 1970 and 1979.

AVSZBE70, 79 = average size (measured in employment) of the largest number of

the smallest plants accounting
for 50 per cent of industry
employment for 1970 and 1979.

For AVSZTE and AVSZBE resort had to be made to the Canadian industry employment/shipments ratio in a similar way as for the construction of USMESE. However, AVSZE was estimated directly from employment data.

The relative plant scale measures, using employment as the size dimension, are defined for 1970 as follows:

EFF270	= AVSZE70/USMESE70, relative average size, total industry.
EFF2T70	= AVSZTE70/USMESE70, relative average size, top half.
EFF2B70	= AVSZBE70/USMESE70, relative average size, bottom half.

and similarly for 1979. As with the relative plant scale measures in the main text, the Canadian data relates to 1970 and 1979, while for the U.S. the closest comparable years are 1972 and 1977, respectively.

Table B-1 presents details of EFF2, EFF2T and EFF2B both for 1970 and 1979 as well as their first differences. The measures of relative plant scale using employment as the size dimension differ somewhat from those using sales (see Table 1 above): typically the employment measures show that sub-optimal plant scale is less

Table B-1

Average Plant Size and Relative Plant Scale Indices for 125 Canadian Manufacturing Industries Using Employment as the Size Dimension: 1970 and 1979

Relative Plant Scale Index[a]	Year 1970	Year 1979	Plant Index	Year 1970	Year 1979
	Average[b]			Average[b] (Number)	
EFF2	0.207 (0.198)	0.212 (0.222)	AVSZE	119.7 (191.0)	120.0 (231.7)
EFF2T	0.820 (0.661)	0.769 (0.653)	AVSZTE	637.3 (1395.9)	617.6 (1568.1)
EFF2B	0.117 (0.121)	0.123 (0.141)	AVSZBE	63.1 (94.3)	62.8 (96.6)

Change 1970-1979[c]

	Average	Standard Deviation	Range Minimum	Range Maximum
EFF2	0.005	0.089	-0.267	0.437
EFF2T	-0.051	0.390	-2.016	1.476
EFF2B	0.006	0.063	-0.149	0.396

a See text for definitions, relative plant scale measures expressed as a ratio.

b Standard deviation in parenthesis.

c Estimated, using EFF2 as an example, EFF279-EFF270.

Note: USMESE70 = 1008.5, USMESE79 = 1073.1, with standard deviation of 1640.3 and 1800.0, respectively.

Source: Statistics Canada. See Appendix A for details. (Vol. 6).

of a problem than the sales based measures -- mean level of EFF2T70 = 0.820, mean level of EFF1T70 = 0.691; all sales based measures show an improvement in relative plant scale over the period 1970-1979 but for the employment based measures this does not apply to EFF2T, which declines, on average, by 5.1 percentage points; employment based measures of average plant size (excepting EFF2) tend to fall on average over the period while sales based measures increase -- reflecting productivity gains discussed in the main text of the paper in section 2 under "Relative Plant Scale; 1970 and 1979"; and, finally, the fact that AVSZE increases, albeit slightly, from 119.7 to 120.0 while AVSZTE and AVSZBE both decline, suggests that perhaps the use of the employment/shipment ratio (used to generate AVSZTE and AVSZBE but not AVSZE) results in an understatement of the change in average plant size for Canada.

The correlation coefficient between the measures of relative plant scale, defined in terms of employment and shipments was usually very high:

EFF170	EFF270	0.931
EFF1T70	EFF2T70	0.912
EFF1B70	EFF2B70	0.950
EFF179	EFF279	0.949
EFF1T79	EFF2T79	0.951
EFF1B79	EFF2B79	0.943
EFF1	EFF2	0.732
EFF1T	EFF2T	0.879
EFF1B	EFF2B	0.740

This suggests that the determinants of the employment and shipment based measures of relative plant scale are likely to be the same, particularly for 1970 and 1979. Hence, it was decided not to use the employment based measures (EFF2, EFF2T, EFF2B) in the regression analysis. These measures involve the assumption of constant employment/shipments ratio to be generated from the shipments based measure. Despite the high correlations, Scherer et al (1975, Table 3.3, p. 68) show that quite wide differences can arise between relative plant scale using employment and capacity or output as the size dimensions. Finally, output related measures avoid problems of differing capital/labour ratio and varying labour productivity.

Appendix C

The Impact of Outliers

As noted in the text, (section 4) some industries were omitted that were classified as miscellaneous. It is recognized that a case may be made that some of the remaining industries might have been too heterogenous for a meaninful analysis or for some other reason did not fit the estimated relationships well, and hence should have been omitted. Therefore two additional regressions were run using different criterion for excluding "aberrant" observations. In the first case (Method 1) all observations whose standardized error was greater than 4 were removed. In the second case (method 2) all observations whose standardized error was greater than two were removed.

Table C-1 presents, for two of the equations (2, 6) presented in Table 7, the impact of removing "aberrant" industries (equations 2, 3, 5 and 6 of Table C-1) which can then be compared with equations 1 and 3 which are estimated for the full 120 industry sample. Most of the results in equations 1 and 3 carry over into equations 2, 3 and 4, 5, respectively. However some differences do occur; IMP is generally much more significant; CA is only weakly significant in 1979; the constant term in 1979 now becomes insignificant, whereas before it was significant; and, finally, the explanatory power of the independent variables increases

Table C-1

Concentration, Effective Tariffs, Foreign Ownership and Relative Plant Scale for 120 Industry Sample: The Impact of "Aberrant" Observations

	EFF1T70						EFF1T79					
			Method 1[a]		Method 2[b]				Method 1[a]		Method 2[b]	
Equation #	(1) Coeff	Sign	(2) Coeff	Sign	(3) Coeff	Sign	(4) Coeff	Sign	(5) Coeff	Sign	(6) Coeff	Sign
Constant	-0.117	.62	0.082	.68	0.091	.56	-0.510	.05	-0.118	.56	-0.170	.36
Trade and Tariffs												
IMP	-0.413	.16	-0.526	.04	-0.397	.04	-0.431	.10	-0.484	.02	-0.427	.02
CA	0.058	.51	0.078	.30	0.037	.53	0.189	.03	0.089	.18	0.079	.20
NRP	0.392	.25	0.260	.37	0.244	.28	0.640	.25	0.350	.40	0.396	.31
ERP	-0.444	.26	-0.363	.28	-0.233	.36	0.076	.62	-0.002	.99	-0.030	.78
Barriers to Entry												
MESMSD	0.009	.01	0.007	.01	0.006	.01	0.014	.0000	0.011	.0000	0.012	.0000
ADVDM	-1.518	.51	-1.277	.51	-0.297	.84	-4.486	.12	-3.047	.15	-2.892	.14
RD	2.723	.42	-0.712	.81	-0.126	.95	-1.760	.54	-0.850	.69	-0.863	.66
CON	1.231	.0001	1.088	.0000	1.014	.0000	1.515	.0000	1.214	.0000	1.067	.0000
Truncation												
CDR1	-0.407	.001	-0.415	.0001	-0.374	.0000	-0.179	.10	-0.190	.02	-0.166	.03
Eastman/Stykolt												
EASTV	0.058	.03	0.061	.01	0.066	.0002	0.043	.08	0.040	.03	0.043	.01
HVTRHCR	-0.424	.11	-0.409	.07	-0.421	.014	-0.652	.01	-0.515	.004	-0.461	.01
Other												
REG	-0.036	.75	-0.044	.65	-0.091	.23	0.017	.88	-0.094	.27	-0.063	.43
FOR	0.073	.71	0.046	.78	0.0005	.997	0.138	.46	0.034	.81	0.125	.34
MARCVA	0.221	.14	0.141	.27	0.142	.15	0.200	.17	0.166	.12	0.184	.07
R^2	.3067	.0000	.3890	.0000	.4704	.0000	.4555	.0000	.4799	.0000	.5306	.0000
N^c	120		119		116		120		119		117	

a) Method 1, all observations with a standardized residual greater than 4 omitted.

b) Method 2, all observations with a standardized residual greater than 2 omitted.

c) Number of industries in regression run.

Source: Statistics Canada. See Appendix A for details. (Vol. 11).

substantially in both years, but particularly 1970, such that the difference between 1970 and 1979 narrows considerably. Thus it may be concluded the major impact of excluding outliers is to strengthen our results. Most conclusions remain intact and, some of the differences between the two years that were puzzling (the emergence of a significant positive intercept in 1979) disappear.

Footnotes

1 See Gorecki (1976, pp. 11 - 14) for a discussion of this.

2 Assume from here forward that cost curves are "L" shaped and that "U" shaped plants beyond OF are not observed.

3 Scherer et al (1975, Table 3.12, p. 85) finds for a sample of 12 industries that the U.S. top 50 per cent measure is 1.53 that of MES. However, since Scherer et al confine themselves to industries where multiplant economies of scale are important 1.53 is probably an upper bound of the potential bias.

4 It is difficult to draw inferences from Table 1 about whether Canadian plants have increased relative to those in the U.S. in the 1970's. This is a reflection of the fact that the 1970 comparison is 1970 for Canada and 1972 for the U.S., while the 1979 comparison is 1979 for Canada and 1977 for the U.S. Hence, for example, if Canadian plants for any given year were always (say) 0.70 those of the U.S., but both U.S. and Canadian plants were growing at x per cent, then the 1970/1972 comparison would be biased downward and the 1979/1977 biased upward, resulting in an observed improvement in the ratio of Canada/U.S. plant sizes.

5 As noted in the previous footnote it is difficult to draw inferences about whether Canadian plant sizes have increased relative to those in the U.S. in the 1970's. Bearing this in mind we see that for the 102 industries for which EFF1T70 1 the average level of EFF1T increased between 1970 and 1979, from 0.461 to 0.579, while the 23 industries for which EFF1T70 1 the average level of EFF1T fell from 1.710 in 1970 to 1.436 in 1979, with nine of the industries falling below 1.000 in 1979, all except two into the range 0.80-1.00. Thus an increase appeared to have taken place in relative plant scale during the 1970's in those industries where sub-optimality existed in 1970, even allowing for the caveat in the previous footnote.

6 The cross-sectional studies linking market structure to performance often found a discontinuity in the effect of concentration on performance - with the concentration variable not being significant for low levels of concentration.

7 Implicit in this hypothesis is some notion of a random growth process that allows not only a large variance in firm size but also larger firms in the larger U.S. market -- that market size thus determines average firm size.

8 Nelson and Winter (1982) have proposed an alternative model of the stochastic process but have not incorporated entry into their model.

9 The cut-off points are derived using the sample of 141 industries -- i.e., the universe of 167 manufacturing industries less the miscellaneous categories. See Table 4 for means of concentration (CON), nominal tariffs (NRP), effective tariffs used here (ERP) and foreign ownership (FOR) for the industry sample used here.

10 Since in a small number of industries the trade variables are not defined, the regression results are presented below for 120, not 125, industries. Hence, the text refers here to the number of HVTRHCR and HNTRHCR industries from the 120 industry sample. Almost no difference is observed between the number of high tariff/high concentration industries (or the number of high concentration/high tariff/high foreign ownership (discussed below) industries) as between the 120 and 125 industry sample. The only difference is that the 120 sample has one less high tariff/high concentration industry in 1970.

11 The means and standard deviations presented below in Table 4 refer to the 120 sample.

12 Caves et al (1980, p. 267) suggest inclusion of a variable CDIF = CDR - USCDR, the difference between the cost disadvantage ratio for Canada and the United States. However, to the extent that the effect of CDR varies between large and small industries, simple first differences will miss the essence of the problem.

13 The median is used rather than the mean because it better captures the ideas in Figure 3. If CDR1 is estimated using the mean level of MESMSD, then the regression results in Tables 7 and 8 are essentially unchanged for 1970; but for 1979 substantial differences do occur, CDR1 estimated using the mean level of MESMSD is insignificant in 1979 while with the median CDR1 is statistically significant.

14 The adjusted R^2 with MESMSD as the only independent variable was 0.0774 in 1970 and 0.1981 in 1979.

15 See Muller (1982) for a summary of results of papers testing the Eastman/Stykolt Hypothesis. Note that Muller refers to studies that use different dependent variables than those used here -- sub-optimal capacity, productivity and technical efficiency.

16 As noted above, Muller (1982) refers to studies where the dependent variable does not exactly match that used here.

17 The adjusted R^2 with CON as the only independent variable was 0.0133 in 1970 and 0.0167 in 1979.

18 The regressions reported correspond to equations 2 and 6 of Tables 7 and 8 except that each of the cost disadvantage ratios discussed is entered separately replacing CDR1. In Tables 7 and 8, equations 4 and 8 included CDR2 instead of CDR1.

19 CDR4, when nominal tariffs were used, was significant at .90 in 1979 with a coefficient of -.018, while, when effective tariffs were used the corresponding numbers .66 and -.066 respectively.

20 It could be argued that the direction of causation specified here is incorrect. For details on this see Caves et al (1980, p. 271).

21 EXP replaces CA in equations 1, 2, 5 and 6 of Tables 7 and 8 while INTRA is entered as the only trade variable in these same equations. Inclusion of an import or export variable in addition to INTRA results in this variable representing exports or imports, respectively. High tariff/high concentration terms are used to represent the Eastman/Stykolt hypothesis rather than the high tariff/high concentration/high foreign ownership term.

22 See Baumann (1974), Grubel (1967) and Lermer (1973).

23 EXP is weakly significant (.17) when effective tariffs are used to represent the Eastman/Stykolt hypothesis with a coefficient of 0.376. However, when nominal tariffs are used the magnitude of both the coefficient (0.287) and significance levels (0.29) drop. For effective tariffs we took the analysis a step further and substituted EXP^2 instead of EXP for 1970 and 1979. In 1979 EXP^2 was weakly sigificant at .13 and positive suggesting perhaps some threshold effect, that is consistent with our results for EXPINT, EXPDUM and CA.

24 That is if IMP > XT then MATCH is 2.XT and if XT > IMP then MATCH is 2.IMP.

25 Although Table 4 does not report the mean of EXPD for the full sample of 120 industries introduced here, it is in fact 16.5 for 1970 and 16.6 for 1979.

26 The regression analysis consisted of estimating three basic equations corresponding to Equations 1 and 5 of Tables 7 and 8 but without IMP and CA but either (A) EXPDUM, INTRADUM, IMPINT, INTRAINT and EXPINT, or (B) EXPDUM, INTRADUM, or (C) IMPINT, INTRAINT and EXPINT. This reflected the fact that the 0 - 1 dummy variables were often quite highly correlated with the INT variables.

27 IMPINT for 1970 is weakly significant (.14) in Equation C only. In 1979 IMPINT is weakly significant in Equation A (.13)

but significant in Equation C (.02). See footnote 26 for a description of Equations A and C.

28 EXPINT was not, in either 1970 or 1979, even weakly significant. In 1979, EXPDUM was statistically significant in Equation (B) and significant or weakly significant in (A). In 1970 EXPDUM was always insignificant. See foonote 26 for a description of Equations A and B.

29 In Equation A of footnote 26, for 1970 INTRAINT is weakly significant and negative, but INTRADUM offsets this since it is positive, although insignificant. In Equation A in 1979, neither INTRADUM nor INTRADIF is significant. Finally, in equations B and C, INTRADUM and INTRAINT are insignificant in both years.

30 A similar statement applies to EASTVDF.

31 One problem in such an exercise is the high correlation, across the 120 industry sample, of ERPDIF with the corresponding tariff changes for high tariff/high concentration and high tariff/high concentration/high foreign ownership industries:

	ERPDIF
EHCFDF	.991
EHCDF	.992

In view of these high correlations (to be discussed further below) it did not make sense to enter tariff changes across the whole of the sample of industries.

In order to take our analysis a step further we decided to examine the reason for the high level of correlations reported above. The high correlations for effective tariffs seemed to be due to three industries 1510, 3651 and 3652 -- Leaf Tobacco Processors, Petroleum Refining, Manufacturers of Lubricating Oils and Greases respectively, -- where the value of ERPDIF was -3.866, 1.495, and 1.495, respectively. If these industries are excluded then the correlations are much reduced:

	ERPDIF
EHCFDF	.435
EHCDF	.516

If ERPDIF is added to Equations 3 and 4 but excluding EASTFVDF and EASTVDF, respectively, of Table 12, with SIC 1510 3651 and 3652 omitted, then ERPDIF is positive but either insignificant or weakly significant, but where weakly significant the coefficient is less in absolute size than that attached to ERPDIF in high tariff/high concentration industries. (For example, in equation 3 ERPDIF is significant at .14 with a coefficient of 0.936 while

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