

PROFITABILITY AND MARKET STRUCTURE:  
CONCENTRATION AND SCALE ECONOMIES IN THE  
CANADIAN MANUFACTURING INDUSTRY, 1965

by

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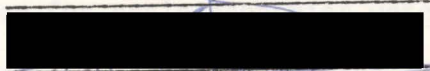
Economics

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#### ABSTRACT

Structure-performance analyses point to a positive relationship between profits and both concentration and scale economies. However, the precise nature of the relationship is obscured by the commonly used proxy measures for scale economies. This study examined and clarified the relationship as it applies to a sample of 62 Canadian manufacturing industries. The sample consisted of 30 consumer-goods industries and 32 producer-goods industries and was determined largely by data availability. Multiple regression analysis based on ordinary least squares regression was employed throughout, standard statistical tests being applied where appropriate.

The analysis was in three main stages. First, to provide a basis for comparison, a conventional structure-performance model was applied to the given sample. Next, in an analysis involving dummy variables, the profits-concentration relationship was examined. Finally, various new proxy measures for scale economies were developed and tested.

A statistically significant difference in the profits-concentration relationship was found at a four-firm concentration ratio of approximately 33 percent, enabling the sample to be divided into 19 low-concentration industries and 43 high-concentration industries which were then analyzed separately. A statistically significant and positive relationship was found to exist between profits and concentration for the high-concentration industries, but not for the low-concentration industries. Further results indicated that scale economies are a significant barrier to entry only when the cost disadvantage facing

smaller plants is substantial. A general finding was that the low-concentration industries do not lend themselves well to the conventional structure-profits analysis.

TABLE Examiners:

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LIST OF TABLES . . . . .

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LIST OF ILLUSTRATIONS . . . . .

[REDACTED]

ACKNOWLEDGEMENTS . . . . .

vii

I. INTRODUCTION . . . . .

1

II. THE BASIC MODEL . . . . .

4

III. PRELIMINARY RESULTS . . . . .

8

IV. THE PROFITS-CONCENTRATION RELATIONSHIP . . . . .

16

V. MEASUREMENT OF SCALE ECONOMIES . . . . .

31

VI. CONCLUSION . . . . .

49

SELECTED REFERENCES . . . . .

51

LIST OF APPENDICES . . . . .

54

## TABLE OF CONTENTS

1. Regression Results for 62 Canadian Industries . . . . .	11
LIST OF TABLES . . . . .	v
2. Analysis of Significant Coefficients in Table 1 . . . . .	12
LIST OF ILLUSTRATIONS. . . . .	vi
the Profit-Structure Relationship, 62 Industries. . . . .	14
ACKNOWLEDGEMENTS . . . . .	vii
Is Replaced by a Dummy Variable, 62 Industries. . . . .	17
I. INTRODUCTION . . . . .	1
Between High-Concentration and Low-Concentration Industries . . . . .	24
II. THE BASIC MODEL. . . . .	4
6. Regression Results for 19 Low-Concentration Industries and 43 High-Concentration Industries. . . . .	27
III. PRELIMINARY RESULTS. . . . .	8
7. Regression Results for 43 High-Concentration Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	29
IV. THE PROFITS-CONCENTRATION RELATIONSHIP . . . . .	16
8. Regression Results Using Various Proxies for Scale- Economy Barriers, 62 Canadian Industries. . . . .	40
V. MEASUREMENT OF SCALE ECONOMIES . . . . .	31
9. Regression Results Using Selected Proxies for Scale- Economy Barriers, 62 Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	49
VI. CONCLUSION . . . . .	49
10. Regression Results Using Selected Proxies for Scale- Economy Barriers, 43 High-Concentration Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	51
SELECTED REFERENCES. . . . .	51
LIST OF APPENDICES . . . . .	54
Economy Barriers, 43 High-Concentration Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	44
12. Comparison of Economies of Scale Figures Based on 80 Percent of Shipments With Those Based on 50 Percent of Shipments. . . . .	47
13. Average Plant Sizes, As a Percentage of Industry Shipments . . . . .	48

## LIST OF TABLES

1.	Regression Results for 62 Canadian Industries . . . . .	11
2.	Analysis of Significant Coefficients in Table 1 . . . . .	12
3.	Regression Results for Alternate Specifications of the Profit-Structure Relationship, 62 Industries. . . . .	14
4.	Regression Results When the Concentration Variable Is Replaced by a Dummy Variable, 62 Industries. . . . .	19
5.	Regression Results in Testing for Differences Between High-Concentration and Low-Concentration Industries. . . . .	24
6.	Regression Results for 19 Low-Concentration Industries and 43 High-Concentration Industries. . . . .	27
7.	Regression Results for 43 High-Concentration Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	29
8.	Regression Results Using Various Proxies for Scale- Economy Barriers, 62 Canadian Industries. . . . .	40
9.	Regression Results Using Selected Proxies for Scale- Economy Barriers, 62 Industries, Consumer-Goods and Producer-Goods Breakdown. . . . .	42
10.	Regression Results Using Selected Proxies for Scale- Economy Barriers, Low-Concentration and High- Concentration Breakdown . . . . .	43
11.	Regression Results Using Selected Proxies for Scale- Economy Barriers, 43 High-Concentration Industries, Consumer-Goods and Producer-Goods Breakdown . . . . .	44
12.	Comparison of Economies of Scale Figures Based on 80 Percent of Shipments With Those Based on 50 Percent of Shipments. . . . .	47
13.	Average Plant Sizes, As a Percentage of Industry Shipments . . . . .	48

## LIST OF ILLUSTRATIONS

1. The Concentration-Profits Relationship for 62 Industries . . . . . 21
2. The Value-Added-Employment Relationship . . . . . 35

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In addition, the author expresses his appreciation for worksheets that were made available by Dr. J.C.H. Jones and Dr. L. Laudadio, of the University of Victoria, and Dr. M. Percy, of the University of British Columbia. These worksheets, from the study Jones, Laudadio, and Percy (1977), greatly facilitated the task of data compilation and undoubtedly made the thesis more complete than it otherwise would have been.

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<sup>1</sup> U.S. studies include Connor and Wilson (1967), Collins and Preston (1969), and Esposito and Esposito (1971). Canadian studies appear to be limited to McPetridge (1973), Jones, Laudadio, and Percy (1977), and Jones, Laudadio, and Percy (1977). Researchers have used both profits and price-cost margins as measures of performance. For example, Connor and Wilson, Esposito and Esposito, and Jones, Laudadio, and Percy used profits, while Collins and Preston, and McPetridge used price-cost margins.

<sup>2</sup> See Connor and Wilson (1967) and Esposito and Esposito (1971).

I. INTRODUCTION

Numerous studies, based mainly on U.S. data, have attempted to relate industry performance, as measured either by profits or by price-cost margins, to various elements of market structure, two of these being concentration and scale economies.<sup>1</sup> It is generally agreed that the number and size distribution of firms in an industry will influence that industry's performance. More precisely, it is felt that highly concentrated industries will be able to exercise some degree of monopoly power and so gain higher than average returns. This hypothesis of a positive relationship between concentration and performance appears to be confirmed by various empirical studies. The exact nature of this relationship is, however, unclear. Similarly, it is generally agreed that scale economies permit an established firm to enjoy higher than average profits. Direct measures of scale economies are, unfortunately, usually unavailable, and the commonly used proxy based on plant size suffers from being highly collinear with measures of the other elements of market structure.<sup>2</sup>

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<sup>1</sup>U.S. studies include Comanor and Wilson (1967), Collins and Preston (1969), and Esposito and Esposito (1971). Canadian studies appear to be limited to McFetridge (1973), Jones, Laudadio, and Percy (1973), and Jones, Laudadio, and Percy (1977). Researchers have used both profits and price-cost margins as measures of performance. For example, Comanor and Wilson, Esposito and Esposito, and Jones, Laudadio, and Percy used profits, while Collins and Preston, and McFetridge used price-cost margins.

<sup>2</sup>See Comanor and Wilson (1967) and Esposito and Esposito (1971).

Two recent articles present what appear to be significant new approaches to the above mentioned problems. In the first of these, Rhoades and Cleaver (1973) treat concentration as a discontinuous variable and discover a distinct break or discontinuity in the price-cost margin-concentration relationship. In the second article, Caves, Khalilzadeh-Shirazi, and Porter (1975) develop and test new measures of economies of scale, based on a cost-disadvantage ratio. These measures reduce multicollinearity and clarify the significance of other variables.

Studies of Canadian industries have not been numerous, partly because of data limitations. Recent studies do, however, indicate that the basic structure-performance model applies. Of interest is the fact that the collinearity problems encountered in the U.S. studies are very much in evidence here as well. Further, it seems that to date no attempt has been made to investigate the nature of the relationship between concentration and profits. In an attempt to clarify the structure-performance relationship as it applies to Canada, this thesis proposes to adapt the Rhoades and Cleaver and the Caves, Khalilzadeh-Shirazi, and Porter approaches to Canadian data. Specifically, the profits-concentration relationship will be examined, new economies of scale measures will be developed, and the results will be integrated into a general structure-performance analysis of the Canadian manufacturing sector.

With reference to the above, in section II of this thesis the basic model and the sample are briefly considered. In section III a conventional profits-structure analysis provides a basis for the analysis to follow. In section IV the profits-concentration relationship is examined in some detail. In section V various new proxies for scale

economies are developed and tested. Finally, in section VI the results are briefly summarized.

## II. THE BASIC MODEL

The basic model considered is a slightly modified version of that used by Jones, Laudadio, and Percy (1977).<sup>1</sup> Profits are specified as a function of concentration, barriers to entry, demand, and foreign competition. The complete model is:

$$(P+I)/TA = f(ANR, ES, CON4, M/Q, A/Q, D, RD, SR),$$

where the variables are defined as follows:

### Dependent variable

(P+I)/TA ratio of profits plus interest to total assets<sup>2</sup>

### Independent variables

#### Concentration:

CON4 four-firm concentration ratio

RD a dummy variable, 1 if identifiable regional concentration exists, 0 otherwise

#### Barriers to entry:

<sup>1</sup> It will be recognized that this model is a modification of the Connor and Wilson (1967) model. Modifications include the addition of the variables M/Q and SR.

<sup>2</sup> There is some discussion in the literature as to whether the return on equity (the ratio of profits to equity) or the return on total assets (the ratio of profits plus interest to total assets) is the most appropriate dependent variable. Stigler (1963, pp. 123-125) argues in favour of return on total assets, while Connor and Wilson (1967), p. 427, among others, argue that the return on equity should be used. This study will follow Stigler. In any case, the desire to compare the results from the present study to those of the Jones, Laudadio, and Percy study dictates the use of return on total assets. The simple correlation between profits to equity and profits plus interest to total assets is .950, so it is to be expected that the results would be similar in either case.

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AKR	absolute capital requirement necessary to establish plant of minimum efficient scale, divided by sales
ES	share of industry output of plant of minimum efficient scale, an economies of scale measure
A/Q	ratio of advertising expenditures to sales
SR	ratio of value added of primary establishments in a given industry to value added of enterprises in that industry

Demand: the signs of the coefficients, a positive relationship is

D ratio of industry shipments at time  $t+n$  to industry shipments at time  $t$

Foreign competition:

M/Q ratio of imports to industry output

Most of the variables in the model, as noted by Jones, Laudadio, and Percy, are common in industrial organization literature and require little further explanation. Two of the variables (SR and AKR) do, however, require some additional comment.

JLP<sup>3</sup> included the variable SR (specialization ratio) to test the hypothesis that diversification is a barrier to entry not usually exposed by the traditional barriers (AKR, ES, and A/Q). Thus there should be a positive relationship between profits and diversification, and hence a negative relationship between profits and specialization.<sup>4</sup>

The capital-requirements variable employed by JLP (1977) was first introduced by Comanor and Wilson (1967), and later used by Esposito and Esposito (1971). This variable is a measure of the capital required to establish a plant of minimum efficient scale. Porter (1974) and

<sup>3</sup>The abbreviation "JLP" will be used for "Jones, Laudadio, and Percy."

<sup>4</sup>For more details, see Rhoades (1973a), Rhoades (1974), and Jones, Laudadio, and Percy (1977).

Caves, Khalilzadeh-Shirazi, and Porter (1975) apparently modified this variable by dividing it by sales, to give a measure of the capital requirement per dollar of output. A preliminary investigation showed that the revised variable gave slightly better results, in terms of increased significance of individual coefficients and higher  $R^2$ 's, and on this basis the revised variable was used in the remainder of this paper.

As for the signs of the coefficients, a positive relationship is expected between profits and the variables representing concentration (CON4 and RD), the traditional barriers to entry (AKR, ES, and A/Q), and demand (D). For producer-goods industries A/Q perhaps may not be significant. The sign of M/Q, as Jones, Laudadio, and Percy explain, cannot be unambiguously predicted. U.S. and U.K. studies<sup>5</sup> have reported a negative relationship, while for Canada JLP (1973 and 1977) have found evidence of a positive relationship. The sign of SR, as indicated above, should be negative.

JLP applied their model to a cross-section sample of 60 Canadian manufacturing industries, divided into 31 consumer-goods industries and 29 producer-goods industries, and accounting for approximately 67.9 percent of factory shipments in 1965. Their choice of sample was constrained to some extent by a desire to match U.S. and Canadian industries. For this thesis the sample was changed by the addition of 4 industries and the deletion of 2 of the original industries to give a sample of 62 industries, 30 consumer-good and 32 producer-good, accounting for approximately 68.5 percent of factory shipments in

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<sup>5</sup>Esposito and Esposito (1971) and Khalilzadeh-Shirazi (1974).

1965.<sup>6</sup>

Details regarding the sample, data sources, construction of variables, and producer-consumer derivation are given in the appendices. The dependent variable,  $(P+I)/TA$ , as well as AKR are derived from data averaged over 1965 to 1967, M/Q is based on 1961 data, SR on 1968 data, and CON4, ES, A/Q, and RD on 1965 data. Data listings, by industry, for the variables used in the regressions are also given in the appendices.

Initial results, however, indicated that the Rhodes and Cleaver analysis was sensitive to large residuals. In view of this the sample was re-examined and it was found to be statistically appropriate to delete 2 industries, distilleries, SIC 1430, and aircraft and parts, SIC 3210, from the sample.<sup>1</sup> The result is, as already mentioned, a 62-industry sample which accounts for approximately 75.1 percent of non-automobile manufacturing in Canada in 1965.

The JLP results were based on a non-linear functional form, all variables being transformed to natural logarithms. However, since Rhodes and Cleaver as well as Caves, Khalilzadeh-Shirazi, and Porter used linear specifications, and since it is proposed to adapt their

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<sup>1</sup>The test used is outlined in Johnston (1972, pp. 206-207) and is attributed to G.C. Chow, and alternately to F.M. Fisher. For the complete model, as in equation 1a, table 1, distilleries and aircraft and parts were found to have the largest residuals of the 64 industries, 5.65 and -3.81 respectively. (The standard deviation of the dependent variable for the 64-industry sample was 2.15.) When distilleries was dropped from the sample, followed by aircraft and parts, the test statistics generated were 22.94 and 7.25 respectively, as compared to asymptotic critical values of 7.13 and 7.14 at the 1 percent level.

<sup>6</sup>Because of the special nature of the automobile industry, it was excluded from the JLP study. In the interests of comparability it has also been excluded from this study. The given samples represent 74.5 percent and 75.1 percent of non-automobile manufacturing in 1965. For a discussion regarding the 2 deleted industries, see section III of this paper.

### III. PRELIMINARY RESULTS

It originally had been intended to work with a sample of 64 industries, adding 4 to the Jones, Laudadio, and Percy (1977) sample.

Initial results, however, indicated that the Rhoades and Cleaver analysis was sensitive to large residuals. In view of this the sample was re-examined and it was found to be statistically appropriate to delete 2 industries, distilleries, SIC 1430, and aircraft and parts, SIC 3210, from the sample.<sup>1</sup> The result is, as already mentioned, a 62-industry sample which accounts for approximately 75.1 percent of non-automobile manufacturing in Canada in 1965.

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approaches to Canadian data, only linear relationships will be considered in this paper.<sup>2</sup> In all cases the dependent variable will be the ratio of profits plus interest to total assets, expressed as percentage.

Throughout the paper the significance of regression coefficients will be tested by the t test, with t values being given in parentheses beneath the coefficients. The significance of the coefficients of multiple determination will be tested by the F test. Unless indicated otherwise, all coefficients of multiple determination are significant at the 99 percent level or higher. All estimation is by ordinary least squares. The structure-profits equations were estimated by the OLSQ procedure of TSP. A few of these equations were also estimated with the OLS option of SHAZAM, with virtually identical results. The regressions of employment on value added in section V used the BMD05R Polynomial Regression routine of BIOMED.<sup>3</sup>

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<sup>2</sup>The recent implementation of the SHAZAM program at the University of Victoria made it possible to determine that for the 62-industry sample the linear specification was, in fact, the most appropriate from a statistical point of view. The extended Box-Cox technique was used, in which both the dependent and the independent variables are transformed to the same power,  $\hat{\lambda}$ , that maximizes the logarithm of the likelihood function. Given  $\lambda$ , it is possible to test whether  $\lambda = 0$ , implying a logarithmic form, or  $\lambda = 1$ , implying a linear form, is the most appropriate. For the JLP specification, equivalent to  $\lambda = 0$  except for RD where  $\lambda$  is restricted to 1, the test statistic generated was 11.61 as compared to a critical value of 1.92 at the 5 percent level, implying rejection of the hypothesis that  $\lambda = 0$ . For the linear specification, equivalent to  $\lambda = 1$ , the test statistic generated was 0.21, again compared to a critical value of 1.92, implying non-rejection of the hypothesis that  $\lambda = 1$ . For details as to the test procedure see Zarembka (1968) and White (1972). Also see SHAZAM under Computer Programs at the end of the Selected References.

<sup>3</sup>The author acknowledges the cooperation and assistance given by Pat Konkin, Programmer/Analyst, University of Victoria, in connection with various programming and computational problems. References for the indicated programs are given at the end of the Selected References.

Jones, Laudadio, and Percy found no evidence of heteroskedasticity in the 60-industry sample. The same was found to be the case for the 62-industry sample. Although an inspection of a plot of the residuals gave no indication of heteroskedasticity, it was decided to follow Esposito and Esposito (1971, p. 349) and test for it on the basis that if present it would likely be associated with concentration. However, neither Bartlett's test nor the Goldfield and Quandt test led to rejection of the hypothesis of homoskedasticity at the 95 percent level of significance. In addition, the simple correlations between each of the variables and the squared residuals, and between each of the variables and the absolute value of the residuals, were examined. The highest correlation was found to be between the residuals and the product-differentiation variable A/Q, but even this was insignificant at the 95 percent level.<sup>4</sup> In connection with heteroskedasticity, it is perhaps of interest to note that while Comanor and Wilson (1967) as well as Esposito and Esposito (1971) found evidence of heteroskedasticity in their U.S. samples, neither RC nor CK-SP<sup>5</sup> mention this problem.

Regression results for the 62-industry sample, as well as for the

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<sup>4</sup>The data was arranged in order of increasing concentration and specification 1a, table 1, was used. For Bartlett's test the residuals were divided into groups of 10, 10, 11, 11, 10, and 10, in that order. For the Goldfield and Quandt test the central 14 observations were omitted. The test statistics generated were 2.02 and 1.38 respectively, while the appropriate critical values are 11.07 and 2.40. Details of these tests are given in Kane (1968, pp. 373-374) and Johnston (1972, pp. 218-219). The first of the correlations mentioned will detect the presence of heteroskedasticity where the variance is proportional to one of the independent variables; the second, where the variance is proportional to the square of one of the independent variables. The simple correlation between the residuals and A/Q was  $-.2036$ , which yields a test statistic of 1.61, as compared to a critical value of 1.67.

<sup>5</sup>The abbreviations "RC" and "CK-SP" will be used for "Rhoades and Cleaver" and "Caves, Khalilzadeh-Shirazi, and Porter," respectively.

TABLE 1  
REGRESSION RESULTS FOR 62 CANADIAN INDUSTRIES

	Constant	AKR	ES	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
62 INDUSTRIES--PRODUCER GOODS AND CONSUMER GOODS											
1a	1.244 (0.679)	0.082 (2.360) <sup>b</sup>	-0.198 (-1.778) <sup>f</sup>	0.028 (1.844) <sup>b</sup>	2.341 (3.332) <sup>d</sup>	0.329 (4.609) <sup>a</sup>	0.349 (0.792)	0.868 (1.149)	0.024 (1.447)	.519	.446
1b	1.712 (0.902)		-0.059 (-0.597)	0.028 (1.774) <sup>b</sup>	2.155 (2.963) <sup>d</sup>	0.285 (3.972) <sup>a</sup>	0.353 (0.769)	1.173 (1.514) <sup>c</sup>	0.019 (1.080)	.469	.400
1c	2.006 (1.104)	0.049 (1.639) <sup>c</sup>		0.009 (0.831)	2.140 (3.026) <sup>d</sup>	0.293 (4.198) <sup>a</sup>	0.381 (0.849)	1.431 (2.046) <sup>b</sup>	0.018 (1.087)	.491	.425
1d	1.949 (1.057)			0.020 (2.256) <sup>b</sup>	2.103 (2.930) <sup>d</sup>	0.277 (3.951) <sup>a</sup>	0.365 (0.802)	1.355 (1.913) <sup>b</sup>	0.017 (1.006)	.465	.407
30 CONSUMER-GOODS INDUSTRIES											
2a	5.329 (2.229) <sup>b</sup>	-0.020 (-0.235)	-0.079 (-0.527)	0.015 (1.041)	1.658 (1.390)	0.392 (5.282) <sup>a</sup>	0.405 (0.543)	1.784 (2.512) <sup>b</sup>	-0.022 (-1.034)	.786	.704
2b	5.428 (2.358) <sup>b</sup>		-0.105 (-1.023)	0.015 (1.066)	1.738 (1.553)	0.396 (5.681) <sup>a</sup>	0.360 (0.510)	1.774 (2.558) <sup>a</sup>	-0.022 (-1.073)	.785	.717
2c	5.257 (2.240) <sup>b</sup>	-0.053 (-0.897)		0.011 (0.916)	1.505 (1.322)	0.375 (5.679) <sup>a</sup>	0.530 (0.762)	1.939 (3.053) <sup>a</sup>	-0.023 (-1.099)	.783	.714
2d	5.666 (2.471) <sup>b</sup>			0.004 (0.417)	1.669 (1.493)	0.372 (5.666) <sup>a</sup>	0.506 (0.731)	2.157 (3.690) <sup>a</sup>	-0.026 (-1.278)	.775	.716
32 PRODUCER-GOODS INDUSTRIES											
3a	-1.821 (-0.717)	0.090 (2.069) <sup>b</sup>	-0.183 (-1.093)	0.041 (1.460) <sup>c</sup>	1.790 (1.990) <sup>f</sup>	0.509 (1.429) <sup>c</sup>	0.536 (0.951)	-1.650 (-0.958)	0.053 (2.278) <sup>e</sup>	.551	.395
3b	-1.331 (-0.494)		-0.045 (-0.276)	0.050 (1.680) <sup>c</sup>	1.702 (1.776) <sup>f</sup>	0.412 (1.095)	0.357 (0.601)	-0.782 (-0.439)	0.048 (1.931) <sup>f</sup>	.467 <sup>e</sup>	.312
3c	-1.044 (-0.427)	0.071 (1.774) <sup>b</sup>		0.020 (0.967)	1.529 (1.756) <sup>f</sup>	0.534 (1.497) <sup>c</sup>	0.547 (0.967)	-1.202 (-0.716)	0.048 (2.105) <sup>e</sup>	.527	.389
3d	-1.133 (-0.444)			0.043 (2.748) <sup>a</sup>	1.630 (1.800) <sup>f</sup>	0.426 (1.162)	0.371 (0.639)	-0.704 (-0.408)	0.047 (1.948) <sup>f</sup>	.465	.337

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

consumer-goods and producer-goods subsamples, are given in table 1. As indicated in table 2, an examination of these results shows that except for the three variables M/Q, SR, and ES all significant coefficients have the expected sign. Of the remaining variables, the coefficients of AKR are significant in 4 of the 12 equations, the coefficients of CON4 are significant in 6 of the 12 equations, those of A/Q are significant in 10 equations, and those of RD in 7 equations. All of the  $R^2$ 's except that for equation 3b are significant at the 99 percent level or higher.

TABLE 2

## ANALYSIS OF SIGNIFICANT COEFFICIENTS IN TABLE 1

Variable	Sample	Equations (s)	Signs of Coefficients	
			Expected	Actual
AKR	All industries	1a,1c	+	+
	Producer goods	3a,3c	+	+
ES	All industries	1a	+	-
CON4	All industries	1a,1b,1d	+	+
	Producer goods	3a,3b,3d	+	+
M/Q	All industries	1a,1b,1c,1d	-	+
	Producer goods	3a,3b,3c,3d	-	+
A/Q	All industries	1a,1b,1c,1d	+	+
	Consumer goods	2a,2b,2c,2d	+	+
	Producer goods	3a,3c	+	+
RD	All industries	1b,1c,1d	+	+
	Consumer goods	2a,2b,2c,2d	+	+
SR	Producer goods	3a,3b,3c,3d	-	+

When the results in table 1 are compared with those in the Jones, Laudadio, and Percy (1977) study, the following points are noted:

1. The revised capital-requirements variable, AKR, is significant and of the expected sign in 4 cases. The corresponding variable in the JLP study was never significant.

2. The variables ES, CON4, A/Q, RD, and SR behave much as they did in the Jones, Laudadio, and Percy study.
3. M/Q is now significant in all cases for the entire sample, as well as for the producer-goods subsample.
4. The variable D is never significant, whereas in the JLP study it was significant for all specifications of the consumer-goods and producer-goods subsamples.
5. The anomalous signs for the variables M/Q, SR, and ES are present in both studies.
6. In general the significance levels of the coefficients are higher in the present study than in the JLP study. This is at least partly a result of the deletion of the 2 "outlying" industries.<sup>6</sup>

In view of the above, it appears that in spite of the different sample, the linear instead of logarithmic form, and the revised capital-requirements variable, the two sets of results are in general agreement. Hence it is felt that the model, as used here, and the 62-industry sample provide a good basis on which to proceed with the present analysis.

It should be noted that the multicollinearity noted by JLP is in evidence here as well. For the total sample CON4 is significant when AKR and ES are included, when both are excluded, when AKR alone is

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<sup>6</sup>The regression results for the 64-industry sample are:

<u>Constant</u>	<u>AKR</u>	<u>ES</u>	<u>CON4</u>	<u>M/Q</u>	<u>A/Q</u>	<u>D</u>
-0.096	0.090	-0.144	0.026	1.664	0.321	0.651
(-0.042)	(2.075) <sup>b</sup>	(-1.036)	(1.390) <sup>c</sup>	(1.965) <sup>f</sup>	(3.601) <sup>a</sup>	(1.232)
	<u>RD</u>	<u>SR</u>				
	0.782	0.034				
	(0.829)	(1.643)				
				R <sup>2</sup> =	.432	

It will be noted that the t values for AKR, ES, CON4, M/Q, A/Q, and RD are lower for the 64-industry sample, while those for D and SR are higher. For tests of significance see table 1.

excluded, but not when ES alone is excluded. The zero-order correlations between these variables range from .610 to .795, so such a collinearity problem is not unexpected.<sup>7</sup>

As expected, the results in table 1 show considerable variation between the consumer-goods and the producer-goods subsamples. In fact, only CON4, M/Q, and A/Q have the same sign in both subsamples and are significant in at least one subsample. This fact suggested that a specification involving only the independent variables CON4, M/Q, A/Q, and a producer-consumer dummy variable might be in order. The results of this specification are shown in table 3 below. Here PCD is a dummy variable

TABLE 3

REGRESSION RESULTS FOR ALTERNATE SPECIFICATIONS OF THE  
PROFIT-STRUCTURE RELATIONSHIP, 62 INDUSTRIES

	Constant	CON4	M/Q	A/Q	PCD	R <sup>2</sup>	$\bar{R}^2$
1	4.468 <sup>a</sup> (9.737)	0.020 <sup>b</sup> (2.273)	1.943 <sup>d</sup> (2.989)	0.374 <sup>a</sup> (5.007)	-0.791 <sup>f</sup> (-1.929)	.451	.412
2	4.748 <sup>a</sup> (9.920)	0.033 <sup>a</sup> (3.278)				.152	.138

The dependent variable is (P+I)/TA, expressed as a percentage.

t statistics are given in parentheses.

The letters a and b indicate significance at levels of 99% and 95%, respectively, one-tail tests.

The letters d and f indicate significance at levels of 99% and 90%, respectively, two-tail tests.

<sup>7</sup>The zero-order correlation matrix for the 62-industry sample is as follows:

<u>AKR</u>	<u>ES</u>	<u>CON4</u>	
1.0	.704	.610	AKR
	1.0	.795	ES
		1.0	CON4

All of these correlations are significant at 99.5 percent or higher. The test statistic for the lowest correlation, .610, is 5.96, as compared to a critical value of 2.66 at 99.5 percent.

equal to 1 for a consumer-goods industry and equal to 0 otherwise. The other variables are unchanged. An even simpler specification, the dependent variable as a function of only CON4, was also tried, with results as shown by equation 2 in the same table.

Equation 1 in table 3 can be compared with equation 1d in table 1, since in both cases neither AKR nor ES is included. It will be noted that the coefficients of CON4, M/Q, and A/Q are of the same sign and of approximately the same magnitudes and levels of significance for both equations. Thus it would appear that the specification involving the producer-consumer dummy variable is valid. The dummy variable is significant, and is negative, a somewhat surprising result.<sup>8</sup>

As noted in section I, the objectives of this thesis are twofold; to examine the profits-concentration relationship, and to develop and test new measures of economies of scale in an attempt to reduce multicollinearity. The results in tables 1 and 3 indicate that both the profits-concentration relationship and the multicollinearity do in fact exist. These will be considered in more detail in sections IV and V.

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<sup>8</sup> Rhoades and Cleaver (1973), using a somewhat different model for 352 U.S. industries, got a positive sign for their producer-consumer dummy variable.

#### IV. THE PROFITS-CONCENTRATION RELATIONSHIP

Rhoades and Cleaver (1973), in a study of 352 U.S. manufacturing industries, were able to find a distinct break or discontinuity in the concentration-margin relationship. Specifically, they found no systematic relationship between concentration and margins for industries with four-firm concentration ratios of less than 51 percent. In contrast, for industries with four-firm concentration ratios of 51 percent or over, they found a statistically significant, and positive, relationship. They conclude that "there appears to be an important structural difference in the nature of the concentration-margin relation between high and low concentration industries...."<sup>1</sup>

In their analysis, RC first applied regression analysis to their complete sample, using specifications similar to those in table 3 above. For both specifications they found that the coefficient of CON4 was positive and highly significant. They then suggested that a specification involving a dichotomous or discontinuous variable for concentration might either improve the explanatory power of concentration and/or provide a guide for the antitrust authorities.<sup>2</sup> Accordingly, they replaced the concentration variable by a 0-1 dummy variable, with industries below a selected value of concentration being assigned a

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<sup>1</sup>Rhoades and Cleaver (1973, p. 99).

<sup>2</sup>If a critical level of concentration exists, it would suggest that mergers in industries which are approaching the critical level should be scrutinized, to avoid the possibility of monopoly profits.

value of 0, and industries equal to or above that value being assigned a value of 1. Twenty-four possible critical values of concentration were examined, a separate regression being run in each case. The results were somewhat inconclusive in that the dummy variable was statistically significant regardless of the critical value selected. This fact suggested the existence of a basic linear relationship. In terms of  $\bar{R}^2$ 's, the "best" equation was for a break point of 51 percent. On the basis of this, and because the greatest change in  $\bar{R}^2$ 's occurred at this same point, industries above and below this point were further examined in the next step of the analysis.

Rhoades and Cleaver then went back to their initial regression equations and introduced dummy variables that allowed both the slope and the intercept to vary between the high-concentration and the low-concentration industries, the break point being the previously mentioned 51 percent.<sup>3</sup> (The coefficient of the slope dummy represents the difference in the slope between the high and the low-concentration industries.) They found both the intercept and the slope dummies to be significant and of the correct sign, indicating a statistically significant difference in the concentration-margin relationship between the low-concentration and the high-concentration industries. Separate regressions of the low-concentration and the high-concentration industries confirmed this finding.

In applying the RC approach to the sample of 62 Canadian industries,

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<sup>3</sup>These dummy variables are added to the variables already present, they do not replace them as in the case of the previously used 0-1 concentration dummy. The intercept dummy variable is simply the previous 0-1 concentration dummy variable (DCON4), while the slope dummy is the product of DCON4 and CON4.

the basic specification employed was the same as that used for equation 1 in table 3. In the first step of the analysis the concentration variable, CON4, was replaced by a 0-1 dummy variable, DCON4.<sup>4</sup> As in the Rhoades and Cleaver analysis, DCON4 was set equal to 0 for industries below a selected break point, and set equal to 1 otherwise. A total of 38 potential critical values of concentration were examined, ranging from 11 percent to 91 percent. Of these 38 values, the regression results for 11 representative values, ranging from 11 percent to 83 percent, are given in table 4.

The results of treating concentration as a discontinuous variable, as given in table 4, are in close agreement with those for equation 1 in table 3 where concentration was assumed to be linear and continuous. The variables M/Q, A/Q, and PCD behave much the same in both cases. Of particular interest here is the fact that the concentration dummy variable is statistically significant at the 95 percent level over the range of concentration from 33 percent to 71 percent, regardless of what break point is used. In terms of the  $R^2$ 's and the t values, the concentration dummy is strongest for break points of 35, 50, and 56 percent, with  $R^2$ 's in each case of .450 and with t values of 2.260, 2.259, and 2.258. The concentration dummy is, however, slightly weaker for break points of 40 and 46 percent. In other words, no clear pattern is evident, and, in addition, it is not possible to select a single "best" equation as it was in the RC analysis.

One further point to be noted is that the  $R^2$ 's and the t values of the concentration variables for the three "best" equations in table 4

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<sup>4</sup>For discussions regarding the use of dummy variables, see Suits (1957), Brown (1968), and Allard (1974, pp. 132-135).

TABLE 4  
REGRESSION RESULTS WHEN THE CONCENTRATION VARIABLE IS  
REPLACED BY A DUMMY VARIABLE, 62 INDUSTRIES

	Level of Concentration Used as Break Point (%)	Number of Industries Below the Break Point	Constant	Concentration Dummy Variable DCON4	M/Q	A/Q	PCD	R <sup>2</sup>	R̄ <sup>2</sup>
1	11	3	5.607 (6.148) a	-0.420 (-0.467)	2.174 (3.233) d	0.423 (5.533) a	-0.922 (-2.149) e	.403	.361
2	21	14	4.804 (10.262) a	0.591 (1.235)	1.980 (2.923) d	0.389 (4.977) a	-0.792 (-1.849) f	.417	.376
3	33	19	4.669 (10.985) a	0.827 (1.982) b	1.987 (3.032) d	0.379 (5.017) a	-0.718 (-1.704) f	.440	.401
4	35	20	4.635 (11.285) a	0.918 (2.260) b	1.984 (3.061) d	0.374 (4.987) a	-0.723 (-1.742) f	.450	.411
5	40	29	4.895 (13.305) a	0.707 (1.866) b	1.916 (2.884) d	0.401 (5.428) a	-0.831 (-2.003) e	.435	.395
6	46	34	4.901 (13.856) a	0.817 (2.161) b	1.839 (2.777) d	0.407 (5.597) a	-0.816 (-1.986) f	.446	.407
7	50	42	5.092 (15.595) a	0.927 (2.259) b	1.685 (2.491) e	0.409 (5.649) a	-0.996 (-2.427) e	.450	.411
8	56	48	5.114 (15.733) a	1.007 (2.258) b	1.874 (2.859) d	0.403 (5.547) a	-0.964 (-2.356) e	.450	.411
9	60	51	5.110 (15.380) a	0.870 (1.774) b	2.084 (3.180) d	0.398 (5.350) a	-0.890 (-2.148) e	.432	.392
10	71	52	5.097 (15.334) a	0.947 (1.853) b	2.111 (3.233) d	0.390 (5.211) a	-0.840 (-2.026) e	.435	.395
11	83	58	5.212 (15.513) a	0.288 (0.340)	2.172 (3.223) d	0.409 (5.157) a	-0.910 (-2.127) e	.402	.360

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

and for equation 1 in table 3 are nearly identical, .450 and .451, and 2.260, 2.259, 2.258, and 2.273, respectively. Hence for statistical purposes it makes little difference whether the continuous or the discontinuous specification of the concentration variable is chosen.

Rhoades and Cleaver, on the other hand, found that the continuous specification gave slightly better results.

The results thus far may appear to be somewhat inconclusive. The significant concentration dummy variable is interpreted as meaning that the intercept or average profits in industries above that level are greater than those in industries below that level. Since this relationship was found over a wide range of concentration, it would appear to suggest the existence of a basic linear relationship. At this stage of their analysis RC reached a similar conclusion, so this result is not unexpected. In addition, however, as already mentioned, no single "best" equation emerged to indicate a possible break point in the profits-concentration relationship. With regard to the "best" equation, it should be pointed out that the "best" equation chosen by RC had an  $\bar{R}^2$  of .227 as compared to other  $\bar{R}^2$ 's in their results of .224, .224, and .225. The corresponding t values for the concentration dummy were 4.711, 4.570, 4.575, and 4.610. The difference in both the  $\bar{R}^2$ 's and the t values are thus relatively minor, and because of this it is felt that the results to this point in the present analysis closely parallel those of RC, despite the lack of a unique "best" equation.

Although the results thus far suggest the existence of a linear, and positive, relationship between concentration and profits, an examination of a plot of profits as a function of concentration suggested otherwise. A modified version of this plot is given in figure 1 in

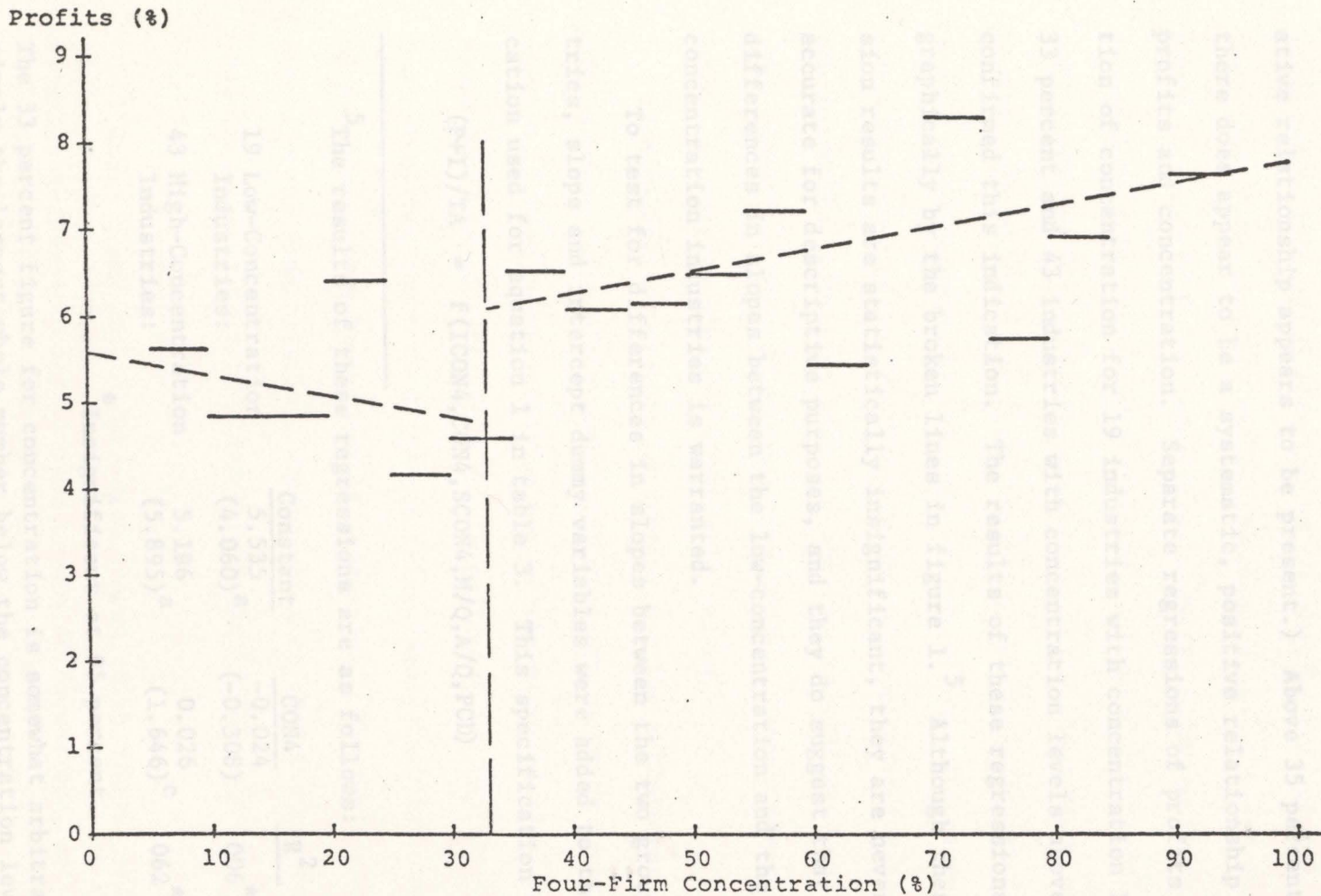


Figure 1: The Concentration-Profits Relationship for 62 Industries

which the average profits over each five percent range of concentration are plotted against concentration. Up to a concentration level of approximately 35 percent there appears to be no systematic, positive relationship between profits and concentration. (If anything, a negative relationship appears to be present.) Above 35 percent, however, there does appear to be a systematic, positive relationship between profits and concentration. Separate regressions of profits as a function of concentration for 19 industries with concentration levels below 33 percent and 43 industries with concentration levels above 33 percent confirmed this indication. The results of these regressions are shown graphically by the broken lines in figure 1.<sup>5</sup> Although these regression results are statistically insignificant, they are nevertheless accurate for descriptive purposes, and they do suggest that a test for differences in slopes between the low-concentration and the high-concentration industries is warranted.

To test for differences in slopes between the two groups of industries, slope and intercept dummy variables were added to the specification used for equation 1 in table 3. This specification then becomes:

$$(P+I)/TA = f(\text{ICON4}, \text{CON4}, \text{SCON4}, \text{M/Q}, \text{A/Q}, \text{PCD})$$

<sup>5</sup>The results of these regressions are as follows:

	Constant	CON4	R <sup>2</sup>
19 Low-Concentration Industries:	5.535 (4.060) <sup>a</sup>	-0.024 (-0.308)	.006*
43 High-Concentration Industries:	5.196 (5.895) <sup>a</sup>	0.026 (1.646) <sup>c</sup>	.062*

\* Insignificant at 95 percent.

The 33 percent figure for concentration is somewhat arbitrary, being simply the largest whole number below the concentration level of 33.15 percent.

The variables CON4, M/Q, A/Q, and PCD are specified as they were previously. ICON4 is the intercept dummy variable and is the same as the previously used DCON4. It is set equal to 0 for industries below a selected concentration break point, and set equal to 1 otherwise. (This dummy is used in addition to the regular intercept.) SCON4 is the slope dummy variable and is the product of ICON4 and CON4. Hence SCON4 is equal to 0 for industries below the selected break point and is equal to CON4 otherwise. With this approach, the coefficient of CON4 gives the slope of the low-concentration industries, while the coefficient of the slope dummy variable, SCON4, indicates the difference in the slope between the two sets of industries. The slope of the concentration-profits relationship should be greater for the high-concentration industries than for the low-concentration industries, so that a positive sign is expected for SCON4. Given a positive sign for SCON4, a negative sign for ICON4 will follow.

The regression results of testing for the differences in slopes when a break point of 33 percent is used are shown in equation 1 in table 5.<sup>6</sup> Both dummy variables are of the expected sign, but only the slope dummy is significant. This significant and positive slope dummy indicates that there is a statistically significant difference in the slopes between the two groups of industries. The coefficient of CON4 is negative and insignificant, which indicates that for the low-concentration industries there is a negative but insignificant relationship between

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<sup>6</sup>Other break points were also tested, with a break point of 35% giving a slightly higher t value for the slope dummy. On the basis of separate regressions for the two groups of industries, as for example equations 2 and 3 in table 5, the break point of 33 percent was chosen as the most appropriate.

TABLE 5

REGRESSION RESULTS IN TESTING FOR DIFFERENCES BETWEEN HIGH-  
CONCENTRATION AND LOW-CONCENTRATION INDUSTRIES

	Constant	Concentration Intercept Dummy ICON4	CON4	Concentration Slope Dummy SCON4	M/Q	A/Q	PCD	R <sup>2</sup>	$\bar{R}^2$
<u>62 INDUSTRIES--ALLOWING SLOPES AND INTERCEPTS TO DIFFER FOR INDUSTRIES WITH CON4 &lt; 33% AND CON4 &gt; 33%</u>									
1	5.950 (5.633) <sup>a</sup>	-1.504 (-1.163)	-0.073 (-1.264)	0.093 (1.571) <sup>c</sup>	2.017 <sup>d</sup> (3.109)	0.385 (5.116) <sup>a</sup>	-0.834 <sup>f</sup> (-1.990)	.476	.419
<u>19 LOW-CONCENTRATION INDUSTRIES</u>									
2	5.493 (4.372) <sup>a</sup>		-0.084 (-1.302)		2.753 (1.674)	0.518 <sup>b</sup> (2.568)	-0.291 (-0.364)	.472 <sup>e</sup>	.321
<u>43 HIGH-CONCENTRATION INDUSTRIES</u>									
3	4.537 (5.916) <sup>a</sup>		0.022 (1.612) <sup>c</sup>		1.825 <sup>e</sup> (2.499)	0.368 <sup>a</sup> (4.253)	-1.013 <sup>f</sup> (-1.924)	.391	.327

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

concentration and profits.<sup>7</sup> The remaining variables behave as they did in equation 1, table 3.

The results thus far indicate no systematic relationship between profits and concentration for the low-concentration industries, and a significant and positive difference in the concentration-profits relationship between the two sets of industries. What is still uncertain is whether or not there is a systematic relationship between concentration and profits for the high-concentration industries. In an attempt to clear up this ambiguity, separate regressions involving the 19 low-concentration industries and the 43 high-concentration industries were run, with results as shown by equations 2 and 3 in table 5. An examination of these results confirms the previous indication of a negative, but insignificant, relationship between concentration and profits for the low-concentration industries. In addition, for these industries both M/Q and PCD are insignificant at the 90 percent level. For the high-concentration industries, a positive and significant relationship between concentration and profits is evident. The remaining variables all have the signs that they had in the complete sample and all are significant. From these results, it is evident that the two sets of industries have different characteristics insofar as concentration, imports, and advertising are concerned. In addition, the results for the producer-consumer dummy variable, which is insignificant in equation 2 but significant in equation 3, indicates that there are differences between the consumer-goods and the producer-goods sections of the high-

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<sup>7</sup>The sum of the coefficients of CON4 and SCON4 gives the slope for the high-concentration industries, which in this case is  $-0.073 + 0.093 = 0.020$ . Since the coefficient  $-0.073$  is statistically insignificant, this result must be interpreted with caution.

concentration industries.

From the above results it would appear that further investigation into the differences between the low-concentration and the high-concentration industries would be in order. In addition, the significant producer-consumer dummy variable in equation 3 indicates that an investigation into the differences between the consumer-goods and the producer-goods industries in the high-concentration sample would be justified. With this in mind it was decided to return to the Jones, Laudadio, and Percy (1977) model and apply it to the 19 low-concentration industries and to the 43 high-concentration industries. In addition, the high-concentration industries were broken down into 19 consumer-goods industries and 24 producer-goods industries and the model was applied to them as well. The regression results of applying the JLP model to these samples are given in tables 6 and 7. These results will now be examined and compared with the initial results given in table 1.

In the results for the low and high-concentration breakdown in table 6, the consistent difference in the signs for CON4 between the two groups of industries is evident. Of particular interest is the fact that when both AKR and ES are omitted CON4 is significant and negative for the low-concentration industries, and is significant and positive for the high-concentration industries, in both cases at the 90 percent level. This appears to be further confirmation of the earlier results that indicated a significant difference in the behaviour of the concentration variable between the two groups of industries. AKR is positive and significant in equations 2a and 2c, but negative and insignificant in equations 1a and 1c, while ES is never significant. The collinearity problem between AKR, ES, and CON4 mentioned earlier is in evidence here

TABLE 6  
REGRESSION RESULTS FOR 19 LOW-CONCENTRATION INDUSTRIES  
AND 43 HIGH-CONCENTRATION INDUSTRIES

	Constant	AKR	ES	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
<u>19 LOW-CONCENTRATION INDUSTRIES</u>											
1a	8.988 (1.786) <sup>c</sup>	-1.364 (-0.825)	0.531 (0.271)	-0.080 (-0.797)	5.668 (3.129) <sup>e</sup>	0.667 (3.550) <sup>a</sup>	-0.814 (-0.890)	3.093 (1.587) <sup>c</sup>	-0.029 (-0.575)	.732 <sup>e</sup>	.518
1b	8.055 (1.667) <sup>c</sup>		-0.963 (-1.315)	-0.059 (-0.614)	4.767 (3.348) <sup>d</sup>	0.689 (3.759) <sup>a</sup>	-0.878 (-0.977)	2.650 (1.436) <sup>c</sup>	-0.016 (-0.342)	.714 <sup>e</sup>	.532
1c	8.686 (1.850) <sup>b</sup>	-0.949 (-1.580)		-0.067 (-0.794)	5.447 (3.517) <sup>d</sup>	0.682 (3.971) <sup>a</sup>	-0.822 (-0.940)	2.848 (1.723) <sup>c</sup>	-0.026 (-0.547)	.730 <sup>e</sup>	.558
1d	8.288 (1.667) <sup>c</sup>			-0.141 (-1.885) <sup>f</sup>	4.093 (2.992) <sup>e</sup>	0.583 (3.438) <sup>a</sup>	-1.019 (-1.110)	4.031 (2.579) <sup>b</sup>	-0.010 (-0.202)	.669 <sup>e</sup>	.503
<u>43 HIGH-CONCENTRATION INDUSTRIES</u>											
2a	0.392 (0.188)	0.079 (2.323) <sup>b</sup>	-0.159 (-1.437)	0.018 (0.901)	1.594 (2.016) <sup>f</sup>	0.263 (3.401) <sup>a</sup>	0.902 (1.811) <sup>b</sup>	0.852 (1.027)	0.032 (1.784) <sup>f</sup>	.517	.403
2b	0.655 (0.297)		-0.030 (-0.297)	0.023 (1.066)	1.335 (1.606)	0.212 (2.699) <sup>a</sup>	0.945 (1.790) <sup>b</sup>	1.178 (1.357) <sup>c</sup>	0.026 (1.364)	.440	.328
2c	1.128 (0.550)	0.055 (1.824) <sup>b</sup>		0.000 (0.015)	1.378 (1.748) <sup>f</sup>	0.228 (3.063) <sup>a</sup>	0.936 (1.853) <sup>b</sup>	1.395 (1.859) <sup>b</sup>	0.028 (1.543)	.488	.386
2d	0.821 (0.389)			0.018 (1.340) <sup>c</sup>	1.300 (1.601)	0.208 (2.729) <sup>a</sup>	0.950 (1.824) <sup>b</sup>	1.290 (1.671) <sup>c</sup>	0.025 (1.357)	.439	.345

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

as well, in that the behaviour of these variables changes considerably with the omission of AKR, or ES, or both of these.  $M/Q$  is still positive, and is somewhat stronger for the low-concentration sample. One explanation may be that perhaps the low-concentration industries import more semi-finished goods for further manufacture than do the high-concentration industries. The demand variable,  $D$ , is of opposite sign for the two samples, but is only significant for the high-concentration sample. The difference here perhaps could be that in the low-concentration industries the growth in demand induced excessive entry, and hence depressed profits. For the high-concentration industries, with high capital requirements for entry, this excessive entry may not have occurred, so that the growth in demand led, as predicted, to higher profits. The variables  $A/Q$ ,  $RD$ , and  $SR$  behave much as they did in table 1 and will not be commented on here.

In comparing the results in table 6 to those in table 1, the difference in the behaviour of  $CON4$  has already been noted. The behaviour of the demand variable in table 6 has been mentioned above, but it should be pointed out here that while it is significant in all cases for the high-concentration sample, it was never significant in table 1. Its significance here agrees with results for the U.S. and the U.K.,<sup>8</sup> which perhaps could be interpreted as an indication that for the Canadian sample the structure-performance model is more valid for the high-concentration industries than for the complete sample.

In examining the consumer-producer breakdown in table 7, it will be noted that the variables  $AKR$  and  $ES$  behave much as they did for the

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<sup>8</sup> See Esposito and Esposito (1971), Rhoades and Cleaver (1973), and Caves, Khalilzadeh-Shirazi, and Porter (1975).

TABLE 7

REGRESSION RESULTS FOR 43 HIGH-CONCENTRATION INDUSTRIES,  
CONSUMER-GOODS AND PRODUCER-GOODS BREAKDOWN

	Constant	AKR	ES	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
<u>19 HIGH-CONCENTRATION CONSUMER-GOODS INDUSTRIES</u>											
1a	2.229 (0.777)	-0.056 (-0.605)	0.006 (0.037)	0.015 (0.814)	0.961 (0.686)	0.307 (3.105) <sup>a</sup>	1.579 (1.491) <sup>c</sup>	2.146 (2.351) <sup>b</sup>	-0.008 (-0.354)	.812	.661
1b	2.698 (1.007)		-0.071 (-0.628)	0.015 (0.828)	1.245 (0.972)	0.329 (3.680) <sup>a</sup>	1.339 (1.405) <sup>c</sup>	2.044 (2.347) <sup>b</sup>	-0.009 (-0.386)	.805	.681
1c	2.250 (0.840)	-0.053 (-0.900)		0.015 (0.961)	0.979 (0.782)	0.309 (3.875) <sup>a</sup>	1.559 (1.791) <sup>c</sup>	2.128 (2.915) <sup>a</sup>	-0.008 (-0.369)	.812	.692
1d	2.694 (1.031)			0.007 (0.567)	1.121 (0.909)	0.306 (3.864) <sup>a</sup>	1.560 (1.806) <sup>b</sup>	2.381 (3.563) <sup>a</sup>	-0.012 (-0.550)	.798	.697
<u>24 HIGH-CONCENTRATION PRODUCER-GOODS INDUSTRIES</u>											
2a	-3.657 (-1.290)	0.054 (1.305)	-0.254 (-1.584)	0.098 (1.973) <sup>b</sup>	1.065 (1.248)	0.178 (0.457)	0.888 (1.656) <sup>c</sup>	-2.799 (-1.787) <sup>f</sup>	0.047 (2.184) <sup>e</sup>	.667 <sup>e</sup>	.489
2b	-4.155 (-1.448)		-0.243 (-1.485)	0.130 (2.937) <sup>a</sup>	0.913 (1.057)	0.034 (0.090)	0.746 (1.390) <sup>c</sup>	-2.866 (-1.792) <sup>f</sup>	0.042 (1.963) <sup>f</sup>	.629 <sup>e</sup>	.467
2c	-1.499 (-0.576)	0.050 (1.170)		0.040 (1.140)	0.889 (1.004)	0.255 (0.630)	0.906 (1.616) <sup>c</sup>	-1.801 (-1.201)	0.042 (1.883) <sup>f</sup>	.611 <sup>e</sup>	.441
2d	-2.055 (-0.795)			0.072 (3.301) <sup>a</sup>	0.754 (0.850)	0.117 (0.298)	0.772 (1.391) <sup>c</sup>	-1.905 (-1.258)	0.038 (1.709)	.578 <sup>e</sup>	.429

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

corresponding samples in table 1, although AKR is now insignificant in the producer-goods sample. CON4 is significant for corresponding specifications in the producer-goods sample, but at higher levels. M/Q is insignificant in all cases for both samples, while A/Q is significant in all cases for the consumer-goods industries, but not for the producer-goods industries. In addition, the demand variable D is significant in all cases for both samples. The variables RD and SR behave much as they did in table 1.

Possibly of greatest interest in the consumer-producer breakdown in table 7 is the behaviour of the variables M/Q, A/Q, and D. To repeat, M/Q still has the unexpected positive sign, but is now insignificant. A/Q has the expected sign and is significant for consumer-goods industries but insignificant for producer-goods, as predicted. D is positive and significant in all cases. These results conform more closely to a priori expectations of the model than do either the results in table 1 or those of Jones, Laudadio, and Percy (1977). It appears, again, that perhaps the structure-performance model is more valid for the high-concentration industries than for the complete sample.

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The symbols used here are those that are used in the analysis that follows.

## V. MEASUREMENT OF SCALE ECONOMIES

Caves, Khalilzadeh-Shirazi, and Porter (1975) developed new measures of scale economies and tested these measures in two studies, one of 60 U.K. industries, and one of 42 U.S. consumer-goods industries. The approach used was to calculate "cost-disadvantage ratios" based on value added per worker, which were then used interactively with conventional proxies for minimum efficient plant size to form various new measures of scale economies. In addition to capturing the previously omitted influence of suboptimal scale, the variables reduced multicollinearity and clarified the influence of other variables.

The cost-disadvantage ratio (CDR) used by CK-SP was the ratio of average value added per worker in the smallest plants supplying 50 percent of industry value added divided by average value added per worker in plants supplying the other 50 percent. In most cases the computed ratios were less than unity, but in any case they were constrained to be no greater than unity, because of the interest in barriers to entry caused by economies of scale. CK-SP then computed conventional estimates of minimum efficient scale, following Comanor and Wilson (1967) for the U.S. study, and Weiss (1963) for the U.K. These variables are comparable to the variable ES appearing in this paper and discussed briefly in appendix 3.<sup>1</sup> The cost-disadvantage

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<sup>1</sup>The symbols used here are those that are used in the analysis that follows.

ratios, CDR, and the conventional scale-economies variable, ES, were then used to construct other variables, as follows:

ESCA the ratio  $ES/CDR$

ES10 equal to ES if  $CDR < 0.90$   
equal to 0 otherwise

ES15 equal to ES if  $CDR < 0.85$   
equal to 0 otherwise

ES20 equal to ES if  $CDR < 0.80$   
equal to 0 otherwise

ES25 equal to ES if  $CDR < 0.75$   
equal to 0 otherwise

The variable ESCA retains ES and CDR as continuous variables, in effect magnifying their influence. As minimum efficient plant size, ES, increases, and as the productivity disadvantage of smaller plants increases (as CDR decreases), the variable ESCA increases. The variables ES10, ES15, ES20, and ES25 are used to test the hypothesis that "large minimum optimal plant size is a source of barriers to entry only when the cost disadvantage of a potential entrant at smaller plant sizes is significant."<sup>2</sup> The cutoff points of 0.90, 0.85, 0.80, and 0.75 were chosen because the authors insisted on a substantial (greater than 10 percent) implied cost disadvantage.

In the U.K. study, variables corresponding to ES10 and ES20 appear to have reduced the multicollinearity that existed between the scale-economy and the concentration variables. When either ES10 or ES20 was used, both the concentration and the scale-economy barriers to entry were statistically significant. When either ES or ESCA was used, however, only the scale-economy barrier was significant. When used alone

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<sup>2</sup>Caves, Khalilzadeh-Shirazi, and Porter (1975, p. 136).

CDR was not significant, but concentration was.

In the U.S. study the variables ESCA, ES10, ES15, ES20, and ES25 all performed well, with increased explanatory power as compared to ES. ES20 and ES25 yielded the best equations, implying a 20 to 25 percent cost disadvantage. In all cases the concentration variable was significant, but with an unexpected negative sign. The effect of the new variables on multicollinearity appears to have been minimal.

The failure of the CDR variable to perform well when used alone was not unexpected, since Caves, Khalilzadeh-Shirazi, and Porter point out that they had only "modest" expectations as to its accuracy as a measure of diseconomies of small scale. Only under certain assumptions are variations with scale in value added per worker a measure of changes in economies of scale. Plants, regardless of size, throughout an industry must be assumed to have similar production functions, similar optimal capital-labour proportions regardless of scale, and similar labour quality and wage rates. Equally distributed advertising and research and development expenditures, as well as similar market conduct and hence profits, also must be assumed. The plants in an industry do, however, differ in age and product mix, do display different market conduct, and do earn different profits. Hence the CDR variable is subject to various biases that could be detected only by a close study of each industry. Because of this, results involving the direct use of CDR must be interpreted with caution. ES10 through ES25, on the other hand, make only indirect use of CDR and results involving these variables can be interpreted with somewhat greater confidence.

In applying the CK-SP approach to the sample of 62 Canadian industries, it was found that data necessary to calculate directly the

required cost disadvantage ratios was not available. In most cases, however, data was available which gave percentage value added and percentage employment accounted for by the largest 4, 8, 12, 16, 20, and 50 establishments in an industry. This data together with the two extreme values at 0 value added and 100 percent value added gave up to 8 observations on value added and employment for each industry. To generate the required information from which to calculate the cost disadvantage ratio for an industry, employment was regressed on value added. The resulting equation was then evaluated at 50 percent value added to give an estimate of percentage employment by the largest firms supplying 50 percent of that industry's value added. Given this estimate, it was possible to calculate an estimated cost disadvantage ratio.<sup>3</sup>

The regressions of employment on value added were of the form:

$$Y = A + BX + CX^2,$$

where Y represents percentage employment, X represents percentage value added, and A, B, and C are the estimated coefficients. The quadratic form was chosen to allow for a non-linear relationship between value added and employment. The procedure followed may be illustrated as shown in figure 2. If employment were strictly proportional to value added, the data points would all fall on the straight line between the origin and the point (100,100). This is not likely to be the case, and for a typical industry with a cost disadvantage ratio of less than unity,

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<sup>3</sup>It will be noted that the cost disadvantage ratio reduces to:

$$\frac{(\text{employment in largest firms supplying 50 percent of value added})}{(\text{employment in smallest firms supplying 50 percent of value added})}$$

For data source see appendix 3 under ES.

the data points will give a "best-fit" regression line such as that indicated in the figure by  $Y = A + BX + CX^2$ . Evaluating the equation of the line at 50 percent value added will give a corresponding percentage employment of OD. OD will then represent employment by the largest firms supplying 50 percent of industry value added, so that the cost disadvantage ratio, CDR, is  $OD/(100-OD)$ .

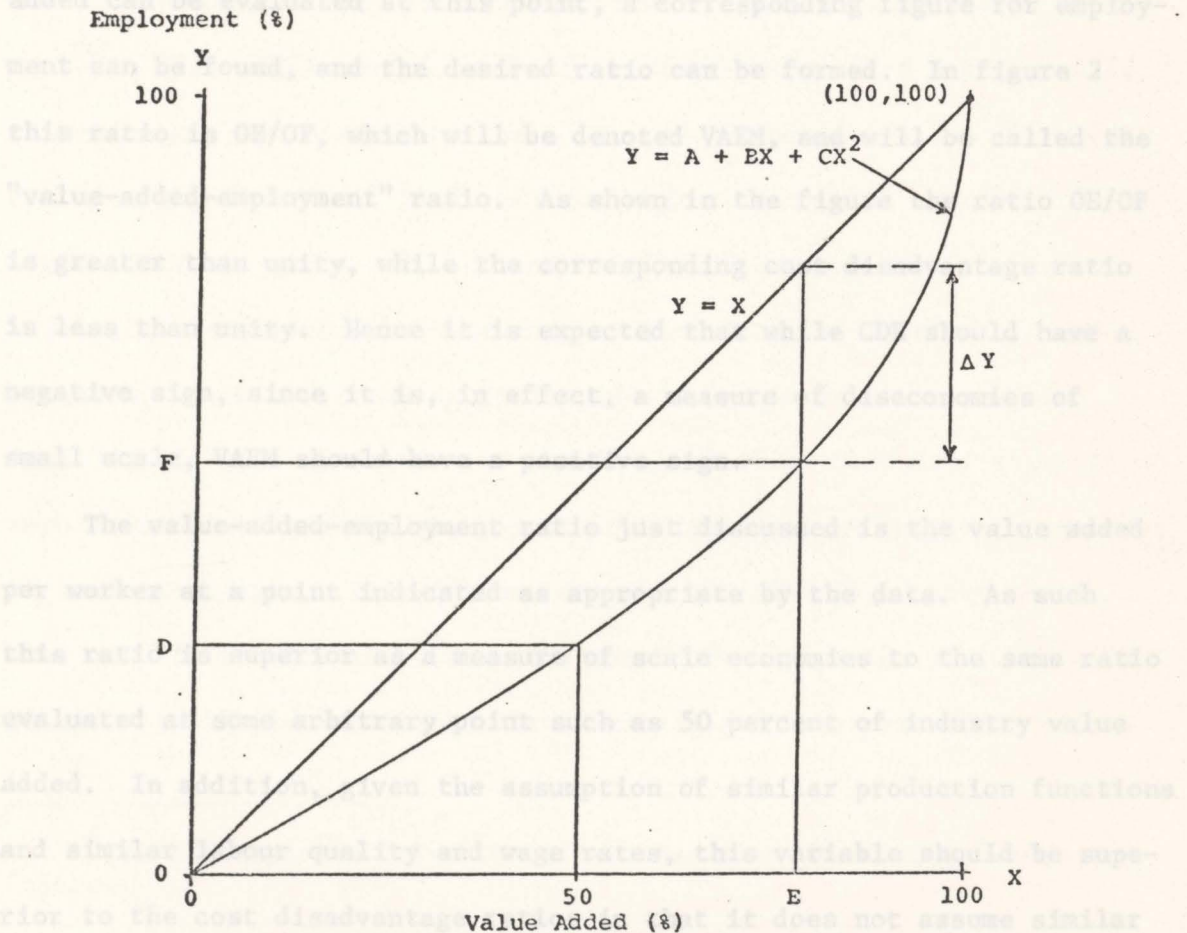


Figure 2: The Value-Added-Employment Relationship

The use of quadratic regression equations in this way allowed another possible measure of scale economies to be developed. This is the ratio of value added to employment calculated at the point where the relation between value added and employment is at its maximum deviation from what it would be if employment were strictly proportional

to value added. In figure 2 the observed relationship between employment and value added is  $Y = A + BX + CX^2$ , while if the two were strictly proportional this relationship would be  $Y = X$ . The difference between the two is  $\Delta Y = A + (B-1)X + CX^2$ , which can be shown to be a maximum at  $X = (1-B)/2C$ . (Strictly speaking it is the absolute value of  $\Delta Y$  that is a maximum at this point, since as illustrated  $\Delta Y$  is negative.) Value added can be evaluated at this point, a corresponding figure for employment can be found, and the desired ratio can be formed. In figure 2 this ratio is  $OE/OF$ , which will be denoted  $VAEM$ , and will be called the "value-added-employment" ratio. As shown in the figure the ratio  $OE/OF$  is greater than unity, while the corresponding cost disadvantage ratio is less than unity. Hence it is expected that while  $CDR$  should have a negative sign, since it is, in effect, a measure of diseconomies of small scale,  $VAEM$  should have a positive sign.

The value-added-employment ratio just discussed is the value added per worker at a point indicated as appropriate by the data. As such this ratio is superior as a measure of scale economies to the same ratio evaluated at some arbitrary point such as 50 percent of industry value added. In addition, given the assumption of similar production functions and similar labour quality and wage rates, this variable should be superior to the cost disadvantage ratios in that it does not assume similar optimal capital-labour proportions regardless of scale.

The sample of 62 Canadian industries represents 86 industries that were initially aggregated to 62 industries because of data considerations. The regressions just outlined of employment on value added were performed for 84 of these 86 industries, establishment data being used for 78

industries, and enterprise data for 6 industries.<sup>4</sup> For one of the two remaining industries, SIC 3370, data on the one available combination of employment and value added was used directly to calculate CDR and VAEM. For the other industry, SIC 1510, no establishment data was available, but as SIC 1510 and SIC 1530 are aggregated in this study, with the latter being weighted more heavily, the CDR and VAEM values for SIC 1530 were taken as representative of the two industries.

The individual coefficients of the regressions were not tested for significance, but F tests on the  $R^2$ 's were performed. All  $R^2$ 's except one were significant at 99 percent or higher, while the remaining  $R^2$  was significant at over 95 percent. It may be argued that the use of regression information in this way, without detailed testing of coefficients, and without taking prediction intervals into account, is invalid. In this connection it should be recalled that many assumptions were required to justify the use of cost-disadvantage ratios as measures of scale economies. In addition, the variable CDR is in most cases used only indirectly along with the conventional measure of scale economies. Finally, since the predicted values occur in most cases near

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<sup>4</sup>The 6 industries for which enterprise data was used are as follows:

<u>Industry</u>	<u>No. of Enterprises</u>	<u>No. of Establishments</u>
SIC 2640	42	45
SIC 3080	954	957
SIC 3110	94	96
SIC 3760	123	134
SIC 3815	558	560
SIC 3830	85	88

For these 6 industries suppression of establishment data left too few degrees of freedom. It will be noted that in these industries the number of establishments and the number of enterprises are approximately the same, so the use of enterprise data should not seriously bias the results. For data source see appendix 3 under ES.

the sample mean, and since the regressions are highly significant, the prediction intervals will be relatively small. In view of the above points, it is felt that the calculated values of CDR and VAEM are valid for the purposes required.

In summary, the variables CDR and VAEM were calculated from regressions of employment on value added. The variable CDR was then used directly with the conventional scale economies measure ES to form the ratio  $ESCA = ES/CDR$ . In addition the variable CDR was used indirectly to form the variables ES10, ES15, ES20, and ES25. These various proxies for scale-economy barriers to entry were then tested in the structure-profits model. The proxies are listed here for ready reference:

ES	share of industry output of a plant of minimum efficient size. Details of this measure given in appendix 3.
CDR	cost disadvantage ratio, as defined in this section
ESCA	the ratio $ES/CDR$
ES10	equal to ES if $CDR < 0.90$ equal to 0 otherwise
ES15	equal to ES if $CDR < 0.85$ equal to 0 otherwise
ES20	equal to ES if $CDR < 0.80$ equal to 0 otherwise
ES25	equal to ES if $CDR < 0.75$ equal to 0 otherwise
VAEM	value-added-employment ratio, as defined in this section

In testing the various measures of scale economies that have been developed as outlined in this section, the model as originally specified, for example equation 1a, table 1, was used, ES being replaced in turn by each of the 7 new variables. The variables were tested for each of the 7 samples of industries that have emerged from the analysis to date, as follows:

<u>Sample</u>	<u>Table</u>
62 industries	1
30 consumer-goods industries	1
32 producer-goods industries	1
19 low-concentration industries	6
43 high-concentration industries	6
19 high-concentration consumer-goods industries	7
24 high-concentration producer-goods industries	7

The regression results presented in the tables indicated above used various combinations of the structural variables AKR, ES, and CON4. Because of multicollinearity, the results obtained when AKR, or ES, or both AKR and ES were omitted varied, but in spite of this a definite pattern emerged for each sample. For example, the results for the 62-industry sample indicated that AKR, CON4, M/Q, A/Q, and RD should be positive and significant, and that the economies of scale variable would likely be negative and significant. Hence for a new economies of scale measure to be an improvement over the conventional one, ES, it should be more highly significant than ES while leaving AKR, CON4, M/Q, A/Q, and RD substantially unchanged. In addition, its use should not decrease, and preferably should increase, the  $R^2$  of the equation. Results to this point indicate a negative sign for ES, so it is expected that ES10, ES15, ES20, and ES25 will have negative signs. As stated earlier, CDR and VAEM should display opposite signs. The sign of ESCA is difficult to predict. In tests of significance for the scale-economy variables, two-tail tests will be used exclusively.

The results of using the 8 different measures of economies of scale in regression equations for the 62-industry sample are given in table 8. It will be noted that ESCA, ES10, ES20, and ES25 are all

TABLE 8  
REGRESSION RESULTS USING VARIOUS PROXIES FOR SCALE-  
ECONOMY BARRIERS, 62 CANADIAN INDUSTRIES

	Constant	AKR	Scale-Economy Barriers	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
1	1.244 (0.679)	0.082 <sup>b</sup> (2.360)	-0.198 <sup>f</sup> ES (-1.778)	0.028 <sup>b</sup> (1.844)	2.341 <sup>d</sup> (3.332)	0.329 <sup>a</sup> (4.609)	0.349 (0.792)	0.868 (1.149)	0.024 (1.447)	.519	.446
2	1.458 (0.731)	0.046 <sup>c</sup> (1.494)	1.092 CDR (0.684)	0.012 (1.012)	2.045 <sup>d</sup> (2.823)	0.320 <sup>a</sup> (3.984)	0.300 (0.644)	1.460 <sup>b</sup> (2.073)	0.015 (0.867)	.495	.419
3	1.265 (0.731)	0.079 <sup>a</sup> (2.616)	-0.181 <sup>d</sup> ESCA (-2.816)	0.040 <sup>a</sup> (2.646)	1.998 <sup>d</sup> (2.992)	0.390 <sup>a</sup> (5.257)	0.234 (0.549)	0.541 (0.741)	0.023 (1.463)	.557	.490
4	1.851 (1.071)	0.078 <sup>a</sup> (2.546)	-0.214 <sup>e</sup> ES10 (-2.607)	0.028 <sup>b</sup> (2.182)	1.624 <sup>e</sup> (2.317)	0.348 <sup>a</sup> (4.999)	0.327 (0.765)	0.776 (1.092)	0.019 (1.195)	.549	.481
5	1.759 (0.979)	0.068 <sup>b</sup> (2.130)	-0.138 ES15 (-1.634)	0.021 <sup>c</sup> (1.598)	1.770 <sup>e</sup> (2.417)	0.327 <sup>a</sup> (4.554)	0.403 (0.911)	1.059 <sup>c</sup> (1.459)	0.019 (1.153)	.515	.442
6	2.000 (1.129)	0.074 <sup>b</sup> (2.315)	-0.161 <sup>f</sup> ES20 (-1.944)	0.021 <sup>b</sup> (1.707)	1.604 <sup>e</sup> (2.160)	0.338 <sup>a</sup> (4.702)	0.347 (0.792)	1.026 <sup>c</sup> (1.439)	0.017 (1.054)	.525	.453
7	2.229 (1.335) <sup>c</sup>	0.062 <sup>b</sup> (2.214)	-0.226 <sup>d</sup> ES25 (-3.331)	0.027 <sup>b</sup> (2.349)	1.572 <sup>e</sup> (2.343)	0.374 <sup>a</sup> (5.457)	0.240 (0.579)	0.997 <sup>c</sup> (1.521)	0.015 (0.958)	.579	.515
8	2.125 (0.770)	0.049 <sup>c</sup> (1.606)	-0.080 VAEM (-0.058)	0.009 (0.818)	2.133 <sup>d</sup> (2.947)	0.295 <sup>a</sup> (3.714)	0.377 (0.818)	1.431 <sup>b</sup> (2.028)	0.018 (1.025)	.491	.414

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

significant, with higher t values than the original variable ES, and with the same negative sign. ES25 gives particularly good results. It is highly significant (99 percent or higher), and in addition it has not unduly affected the t values of the other variables. Comparing equations 1 and 7 in table 8 it will be noted that AKR, ES and ES25, CON4, M/Q, and A/Q are all significant and of the same sign in both equations. RD is significant in equation 7, as it was in 3 of the 4 specifications in table 1.

Complete listings of all the results for each sample of industries will not be given. Based on the procedure followed for the 62-industry sample, 1 to 3 "best" economy of scale variables were selected for each sample. The regression results for these "best" variables, along with the corresponding results using the original variable, are given for each of the samples in tables 9, 10, and 11. It will be noted that in 4 cases ES25 was selected, and in 2 cases ES20 was selected. The 20 to 25 percent cutoff point that Caves, Khalilzadeh-Shirazi, and Porter found gave the best results also appears to be the appropriate one in this study.

For the producer-goods samples, both for the 32-industries and for the 24 high-concentration industries, ESCA performed well, but in view of its direct use of the calculated CDR, the variables ES25 and ES20 are preferred. CDR displayed the correct sign and was significant, at the expense of CON4, in the sample of 43 high-concentration industries, but again ES25 is preferred. It will be noted that M/Q is now insignificant, perhaps a preferred result in view of its puzzling positive sign.

The variable ES10 was selected as "best" for the 19 low-concentration

TABLE 9

REGRESSION RESULTS USING SELECTED PROXIES FOR SCALE-ECONOMY BARRIERS,  
62 INDUSTRIES, CONSUMER-GOODS AND PRODUCER-GOODS BREAKDOWN

	Constant	AKR	Scale-Economy Barriers	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
<u>62 INDUSTRIES</u>											
1a	1.244 (0.679)	0.082 <sup>b</sup> (2.360)	-0.198 <sup>f</sup> ES (-1.778)	0.028 <sup>b</sup> (1.844)	2.341 <sup>d</sup> (3.332)	0.329 <sup>a</sup> (4.609)	0.349 (0.792)	0.868 (1.149)	0.024 (1.447)	.519	.446
1b	2.229 <sup>c</sup> (1.335)	0.062 <sup>b</sup> (2.214)	-0.226 <sup>d</sup> ES25 (-3.331)	0.027 <sup>b</sup> (2.349)	1.572 <sup>e</sup> (2.343)	0.374 <sup>a</sup> (5.457)	0.240 (0.579)	0.997 <sup>c</sup> (1.521)	0.015 (0.958)	.579	.515
<u>30 CONSUMER-GOODS INDUSTRIES</u>											
2a	5.329 <sup>b</sup> (2.229)	-0.020 (-0.235)	-0.079 <sup>ES</sup> (-0.527)	0.015 (1.041)	1.658 (1.390)	0.392 <sup>a</sup> (5.282)	0.405 (0.543)	1.784 <sup>b</sup> (2.512)	-0.022 (-1.034)	.786	.704
2b	5.199 <sup>b</sup> (2.253)	-0.019 (-0.303)	-0.137 <sup>ES25</sup> (-1.327)	0.021 <sup>c</sup> (1.512)	0.803 (0.649)	0.403 <sup>a</sup> (5.902)	0.535 (0.782)	1.587 <sup>b</sup> (2.338)	-0.024 (-1.145)	.800	.724
<u>32 PRODUCER-GOODS INDUSTRIES</u>											
3a	-1.821 (-0.717)	0.090 <sup>b</sup> (2.069)	-0.183 <sup>ES</sup> (-1.093)	0.041 <sup>c</sup> (1.460)	1.790 <sup>f</sup> (1.990)	0.509 <sup>c</sup> (1.429)	0.536 (0.951)	-1.650 (-0.958)	0.053 <sup>e</sup> (2.278)	.551	.395
3b	-0.445 (-0.189)	0.074 <sup>b</sup> (1.951)	-0.174 <sup>f</sup> ES25 (-1.876)	0.030 <sup>c</sup> (1.515)	1.337 (1.601)	0.549 <sup>c</sup> (1.617)	0.412 (0.759)	-0.961 (-0.600)	0.042 <sup>f</sup> (1.908)	.590	.447
3c	-1.683 (-0.712)	0.095 <sup>b</sup> (2.356)	-0.205 <sup>f</sup> ESCA (-1.826)	0.052 <sup>b</sup> (1.982)	1.643 <sup>f</sup> (1.970)	0.561 <sup>c</sup> (1.646)	0.439 (0.807)	-1.325 (-0.826)	0.051 <sup>e</sup> (2.340)	.587	.443

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

TABLE 10  
REGRESSION RESULTS USING SELECTED PROXIES FOR SCALE-ECONOMY BARRIERS,  
LOW-CONCENTRATION AND HIGH-CONCENTRATION BREAKDOWN

	Constant	AKR	Scale-Economy Barriers		CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	$\bar{R}^2$
<u>19 LOW-CONCENTRATION INDUSTRIES</u>												
1a	8.988 (1.786) <sup>c</sup>	-1.364 (-0.825)	0.531 (0.271)	ES	-0.080 (-0.797)	5.668 (3.129) <sup>e</sup>	0.667 (3.550) <sup>a</sup>	-0.814 (-0.890)	3.093 (1.587) <sup>c</sup>	-0.029 (-0.575)	.732 <sup>e</sup>	.518
1b	7.398 (1.568) <sup>c</sup>	-1.228 (-1.945) <sup>f</sup>	0.893 (1.214)	ES10	-0.113 (-1.236)	6.639 (3.675) <sup>d</sup>	0.506 (2.284) <sup>b</sup>	-0.574 (-0.652)	3.431 (2.033) <sup>b</sup>	-0.012 (-0.250)	.765 <sup>e</sup>	.577
1c	13.346 (2.769) <sup>a</sup>	-0.705 (-1.280)	-9.660 (-1.954) <sup>f</sup>	CDR	-0.073 (-0.962)	4.687 (3.265) <sup>d</sup>	0.365 (1.635) <sup>c</sup>	-0.308 (-0.374)	0.347 (0.178)	0.009 (0.200)	.805	.649
1d	-8.848 (-0.837)	-0.662 (-1.162)	13.442 (1.814) <sup>b</sup>	VAEM	-0.084 (-1.075)	4.636 (3.135) <sup>e</sup>	0.354 (1.484) <sup>c</sup>	-0.160 (-0.182)	-0.333 (-0.144)	0.000 (0.007)	.797 <sup>a</sup>	.635
<u>43 HIGH-CONCENTRATION INDUSTRIES</u>												
2a	0.392 (0.188)	0.079 (2.323) <sup>b</sup>	-0.159 (-1.437)	ES	0.018 (0.901)	1.594 (2.016) <sup>f</sup>	0.263 (3.401) <sup>a</sup>	0.902 (1.811) <sup>b</sup>	0.852 (1.027)	0.032 (1.784) <sup>f</sup>	.517	.403
2b	1.388 (0.807)	0.061 (2.429) <sup>b</sup>	-0.242 (-3.968) <sup>d</sup>	ES25	0.028 (1.845) <sup>b</sup>	0.657 (0.957)	0.319 (4.791) <sup>a</sup>	0.763 (1.793) <sup>b</sup>	0.731 (1.123)	0.019 (1.263)	.650	.568
2c	-0.150 (-0.073)	0.047 (1.627) <sup>c</sup>	3.326 (2.073) <sup>b</sup>	CDR	0.004 (0.282)	0.974 (1.251)	0.309 (3.806) <sup>a</sup>	0.631 (1.250)	1.301 (1.810) <sup>b</sup>	0.018 (1.030)	.545	.438

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

TABLE 11

REGRESSION RESULTS USING SELECTED PROXIES FOR SCALE-ECONOMY BARRIERS,  
43 HIGH-CONCENTRATION INDUSTRIES, CONSUMER GOODS  
AND PRODUCER-GOODS BREAKDOWN

	Constant	AKR	Scale-Economy Barriers	CON4	M/Q	A/Q	D	RD	SR	R <sup>2</sup>	R̄ <sup>2</sup>
<u>19 HIGH-CONCENTRATION CONSUMER-GOODS INDUSTRIES</u>											
1a	2.229 (0.777)	-0.056 (-0.605)	0.006 ES (0.037)	0.015 (0.814)	0.961 (0.686)	0.307 (3.105) a	1.579 (1.491) c	2.146 (2.351) b	-0.008 (-0.354)	.812	.661
1b	2.204 (0.842)	-0.024 (-0.383)	-0.132 ES20 (-1.228)	0.027 (1.487) c	0.297 (0.221)	0.332 (4.140) a	1.622 (1.903) b	1.690 (2.119) b	-0.011 (-0.477)	.836	.706
<u>24 HIGH-CONCENTRATION PRODUCER-GOODS INDUSTRIES</u>											
2a	-3.657 (-1.290)	0.054 (1.305)	-0.254 ES (-1.584)	0.098 (1.973) b	1.065 (1.248)	0.178 (0.457)	0.888 (1.656) c	-2.799 (-1.787) f	0.047 (2.184) e	.667 <sup>e</sup>	.489
2b	-1.636 (-0.728)	0.072 (1.878) b	-0.211 ES20 (-2.540) e	0.067 (2.074) b	0.062 (0.075)	0.281 (0.803)	0.866 (1.788) b	-2.452 (-1.857) f	0.036 (1.898) f	.728	.583
2c	-3.292 (-1.449)	0.054 (1.494) c	-0.256 ESCA (-2.790) e	0.113 (2.867) a	0.776 (1.046)	0.248 (0.730)	0.728 (1.535) c	-2.436 (-1.906) f	0.042 (2.264) e	.744	.607

The dependent variable is (P+I)/TA, expressed as a percentage. t statistics are given in parentheses. The letters a, b, and c indicate significance at levels of 99%, 95%, and 90%, respectively, one-tail tests. The letters d, e, and f indicate significance at levels of 99%, 95%, and 90%, respectively, two-tail tests.

industries. The results for this group of industries obtained from CDR and VAEM are interesting and are also given. It will be noted that both ES and ES10 display a positive sign, even though neither are significant. CDR and VAEM are significant, but apparently at the expense of A/Q and RD, both of which showed up strongly in table 6. As predicted, CDR and VAEM have opposite signs. The results for the low-concentration industries, with perverse signs for both ES10 and CON4, further strengthen the earlier indication that these industries are in some way not typical of the manufacturing industries and do not lend themselves well to the conventional structure-profits analysis.

Caves, Khalilzadeh-Shirazi, and Porter (1975) found that the new measures of scale economies reduced multicollinearity and clarified the significance of other variables. An examination of the results in tables 9, 10, and 11 will indicate that the new variables have performed at least as well in the present study. In 3 of the 7 samples of industries, the use of the "best" measure has increased the significance of both CON4 and AKR. In the remaining 4 samples, the new measures have increased the significance of CON4 while not appreciably affecting the significance of AKR. The "best" scale-economy variables are themselves significant in 4 of the samples, while ES is significant in only 1 sample. The performance of the remaining variables has not been unduly affected. M/Q has dropped in significance in most cases, which in view of its unexpected positive sign is perhaps as it should be. The  $R^2$ 's have increased in all cases.

Except for the low-concentration sample, the sign of all measures of scale economies involving the conventional measure, ES, is negative. This result is difficult to interpret, but in view of the high levels

of significance it cannot be ignored. It is suggested that the perverse sign is perhaps a result of misspecification of this variable in the Jones, Laudadio, and Percy (1973, 1977) models because of data considerations.<sup>5</sup> The Comanor and Wilson (1967) economies of scale variable, used by Caves, Khalilzadeh-Shirazi, and Porter, was based on the average size of the largest plants supplying 50 percent of factory shipments. JLP, because of data availability, based their measure on the average size of the largest plants supplying 80 percent of shipments. The use of the 80 percent figure will result in the inclusion of smaller plants in the calculated value of ES. If enough of these smaller plants are of suboptimal size, ES could become a measure of "diseconomies of (small) scale" rather than a measure of "economies of scale," so that the negative sign would be appropriate.

Data is not in general available on the number of the largest plants supplying 50 percent of shipments, but to illustrate the suggestion put forward in the last paragraph, figures based on linear interpolation of available data were calculated for 4 industries selected at random. These figures, with the comparable figures for the largest plants supplying 80 percent of shipments, based on available data, are given in table 12. Of interest is the fact that for every industry listed, the number of plants supplying 80 percent of shipments is approximately 3 times as great as the number supplying 50 percent of shipments. This being the case, it seems likely that at least some of the plants supplying 80 percent of shipments are considerably smaller than those that supply 50 percent of shipments.

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<sup>5</sup> See Jones, Laudadio, and Percy (1973, p. 358).

TABLE 12  
COMPARISON OF ECONOMIES OF SCALE FIGURES BASED ON 80 PERCENT  
OF SHIPMENTS WITH THOSE BASED ON 50 PERCENT OF SHIPMENTS

Industry SIC	Total Number of Plants	Number of of Largest Plants	Percentage of Total	Calculated Value of ES
<u>LARGEST PLANTS SUPPLYING 80 PERCENT OF SHIPMENTS</u> *				
1110	376	85.97	22.86	0.93
2010	64	19.11	29.86	4.19
2310	134	52.51	39.19	1.52
3030	634	131.94	20.81	0.61
<u>LARGEST PLANTS SUPPLYING 50 PERCENT OF SHIPMENTS</u> **				
1110	376	32.34	8.60	1.55
2010	64	5.19	8.11	9.63
2310	134	20.06	14.97	2.49
3030	634	35.39	5.58	1.41

\* For data source, see appendix 3, under ES.

\*\* These figures are based on linear interpolation. For data source, see above.

This last point is illustrated by table 13 where average plant sizes have been calculated for 3 cases, largest plants supplying 50 percent of shipments, largest plants supplying 80 percent of shipments, and largest plants supplying 30 percent of shipments in the range from 50 percent to 80 percent of shipments. The figures in the first column of the table correspond to Comanor and Wilson's (1967) measure, while those in the second column correspond to the Jones, Laudadio, and Percy measure. In going from 50 percent of shipments to 80 percent of shipments, plants of the sizes indicated in the third column have been added to the "efficient" plants. As indicated, average plant sizes when the JLP measure is used are considerably smaller than those obtained when the Comanor and Wilson measure is used. Even so, it could possibly be argued that plants of the sizes indicated by the JLP measure are efficient. The point is, however, that even granted that plants of this

size are "efficient," it is not unreasonable to suggest that plants of the sizes in the third column, the "added" plants, are not of efficient size, especially in view of the original Comanor and Wilson sizes.

Hence it appears safe to assume that some or even many of the smaller or "added" plants in the 80 percent case are of suboptimal size. The bias introduced may, in fact, be sufficient to account for the observed negative sign of the economies of scale measures, as already suggested.

Until more adequate data is available, however, it seems that this question will have to go unresolved.<sup>6</sup>

TABLE 13

AVERAGE PLANT SIZES,\* AS A PERCENTAGE  
OF INDUSTRY SHIPMENTS

Industry SIC	Largest Plants Supplying 50 Percent of Shipments	Largest Plants Supplying 80 Percent of Shipments	Largest Plants Supplying (80-90) Percent of Shipments
1010	5.81	3.50	2.10
2010	6.17	2.68	1.38
2310	3.34	2.04	1.24
3030	8.96	3.84	1.97

\* These figures are calculated from those in table 12.

<sup>6</sup>Caves, Khalilzadeh-Shirazi, and Porter (1975) were only partly able to resolve the problem of a negative sign for concentration. For the total sample of 42 consumer-goods industries, the concentration variable was always negative. By following Porter (1974) and dividing the sample into convenience and nonconvenience industries, they did get the expected positive sign for the concentration variable for 19 convenience industries.

## VI. CONCLUSION

The objective of this thesis was to examine and attempt to clarify two aspects of the structure-performance relationship as it applies to a sample of 62 Canadian manufacturing industries. First, the profits-concentration relationship was examined. Second, various new proxies for scale-economy barriers to entry were developed and tested.

In the first stage of the analysis, a statistically significant difference was found to exist in the profits-concentration relationship for industries with four-firm concentration ratios greater than 33 percent and those with four-firm concentration ratios less than 33 percent. Because of this difference, the sample was divided into 43 high-concentration industries and 19 low-concentration industries, and the two groups were separately analyzed. For the high-concentration industries, a statistically significant and positive relationship between profits and concentration was found to exist. For the low-concentration industries no clear picture emerged, although indications were that the relationship was perhaps negative. In addition, it appeared that the low-concentration industries do not lend themselves well to the structure-performance analysis.

In the second stage of the analysis, it was possible to develop proxies for scale-economy barriers to entry that were themselves highly significant and that in addition reduced multicollinearity and clarified the significance of other variables. Indications were that, for all but the low-concentration industries, scale economies are a significant

barrier to entry only when the cost disadvantage facing smaller plants is from 20 to 25 percent, a finding in agreement with that of a previous study based on U.S. data.<sup>1</sup> The problem of an unexpected sign for the "best" scale-economy proxies was not resolved. It was argued, however, that this is likely a result of misspecification due to data considerations.

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<sup>1</sup>This does not, as it may appear, ignore the problem of the negative sign. If, as has been mentioned, the variable ES is really a measure of "diseconomies of small scale," then the sign is appropriate. The problem is not with the model, but with the available data.

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APPENDIX I

THE SAMPLE

The initial sample consisted of 22 consumer-goods industries and 22 producer-goods industries. An industry was classified as a producer-goods industry if 30% of its output consisted of intermediate inputs, as determined from The Input-Output Structure of the Economy, based on section IV of this thesis. The Standard Industrial Classification of Canada, pages 233 to 234, where more than one SIC number is listed, is used.

LIST OF APPENDICES

1. The Sample . . . . .	55
2. Data Sources and a Note on Aggregation . . . . .	58
3. Definitions and Construction of the Variables. . . . .	59
4. Data Listings. . . . .	62

Standard Industrial Classification	Industry
---------------------------------------	----------

11 Low-concentration Consumer-goods Industries

1060	Dairy products
1740, 1792, 1799	Leather products <sup>c</sup>
2310	Hosiery mills
2390	Knitting mills <sup>d</sup>
2431, 2432	Men's clothing
2441, 2442	Women's clothing
2450	Children's clothing <sup>c</sup>
2460	Fur goods
2610	Household furniture <sup>c</sup>
2650	Miscellaneous furniture
2740	Pharmaceuticals and medicines

21 High-concentration Consumer-goods Industries

1010, 1019	Meat products
1120	Fruit and vegetable preservers
1280, 1290	Bakeries
1310, 1392	Confectionery and miscellaneous food <sup>c</sup>
1410	Soft drinks
1430	Distilleries <sup>b</sup>
1450	Breweries
1470	Vineries

## APPENDIX 1

## THE SAMPLE

The initial sample consisted of 32 consumer-goods industries and 32 producer-goods industries. An industry was classified as a producer-goods industry if 50 percent or more of its output consisted of intermediate inputs, as determined from The Input-Output Structure of the Canadian Economy, 1961. The low-concentration and high-concentration breakdown is based on section IV of this thesis. The Standard Industrial Classifications follow those given in Concentration in the Manufacturing Industries of Canada, pages 235 to 259. Where more than one SIC number appears for an industry, the given SIC industries have been aggregated.

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Standard Industrial  
Classification

Industry

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11 Low-concentration Consumer-goods Industries

1060	Dairy Products ✓
1740, 1792, 1799	Leather Products <sup>c</sup>
2310	Hosiery mills ✓
2390	Knitting mills <sup>a</sup>
2431, 2432	Men's clothing ✓
2441, 2442	Women's clothing
2450	Children's clothing <sup>c</sup>
2460	Fur goods
2610	Household furniture <sup>c</sup> ✓
2660	Miscellaneous furniture
3740	Pharmaceuticals and medicines ✓

21 High-concentration Consumer-goods Industries

1010, 1030	Meat products ✓
1120	Fruit and vegetable preservers
1280, 1290	Bakeries
1310, 1392	Confectionary and miscellaneous food <sup>c</sup>
1410	Soft drinks
1430	Distilleries <sup>b</sup>
1450	Breweries
1470	Wineries

APPENDIX 1--Continued

Standard Industrial Classification	Industry
- 1510, 1530	Tobacco products
2480	Foundation garments
- 3210 2740	Aircraft and parts <sup>b</sup>
3310 2732, 2733	Small electrical appliances
3320 2920	Major appliances
3340	Household radio and T.V. receivers
3350 2980	Communications equipment
3360	Electrical industrial equipment
3370	Batteries
3760	Soap and cleaning compounds
3770	Toilet preparations
3811, 3812, 3814, 3815	Instruments and related products
3830	Brooms, brushes, and mops
<u>8 Low-concentration Producer-goods Industries</u>	
2511, 2513	Shingle mills, sawmills, and planing mills
- 2541, 2542	Sash, door, and other millwork plants
2850, 2870	Publishing and printing
3030	Ornamental and architectural metal
3060	Hardware, tools, and cutlery
3070	Heating equipment <sup>a</sup>
- 3080	Machine shops
3150, 3180	Miscellaneous machinery and equipment
<u>24 High-concentration Producer-goods Industries</u>	
1110	Fish products
1230, 1240	Feed and flour <sup>c</sup>
1950	Wool yarn and cloth mills <sup>c</sup>
2010	Synthetic textiles
2520	Veneer and plywood mills

## APPENDIX 1--Continued

Standard Industrial Classification	Industry
2640	Office furniture
2710	Pulp and paper mills
2720, 2740	Miscellaneous paper converters <sup>a</sup>
2731, 2732, 2733	Cartons, boxes, and bags
2910, 2920	Iron and steel mills
2940	Iron foundaries <sup>a</sup>
2960, 2980	Metal rolling, casting, and extruding <sup>c</sup>
3020	Fabricated structural metal
3040	Metal stamping, pressing, and coating
3050	Wire and wire products
3110	Agricultural implements
3160	Commercial refrigeration and air conditioning
3380, 3390	Electrical wire and cable
3410	Cement
3511, 3512	Clay products
3530, 3570	Stone products and abrasives <sup>c</sup>
3690	Other petroleum and coal products
3750	Paints and varnishes
3780	Industrial chemicals

<sup>a</sup>These industries were not included in the Jones, Laudadio, and Percy (1977) study.

<sup>b</sup>These industries were dropped from the final sample. See section III of this paper.

<sup>c</sup>For these industries asset data was disaggregated by factory shipments, 1965, in the formation of the capital-requirement variable, AKR. See appendix 2.

## APPENDIX 2

## DATA SOURCES AND A NOTE ON AGGREGATION

The data sources used in this study are identical to those used in the Jones, Laudadio, and Percy (1977) study. They are listed here for easy reference. The abbreviation preceding each sources will be used for brevity here and in appendix 3.

- AdExps Dominion Bureau of Statistics, Advertising Expenditures in Canada, 1965, Ottawa, 1968.
- CFS Dominion Bureau of Statistics, Corporation Financial Statistics, 1965, 1966, and 1967, Ottawa, 1968, 1969, and 1969.
- ConMan Department of Consumer and Corporate Affairs, Concentration in the Manufacturing Industries of Canada, Ottawa, 1971.
- Indpubs Dominion Bureau of Statistics, Industry publications, 1956. (See ConMan, pp. 235-259, for individual bulletin numbers.)
- InOut Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy, 1961, Ottawa, 1969.
- IOCon Statistics Canada, Industrial Organization and Concentration in the Manufacturing, Mining, and Logging Industries, 1968, Ottawa, 1973.
- TaxStats Department of National Revenue, Taxation Statistics, 1956, Ottawa, 1958.

The industry data in ConMan, InOut, and IOCon was in most cases at the SIC 3-digit level, whereas that in CFS and AdExps was more highly aggregated. For this study, ConMan, InOut, and IOCon data was aggregated to match that in CFS, following the aggregation indicated in table 4 of CFS and using 1965 shipments as weights. For 8 industries ConMan data was not available for all of the SIC components making up the CFS classification, and in these cases the given CFS figures were disaggregated by 1965 shipments. This adjustment affects only the capital-requirements variable, AKR, as indicated in appendix 3, and should not seriously bias the results. The earlier TaxStats and Indpubs data, as well as the commodity data in InOut, was matched to SIC classifications on the basis of the industry definitions in appendix B of ConMan.

## APPENDIX 3

## DEFINITIONS AND CONSTRUCTION OF THE VARIABLES

The variables used are given here in the order in which they appear in the regression equations, with the dependent variable shown first.<sup>a</sup>

1. The dependent variable (P+I)/TA

This variable is the ratio of profits plus interest to total assets. The three components are averaged over the years 1965, 1966, and 1967. Source: CFS

2. The capital requirements variable AKR

This variable represents the capital required to establish a plant of minimum efficient size (see ES below) divided by industry shipments.

$$AKR = \frac{(ES)(Assets)}{Shipments}$$

The asset figure is determined as in 1. above. Shipments are for 1965. Sources: Asset data from CFS; shipments from ConMan.

3. The economies of scale variable ES

This variable represents the average plant size of the largest plants that account for 80 percent of industry output, expressed as a percentage of shipments. This can be shown to reduce to:

$$ES = \frac{80}{\text{Number of largest plants supplying 80 percent of shipments}}$$

Source: ConMan

4. The concentration variable CON4<sup>b</sup>

This variable is the four-firm concentration ratio, the sales of the largest four firms in the industry as a percentage of industry sales. Source: ConMan

<sup>a</sup>The source abbreviations are given in appendix 2.

<sup>b</sup>For a discussion of various measures of concentration, see Singer (1968).

5. The foreign competition variable M/Q

This variable is the ratio of imports to industry output. Source: InOut

6. The product differentiation variable A/Q

This variable is the ratio of advertising to sales. Source: AdExps

7. The growth of demand variable D

This variable is the ratio of industry sales in 1956 to those in 1965. Sources: 1965 from ConMan, 1956 from TaxStats and Indpubs.

8. The regional concentration variable RD

This is a dummy variable set equal to 1 for industries with identifiable regional markets, and set equal to 0 otherwise. In the 62-industry sample, industries with regional markets were dairy products, bakeries, soft drinks, breweries, and cement. For a discussion on this point, see Rosenbluth (1957, pp. 67-68).

9. The specialization variable SR

This variable is the ratio of value added of primary establishments in an industry to value added of enterprises in that industry. Primary establishments are establishments coded to the same industry as the enterprise to which they belong. The higher this ratio is, the less secondary activities there are of enterprises coded to that industry. Source: IOCon.

10. The producer-consumer dummy variable PCD

This variable is set equal to 1 for a consumer-goods industry and set equal to 0 otherwise. An industry was classified as a producer-goods industry if 50 percent or more of its output was destined as intermediate inputs, as given in InOut.

Additional variables used in sections IV and V are listed below. These variables have been discussed in the respective sections and will only be briefly considered here.

11. Additional variable in section IV

DCON4	concentration dummy variable, equals 0 for industries with concentration below a selected value, equals 1 otherwise
ICON4	intercept dummy variable, equal to DCON4 above
SCON4	slope dummy variable, equals the product of CON4 and ICON4

12. Additional variables in section V

ES	the scale-economies variable, see 3. above
CDR	cost disadvantage ratio, defined in section V
ESCA	the ratio $ES/CDR$
ES10	equal to ES if $CDR < 0.90$ equal to 0 otherwise
ES15	equal to ES if $CDR < 0.85$ equal to 0 otherwise
ES20	equal to ES if $CDR < 0.80$ equal to 0 otherwise
ES25	equal to ES if $CDR < 0.75$ equal to 0 otherwise
VAEM	value-added-employment ratio, defined in section V

APPENDIX 4

DATA LISTINGS

Listings of the data used in the regressions are given on the following 3 pages. The industries are in the order in which they were given in appendix 1. In cases where industries were aggregated, the data is for the aggregated industries, even though only a single SIC reference is given.

SIC	(Y1)/TA	CONA	R/SQ
1000	0.1379	0.1379	0.0000
1010	0.4224	0.4224	0.0000
1020	2.5917	2.5917	0.0000
1030	0.4001	0.4001	0.0000
1040	0.8804	0.8804	0.0000
1050	0.5597	0.5597	0.0000
1060	1.4384	1.4384	0.0000
1070	0.8158	0.8158	0.0000
1080	19.7470	19.7470	0.0000
1090	0.9260	0.9260	0.0000
1100	21.5560	21.5560	0.0000
1110	13.7110	13.7110	0.0000
1120	3.8898	3.8898	0.0000
1130	3.0773	3.0773	0.0000
1140	2.5520	2.5520	0.0000
1150	10.1800	10.1800	0.0000
1160	3.9169	3.9169	0.0000
1170	5.2083	5.2083	0.0000
1180	4.4203	4.4203	0.0000
1190	8.1725	8.1725	0.0000
1200	3.9011	3.9011	0.0000
1210	4.8684	4.8684	0.0000
1220	3.5512	3.5512	0.0000
1230	0.3805	0.3805	0.0000
1240	1.1243	1.1243	0.0000
1250	0.1972	0.1972	0.0000
1260	0.7818	0.7818	0.0000
1270	2.6499	2.6499	0.0000
1280	0.5586	0.5586	0.0000
1290	0.9775	0.9775	0.0000
1300	0.0915	0.0915	0.0000
1310	0.1361	0.1361	0.0000
1320	0.0024	0.0024	0.0000
1330	0.0024	0.0024	0.0000
1340	0.0024	0.0024	0.0000
1350	0.0024	0.0024	0.0000
1360	0.0024	0.0024	0.0000
1370	0.0024	0.0024	0.0000
1380	0.0024	0.0024	0.0000
1390	0.0024	0.0024	0.0000
1400	0.0024	0.0024	0.0000
1410	0.0024	0.0024	0.0000
1420	0.0024	0.0024	0.0000
1430	0.0024	0.0024	0.0000
1440	0.0024	0.0024	0.0000
1450	0.0024	0.0024	0.0000
1460	0.0024	0.0024	0.0000
1470	0.0024	0.0024	0.0000
1480	0.0024	0.0024	0.0000
1490	0.0024	0.0024	0.0000
1500	0.0024	0.0024	0.0000
1510	0.0024	0.0024	0.0000
1520	0.0024	0.0024	0.0000
1530	0.0024	0.0024	0.0000
1540	0.0024	0.0024	0.0000
1550	0.0024	0.0024	0.0000
1560	0.0024	0.0024	0.0000
1570	0.0024	0.0024	0.0000
1580	0.0024	0.0024	0.0000
1590	0.0024	0.0024	0.0000
1600	0.0024	0.0024	0.0000

SIC	(P+I)/TA	AKR	ES	CON4	M/Q
1060	6.3291	0.0671	0.22	25.13	0.013
1740	5.0417	0.7584	1.34	22.27	0.235
2310	6.8750	0.9002	1.52	18.13	0.076
2390	2.7815	0.6628	1.00	15.29	0.233
2431	4.0602	0.2911	0.53	11.45	0.070
2441	5.1195	0.1155	0.32	6.48	0.070
2450	3.6526	0.7572	1.15	13.68	0.070
2460	3.5040	0.3612	0.63	18.43	0.103
2610	4.5967	0.1579	0.31	9.16	0.102
2660	5.0000	0.4224	0.73	18.15	0.088
3740	7.8780	2.5917	2.61	21.24	0.226
1010	5.3199	0.4001	1.60	54.07	0.047
1120	5.4505	0.8804	1.23	39.27	0.329
1280	7.8068	0.8597	1.32	38.84	0.026
1310	7.8537	1.4388	1.98	36.24	0.168
1410	9.0761	0.4158	0.51	40.86	0.027
1430	14.4770	19.7470	11.85	84.23	0.282
1450	9.0237	4.9266	4.35	94.57	0.044
1470	5.1339	21.5560	11.11	71.18	0.044
1510	6.3320	13.7110	11.99	91.62	0.028
2480	7.1053	3.8858	5.57	42.03	0.070
3210	3.0056	13.4340	8.47	76.81	0.778
3310	7.1763	3.0773	5.00	50.44	0.387
3320	3.2659	2.6520	5.86	41.16	0.451
3340	5.5033	10.1040	11.35	53.43	0.345
3350	5.6843	3.9169	3.34	56.39	0.455
3360	5.4517	5.2083	3.45	60.21	0.395
3370	4.5936	4.2243	8.08	83.62	0.178
3760	9.2632	8.1725	11.36	84.00	0.087
3770	9.6852	3.9011	4.90	36.47	0.044
3811	8.0617	4.9684	5.24	56.14	1.041
3830	6.8182	3.2512	4.93	48.43	0.493
2511	3.9740	0.3895	0.41	17.04	0.057
2541	4.0996	1.1243	1.22	13.69	0.027
2850	7.5465	0.1972	0.24	13.83	0.169
3030	3.1907	0.3699	0.61	17.13	0.035
3060	8.5586	0.7818	0.89	17.40	0.646
3070	1.9774	2.6496	2.58	29.83	0.123
3080	7.0915	0.1761	0.26	8.30	0.304
3150	6.3399	3.2476	2.65	22.25	1.021
1110	3.9979	0.6651	0.93	37.09	0.108
1230	4.7783	1.2882	2.22	47.88	0.014
1950	4.5965	2.6633	3.38	33.15	0.373
2010	5.3927	6.4222	4.19	53.79	0.276
2520	4.6844	3.4539	3.05	43.82	0.119
2640	6.8966	3.1876	6.24	49.66	0.088
2710	5.5131	3.5792	1.49	35.74	0.039
2720	6.4604	1.9112	2.78	37.50	0.138
2731	6.5317	1.4482	3.05	49.37	0.033
2910	5.8934	22.6480	15.56	77.49	0.089
2940	6.3792	2.8608	2.83	44.70	0.217
2960	9.8028	46.4000	8.52	74.93	0.232
3020	5.6393	2.6770	2.59	46.94	0.541
3040	6.9580	0.6041	0.69	36.20	0.196
3050	7.1026	1.1282	2.27	48.34	0.271
3110	9.2051	13.5350	10.54	71.60	1.549
3160	9.8667	4.7929	6.14	51.51	0.816
3380	7.9142	2.8324	5.51	58.16	0.206
3410	5.5823	23.9800	6.42	76.79	0.018
3511	5.7143	5.5814	5.63	51.13	0.745
3530	9.1244	17.1160	9.08	71.21	0.276
3690	5.5394	11.6740	5.33	46.42	0.118
3750	5.9445	1.7521	2.24	46.05	0.048
3780	5.0663	3.4188	2.68	38.29	0.353

SIC	A/Q	D	SR	CDR	ESCA
1060	0.65	1.92	92.1	0.6247	0.3522
1740	1.09	1.55	97.4	0.8905	1.5048
2310	2.01	1.34	82.3	0.7979	1.9050
2390	0.76	2.18	97.4	0.9189	1.0883
2431	1.31	1.40	98.1	0.9290	0.5705
2441	0.42	1.66	97.7	0.9356	0.3420
2450	0.22	1.62	95.0	0.9223	1.2469
2460	0.26	1.15	100.0	0.9122	0.6906
2610	1.11	1.52	99.6	0.9700	0.3196
2660	1.03	1.78	98.3	0.9413	0.7755
3740	8.65	1.94	90.1	0.6586	3.9630
1010	0.36	1.86	85.4	1.0000	1.6000
1120	2.97	1.74	97.1	0.6950	1.7698
1280	1.28	1.78	83.1	0.7302	1.8077
1310	4.93	1.66	88.7	0.4507	4.3932
1410	8.20	1.77	95.0	0.6735	0.7572
1430	2.74	1.58	95.0	0.3304	35.8660
1450	6.56	1.38	95.0	0.6160	7.0617
1470	3.99	1.74	100.0	0.6579	16.8870
1510	6.13	1.59	96.3	0.5665	21.1650
2480	5.42	1.97	95.0	0.7232	7.7019
3210	0.17	0.98	85.0	0.8157	10.3840
3310	3.27	1.84	95.0	0.6200	8.0645
3320	1.90	1.48	85.0	0.6692	8.7567
3340	3.00	1.26	91.8	0.8640	13.1370
3350	0.47	2.24	82.5	0.7822	4.2700
3360	0.62	1.61	55.0	0.7242	4.7639
3370	1.20	1.32	100.0	0.4171	19.3720
3760	10.85	1.81	75.0	0.4571	24.8520
3770	15.22	2.51	95.0	0.4810	10.1870
3811	2.06	2.59	94.7	0.8327	6.2928
3830	2.65	1.79	95.0	0.8304	5.9369
2511	0.04	1.00	71.0	0.8043	0.5098
2541	0.44	0.79	95.0	0.7879	1.5484
2850	1.01	1.68	96.9	0.7272	0.3300
3030	0.69	2.28	95.5	0.8742	0.6978
3060	3.41	1.28	90.7	0.7191	1.2377
3070	0.84	1.76	75.0	0.8679	2.9727
3080	0.35	1.59	98.9	0.8514	0.3054
3150	0.81	1.97	93.3	0.9041	2.9311
1110	0.34	1.53	98.3	0.6642	1.4002
1230	1.20	1.36	87.1	0.3860	5.7513
1950	0.17	1.43	97.5	0.7348	4.5999
2010	1.05	2.32	55.0	0.6117	6.8498
2520	0.33	1.62	63.0	0.7080	4.3079
2640	1.39	2.19	95.0	0.7990	7.8098
2710	0.24	1.45	59.0	0.7331	2.0325
2720	1.26	1.65	91.1	0.8486	3.2760
2731	0.16	1.90	92.4	0.8587	3.5519
2910	0.16	2.10	80.9	0.7345	21.1840
2940	0.13	1.68	92.6	0.8416	3.3626
2960	0.23	1.86	81.7	0.7936	10.7360
3020	0.68	1.82	78.9	0.8550	3.0292
3040	0.68	2.06	84.4	0.6148	1.1223
3050	0.21	2.22	95.7	0.8154	2.7839
3110	0.98	2.32	86.4	1.0000	10.5400
3160	0.55	2.76	100.0	1.0000	6.1400
3380	0.90	1.27	92.6	0.7946	6.9343
3410	0.85	1.84	65.0	0.5620	11.4230
3511	1.01	1.26	95.0	0.5715	9.8513
3530	0.69	1.00	100.0	1.0000	9.0800
3690	1.14	0.16	100.0	0.6424	8.2970
3750	3.32	1.53	82.0	0.5569	4.0223
3780	0.41	2.15	86.5	1.0000	2.6800

SIC	ES10	ES15	ES20	ES25	VAEM
1060	0.22	0.22	0.22	0.22	1.3123
1740	1.34	0.00	0.00	0.00	1.0588
2310	1.52	1.52	1.52	0.00	1.1270
2390	0.00	0.00	0.00	0.00	1.0394
2431	0.00	0.00	0.00	0.00	1.0398
2441	0.00	0.00	0.00	0.00	1.0355
2450	0.00	0.00	0.00	0.00	1.0494
2460	0.00	0.00	0.00	0.00	1.0880
2610	0.00	0.00	0.00	0.00	1.0168
2660	0.00	0.00	0.00	0.00	1.0317
3740	2.61	2.61	2.61	2.61	1.2343
1010	0.00	0.00	0.00	0.00	0.9982
1120	1.23	1.23	1.23	1.23	1.2052
1280	1.32	1.32	1.32	1.32	1.1891
1310	1.98	1.98	1.98	1.98	1.5946
1410	0.51	0.51	0.51	0.51	1.2404
1430	11.85	11.85	11.85	11.85	1.8700
1450	4.35	4.35	4.35	4.35	1.2782
1470	11.11	11.11	11.11	11.11	1.2223
1510	11.99	11.99	11.99	11.99	1.2976
2480	5.57	5.57	5.57	5.57	1.1876
3210	8.47	8.47	0.00	0.00	1.1146
3310	5.00	5.00	5.00	5.00	1.3127
3320	5.86	5.86	5.86	5.86	1.2554
3340	11.35	0.00	0.00	0.00	1.0662
3350	3.34	3.34	3.34	0.00	1.1331
3360	3.45	3.45	3.45	3.45	1.1789
3370	8.08	8.08	8.08	8.08	1.1621
3760	11.36	11.36	11.36	11.36	1.5613
3770	4.90	4.90	4.90	4.90	1.5046
3811	5.24	5.24	0.00	0.00	1.1043
3830	4.93	4.93	0.00	0.00	1.0983
2511	0.41	0.41	0.00	0.00	1.1222
2541	1.22	1.22	1.22	0.00	1.1291
2850	0.24	0.24	0.24	0.24	1.1848
3030	0.61	0.00	0.00	0.00	1.0672
3060	0.89	0.89	0.89	0.89	1.1963
3070	2.58	0.00	0.00	0.00	1.0783
3080	0.26	0.00	0.00	0.00	1.0907
3150	0.00	0.00	0.00	0.00	1.0542
1110	0.93	0.93	0.93	0.93	1.2486
1230	2.22	2.22	2.22	2.22	1.9065
1950	3.38	3.38	3.38	3.38	1.1731
2010	4.19	4.19	4.19	4.19	1.3172
2520	3.05	3.05	3.05	3.05	1.1958
2640	6.24	6.24	6.24	0.00	1.1321
2710	1.49	1.49	1.49	1.49	1.1788
2720	2.78	2.78	0.00	0.00	1.0862
2731	3.05	0.00	0.00	0.00	1.0963
2910	15.56	15.56	15.56	15.56	1.2134
2940	2.83	2.83	0.00	0.00	1.0856
2960	8.52	8.52	8.52	0.00	1.1502
3020	2.59	0.00	0.00	0.00	1.0738
3040	0.69	0.69	0.69	0.69	1.3189
3050	2.27	2.27	0.00	0.00	1.1056
3110	0.00	0.00	0.00	0.00	0.9652
3160	0.00	0.00	0.00	0.00	0.9588
3380	5.51	5.51	5.51	0.00	1.1482
3410	6.42	6.42	6.42	6.42	1.3232
3511	5.63	5.63	5.63	5.63	1.4143
3530	0.00	0.00	0.00	0.00	0.9878
3690	5.33	5.33	5.33	5.33	1.2329
3750	2.24	2.24	2.24	2.24	1.3521
3780	0.00	0.00	0.00	0.00	0.9551

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IN THE CANADIAN MANUFACTURING INDUSTRY, 1965

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