Scale Economies and Labour Productivity in Atlantic Canada

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The lower labour productivity in manufacturing of the Atlantic provinces when compared to that of the rest of Canada is a well-known feature of the Canadian economy. Auer (1979: Table 3.2) reports that for 1970-1973, value added per worker was between 21 (Nova Scotia) and 33 percent (Prince Edward Island) lower than the national average.

Less well understood are the reasons for lower labour productivity. In the most thorough study, Auer (1979) uses a production function analysis in which the sources of productivity within a region (industry mix, capital-labour ratios, labour quality, and other factors) are systematically compared with those same sources nationally. A surprising result—also obtained by Drugge (1983)—is that industry mix plays no significant role in Atlantic Canada's productivity disadvantage. Furthermore, while some of the region's disadvantage is linked to below-average labour quality, the lion's share can be linked to other factors (Auer 1979: Table 3.7).[1] These "other factors" include age of equipment, the transfer of technology, management skills, and the scale of firms. But these factors are not easily isolated or measured.

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1. Also, surprisingly, capital-labour ratios appear to work in favour of the Atlantic Region. Bradfield (1976) has argued that capital-labour ratios should not be used to explain labour productivity. Instead, the causal mechanism is that a high capital-labour ratio is the profit-maximizing response to a low wage rate rather than the cause of high wages. In the same vein, Anderson (1988: 82) has maintained that industry mix should be viewed as a result of factor endowments rather than a determinant of labour productivity differentials.

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This paper looks at one of these difficult-to-measure factors—the scale of plants—as a source of lower labour productivity in Atlantic Canada. The contribution of suboptimal scale to the region's productivity deficit is explored for each of the 126 three- and four-digit Standard Industrial Classification (SIC) industries in the region.

To accomplish this, a Cobb-Douglas production function is specified for a typical plant in each industry. (Unlike Auer's work, constant returns to scale are not assumed.) After aggregating to the industry level, an expression for industry value added per employee is obtained. Then, using estimates of the Cobb-Douglas production function for each of the 126 industries obtained from Baldwin and Gorecki (1986), as well as estimates of the distribution of plants across employment size classes for both the Atlantic Region and Canada, a technique is developed to determine how much of the region's labour productivity shortfall in each industry results from inadequate scale. Briefly, these two estimates are used to compute value added per employee for each Atlantic industry on the premise that Atlantic and Canadian industries are identical in efficiency except for the size distribution of plants. These figures, when compared to the Canada-wide value-added-per-employee figures for each industry, measure the contribution of inadequate scale to the region's lower productivity.

The results indicate that for 1979 about 33 percent of the region's productivity gap could be attributed to inadequate scale. By extension, this means that all other efficiency factors, which were held identical to allow a focus on scale, are responsible for the remaining 67 percent. These results are significant because they indicate for the first time what role scale can play in regional economic disparities.

Later in this paper, a simple regression analysis is used to account for interindustry differences in the importance of scale as a factor in the region's lower productivity. The results indicate that high transport cost and small market size are factors constraining plant size and labour productivity.

Measuring Scale Disadvantage at the Industry Level

The technique used to measure the impact of scale at the industry level is based on Davies and Caves (1987). Suppose that the ith plant, like all plants in an industry of n plants, produces according to a Cobb-Douglas technology

$$Y_i = A_i K_i^a L_i^b \tag{1}$$

where Y_i is plant value added, A_i is the efficiency parameter, K_i is capital input, L_i is labour input, and (a + b) indicates the returns to

scale. Equation (1) represents the microproduction function for a plant in the industry rather than the industry-level macroproduction function. The latter is defined in terms of the sum of the plant-level variables—that is, industry levels of value added, capital, and labour. The macroproduction function of ultimate interest will depend not only on the microproduction function but also on the size distribution of plants within the industry.

Davies and Caves address the size distribution issue and convert from the microproduction function to the industry level by assuming that all plants have the same capital-labour ratios. Thus, summing over the n plants and dividing by industry employment $L = \Sigma L_i$ yields the required industry value added per employee

$$Y/L = A\,(K/L)^a\, L^{a+b-1} \sum_i (L_i/L)^{a+b} \tag{2}$$

Equation (2) indicates that value added per employee in the industry is related to the efficiency parameter A ($A_i = A, \forall i$), the industry capital-labour ratio, and a term summarizing the size distribution of plants.

To clarify the latter, Caves and Davies use the following definition:

$$P = L/(\Sigma s_i^{a+b})^{1/(1-a-b)} \tag{3}$$

In equation (3), $s_i = L_i/L$ is plant i's share of industry employment. Thus, equation (2) can be rewritten as

$$Y/L = A(K/L)^a P^{a+b-1} \tag{4}$$

Clearly, P is related to the generalized concentration index developed by Hannah and Kay (1977), $HK = \Sigma s_i^e$, where e is some chosen elasticity parameter (if e equals two, the index collapses to the well-known Herfindahl index). Therefore, P is also related to the unique number of equal-sized firms that would give the corresponding HK value—that is, the so-called numbers equivalent

$$N[e] = (\Sigma s_i^e)^{1/(1-e)} \tag{5}$$

It then follows that

$$P = L/N[a+b] \tag{6}$$

In other words, P is simply industry employment divided by a numbers equivalent in which the chosen parameter is the returns-to-scale measure (a + b) and thus can be seen as a measure of average effective plant size.

The common sense of P is that higher (a + b) values or greater returns to scale mean that large firms are weighted more heavily when converting the size distribution to an equivalent number of equal-sized plants. Thus, as (a + b) increases, N[a + b] declines and average effective plant size increases. Average plant size depends more on those plants who contribute most to industry output. By contrast, the arithmetic mean weighs all plants equally and may diverge greatly from typical size when there are numerous fringe firms.[2]

To measure how scale influences productivity in the Atlantic Region relative to Canada, equation (4) is defined for value-added production in both the Atlantic Region and Canada. Using the subscripts A and C to represent the Atlantic provinces and Canada gives

$$(Y/L)_A = (Y/L)_C \ (EFF)\,(CAP)^a \ PS^{a+b-1} \qquad (7)$$

where $EFF = A_A/A_C$, $CAP = (K/L)_A/(K/L)_C$, and $PS = P_A/P_C$. To isolate the impact of scale alone, both the Atlantic Region and Canada are assumed to be identical in their efficiency parameters and capital intensities. (Moreover, because the quality of inputs and regional price differences are not explicitly introduced, both areas are taken to be identical in these respects.) Since these assumptions change the nature of $(Y/L)_A$, we represent this new concept as $(Y/L)_{AA}$ to indicate this is a figure adjusted to reflect only the impact of scale. Thus, equation (7) collapses to

$$(Y/L)_{AA} = (Y/L)_C \ PS^{a+b-1} \qquad (8)$$

Equation (8) indicates what role scale plays in the Atlantic Region's productivity shortcomings, assuming no other disadvantage exists. Henceforth, we shall refer to $(Y/L)_{AA}$ as the scale disadvantage output per employee. Normally, this should be greater than actual output per employee in the Atlantic Region since it is constructed assuming no other sources of disadvantage. The variable $(Y/L)_{AA}$ in equation (8) implies that the importance of scale is linked to the size distribution of plants in the two areas and returns to scale. Equation (8) shall be used as the centrepiece for analyzing the impact of scale and plant size distributions.

2. The assumption of identical capital-labour ratios is needed to isolate the plant scale effect represented by P. This understates the role of scale in influencing Y/L if capital-labour ratios increase with plant size. The possible bias appears minor. For example, in a simulation of a two-plant industry, a 12.5 percent increase in the capital-labour ratio associated with a 33 percent larger plant increased Y/L by only 0.11 percent.

Data Availability Problems

Studies of subnational regions typically suffer from lack of data.[3] To obtain estimates of $(Y/L)_{AA}$ for all 126 Atlantic industries, $(Y/L)_C$ must be known, returns-to-scale estimates must be available, and P must be known for both the Atlantic Region and Canada. The first requirement is easily met since figures for the manufacturing value added per employee are available from Statistics Canada at the national, if not the regional, level. Values for (a + b) are obtained from Baldwin and Gorecki (1986). Using unpublished data taken from individual establishments in each industry, they estimated with cross-sectional regressions the Cobb-Douglas micro production function in Canada for 107 three- and four-digit SIC industries.[4] Since there are 126 industries in the Atlantic Region, the corresponding estimate was not always available from Baldwin and Gorecki's 107-industry sample. In these cases, the estimate of the Cobb-Douglas function for the corresponding two-digit industry was used.

The data requirements for P are more demanding. For each industry in both the region and the nation, the total number of employees and each plant's share of industry employment are required. Fortunately, Statistics Canada (Cat. No. 31-203) publishes tables for the nation and each region showing the number of establishments (n_j) by employee size class for each three- or four-digit industry. The nine employee size classes range from one to four employees to 1,000+ employees. These can be used to obtain the estimates of s_i needed to construct P. Since the returns-to-scale estimates are for 1979, the values for P are calculated for 1979. The procedure will be explained first for Canada and then for the Atlantic Region.

To obtain s_i, it is assumed that all plants in a size class have the same number of employees, which is taken to be the mid-point of each size-class range. Because the 1,000+ class is open-ended, typical employee plant size (l_9) for this class is found by solving

3. In Canada studies usually proceed at the two-digit SIC level and often only a fraction of the 20 industries at that level have published regional or provincial data. For example, Denny, Fuss, and May (1981) attempted to measure the differences in regional unit cost attributable to factor productivity (our A). For the Atlantic Region data were available for only 7 of the 20 industries. One four-digit industry for which regional data are available is beer. For this industry Denny and May (1980) concluded that differences in productivity levels among regions are related to plant size.

4. This is an unusually rich data source. In contrast, Auer assumes constant returns to scale and uses factor shares to infer a and b. In their study of British and American industries, Davies and Caves used dummy variables for groups of industries to represent scale economies. Moreover, in their study productivity in a U.K. industry relative to a U.S. industry is regressed against variables representing differences between the nations in efficiency, quality of inputs, capital intensities, and P, which is proxied by median plant size.

$$\sum_j n_j l_j + n_9 l_9 = L \tag{9}$$

for l_9. In equation (9) n_j and l_j are the number of establishments and employees per establishment in each size class j = 1, ... , 8, and L is industry employment.[5] With the values for l_j thus obtained, plant share values are easily constructed and joined with the returns-to-scale estimates to create P_C.

For the Atlantic Region the procedure is similar except that L in equation (9) is unavailable regionally. Thus, the mid-point estimates of l_j are put into equation (9) to obtain a provisional L for each Atlantic industry. (Since six of the 126 industries had observations in the 1,000+ class, plant size here was taken to be the same as for the nation.) After summing all the provisional L's over the 126 industries, however, this total is slightly less than the region's published total employee figure of 92,558. Consequently, all the employee numbers in equation (9) are adjusted proportionally upward to account for all regional employment.

Results for the Atlantic Region

Equation (8) was used to determine the scale-disadvantage value added per worker $(Y/L)_{AA}$ for each of the 126 industries in the Atlantic Region—see the Appendix, which lists values for (a + b), P_A, P_C, and $(Y/L)_{AA}$ for each regional industry. Recall that such a determination was made possible because in equation (8) we use the national value-added-per-employee figures for each industry to compute the corresponding regional figure that occurs when regional and national industries are identical except for scale effects. To help focus on these scale effects, several aggregate measures of labour productivity were computed.

First, labour productivity in the Atlantic Region, measured as the total of value added in the 126 industries divided by total employment, was \$28.44 thousand (hereafter simply 28.44) per employee. In contrast, for Canada the corresponding figure for the 126 industries was 34.41, which became 34.14 when the Canadian figures were adjusted to reflect the same industry composition as that of the Atlantic Region.[6] (Since the figures 28.44 and 34.41 are based on regional and national totals for the 126 industries, they could be calculated directly from

5. When solving equation (9), l_9 was occasionally less than 1,000. When this occurred, the mid-point employee numbers in each size class were adjusted downward by a proportionality factor until l_9 equaled 1,000 employees.

6. Adjustments to make the Canadian industry mix similar to the Atlantic mix consisted of using a weighted average of each Canadian industry's Y/L, where the weights are estimated employment in the Atlantic Region industry from equation (9) as a proportion of total estimated employment in the Atlantic Region.

Statistics Cat. No. 31-203—that is, data for individual industries are not required.)

By comparison, based on the application of equation (8), in the Atlantic Region the total scale-adjusted value added (Y_{AA}) divided by total employment is \$32.24 thousand per employee.[7] This figure exceeds 28.44 because it is constructed assuming that the only disadvantage is scale, whereas 28.44 reflects all sources of disadvantage.

These figures mean that, after adjusting for industry mix, labour productivity in the Atlantic Region is 28.44/34.14, or 83.3 percent of Canadian productivity. Without adjusting for mix, Atlantic productivity is 28.44/34.41, or 82.6 percent of labour productivity. After netting out the effect of all other factors but scale, however, productivity in the region is 32.24/34.14, or 94.4 percent of the national productivity. Thus, 33.5 percent of the region's 16.7 percent shortfall is related to scale. The rest of the shortfall is apparently associated with capital-labour ratios and factors embedded in the efficiency parameter—that is, age of equipment, management skills, technical knowledge, and quality of inputs.

Another perspective is provided by looking at the region's relative scale-disadvantage productivity (RSDP), defined as $(Y/L)_{AA}/(Y/L)_C$. Expressed in percentages, this ratio takes on values (given in the Appendix) that vary from 33 to 131. The simple average of this ratio over the 126 industries is 85.5 percent. In contrast, the weighted average, where the weights are Atlantic industry employment as a proportion of total Atlantic employment, is 95.5 percent. Since scale factors are more important in the simple average than the weighted average, this indicates that those industries in which the scale disadvantage is largest are ones whose share of Atlantic manufacturing output is relatively small. This is appealing intuitively since in market economies one would expect industries populated by scale-inefficient firms to be small or in decline. This raises the question, however, of what factors are responsible for interindustry differences in scale disadvantage?

Differences in Scale Disadvantages

In this section a somewhat ad hoc attempt is made to account for differences in scale disadvantage among industries. As is evident in the Appendix, there are large interindustry differences in relative scale disadvantages. What factors explain this? From equation (8) it

7. More precisely, \$32.24 thousand is $\Sigma(Y/L)_{AA}*(L/TL)$ summed over 126 industries. $(Y/L)_{AA}$ is from equation (8), L is from equation (9), and TL is the sum of L for all industries, or 92,558. In contrast, \$28.44 thousand is $\Sigma(Y/L)_A(L/TL) = (\Sigma Y)/TL$.

is clear that the relative scale disadvantages of the region's industries are defined entirely by returns to scale and the size distribution of firms in Canada and the Atlantic Region. Since returns to scale are assumed common to each area and are usually thought of as exogenous, we focus on those forces that lead to different clustering tendencies in the regional and national size distributions. Accordingly, in the following regression analysis, we select the ratio of average effective plant sizes, P_A/P_C, as the dependent variable.

This dependent variable is a relative plant size variable similar to others—for example, Baldwin and Gorecki (1983) study the determinants of relative Canadian-to-American plant size. Our approach must necessarily be limited because regional level data on independent variables are rarely available. It is possible, however, to focus on some of the central variables, in particular market size and transport costs.

One market size argument, introduced by Eastman and Stykolt (1967), is that large plant size increments, because they depress prices too much, are not easily digested in small markets. The result is that in small oligopolistic markets, such as those that may occur in the Atlantic Region, smaller plants are more likely to be established. For the market size argument to hold, however, there must be entry barriers to protect inefficient capacity from outside competition. The most important entry barrier, in the context of region and nation—and the one that distinguishes regional from national markets—is transportation cost. The higher the transport costs for the final output, the more likely small plants will be established.

Another important entry barrier is capital costs. If large capital costs indicate sunk costs, then firms in smaller markets may be less willing to establish large capacity because of the greater risks associated with these unrecoverable costs. The risk is greater in small markets because large-capacity increments are more disruptive of price discipline and because firms are more likely to be stuck with capacity they cannot use. Sunk costs also help explain why small, inefficient plants are not eliminated by efficient hit-and-run plants—that is, there is less than perfect contestability. Following Caves (1990), a capital-output ratio is used to proxy sunk cost. The usefulness of this proxy is diminished if there are significant interindustry differences in the degree to which capital is use-specific.

A least-squares regression in which P_A/P_C is related to relative market size, a proxy for transport costs, and capital interests was estimated[8] as

8. A log-linear form is suggested by the multiplicative interaction of market size and entry barriers—for example, a low market size constrains plant size more so when transport costs are high. More variables could be tested if regional-level data were

$$\ln(P_A/P_C) = 3.18 + \underset{(18.20)}{.74\ln MS} - \underset{(2.17)}{.28R} - \underset{(5.42)}{.44\ln KV}, \quad R^2 = .75 \qquad (10)$$

where the figures in parentheses are t-statistics.

In this equation, MS is relative market size, which is value added in the Atlantic Region as a percentage of value added in the corresponding Canadian industry. Value added in the Atlantic Region was estimated by multiplying $(Y/L)_{AA}$ by the estimate of Atlantic employment from equation (9). Because P_A/P_C is contained in $(Y/L)_{AA}$, there can be some spurious correlation. The extent of the problem depends on the error in measuring P_A/P_C relative to the overall variance of the resulting variables (Scherer et al. 1975: 103). R is a dummy variable identifying those industries considered regional because of high transport cost. It is based on a designation from Consumer and Corporate Affairs (1971). The variable KV is the log of the ratio of national gross capital stock to national value added, the implication being, consistent with our earlier assumptions, that there are no meaningful differences between regional and national capital intensities. Capital stock is from an unpublished document by Statistics Canada (1983).

These results, though based on a rather speculative regression, are as expected. With respect to relative market size, for example, they indicate that a 10 percent increase in relative market size would result in a 7.4 percent increase in the relative effective plant size, P_A/P_C. Evaluated at the sample mean for returns to scale (1.167), this increase implies a corresponding improvement of 1.23 percent in the relative scale disadvantage of Atlantic industries. The results also indicate that transport costs and capital barriers lead to smaller relative plant sizes.

Conclusions

In examining the impact of scale on the productivity disadvantage of manufacturing in Atlantic Canada, this note departs from previous studies of the productivity problem which assumed constant returns to scale. Approximately one-third of the region's productivity disadvantage may be attributed to inadequate scale. Differences in the level of disadvantage among industries appear to be related to relative market size, transport cost factors, and capital intensities. Of course, the reliability of these conclusions depends both on the

available. For example, one argument is that large exports increase average plant size. Some of the variation in relative market size may stem from interindustry differences in exports.

Baldwin-Gorecki estimates of returns to scale and on our own procedure for estimating P_A and P_C.

The lower value added per employee associated with smaller scale in the Atlantic Region means that, for a given output price, payments to value-adding factors in the region must be smaller than in Canada. This is one way in which suboptimal plants can survive against more efficient-sized plants from outside the region. Smaller payments to value-adding factors in the region are consistent with the evidence. For example, Auer (1979: Table C-12) reports that wage rates in Atlantic manufacturing are approximately 80 percent of the national average, whereas labour quality in no Atlantic province is more than 7 percent below the national average (Table C-7).

To what extent are the problems of small scale remediable? When transport costs are large, smaller plants located strategically across Canada, with higher production costs but lower transport costs, may be an efficient adaptation to the exigencies of great distances. In this circumstance small scale may be an unavoidable cost of small and isolated markets.

The form of remedial public policy also may depend on viewpoint—that is, are low payments to value-adding factors in the Atlantic Region in part the result of small scale or do they, in some sense, cause small scale? From the latter perspective, one could argue that small scale, like inefficient management and technical backwardness, are able to persist only because wages are lower in the Atlantic Region. Lower wages are a necessary if not a sufficient condition for the survival of the various regional inefficiencies, including inadequate scale.[9] This perspective suggests that remedial action should attempt to increase the efficiency of labour markets and migration. This would reduce wage inequalities among regions and, consequently, would make it more difficult for inefficiencies of any type to persist.

Finally, the other, more obvious viewpoint is that small scale is itself a cause rather than an effect of lower labour productivity. This implies that public policies should seek directly to increase scale. But such policies are difficult to formulate. For example, the regression analysis suggested that transport cost, capital intensity, and small relative market size are impediments to efficient scale. Policies that would reduce these impediments, such as subsidization of transport cost and capital, also may encourage inefficient location of plants and inefficient capital structures, and hence a weaker industrial structure.

9. Of course, the puzzle is why are wages lower? Mansell and Copithorne (1986: 42) conclude that large geographical distances, regional attachments, and factor mobility costs can explain equilibrium differences in market incomes but probably not to the degree observed.

With respect to the market size variable, one factor that may loosen the constraint of small local market size, by opening up the American market, is the recent free-trade agreement with the United States.

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Appendix: Results for 126 Atlantic Region Industries

Industry (SIC code)	(a + b)	P_A	P_C	$(Y/L)_{AA}$	RSDP
Slaughtering (1011)	1.122	207	357	30.0	94
Poultry (1012)	1.062	115	196	21.4	97
Fish products (102)	1.065	175	184	22.2	100
Fruit and veg. canning (1031)	1.262	140	212	31.3	90
Fruit and veg. proc. (1032)	1.014	545	294	30.7	101
Dairy products (104)	1.185	75	147	33.6	88
Flour-breakfast cereal (105)	1.174	36	245	36.3	71
Feed (106)	2.205	31	75	13.7	34
Biscuit (1071)	1.222	75	393	19.3	69
Bakeries (1072)	1.261	93	89	23.1	101
Confectionary (1081)	1.145	194	299	36.6	94
Cane and brown sugar (1082)	1.269	366	302	44.7	105
Misc. food processing (1089)	1.269	168	228	43.5	92
Soft drink (1091)	1.195	59	129	30.1	86
Distilleries (1092)	1.125	55	372	57.8	79
Breweries (1093)	1.166	166	636	48.6	80
Wineries (1094)	1.736	23	83	21.5	39
Rubber pdts. (162)	1.101	1,739	800	35.0	108
Plastic fabricating (165)	1.101	91	85	28.5	101
Shoe factories (174)	0.997	102	176	19.4	100
Misc. leather processing (1799)	1.096	6	72	14.8	79
Cotton mills (181)	1.180	326	738	21.2	86
Wool mills (182)	1.086	16	227	18.8	80
Spun yarn-cloth (1832)	1.097	195	246	22.1	98
Other textiles (184)	1.097	26	81	22.8	90
Carpet, mat, rug (186)	1.092	671	380	28.6	105
Cotton-jute bag (1871)	1.092	59	47	22.0	102
Canvas products (1872)	0.976	5	27	20.3	104
Embroidery (1893)	0.986	13	38	15.4	102
Textile dyeing (1894)	1.005	38	83	22.1	100
Misc. textiles (1899)	1.097	15	142	20.4	81
Other knit. mills (2392)	1.061	358	160	18.2	105
Mens cloth. factories (2431)	1.039	40	166	19.0	95
Mens cloth. contractors (2432)	1.039	291	90	13.4	105
Wom. cloth. factories (2441)	1.039	13	94	19.4	92
Wom. cloth. contractors (2442)	1.039	63	43	11.5	102
Other clothing (246)	1.199	27	18	32.6	108
Shingle mills (2511)	1.256	7	39	19.6	65
Sawmills (2513)	1.256	57	201	27.7	72
Veneer-plywood (252)	1.087	191	268	27.9	97
Sash-door (2541)	1.424	77	59	27.4	112
Pre-fab. bldg. (2543)	1.256	72	118	24.8	88
Wood kitch. cabinets (2544)	1.256	12	38	17.9	74
Wooden box factories (256)	1.197	10	73	14.1	68
Coffins (258)	1.444	11	42	11.1	55
Wood preservation (2591)	1.099	43	70	29.8	95
Wood handles (2592)	1.256	18	56	17.1	75
Particle board (2593)	1.572	205	167	41.4	112
Misc. wood (2599)	1.256	23	7	15.2	89
Furn. upholstery (2611)	1.150	3	7	10.3	89
Household furn. (2619)	1.150	63	94	19.1	94
Office furn. (264)	1.159	6	125	16.0	62
Misc. furn. (266)	1.150	59	65	23.1	99
Pulp and paper (271)	1.269	779	843	51.0	98
Folding carton (2731)	1.150	20	119	19.7	76
Corrugated box (2732)	1.274	90	198	21.2	81
Paper-plastic bag (2733)	1.150	26	101	23.2	82
Misc. paper converters (274)	1.222	189	155	32.3	104
Commercial print. (286)	1.180	15	75	20.2	75
Platemaking, typeset. (287)	1.225	19	37	21.9	86
Publishing only (288)	1.225	16	66	32.4	73
Pub., pntg. (289)	1.225	105	291	12.7	79
Iron and steel manuf. (291)	1.139	5,065	3,651	42.9	105
Iron foundries (294)	1.044	17	195	25.4	90
Smelting-refining (295)	1.128	699	1,865	37.6	88
Aluminum rolling (296)	1.128	7	318	19.7	61

Appendix Continued

Industry (SIC code)	(a + b)	P_A	P_C	$(Y/L)_{AA}$	RSDP
Metal rolling (298)	1.128	11	141	22.9	73
Boiler-plateworks (301)	1.190	61	293	23.0	74
Fabricated structural metal (302)	1.084	216	206	31.2	100
Metal door-window (3031)	1.176	18	67	21.3	80
Ornamental metal (3039)	1.136	14	48	25.6	84
Metal coating (3041)	1.116	8	49	22.0	82
Metal stamping (3042)	1.159	31	124	29.5	80
Fastener manuf. (3051)	1.136	3	245	19.2	54
Wire prod. not elsewhere specified (3059)	1.136	38	156	26.3	83
Hardware-tool (306)	1.100	16	83	24.8	85
Heating equip. (307)	1.197	40	133	23.1	79
Machine shops (308)	1.136	18	28	25.7	94
Misc. metal fabricating (309)	1.136	43	105	25.6	89
Agric. implement (311)	1.142	18	47	21.7	63
Misc. machinery (315)	1.072	69	156	33.4	94
Aircraft, parts (321)	1.121	216	1,693	24.1	78
Motor vehicle manuf. (323)	1.128	108	4,144	33.1	63
Truck body (3241)	1.124	16	120	17.6	78
Non-comm. trailer (3242)	1.139	42	95	22.5	89
Motor vehicle parts (325)	1.165	33	663	24.1	61
Railroad rolling stock (326)	0.959	1,636	1,120	33.8	98
Shipbuilding-repair (327)	1.079	585	700	28.9	99
Boatbuilding-repair (328)	1.094	14	31	21.9	93
Major appliances (332)	1.090	249	703	26.5	91
Communications equip. (335)	1.075	154	533	31.7	91
Elec. indust. equip. (336)	1.094	103	361	27.1	89
Elec. wire-cable (338)	1.051	33	369	31.4	88
Battery (3391)	1.131	62	169	36.0	88
Misc. elec. prod. (3399)	1.131	7	299	17.2	61
Clay (domestic) (3511)	1.292	77	79	27.4	99
Clay (import) (3512)	1.010	3	110	24.3	96
Cement (352)	1.300	154	227	71.7	89
Stone pdts. (353)	1.179	11	15	22.3	95
Concrete pipe (3541)	1.300	44	66	26.7	89
Struct. concrete (3542)	1.332	114	119	39.0	98
Concrete not elsewhere specified (3549)	1.300	18	30	28.0	86
Ready-mix concrete (355)	1.300	24	48	29.9	82
Glass manufactures (3561)	1.364	326	737	26.0	74
Glass product manufactures (3562)	1.204	27	124	30.4	74
Lime manuf. (358)	0.844	13	78	69.8	131
Misc. mineral pdts. (3599)	1.300	85	277	27.3	70
Petrol. refin. (3651)	1.106	387	581	73.9	96
Mixed fertilizer (372)	1.021	13	16	59.6	99
Plas.-syn. resins (373)	1.117	3	213	43.9	61
Pharm.-medicine (374)	1.246	15	311	21.0	47
Paint-varnish (375)	1.317	42	136	30.4	69
Soaps-cleaning (376)	1.226	30	259	34.0	61
Indust. non-organ. chem. (3782)	1.246	375	486	55.8	94
Indust. org. chem. (3783)	1.246	14	1,208	24.9	33
Misc. chemicals (3799)	1.246	28	140	30.7	67
Instruments (3911)	1.074	33	406	27.4	83
Clock-watch (3912)	1.205	3	154	14.6	43
Orthopedic (3913)	1.297	10	36	14.3	67
Ophthalmic (3914)	0.921	57	36	17.0	97
Dental lab. (3915)	1.042	18	18	14.2	100
Jewelry, silverware (392)	1.003	2	52	27.1	99
Toys-games manuf. (3932)	1.104	8	146	26.5	74
Signs and displays (397)	1.023	20	28	24.9	99
Broom, brush, mop (3991)	1.156	282	85	26.9	121
Other misc. manuf. (3999)	1.042	17	29	21.9	98

Note: (a + b) = returns-to-scale measure from Baldwin and Gorecki (1986); P_A and P_C = number of employees of an average effective plant in Atlantic Canada and Canada; $(Y/L)_{AA}$ = scale disadvantage value added per employee in Atlantic Canada (thousand dollars per employee); RSDP = relative scale-disadvantage productivity of Atlantic Canada, $(Y/L)_{AA}/(Y/L)_C$, expressed in percent.