

Measuring the Dynamics of Market Structure

Concentration and Mobility Statistics for the Canadian Manufacturing Sector

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ABSTRACT. — This paper provides measures of the importance of entry, exit, and other indicators of firm mobility in the Canadian manufacturing sector during the 1970s. It also asks whether these measures yield different information about market structure than traditional measures of concentration.

Une mesure de la dynamique de la structure de marché. Statistiques de concentration et de mobilité du secteur manufacturier canadien

RÉSUMÉ. — Cet article fournit des mesures de l'importance des entrées, des sorties et d'autres indicateurs de la mobilité des entreprises de l'industrie manufacturière canadienne dans les années 1970. Il compare l'information fournie par des mesures sur la structure des marchés avec les indices traditionnels de concentration.

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1 Introduction

Market structure in industrial organization has traditionally been characterised as exhibiting considerable inter-temporal stability. This reflects two inter-related, but mutually reinforcing factors:

1. Market structure, as measured by the concentration ratio, showed little change over time (ADELMAN [1951], MUELLER and HAMM [1974] and SCHERER [1980], p. 70). In reviewing the Canadian evidence KRAUSS and LOTHIAN [1988], p. 1, state "*over time this analysis produced a body of statistics which concluded that up to the mid-1970s concentration though fairly high had remained constant*". This picture is confirmed by the most recent data used in this paper. For example, the mean four firm concentration ratio across 167 4-digit Canadian manufacturing industries was 50.7 and 49.9% in 1970 and 1979, respectively; the mean of the ratio of the 1979 concentration ratio to the 1970 value across the same set of industries, was 0.98 with a standard error of .012.

2. The dominant paradigm of industrial organization, the structure-conduct-performance model (SCP), for a long time treated industry structure as being determined primarily by exogenous factors. Implicit in much of this discussion was the view that these exogenous conditions, and thus structure itself, changed gradually over time. While those who utilized the SCP framework recognized there were many aspects to structure, concentration received by far the most attention (REID [1987], p. 12). This reflected both the ease with which concentration could be understood and the fact such data were widely available.

Thus, the assumptions underlying the dominant model of industrial organization and the empirical finding of slowly changing industry concentration were mutually reinforcing.

As has long been recognized, market structure as measured by concentration ratios may be unchanging at the same time as there is considerable underlying change in the number and the size distribution of firms and the identity of the leading firms. While some have suggested therefore that measures should be utilized that consider the extent to which firms change position within an industry,¹ their admonishments have had little practical effect. There have been no systematic attempts to investigate the characteristics of market dynamics across a wide range of industries. Most expositions of structure even today focus almost exclusively on concentration measures as opposed to the mobility measures that capture the extent of intra-industry movement.²

1. See ADELMAN [1958], GORT [1963], GROSSACK [1965], [1972], HYMER and PASHIGIAN [1962], IJIRI and SIMON [1977].

2. See SCHERER [1980], KHEMANI [1986] and JACQUEMIN [1987].

This paper is meant to fill the gap in our knowledge about market dynamics. The first section of the paper provides a discussion of conceptual and measurement issues, the next quantifies the amount of market dynamics using a variety of measures with the aid of a specially created data set put together at Canada's major statistical agency, Statistics Canada. In the following section, that makes a comparison of mobility and the concentration statistics, the critical issue discussed is whether mobility statistics add or provide extra information about market structure to that already contained in the concentration data. In general the answer would appear to be yes. The paper finishes with a brief conclusion.

2 Issues in the Measurement of Market Dynamics

The measures of market dynamics—referred to here as mobility statistics—chosen to characterize the degree of intra-industry firm movement will depend on both the nature of the data available and the objectives of the analysis. Decisions have to be made regarding the industry level at which the statistics will be calculated, the time period to be chosen, the unit of analysis, and the degree of detail to be contained in the statistics. In this section, these conceptual issues are discussed and the data sources and definitions presented.

2.1. Conceptual Issues

If interest in mobility statistics relates to their usefulness in providing information about market structure, then the statistics need to be defined at the level that are used for concentration statistics. This requires a level of disaggregation at the 3 or 4-digit level for a detailed analysis. In the mobility statistics presented here the 4-digit level of industry classification is used.

The choice of the time period for study is important because the various components of change within industries may vary in importance in the short as opposed to the long run. In the short run, for example, there may be a large transitory component which disappears when longer periods are considered as structural factors came to the fore. But long run data is more difficult to generate because of the lack of longitudinal data bases that extend over longer periods—which in turn is related to the difficulty of keeping track of a firm's identity over longer periods. For this reason, short run data may out of necessity have to be used. However, since the specially created data base used for this paper did track a firm's identity through time, the long run—1970 to 1979—is used to measure

mobility.³ Furthermore, the longer run is most appropriate in view of the emphasis in the concentration literature on intertemporal stability.

In addition to decisions as to the appropriate level of industry classification and the time period chosen, the emphasis to be given to the various components of firm share change has to be determined. Some measures summarize all change that is occurring within the firm size distribution. Others concentrate on only part of the distribution. For example, measures of entry to and exit from an industry capture only part of the firm growth and decline process—the extra-marginal as opposed to the infra-marginal component of change.

Ultimately, the measures chosen should capture those components which theory suggests determine the intensity of the competitive process. In the subsequent sections, values for a number of mobility measures are derived. Amongst others, these include measures of entry and exit, changes in share and the rank of just the leading firms, and of total share change in the industry.

2.2. Data Considerations

Decisions on the above matters cannot be taken in isolation one of another or of the data base available for the exercise. The construction and interpretation of mobility statistics must be cognizant of the strengths and weaknesses of the data base being used. This study makes use of data that come primarily from the Canadian Census of Manufactures.

Census data offer the advantage of comprehensiveness over data that have been constructed from the trade press. Their disadvantage for the calculation of mobility statistics is that they are often not collected with the purpose of calculating mobility statistics. To do so, the identifiers attached to plants and firms have to be constructed properly to provide a longitudinal panel. Fortunately, Canadian firms and plants can be followed over time. Furthermore, firms and plants can be linked together.

In the Canadian case, there is a unique identifier associated with a plant. It disappears only if the plant ceases production in the manufacturing sector or the plant has changed its name, owner and location, simultaneously. The disappearance of the plant identifier from the universe of all plant identifiers is used here to define a plant death. The converse event is used to define a plant birth. Because the situation in which a plant identifier disappears is narrowly-defined, the meaning attached to a plant death is straightforward.

In contrast, the disappearance of a firm level identifier in the Canadian data can result from a number of separate events and, therefore, its interpretation is less straightforward. First, the firm identifier may cease to exist

3. For a discussion of the importance of using both the short and longer run to measure entry and exit, producer rise and decline, and other mobility statistics, see BALDWIN and GORECKI [1989 *a*], [1989 *b*], [1990].

because all its plants are closed. Secondly, a firm's identifier may change even though the plant identifiers associated with the original firm continue as part of another firm. In the latter case, the firm has exited as a result of a corporate reorganization – a broad classification which normally includes divestiture as well as consolidations. In the data base used here name changes and minor reorganizations have been removed.

The nature of the data base influences the unit of analysis that can be used. The unit of the analysis can be either the plant or the firm.⁴ Use of the firm has the obvious advantage that it is the locus of decision-making that is likely to influence the degree of competition in the industry. However, while the firm is the preferred unit of analysis, changes in the firm level identifiers occur for several reasons and thus measures of change calculated at the firm level may obscure the underlying process. Thus, in the mobility statistics presented here we use additional information on plant status to aid in determining the importance of divestiture and acquisition in the process of change.⁵

3 Mobility Statistics

The discussion of mobility statistics proceeds in two steps. In the first step, attention is paid to the extra-marginal component of mobility – that is to say the primary focus of attention is on the importance of firm entry and exit and the method(s) by which this is achieved. The second step turns away from focussing on changes in the identity of the firms classified to an industry and instead concentrates on infra-marginal or within industry change. Mobility statistics thus concentrate upon such measures as the stability of the market share and identity of the leading producers in an industry. Of course, some measures combine both aspects, although the main source of interest might be extra (or infra) marginal change.

4. Throughout this paper, the words "company", "firm" and "enterprise" are used synonymously. Statistical agencies often draw distinctions between these terms by using them to define the firms at different levels of aggregation.

5. In some of our work, however, only plant data were used and no distinction was made between those plants which did and did not have a change in ownership status. This is the case where we derived yearly aggregate annual manufacturing level indicators of turnover. We do not present such material here in view of space constraints and our emphasis on the long run. For more detail, see BALDWIN and GORECKI [1990].

3.1. Extra-Marginal Mobility: Firm Entry and Exit⁶

Entry and exit statistics are calculated at the 4-digit level by comparing the status of firms and establishments in 1970 to 1979 – the longest period for which such data obtained when work first started on this project. The data base allows the calculation of the importance of the different methods of firm entry and exit and permits a comparison of the importance of the entering and exiting segment to the continuing firm sector. Entry and exit is first examined by itself and then considered in the context of measures of overall mobility.

The importance of entry and exit is derived from a data base that links the creation of new plants to firms. Establishments are classified as births (existing in 1979 but not 1970), deaths (existing in 1970 but not 1979), or continuing (existing in both 1970 and 1979). Establishments are then aggregated into firms at the 4-digit level of the SIC. A firm is defined to consist of all establishments at the 4-digit SIC level under common control. This classification, in turn, allows enterprises to be grouped into new firms, exiting firms, and continuing firms on the basis of the status of their plants. New firms are divided into two groups – those that entered by building new plant or by acquiring existing plant. Similarly, exiting firms are divided into those that did so by divesting themselves of plant or by closing plant. Finally, the plants of continuing firms are divided into those that were new, those that were closed, those divested, those acquired, and those that survived.

The importance of the various forms of entry is measured first in terms of the proportion of the number of firms involved, and secondly by the relative proportion of the new, acquired, divested, and closed plants' shares of industry employment. Data are presented in Table 1 both in terms of employment shares and the numbers of firms in the various categories. In each case, the proportion cited is the mean taken across 141 4-digit industries, those industries of a miscellaneous nature having been excluded.

The data show that the entry and exit process at the individual 4-digit industry level is of considerable importance. Firm entrants via plant opening over the period 1971 to 1979 accounted for, on average, 27.4% of the number of firms in an industry in 1979 and 16.5% of industry employment. Most new plant creation was associated with the emergence of new firms and was not created by continuing firms. The mean share of 1979 industry employment accounted for by new plants was 20.9%; 16.5% by new firm entrants and 4.4% by continuing firms or incumbents.

The data in Table 1 also show that there is a second very important process by which new firms are created. New firms arise in an industry not only through the building of new plants but also via acquisition of existing plant – either through diversified mergers or more general forms of corporate reorganization. In 1979, 27.4% of enterprises are entrants since

6. Much more extensive discussion of entry and exit to the Canadian manufacturing sector can be found in BALDWIN and GORECKI [1983], [1987] and [1989 a] and McVEY [1976].

TABLE 1

Average Share of Number of Enterprises and of Employment Across 141 Canadian Manufacturing Industries¹ for Various Categories of Entry and Exit, 1970 and 1979

Firm category	Share of number of firms ²		Share of employment ²	
	1970	1979	1970	1979
(1) All firms	100.0	100.0	100.0	100.0
(2) All entrants ³	—	32.5	—	29.3
(i) Entry by plant opening	—	27.4	—	16.5
(ii) Entry by plant acquisition	—	5.9	—	12.8
(3) All exists ⁴	42.9	—	32.3	—
(i) Exit by plant divestiture	7.5	—	14.6	—
(ii) Exit by plant closing	36.3	—	17.7	—
(4) All continuing firms ⁵	57.1	67.4	67.7	70.7
(i) With continuing plants	56.5	66.8	62.2	63.1
(ii) With plant divestiture	0.6	—	1.1	—
(iii) With plant acquisition	—	2.1	—	3.2
(iv) With plant openings	—	3.9	—	4.4
(v) With plant closure	3.1	—	4.4	—

1. The sample corresponds to the 167 4-digit SIC industries for which data existed in both 1970 and 1979 less those industries classified as miscellaneous or 141 industries in total.

2. The average is calculated across the 141 industry sample.

3. Firms that entered between 1970 and 1979 by plant opening and/or plant acquisition. Note a firm may enter by both methods so the sum of 2 (i) and 2 (ii) may be larger than 2.

4. Firms that exited between 1970 and 1979 by plant divestiture and/or plant closing. A firm may exit by both methods so the sum of 3 (i) and 3 (ii) may be larger than 3.

5. Firms that exited in both 1970 and 1979. As above, a continuing firm may fall into more than one subcategory. The shares of employment for categories 4 (i)-4 (v) refer to the plants of continuing enterprises that fall into these categories.

Source: Special Tabulations, Business Microdata Integration and Analysis Division, Statistics Canada.

1970 via plant opening. Only 5.9% are entrants via plant acquisition, but they accounted for 12.8% of industry employment. On average, 7.5% of the number of firms classified to an industry in 1970 had exited by divestiture by 1979; but they accounted for 14.6% of industry employment in 1970.

Together these data show that, during the decade, substantial turnover took place as a result of firm entry and exit. They also illustrate the need for careful distinctions to be made when measuring this phenomenon. Not all firm entry involves new plant creation. At the small end of the firm size distribution, the identity of participants change because of entry and exit due to plant opening and closure. For large firms, exit and entry occurs more often via the sale and acquisition of assets. Corporate reorganizations are the means by which failures in the large firm population are disciplined.

3.2. Infra-Marginal Mobility: Intra-Industry Change

This section, instead of concentrating on entry and exit to the size distribution of firms in an industry, pays most attention to the extent to which producer growth and decline leads to the shifting of relative position of firms. To do so, various measures of mobility are derived, some of which allow for the influence of entry and exit. As with the entry and exit discussion market shares of firms in 1970 are compared to those for the same firms in 1979 in order to examine the long run intra-industry structural change that is brought about by the competitive process.

The first mobility measure presented follows HYMER and PASHIGIAN [1962] and is the sum of the absolute value of the share changes of all firms in an industry divided by two. It is analogous to the entry and exit share statistics examined previously. This measure, referred to as PASHIG, captures the amount of market share that is transferred from those firms that are declining to those that are growing in relative importance. It varies from 0 to 1 and therefore provides a metric in which the amount or severity of change can be readily evaluated.

TABLE 2

The Division of Market Share Change Between Entrants, Exits, and Continuing Firms over the Period 1970-1979

	Average share change due to entry and exit ¹	Average share change due to all firm changes ²
Entry and exit via acquisition counted ³ . . . . .	.289	.409
Entry and exit via acquisition omitted ³ . . . . .	.159	.325

1. Share change is the sum of entry plus exit divided by two calculated across 167 4-digit manufacturing industries.

2. Share change is the sum of the absolute value of the increase in share due to growth (including entrants) and to decline (including exits) divided by two.

3. The differences between columns 1 and 2 are not the same for each row because in the first row entry and exit via acquisition would be counted as $(S_1 + S_2)/2$ while in the second row it would be entered as $(S_2 - S_1)/2$, where S_1 and S_2 are the shares of the acquired entity in period 1 and 2, respectively.

Source: Special Tabulations, Business Microdata Integration and Analysis, Statistics Canada.

Table 2 contains the mean value of this index across 167 Canadian manufacturing industries for the share changes that took place between 1970 and 1979. Two measures are provided. The first includes firm entry by acquisition and firm exit by divestiture in the calculation. In this variant, the share change for firms that are divested is equated to the opening year share—that is, these firms are treated as exiting. For firms that enter by merger, an analogous procedure is followed. The second measure does not count these as entrants and exits but includes the firm as part of the continuing segment. For comparison, the value of the index using only share changes due to entry and exit is also provided. The

difference between the two is the amount of share change that is accounted for by the continuing firm sector. Once again, the entry and exit index is calculated both with and without the inclusion of diversified firm entry and exit.

Entry by acquisition and exit by divestiture are treated in these two different ways because these events change the ownership of the producer and new owners may institute new policies and thus be regarded as an entry and exit for some purposes. Of course, there will be other forms of organizational change, such as management replacement, that will do the same. Because of this, the measure which takes into account entry and exit via acquisition may underestimate the total amount of change when this more inclusive definition of what constitutes a change in players is used.

Of course, ownership change may not involve any change in the operating entity and its policies—only a change in the legal entity. Not all mergers are undertaken to exploit potential profit opportunities that existing management have failed to undertake. Mergers that are undertaken for tax-related reasons may have little effect on the policies of the entity that is acquired and ultimately little impact on competition in the industry. Therefore, the opposite approach is also taken here and entry and exit by acquisition is excluded when the mobility measures are calculated. The difference between the two results allows an evaluation of the importance of entry and exit by acquisition.

When entry by acquisition is included as a change in relative position, the value of the PASHIG index (Table 2) indicates that some 41% of market share on average was transferred from losers to winners over the decade of the 1970s. When entry and exit by acquisition is excluded from the index, there is still some 33 percentage points out of a possible total of 100 transferred. About half of the share change, some 16 percentage points, that is transferred, comes from entry and exit. Each of the three sources of change (greenfield entry and exit, growth and decline, entry and exit by acquisition) is important over the decade being considered here.

An alternate, but closely related mobility measure, PASHIG1, sums the weighted absolute share changes, using the original year shares as weights. Share changes in the larger firms are given more emphasis in this summary statistic. PASHIG1 needs to be normalized before it can be used to order industries in terms of mobility. In a world where the stochastic growth process leads to a change in share equal to k times initial share (see Table 4), then PASHIG1 will equal (k) times the Herfindahl. Thus, normalizing by the Herfindahl provides a measure of the extent of share change corrected for initial firm size distribution. Across 167 industries, PASHIG1 has an average value of .057, with entry by acquisition and exit by divestiture included as a share change, and .046 without. The mean value of the Herfindahl for 1979 was .116. The mean of the ratio of PASHIG1 to the Herfindahl across 167 industries is .63 and .53, again with and without entry and exit by acquisition included as a share change.

There is a more direct manner of showing the extent to which change is not restricted to the smaller firms in the size distribution. Two share change indices (the sum of the absolute share changes both weighted and

unweighted) were calculated for only the largest firms as of 1970—using shipments as the measure of size. Entry and exit by acquisition were excluded from the calculations.⁷ The values of the share indices are presented in Table 3. Three different estimates were obtained. The first two

TABLE 3

Average Share Change Across 167 Manufacturing Industries in the Largest Firms Between 1970 and 1979

Measure of share change ¹	Top ten firms 1970	Top five firms 1970	Firms accounting for top 75% shipments ²
Share change (unweighted) . . . . .	.28	.21	.27
Share change (weighted) ³ . . . . .	.04	.04	.04
Share of sample . . . . .	.75	.61	.71 ²
Ratio of share change to initial share . . . . .	.38	.36	.37
Ratio of weighted share change to Herfindahl of sample . . . . .	.36	.36	.36

1. Share change is the sum of the absolute values of individual firm change.

2. The mean of the sample is less than 75% because of the truncation routine used.

3. The weights are the 1970 market shares defined over the relevant sample.

Source: Special Tabulations, Business Microdata Integration and Analysis, Statistics Canada.

use the top ten and the top five firms, respectively. The third uses those firms that make up the top 75% of firms.

The two share indices calculated in this case will not have the same bounds as in the previous case because only the top firms as of 1970 (and not both for 1970 and 1979) are included. The maximum for the unweighted share decline is the share of the top firms in 1970 (all firms exit). The maximum of the weighed share decline index is the Herfindahl, with this index calculated over the share of the top firms.

The top 10 firms accounted for, on average, 75% of the market. Their average share decline was 28 percentage points and the mean ratio of the share decline to the maximum was 38%. Their weighted share decline averaged 36% of the maximum. The top 5 firms accounted for 61% of the market, on average, had a 21 percentage point share change which averaged 36% of the maximum. Their weighted share decline also averaged 36% of the maximum possible decline. Each of these measures then indicates that change in the largest firms, as a percentage of the maximum possible decline that these indices could have exhibited, is substantial.

7. In other words, all firms that existed in 1970 are treated as though they continued as separate entities until the end of the decade even if they were acquired at some time during the decade. Since data are available for establishments in both 1970 and 1979, it is possible to calculate the size in 1979 of the acquired establishments even if the original firm had been subsumed into a larger unit. The same procedure was used to produce row 2 of Table 2.

Because the small size of the Canadian manufacturing sector, a small number of firms generally account for a large percentage of the market. However, the same number of firms accounts for a different percentage of each market so the share change indices were also calculated for those firms that made up the same percentage of industry sales for each industry. A level of 75% was chosen. Share change in this segment averaged 27 percentage points. This was 37% of the original share on average. The two methods then yield a similar picture of the amount of change that is taking place in the largest firms.

Since the top firms are so important in many industries and the share change indices obscure what is happening to individual firms in this segment, the share and rank changes for just the largest four firms were examined in more depth. Once again, entry and exit by acquisition are excluded from

TABLE 4

Mean Share Change Between 1970 and 1979 for Each of the Top Four Firms as of 1970 across 167 4-digit Canadian Manufacturing Industries

	Rank of firm in 1970			
	First	Second	Third	Fourth
Percentage point share change. . .	-5.5 (0.7)	-3.1 (0.4)	-2.6 (0.3)	-1.2 (0.3)
Average 1970 share	24.4 (1.1)	14.6 (0.6)	9.8 (0.4)	7.1 (0.3)
Share change divided by original share	-24.2 (3.1)	-25.2 (2.7)	-30.5 (3.1)	-16.5 (4.7)

Note: The mean share change is calculated across 167 4-digit Canadian manufacturing industries. The standard error of the mean is presented in parenthesis.

Source: Special Tabulations, Business Microdata Integration and Analysis, Statistics Canada.

the calculations. The results are reported in Table 4. Each of the top four firms experienced a decline on average. The percentage point decline was greater for the largest firm and decreased monotonically for the next three ranks; but the rate of share decline does not exhibit the same inverse relationship to size. The largest firm had no greater rate of decline in its market share than two of the three other ranks.

The share change indices show that there was substantial overall movement in shares and that the top firms also experienced substantial share change. Whether this caused the top firms to change relative ranking is another matter. Large share change at the upper end of the size distribution may have little affect on rank because of the skewed nature of firm sizes. And for some it is the movement in ranks that is most indicative of the degree of competition. Therefore, the change in ranks of each firm was also measured.

For all firms as a whole, there is substantial change in ranks. But, in the top four firm class, a different picture emerges. The process of growth and decline in this group over the decade of the 1970s does not lead to as

TABLE 5

Percentage of Distribution of Rank Changes Between 1970 and 1979 for Each of the Top Four Firms as of 1970

Rank change	Rank of firm in 1970			
	First	Second	Third	Fourth
+3.....	—	—	—	6.6
+2.....	—	—	4.8	16.8
+1.....	—	15.0	12.0	25.7
0.....	64.7	39.5	28.1	16.8
-1.....	19.8	15.0	15.0	9.0
-2.....	4.2	8.4	6.6	3.6
-3.....	1.2	3.6	3.6	3.6
-4.....	0.6	5.4	4.2	1.8
-5.....	1.2	2.4	6.0	1.2
-6 or more.....	8.3	10.7	19.7	14.9

Note: The distribution is calculated across 167 4-digit Canadian manufacturing industries.

Source: Special Tabulations, Business Microdata Integration and Analysis, Statistics Canada.

dramatic a change in relative positions. In Table 5, the distribution of the change in the number of ranks that each of the top four firms experienced over the 1970s is tabulated. Over 64% of the largest firms as of 1970 are still the leaders as of 1979; but the next three ranks do not exhibit the same stability. There is a steady decline in the percentage of each of the next three ranks that stay in the same rank over the decade. Thus while percentage share change is generally as large in the large firm population as across the entire distribution, it does not lead to substantial changes in the rank of the top firm. It does for the next three.

A different approach to measuring the stability of market shares has been taken by those who calculate the correlation of a firms' market shares between periods or the coefficient obtained from regressing the end period firm share on the opening period firm share. GORT [1963] uses this technique to examine the relationship between the market shares of the fifteen leading firms in 205 4-digit US manufacturing industries between 1947 and 1954. Correlation coefficients were found generally to be above .8 and 78 of 197 regression coefficients fell between .9 and 1.1. On the basis of this evidence, SCHERER [1980], p. 74, concluded that there was little movement in relative firm size.

In order to investigate whether the same impression would be produced using Canadian data, despite the relatively large changes demonstrated by the various indices discussed above, correlation and regression analyses were performed for 167 4-digit Canadian manufacturing industries using 1970 and 1979 market shares. The mean value of the correlation coefficient between beginning and end period firm shares is .783 when merger entry and exit is excluded, .659 when it is included. The former is not dissimilar to the mean value of the correlation coefficients calculated by GORT. The

mean regression coefficient – using a number of different techniques⁸ – of 1979 share on 1970 share ranged from 0.65 to 0.80.

The correlation and regression statistics yield a very different picture of the amount of change than do the share change statistics because they measure not so much the amount of change as its pattern. The correlation coefficient only tests for a linear relationship. The usual form of the share regressions do the same. The relationship may be linear but there still may be a very large variance around the trend indicating substantial underlying change. The square of the correlation coefficient reported above is just the coefficient of determination for the regression of 1979 share on 1970 share. Its mean value is .51. Thus, only 51% of the variability of 1979 share is “explained” by 1970 share. A large component of final year share is not explained by a linear relationship between opening and end year share. To reiterate, even a finding that the regression coefficient was not significantly different from one would not by itself indicate that there was little relative change taking place among firms in the industry.

4 A Comparison of Mobility to Concentration Statistics

The previous sections demonstrated the extent of change that results from the growth and decline of firms. The mobility statistics presented above do not show a relatively static firm universe. This is in marked contrast to the view of the world that a comparison of concentration ratios over time generally yields.

Despite this contribution, there is a sense in which these data may not provide “new” information about industry structure. Concentration measures have been used to rank industries as to market imperfections or to explain performance in cross-sectional studies. Entry and firm mobility statistics may not add much information to that which we already possess from concentration statistics if either they rank industries in the same way or if their variability across industries is the essentially the same as that of the traditional measures of concentration.

A comparison at the 2-digit SIC level of the long run (1970-1979) plant birth rates (SH) and the Herfindahl concentration ratio is provided in

8. Full details may be found in BALDWIN and GORECKI [1989*b*]. In general, the mean regression coefficient was lower with entry and exit via acquisition included than when it was excluded. The regression techniques used included weighted OLS, an instrumental regression using 1970 ranks as the instrument, and a procedure following GORT [1963].

TABLE 6

A Comparison of Selected Entry Characteristics to the Herfindahl Concentration Ratio at the 2-digit Level for the Canadian Manufacturing Sector, 1970-1979

Industry	SH ¹	ENTRY ²	SIZE ³	HF ⁴
		(Mean value) ⁵		
Food and beverages	10.5	12.8	31.8	.122
Tobacco products	3.8	8.4	10.7	.355
Rubber and Plastics	26.5	23.9	26.2	.068
Leather	15.1	22.4	36.7	.080
Textiles	18.7	19.6	30.1	.153
Knitting mills	15.2	18.6	43.2	.034
Clothing	26.8	27.7	44.6	.046
Wood	24.4	26.6	45.5	.106
Furniture and fixtures	25.9	21.5	45.5	.028
Paper and allied products	9.0	16.4	25.3	.097
Printing and publishing	17.6	25.6	32.5	.034
Primary metals	6.4	14.8	33.4	.210
Metal fabricating	24.1	17.3	36.5	.041
Machinery	27.8	18.1	34.0	.162
Transport equipment	16.4	13.4	24.5	.148
Electrical products	21.1	19.2	31.4	.129
Non-metallic mineral products	16.7	21.8	35.3	.152
Petroleum and coal products	16.4	29.3	31.3	.197
Chemical and chemical products	15.4	20.9	36.3	.104
Miscellaneous manufacturing	18.6	25.1	47.1	.105

1. SH is the percentage of 1979 employment in plants new since 1970.

2. ENTRY is the average, over the period 1970-1981, of the annual ratio of growth due to entry of new plants relative to growth in the continuing sector multiplied by 100.

3. SIZE is the annual average, over period 1970-1981, of the ratio of the size of a new plant to that of existing plants, multiplied by 100.

4. HF is the Herfindahl calculated using shipment values.

5. The mean value of the index for SH, and HF for 1970, across the 4-digit industries which comprise the 2-digit industries. All 167 4-digit industries were used. For SIZE and ENTRY the 2-digit level is used.

Source: Special Tabulations, Business Microdata Integration and Analysis Division, Statistics Canada.

Table 6. Entry rates do vary considerably, from a low of 4 to 28%, and are inversely related to the Herfindahl measure of concentration, but their rank correlation is only $-.31$. The rank correlation between firm entry by plant opening and the Herfindahl is $-.57$; well below the 0.90 or greater recorded between the Herfindahl and other measures of concentration. Thus entry is related to concentration but not as closely as are alternative concentration measures.

There are two other measures that the entry and exit data yield which are also included in Table 6. The mean ratio of the importance of employment in plant births to employment growth in continuing firms (column 2) captures both openness to new firms and the importance of plant renewal. The ratio of the average size of a new plant to that of existing establishments (column 3) proxies the difficulty of entry at large size and

the advantage incumbents may have. They have negative rank correlations of $-.32$ and $-.50$ respectively with the Herfindahl concentration measure.

Entry then is related to those measures that have been used most widely to describe industry structure; but the entry statistics do not appear to be as closely related as are concentration measures one to another. The issue which must be addressed is whether mobility statistics provide additional information to that given by the use of concentration statistics alone.

Two approaches can be taken to answer this question. Mobility measures can be tested to see if they do a more effective task of "explaining" performance or to see if they yield some independent information that is not provided by concentration statistics. We adopt the latter strategy. Rather than just asking whether the concentration and the mobility measures are highly correlated, a principal components analysis is used to examine the number of independent elements in a data set containing both types of measures and the importance of each.

Principal components analysis is performed separately on the concentration statistics,⁹ on the mobility statistics,¹⁰ and finally on the two sets of measures combined. Principal components analysis will determine how much independence there is in the sample. It also will determine the ability of each of the independent components to discriminate—since the variance of a variable is a measure of the extent to which industries differ in their score on that component. Maximal power to differentiate should not be confused, however, with maximal explanatory power. The linear combination that maximizes differentiation may not be the same as the linear combination which correlates most highly with a criterion variable such as performance. How the different components fare in such analyses is the subject of another paper.

Rather than present the detailed findings of the principal components analysis—which space constraints do not permit in any event—only the major conclusions will be stated.¹¹ The important question, as was stressed previously, is the extent to which the mobility components yield "new" information in addition to that yielded by the traditional structure measures. When the mobility statistics are combined with the concentration statistics and a principal components analysis applied to the joint set, the former may be submerged in the latter, in which case they would add little. The extent of the overlap between the concentration and the mobility

9. Many different concentration statistics were used in the analysis. These included the traditional four-firm concentration ratio, the Herfindahl index, the entropy measure, and those proposed by HANNAH and KAY [1977], ROSENBLUTH [1961], HALL-TIDEMAN [1967], and HORVATH [1970]. Other measures included the variance of logarithms of firm size, favoured by HART and PRAIS [1956], the coefficient of variation of the top eight firms (SPENCE [1978]), as well as a number of measures of the skewness of the firm size distribution.

10. The mobility measures included those discussed in the text with respect to extra- and infra-marginal change as well as others suggested by GROSSACK [1965], [1972].

11. The more detailed findings of the principal components analysis can be found in BALDWIN and GORECKI [1989 c].

measures determines the extent to which additional information is being generated by the mobility statistics.

In general the principal components from the concentration and mobility statistics are to be found separately when the two sets of measures are combined. Where measures from one set are combined with those already found to be included in the component that emerged from analysis of the other, the additional information corroborates or extends in a sensible manner the original interpretation placed on the component. Thus reliance on traditional measures of market structure to characterise the size distribution of firms does not capture all elements of that size distribution. In particular, such measures of market structure do not fully reflect changes in the composition of the firms in an industry nor the considerable mobility of firms within an industry.

These results should not be misinterpreted. They do not imply that stochastic models of market structure are incorrect. For example, the variability in firm growth rates and the variance of firm sizes both make up one of the principal components.¹² Other evidence suggests that entry rates and the estimated Pareto parameter of the firm size distribution make up another principal component as SIMON and BONINI [1958] suggest. But these are neither the only nor the primary components. Other aspects, such as merger intensity, are just as important. This merely suggests that there are a number of different aspects to mobility and market structure. But this has always been recognized by the stochastic theorists as they attempted to explain the deviation of actual firm size distributions from the predictions of their simplified models.

5 Conclusion

Since the 1970s there have been a number of largely theoretical developments that have placed much greater emphasis on market dynamics, on intra- rather than inter- industry and on firm rather than industry analysis. These developments include contestability theory, the concept of strategic groups, and a desire to go beyond the static SCP model by considering and modelling such things as entry and exit as well as feedback relationships between performance and structure. Despite this theoretical interest, little empirical work, particularly across a wide array of industries, has been conducted on these topics.¹³ This paper attempts to redress the balance by providing mobility statistics for as broad a cross-section of

12. See PRAIS [1976].

13. For two recent exceptions, see the special issues of the *Journal of Industrial Economics* (35, No. 4, June 1987) and the *International Journal of Industrial Organization* (5, No. 1, March 1987).

industries for which concentration ratios are usually calculated. The burden of the paper is that the picture of slowly changing structure suggested by concentration ratios does not preclude substantial mobility. The research agenda that lies ahead must try to characterize the process that is generating change within industries.

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