Industry Canada Industrie Canada

## Working Paper Series / Collection Documents de travail

# BENCHMARKING STRUCTURE-CONDUCT-PERFORMANCE INDICATORS OF COMPETITIVE INTENSITY IN CANADIAN INDUSTRIES

Henry Thille, University of Guelph

Working Paper 2006-06

Canada

The Micro-Economic Policy Analysis Branch's Working Paper Series is intended as a means of diffusing research findings from Industry Canada projects for discussion and comment.

Working Papers are circulated in the language in which they were written. The papers reflect the views of the authors and no responsibility for them should be attributed to Industry Canada or the federal government. Comments on the papers are invited and may be sent directly to the authors.

La série Documents de travail de la Direction générale de l'analyse de la politique micro-économique se veut un moyen de diffuser les résultats des recherches issues des projets d'Industrie Canada dans le but de favoriser la discussion et la réception d'observations.

Les documents de travail sont diffusés dans la langue dans laquelle ils ont été écrits. Les opinions qui y sont exprimées sont celles des auteurs et n'engagent pas Industrie Canada ou le gouvernement fédéral. Le lecteur est prié de faire part de ses commentaires aux auteurs.

# Working Paper Series / Collection Documents de travail

**BENCHMARKING STRUCTURE-CONDUCT-PERFORMANCE INDICATORS OF COMPETITIVE INTENSITY IN CANADIAN INDUSTRIES**

Henry Thille, University of Guelph

Working Paper 2006-06

IC 60087

---

To obtain copies of documents published under the Working Paper Series, please visit : http://strategis.ic.gc.ca/epic/internet/ineas-aes.nsf/en/h_rao1967e.html or contact:

Publications Coordinator
Micro-Economic Policy and Analysis
Industry Canada
10th Floor, East Tower
235 Queen Street
Ottawa, Ontario K1A 0H5

Tel.: (613) 952-6411; Fax.: (613) 991-1261
E-mail: mepa.apme@ic.gc.ca

Pour obtenir des exemplaires des documents publiés dans la collection des documents de travail, cliquer sur http://strategis.ic.gc.ca/epic/internet/ineas-aes.nsf/fr/h_rao1967f.html ou s'adresser à :

Coordinatrice des publications
Analyse de la politique micro-économique
Industrie Canada
10e étage, tour Est
235, rue Queen
Ottawa (Ontario) K1A 0H5

Tél.: (613) 952-6411; Fax.: (613) 991-1261
Courriel: mepa.apme@ic.gc.ca

**Abstract**

The notion of competitive intensity is of broad interest to economists and often finds itself the subject of comparisons between different countries. Case in point, in a recent survey of Canada the OECD concluded that product market competition appeared relatively strong in Canada as compared to other OECD economies. This conclusion was drawn based on the analysis of a number of indicators of competitive intensity, some macroeconomic in nature, others drawn from industrial economics. This paper reviews the type of measures of competitive intensity used by the OECD and others used in empirical industrial economics. Although a broad characterization of stylized facts can be obtained from these measures, the paper argues that such measures are not direct measures of competitive intensity and can be misleading. The paper then discusses a recent empirical framework that pivots around the notion of 'toughness of competition' but finds little robust evidence for the OECD's claim.

*Key words*: *competition, market structure, sunk costs*

**Résumé**

La notion d'intensité de la concurrence intéresse grandement les économistes et fait souvent l'objet de comparaisons entre les pays. Par exemple, dans une récente étude sur le Canada, l'OCDE a conclu que la concurrence sur le marché des produits semble relativement forte au Canada comparativement aux autres économies de l'OCDE. L'OCDE en est arrivée à cette conclusion après avoir analysé des indicateurs de l'intensité de la concurrence dont certains sont d'ordre macro-économique et d'autres relèvent de l'économie industrielle. L'auteur examine le type de mesures de l'intensité de la concurrence utilisées par l'OCDE ainsi que d'autres qui sont utilisés en économie industrielle empirique. Bien que l'on puisse obtenir une caractérisation générale de certains faits stylisés à partir de ces mesures, l'auteur soutient que ces mesures ne permettent pas de mesurer directement l'intensité de la concurrence et qu'elles peuvent nous induire en erreur. L'auteur examine ensuite un récent cadre empirique qui gravite autour de la notion de « férocité de la concurrence » et, à son avis, peu de preuves confirment l'affirmation de l'OCDE.

*Mots clés : concurrence, structure du marché, coûts irrécupérables*

# Table of Contents

## *1. Introduction*

The measurement of the relative competitive intensity of industries is an issue that has important implications for understanding the performance of industries and the economy. This particular issue has attracted the largest body of empirical research by industrial economist (Cohen and Levin, 1989 p.1060). This understanding is furthered by learning which industries within a country are performing better than others as well as comparing industry performance across countries. A recent example of this type of comparison was performed in a recent OECD survey (OECD (2004)). This comparison uses a variety of measures to rank the competitiveness of Canadian industries relative to other OECD countries and tries to link these measures of competitiveness to macroeconomic performance. This type of analysis fits fairly closely with what industrial economists refer to as the Structure-Conduct-Performance paradigm in the empirical analysis of markets.

This paper examines the correspondence between the "macroeconomic" approach of the OECD and the standard industrial economics[1] approach.The OECD study provides a variety of measures meant to capture the notion of "competitive intensity". Yet, industrial economists have long noted the limitation of such indicators. In industrial economics, a more precise notion of competitive intensity has been presented with the objective of clarifying the link between some of the measures that have been used in the past to measure product market competition.

This paper has two objectives. The first objective is to review the measures used to perform this ranking from the point of view of what is usually done to measure the performance of markets by industrial economists. The second objective is to examine some alternative measures that are used to compare industrial performance that were not included in the OECD survey. In this paper, the focus will be on comparing industries in Canada to counterparts in the United States. A focus on just these two countries is justified on the grounds that since the United States is by far Canada's largest trading partner, the performance of Canadian industries relative to those in the U.S. is arguably more important that comparisons to other countries.[2] Furthermore, it allows us to examine a more comparable set of industries than we could if we were to use a larger set of countries for comparison.

1 The field of industrial economics is concerned with the "study of the operation and performance of imperfectly competitive markets and the behaviour of firms in these markets." (Church and Ware (2000, p. 7))

2 There is a significant body of empirical literature in antitrust that finds the geographic scope of product markets to be smaller than the North American continent or the domestic market.

In what follows, I first provide an overview of the methods that industrial economists have used to measure market structure and performance of industries. I then provide some discussion of the measures used in the OECD survey of Canada from an industrial economics point of view. In the fourth section, I tabulate measures of concentration for manufacturing industries in Canada and the United States. Section 5 expands the analysis to compare R&D intensity in the two countries manufacturing industries with a focus on how these numbers affect our thinking about market structure and "competitive intensity".

## *2. Measuring the Performance of Markets and Industry*

Industrial economists have long attempted to measure and explain the relative performance of various industries. Most of the early work in this area is now regarded as following the Structure-Conduct-Performance (S-C-P) paradigm[3]. Here, "structure " refers to the number and size of firms in a market, "conduct" is the behaviour of these firms, and "performance" is the market outcome.[4] This paradigm implements the simple idea that the more concentrated the market structure, i.e., the fewer and larger the firms, the less competitive the firms' conduct is expected to be and hence the worse the market performs.

In order to implement the idea behind the S-C-P paradigm, measures of structure and performance are required; conduct is assumed to be entirely determined by structure. The paradigm therefore assumes that accurate measures of performance and structure are available. The ideal measure of performance is one which captures the extent to which price deviates from marginal cost (usually expressed as the difference between price and marginal cost relative to the price and called the Price-Cost Margin (PCM) or the Lerner Index).[5]

The practical problem is that we generally do not have accurate measures of marginal cost for most industries, so we cannot confidently determine industrial performance without further investigation. It is important to point out that any consistent measure of unit production costs that we may have for a variety of industries is going to be a measure of average cost, which is not generally a good approximation to marginal cost.

---

3 See Schmalensee (1989) for a details survey of this approach.

4 For a detailed graphical representation of the Structure-Conduct-Performance paradigm, see Figure 1 (Appendix).

5 The Lerner index is defined as L= (P-MC)/P where P is the product's price and MC is its marginal cost. Since MC is rarely directly observable, PCM=(P-AVC)/P is often used instead, where AVC is average variable cost. Typically PCM is calculated with the following proxy pcm=(sales-payroll and material input costs)/sales.

Furthermore, measures of average cost, and hence mark-ups, that are readily available generally come from accounting data. There are well-known problems associated with the ability of accounting data to accurately provide measures of cost[6]. Beyond theoretical distinctions between accounting and economic definitions of cost, Schmalensee (1989) has summarized the empirical evidence against the use of accounting measures of profitability. First, correlations between alternative accounting measures of profitability are not always high, which implies that analytical results are sensitive to the measure used. Second, there is evidence that the type of accounting methods used in the U.S. vary by the size of firm, which can result in spurious results if used uncritically.

The S-C-P paradigm suggests that looking at measures of market structure can give us an indication of how markets perform through the S-C-P link. There are two broad types of measures of market structure: measures of the size distribution of firms and measures of barriers to entry.

Typically, the size distribution of firms is measured by two common alternative indexes. Concentration ratios measure the proportion of sales or production that are accounted for by the largest firms in the industry (the four largest and eight largest firm concentration ratios are common). While simple to implement and understand, concentration ratios do not summarize information about all firms in an industry. The Hirschman-Hirfindahl Index (HHI) does incorporate information about all firms in the industry and is defined as the sum of the squared market share for all firms in the industry. Studies that have examined the link between concentration (using either of the above measures) and performance have found a positive relationship between the two[7]. A significant criticism of the S-C-P approach is that even if a positive relationship is found, it is not clear how to interpret it. The most basic problem is that equilibrium industry concentration and performance are jointly determined, so the finding that there is a positive relationship does not necessarily provide support for the hypothesis that increased concentration increases profitability.

A market in which there are no barriers to entry is in theory likely to perform well even if there are not many firms in the industry. Barriers to entry are crucial if firms are to be able to maintain prices above the level that attracts entry. Barriers to entry are generally more difficult to measure than the size distribution of firms. Researchers have used variables such as advertising to sales ratios, capital requirements, and the cost of MES plants. The evidence of the effects of such entry barriers to the performance of firms in Canada has been fairly weak[8].

---

6 See Carleton and Perloff (2005, Ch. 8) for a summary of these.

7 For studies of Canadian industry see McFetridge (1973), Jones, Laudadio and Percy (1973), and Thompson (2003).

8 See McFetridge (1973), Jones, Laudadio and Percy (1973), and Orr (1974a,b).

A final, though crucial, point to make about the measurement of the performance of markets is that one needs to be sure that the data is at the same level of aggregation as the definition of the market. Examining national level statistics might either overestimate or underestimate the degree of concentration. For example, gasoline retailing is a relatively local affair. A national measure of the concentration in gasoline retailing is unlikely to tell us much about how competitive any particular market is. Alternatively, the openness of the Canadian economy to trade suggests that a national measure of concentration might be too narrow. For many consumer products there are few or no Canadian manufacturers of a good, but we do not consider this to be a major problem. More generally, to the extent that imports provide substantial competition to domestic manufacturers, a given level of domestic concentration is less of a worry.

Beyond measurement difficulties, the S-C-P paradigm has long been the subject to objections on theoretical grounds. First, since there is no single accepted theory predicting what the equilibrium price is in an oligopoly, there cannot be a unique, stable relationship between the number and size of firms and price-cost margins. Second, Demsetz (1973, 1974) provided a persuasive argument that there is no causal link between profitability and size. The argument reduces to the notion that efficient firms are likely to be both profitable and large. Any firm that enjoys a cost advantage over its rivals would tend to increase its market share over time as well as enjoying the ability to receive a price for its output above marginal cost. This would give rise to a positive observed relationship between concentration and price-cost margins, but this could not be interpreted as a poorly performing market.

In summary, the measurement of market performance has been subject to criticisms on both empirical and theoretical grounds. [9] However, as argued by Schmalensee (1989), we can obtain broad characterizations of several stylized facts that illustrate variations in performance across industries and countries with the S-C-P approach.

## *3. Measures of Competitiveness in the OECD Survey*

The notion of competitive intensity is of broad interest to economists in general and often finds itself the subject of macroeconomic comparisons of different countries. The 2004 OECD survey of Canada is a case in point. It concluded that product market competition is relatively strong in Canada as compared to other OECD economies. This

9 Summarizing the view of many industrial economists, Sallinger (1990, p.287) observes that “it is hard to imagine a literature for which modern graduate students in economics are taught to have more contempt” than.

conclusion was drawn based on the analysis of a number of indicators of competitiveness, some macroeconomic in nature, others drawn from industrial economics. In this section, I review the measures used to come to this conclusion.

*Concentration:* One of the most commonly used measures of market structure is an index of concentration. However, the OECD survey has little to say about concentration in Canada relative to other OECD economies. This is partly due to data problems: only Canada, the U.S., and Japan report concentration measures using establishment data, other countries use enterprise data. Hence, the OECD only tabulates HHIs for these three countries. However, the data used are from different years for the three countries: for Canada 2001 data is used while 1997 is used for the U.S. and Japan. Although one might think that these measures are fairly stable through time, that is not necessarily the case, as I document in the next section. Another problem with the HHIs used by the OECD is that they are not the ones reported by the U.S. Census Bureau and Statistics Canada. See Crépeau and Duhamel (2006) for a discussion of the problems with the OECD's computation of HHIs.

*Mark-ups:* Although mark-ups are in principle the ideal measure of market power, they are only so when the measured mark-ups can be considered an accurate gauge of the difference between price and marginal cost. Industrial economists have long suspected measured mark-ups as being extremely poor indicators of market power, largely due to differences in the treatment of costs by accountants versus economists (see Carlton and Perloff (2005), Chapter 8 for a discussion of these issues). Note that the categorization of industries by R&D intensity is potentially problematic in this respect, since the account of intangible capital creates particular problems for measuring costs.

*Barriers to entry:* There is not much direct discussion of entry barriers *per se* in the OECD survey. They do discuss restrictions on foreign direct investment (FDI) which is potentially a barrier if domestic capital is scarce. The concern over barriers to entry is much broader than this however. As discussed above, S-C-P studies have used a variety of measures meant to capture the extent of barriers to entry, largely following Bain (1956). Recently a more nuanced view of barriers to entry has arisen. Gilbert (1989) summarizes this view as being that barriers to entry result from immobility of capital in or out of an industry. For our purposes, an important immobility is captured by the notion that participants in a market must make investments of which at least part is sunk. It is the sunk nature of the investments that result in a barrier to entry. The higher these sunk costs, the higher the profit an entrant must expect before it commits its capital. With respect to restrictions on FDI identified by the OECD, this does not necessarily constitute a barrier to entry in the sense of Gilbert. In the absence of sunk costs to entry, whether the capital is domestic or foreign is of no consequence for the analysis of the competitiveness of an industry.

*R&D:* On page 79 the OECD survey argues for a link from competitiveness to innovation (measured by R&D expenditure). While reasonable enough, this is far from a complete story. Sutton (1991) lists R&D costs as a potential barrier to entry. That is, if substantial R&D expenditures are required to enter an industry, then R&D intensive industries will likely have higher levels of concentration and perhaps lower competitiveness[10]. Indeed, the argument of Schumpeter was that the pursuit of monopoly profit was a prime motivator for innovation, so the link between R&D and competitiveness is far from clear.

*Causality issues:* Simulations based on reduced-form regressions are used to measure the benefit to Canada from reducing regulations (pp. 80-81). This methodology is suspect in that it does not appear to deal with causality questions in an adequate manner. For example, what if better performing countries desire fewer regulations? In this case, simply reducing regulation in a poor-performing country will not necessarily cause improved performance.

*Inter-provincial trade:* The OECD survey points to concerns that many have that there still are substantial barriers to inter-provincial trade. To the extent that these barriers are significant, the analysis of competitive performance at the national level is less relevant. In the next section, measures of market concentration at the provincial level are discussed as an illustration of the potential difference in perceived market structure that would follow from this narrower definition of the geographic boundaries of markets.

*International trade:* The examination of import penetration as potentially affecting competitiveness is an important one for Canada. Several S-C-P studies have been performed in the past with this idea in mind, but have not found unanimous support for the notion that import competition strongly affects performance[11].

## *4. Comparing Market Structure in Canada and the United States*

In order to provide a closer examination of the relative structure of Canadian and American industries, measures of concentration for 3-digit manufacturing industries are presented in tables 1-4. The latest data available for the U.S. at the time of writing is 1997, so comparisons are made for that year. Hirschman-Herfindahl Indexes (HHIs) for manufacturing industries in the U.S. and Canada are tabulated in Table 1. Out of the 21 three-digit manufacturing industries, Canada has higher measured concentration than

10 This is discussed further in Section 5 below.

11 See Jones, Laudadio and Percy (1973), Gorecki (1976), Orr (1974a), Hazeldine (1980), and Thompson (2003).

the U.S. in 18. Only in the Food, Apparel, and Paper categories are industries less concentrated in Canada. In 9 out of the 21 industries, concentration in Canada is more than twice what it is in the United States. The extreme cases are the Printing and the Computer and Electronic products where concentration in Canada is five times the U.S. level.

It is worth delving below the numbers contained in Table 1. As mentioned above, it is unlikely that the three-digit NAICS definitions of industries coincide with markets as economists usually think of them. The concentration measures for these aggregate industry groupings can mask substantial variations in concentration at lower levels of aggregation. Consider the Food Manufacturing industry (NAICS 311). It appears relatively unconcentrated in Table 1, but consider a couple of its constituent industries. The Breakfast Cereal Manufacturing industry (NAICS 31123) is one that has received attention from anti-trust authorities in the U.S. The HHI for this industry is 2320 for Canada and 2450 for the U.S., substantially higher than for the Food Manufacturing industry in aggregate. A similar story arises with the Chocolate and Confectionery Manufacturing from Cacao Beans (NAICS 31132) with HHIs of 2630 for Canada and 2570 for the U.S. Similarities at the aggregate level can also mask differences across countries. An example of this is the Dairy Product Manufacturing industry (NAICS 3115) with HHIs of 584 for Canada and 147 for the U.S. Although this sub-industry is less concentrated than the Food Manufacturing industry as a whole, the Canadian industry is substantially more concentrated than the U.S. one. As a final example of this aggregation problem, consider the Beverage and Tobacco Product Manufacturing industry (NAICS 312). Examining the Brewing sub-industry for Canada, we find an HHI of 3300, substantially higher than the 777 value for the aggregate industry. (The HHI for U.S. brewing is not available).

Table 2 gives the four- and eight-firm concentration ratios for the same industries and illustrates that the pattern of concentration between Canada and the U.S. is not particular to the measure of concentration used. The differences tend to be less extreme than when the HHI is used, with concentration in Canada not measured to be more than three times the U.S. level in any industry. This suggests that the “fringe” firms left out of the concentration ratios tend to be relatively larger in Canada than in the U.S. for these industries.

The recent trend in concentration in Canada is examined in Table 3 which compares the manufacturing HHIs for 1997 and 2003. Half of the industries saw concentration rise over this period and half saw it fall. The most significant change was to the Paper industry which saw concentration nearly double over these five years. Note that the OECD survey discussed above compared 2001 Canadian numbers with 1997 for U.S. and Japan. The trend observed in Table 3 suggests that this could be quite

misleading[12].

In order to examine the potential issues involved in the notion that inter-provincial trade is less than free, Table 4 presents concentration measures (HHI) by province for the three-digit manufacturing industries. Not surprisingly, HHIs for many industries are dramatically higher in many provinces, especially the smaller ones. This is not a problem to the extent that inter-provincial trade is costless (i.e. markets are national in scope). For many of the manufacturing industries this is likely the case. However, for some goods, such as beverages, where transportation costs might be high relative to price, high provincial concentration might be cause for concern. Transportation costs (and any other cost that affects inter-provincial trade) are important determinants of the geographic scope of the market. For many goods, the market is much smaller than the national level, so measures aggregated to the national level are not appropriate to judge the actual extent of concentration.

Table 3 presents trends in concentration at the provincial level for the largest province (Ontario) and a median province (Manitoba). Trends at the national level mask substantial differences in trends at a regional level over this relatively short period. For several industries such as Food, Apparel, and Plastics and Rubber, concentration declined substantially in Ontario while rising in Manitoba. The reverse occurred in Leather and Allied Products and Machinery. Clearly variations in market structure can be dramatic over short periods of time at the regional level[13].

It is important to mention one particular caveat to the data that has been presented here. No attempt has been made to adjust the measures for imports and exports. This is particularly an issue for Canadian industries. The measures of concentration are based on industry shipments, not domestic sales. This is one other way in which commonly used measures of concentration calculated at an industry level might not coincide with the definition of the market that the analyst has in mind.

## *5. "New" Approaches to Market Structure*

A recent approach to the analysis of market structure highlights the conditions under which entry occurs in a more careful way than was done in the past. The impetus for this new approach was the large body of theoretical work done in the 1980s examining strategic entry deterrence by incumbent firms. The implications of this work for the

12 Concentration measures for the U.S. for 2002 were not available at the time of writing. These will become available in the summer of 2006 and will provide more context in which to interpret the Canadian trends.

13 The fact that aggregate concentration measures mask considerable mobility of firms has been documented by Baldwin and Gorecki (1994).

notion of barriers to entry is summarized by Gilbert (1989).[14]

For the purpose of benchmarking industry market structure, the book of Sutton (1991) is a seminal contribution. His object is to determine whether there are any general implications of oligopoly theory that have empirical implications for the structure of markets. Sutton shows that there exists general predictions that pivot around three dimensions: market size, sunk costs, and toughness of competition[15]. He finds the following three general results (discussed in more detail below):

1. For a given market size, the tougher competition is, the more concentrated the market structure will be in a long run equilibrium.
2. If sunk costs are exogenous, for a given "toughness" of competition, the larger the market size, the less concentrated the market will be.
3. If sunk costs are endogenous, concentration does not necessarily decrease with market size. High levels of concentration are possible in large markets.

Sutton summarizes the predictions of theory as providing a lower bound to the concentration of an industry. In the case of exogenous sunk costs (2. above) this bound shrinks as market size increases. With endogenous sunk costs, however, concentration is bounded away from zero as market size increases. This results in an empirical prediction about how industry concentration is expected to differ across industries with different degrees of exogenous versus endogenous sunk costs and differences in the toughness of competition.

Much of the early research on market structure focused on the technological determinants of market structure. Simply put, the cost conditions faced by firms (summarized by Minimum Efficient Scale) compared with the size of the market demand determines the long-run number of firms that the market can sustain. Firms will enter or exit the industry until profits are roughly zero. Concentrated industries arise when the technology of production involves declining average costs over a substantial range of output. Consequently, the number of firms that emerge in an industry is determined by the size of the market relative to any fixed costs of production or sunk costs associated with entry. The nature of these sunk costs turns out to be an important consideration for analysing the evolution of market structure and performance. An important distinction for the analysis is whether the sunk entry costs are exogenous or endogenous in nature. Endogenous sunk costs arise when existing firms' behaviour results in new entrants being forced to increase expenditure on these costs. In this case, producing for larger markets entails higher fixed costs (say on advertising). If the

14 Gilbert (1989) characterizes several factors (e.g. scale economies, sunk costs, absolute cost advantages and product differentiation) that impede free-entry and yield economic rents to incumbents.

15 The "toughness of competition" refers to the fact that how firms compete - whether by colluding, or competing on prices versus quantities - determines profitability and price-cost margins in any given setting. Price competition is the most tough while collusion is the least.

higher cost of entering a large market is high enough, then the concentration-reducing effect of free entry is attenuated and we might not see reduced levels of concentration in larger markets.

Even with exogenous sunk costs to entry, there are important implications for the notion of “competitiveness” of markets. In particular the notion of the “toughness” of competition determines the relationship between market size and concentration, which is the first result mentioned above. Consider first the most extreme form of product market competition: price competition with homogeneous products. It has long been known that even with only two firms in such a market, if they are unable to collude, price will equal marginal cost. In such an industry, if there are fixed costs, no firm will wish to enter the industry if there is already one firm in place, so the long run equilibrium number of firms is one, regardless of market size. At this extreme, market concentration is independent of market size. Consider now the other extreme: however many firms are in a market, they are able to successfully collude to set the monopoly price and share the profits equally. Since profits are maximal in such an industry, the incentive to enter is strong, and for a given market size, this market structure will have more firms than any other. Other types of oligopoly behaviour result in a level of concentration between these two extremes. Hence, we have the result: for a given market size, the tougher the competition is, the less concentrated the market is. This results in a negative relationship between concentration and profitability[16].

Sutton's approach is to distinguish exogenous from endogenous sunk costs.
He shows that the effects of entry on concentration depends importantly on the type of costs associated with entry. When firms must sink fixed costs in order to enter an industry the resulting long run equilibrium entails firms earning zero profit, but price above marginal cost. Sutton shows that if these sunk costs of entry are exogenous, we get the standard result that larger markets can support more firms, resulting in a negative relationship between market size and concentration. However, if the sunk costs are due to expenditures that firms make on advertising (to create brand awareness, say) or R&D (to create an better quality product, say), then the relationship between market size and concentration is not so clear. For example, as the demand for a product grows, the incentive for a firm to advertise may grow as it is able recoup the sunk advertising costs from more consumers. However, this raises the hurdle for new firms to enter and raises the fixed costs of all firms in the industry if they wish to stay. Hence, the number of firms will not rise as quickly as market size grows when there are endogenous sunk costs.

Sutton's empirical approach is to look for relationships between market size and the extent of endogenous sunk costs and concentration. He uses estimates of minimum

16 The above analysis assumes that the toughness of competition does not vary with exit and entry.

efficient scale for U.S. plants in order to get a measure of setup costs for a new plant, which is defined to be the cost of building an plant of minimum efficient scale. These setup costs are assumed to be the same for all countries in the sample so Sutton can compute the ratio of the size of the market (measured by sales) to the level of setup costs for each of the industries he examines. This ratio gives a measure of the number of plants of efficient scale can be accommodated in each country. He uses a sample of industries in the food and beverage category, some of which use advertising extensively and some of which do not. In Table 5 Sutton's numbers are reproduced along with analogous values for Canadian industries[17] at the same time period. Not surprisingly, the U.S. has by far the largest market size. For the Soft Drink and Processed Meat industries Canada's size to setup cost ratio is substantially larger than the other countries, for the Bread industry it is substantially lower, and it is comparable for the rest. Hence the old notion that Canada is a “small” economy relative to minimum efficient scale is not borne out when we compare data for Canada with other non-U.S. economies.

Sutton tabulates measures of concentration and advertising-to-sales ratios for these countries and industries in order to investigate link between endogenous sunk costs and the market structure-size relationship. His theory argues that for products for which advertising is likely to play a minor role as an endogenous sunk cost, concentration should fall with market size. This pattern holds for sugar for which the large U.S. market exhibits lower concentration. Conversely, for products for which advertising is likely important, concentration need not fall with market size. An example of this is the soft drink industry for which the U.S. has the highest level of concentration even though it is also the largest market. Overall, Canada fits in with the smaller economies included in Sutton's analysis. One exception is processed meat for which Canada has substantially higher concentration than most other countries. However, this could be due to the fact that the closest data available for Canada is for the Slaughtering and Meat Processing industry which is more aggregate than what Sutton used.

Ideally, we would examine advertising to sales ratios for Canada to further examine how the Canadian industries fit in to the analysis. Unfortunately, advertising data for Canada is relative sparse for 1976, and what exists is at a higher level of aggregation than what is used by Sutton, so comparisons are not likely to be fruitful.

In summary, distinguishing between the form of sunk costs that generate the limits to entry in a particular industry turns out to be quite helpful for the analysis of the evolution of structure over time and across industries[18]. However, this type of analysis does not provide a direct measure of “competitive intensity,” instead it provides an approach to

17 The Canadian industries used are as close as possible to the ones used by Sutton.

18 The interested reader can read Sutton (1991) where he goes much beyond the analysis described here in order to undertake a careful analysis of each industry in his data.

inferring competitive intensity from the measured characteristics of the industry. For example, if we were to compare an industry in two different countries (or markets) that had similar market sizes and advertising intensities, we could conclude that the one with the more concentrated market structure was more competitive. Conversely, if the industries in the two countries had widely different advertising intensities (or differed in other ways with respect to the cost of entry) we would not have much confidence in the ability of concentration measures to indicate relative competitive intensity in the two countries. In the case of endogenous sunk costs, firms may be "competitive" in making sunk investments (such as in advertising) which then mask our ability to discern the degree of competitiveness in product market competition.

*Research and Development*

Advertising intensity is only one potential avenue for the manifestation of sunk costs in an industry. Another activity that can have this effect is R&D. Sutton (1991) explicitly chooses to study industries that are likely to have relatively low R&D levels. In Sutton (1998), he pursues the R&D-market structure link. In this case, an increase in market size might cause an escalation in R&D expenditure (on say new product development), which then induces a high degree of market concentration as entry requires a correspondingly high effort at R&D. The key idea is that a fragmented industry (a large number of small firms unable to spend much on R&D) can be destabilized by a high-spending entrant. This type of situation leads to concentration and R&D increasing together, perhaps with market size. However, suppose that firms produce goods that are not very strong substitutes for each other, then the returns to R&D are lower, since a firm is unable to capture sales from a large number of rival firms. In this case, low concentration obtains. This results in empirical predictions more subtle than was the case with advertising as the bound to concentration varies with a measure of product homogeneity.

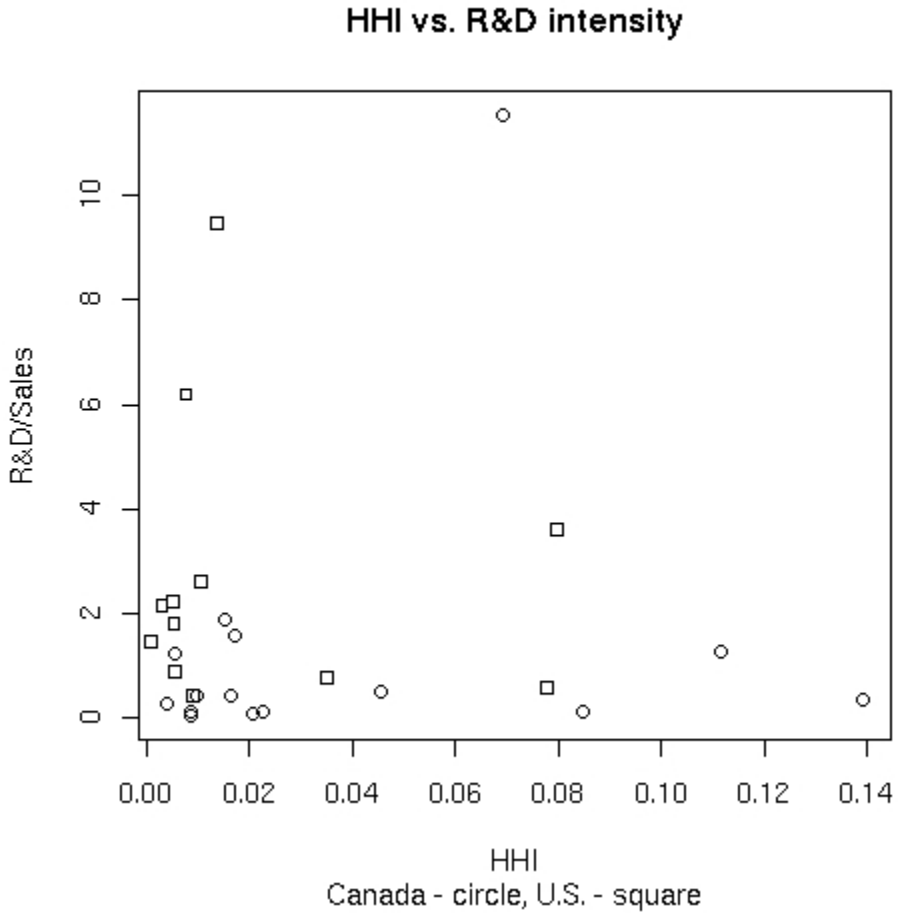
As an initial attempt to use this thinking to compare competitiveness between industries in Canada and the United States, consider the importance of R&D expenditure in a sample of manufacturing industries[19].

I examine data for the year 1998 is chosen for the analysis, which is the latest year for which I was able to obtain U.S. data. The ratio of R&D expenditure to industry sales are presented in Table 6. There are some industries for which there is a substantial difference between the ratio for Canada and for the U.S.. For Chemicals, Plastics and Rubber, Nonmetallic Minerals, and Fabricated Metal Products, the U.S. industries have substantially higher R&D intensities. For a couple of these broad industries, there are sub-industries where the differences are clear. For the case of Chemicals,

19 This analysis is not as clear cut as in the case of advertising since the benefits to R&D expenditures need not be limited to the country in which they occur.

pharmaceuticals are a sub-industry for which the U.S. clearly has substantially larger R&D intensity that Canada does. Another case is Transportation Equipment, for which the rather large defence industry in the U.S. explains part of the difference. Finally, there is one industry in which R&D intensity is higher in Canada than the U.S.: Computer and Electronic Product Manufacturing, with an R&D to Sales ratio of 11.52 in Canada versus 9.46 in the United States.

To get a notion of the correlation between the HHI and R&D intensiveness for Canada, one can rank the industries and then compute the Spearman rank correlation coefficient for the rankings. The coefficient for the data presented here (1997 HHI and 1998 R&D/Sales) is 0.22 which is not significantly different from zero. This is confirmed with a scatter plot of the data in Figure 1. There does not appear to be much correlation once the outlier of the Computer and Electronic Product manufacturing industry is removed. Figure 1 is suggestive that there might be a positive relationship between R&D and concentration for the U.S. if one were to examine less aggregate industries.



## *6. Conclusion*

This paper has examined some of the commonly used S.C.P indicators that pertain to the Canadian economy as well as attempted to calculate some of the more nuanced indicators that have been suggested as being important for an explanation of the relationship between concentration and market size. While these recent approaches are useful for understanding differences in market structure across industries and countries, they are not direct measures of the “competitiveness” of industries. They also highlight how the use of traditional S-C-P measures of market structure can mislead.

## *Appendix: Data*

*Concentration Measures:*

Canada: Statistics Canada.

United States: Both concentration ratios and Hirschman-Hirfindahl Indexes were taken from the U.S. Census Bureau publication *Concentration Ratios in Manufacturing* 1997 Economic Census.

*Advertising Outlays:*

Canada: Statistics Canada Input-Output tables.

United States: Sutton (1991).

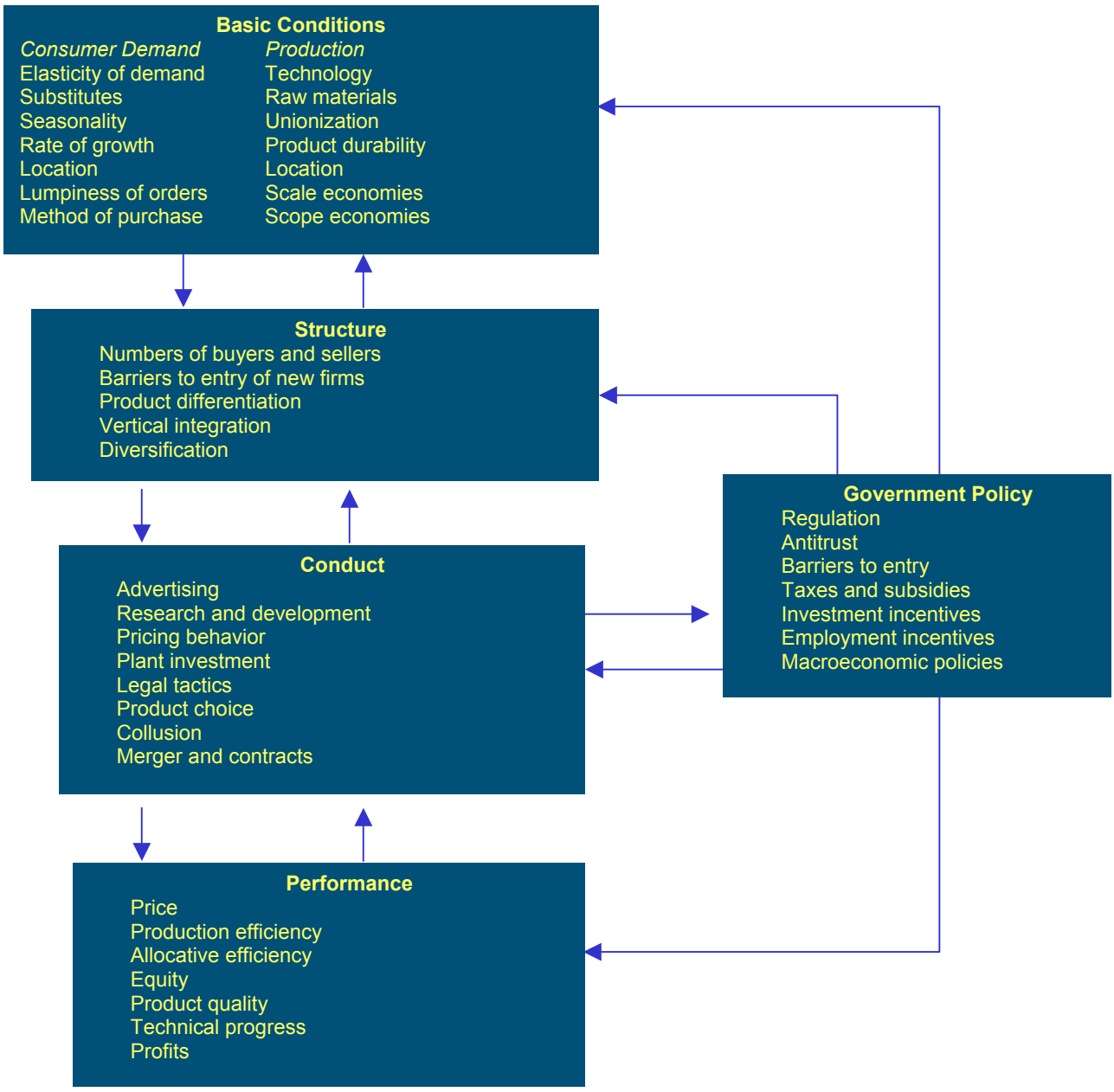
*Research and Development Expenditures:*

Canada: The R&D expenditure series used were the *Total business enterprise research and development current expenditures* from CANSIM. Table 358-0024 series v29793186 – v29793212. Sales for each industry were taken from the *Annual survey of manufactures (ASM), sales of manufactured goods by NAICS and industry sub-sector.*

*United States:* R&D expenditures and sales were taken from the National Science Foundation *Research and Development in Industry: 1999*, March 2002.

Appendix: Figures

Figure 1: Structure-Conduct-Performance Paradigm[20]




[20] Source: Scherer (1996, p.2)

## *References:*


Bain, J. (1956) *Barriers to New Competition*. Cambridge: Harvard University Press.

Baldwin, John R. and Paul K. Gorecki (1994) "Concentration and Mobility Statistics in Canada's Manufacturing Sector." *The Journal of Industrial Economics*. XLII(1): 93-103.

Carlton, Dennis W. and Jeffrey M. Perloff (2005) *Modern Industrial Organization*. 4th ed. Boston: Addison-Wesley.

Cohen, Wesley M. and Richard C. Levin (1989)"Empirical Studies of Innovation and Market Structure." In Richard Schmalensee and Robert Willig eds. Handbook of Industrial Organization, Vol. 2, Chapter 18, Amsterdam: North-Holland.

Demsetz, H. (1973) "Industry Structure, Market Rivalry, and public Policy." *Journal of Law and Economics*. 16:1-10.

Demsetz, H. (1974) "Two Systems of Belief About Monopoly." In H.J. Goldschmid, H.M. Mann, and J.F. Weston, eds. *Industrial Concentration: The New Learning*. Boston: Little, Brown.

Crépeau, Stéphane and Marc Duhamel (2006) "Competition Intensity in Canada: A Critique of Recent OECD Findings", mimeo, Industry Canada.

Gilbert, Richard J. (1989) "Mobility Barriers and the Value of Incumbency." In Richard Schmalensee and Robert Willig eds. *Handbook of Industrial Organization.* Vol. 1. Amsterdam: North Holland.

Gorecki, Paul K. (1976) "The Determinants of Entry by Domestic and Foreign Enterprises in Canadian Manufacturing Industries: Some Comments and Empirical Results." *The Review of Economics and Statistics*. 58(4): 485-88.

Hazeldine, Tim. (1980) "Testing Two Models of Pricing and Protection with Canada/United States Data." *The Journal of Industrial Economics*. 29(2): 145-54.

Jones, J.C.H, L. Laudadio, and M. Percy. (1973) "Market Structure and Profitability in Canadian Manufacturing Industry: Some Cross-Section Results." *Canadian Journal of Economics*. 6(3): 356-68.

Maher, Maria and Jay Shaffer (2005) Product Market Competition and Economic Performance in Canada. OECD Economics Department Working Paper No. 421.

McFetridge, Donald G. (1973) "Market Structure and Price-Cost Margins: An Analysis of the Canadian Manufacturing Sector." *Canadian Journal of Economics*. 6(3): 344-54.

Organization for Economic Co-operation and Development (2004), OECD Economic Surveys Canada, Vol. 2004/16 – December, 2004, Section 2, Product market competition and macroeconomic performance.

Orr, Dale. (1974a) "The Determinants of Entry: A Study of the Canadian Manufacturing Industries." *The Review of Economics and Statistics*. 56(1): 58-66.

Orr, Dale. (1974b) "An Index of Entry Barriers and its Application to the Market Structure Performance Relationship." *The Journal of Industrial Economics*. 23(1): 39-49.

Salinger, Michael (1990) “The Concentration-Margins Relationship Reconsidered.” *Brookings Papers on Economic Activity: Microeconomics, pp. 287-321.*

Scherer, Frederic M. (1996) *Industry Structure, Strategy, and Public Policy*. New York, NY: HarperCollins College Publishers.

Schmalensee, Richard. (1989) “Inter-Industry Studies of Structure and Performance.” In Richard Schmalensee and Robert Willig eds. *Handbook of Industrial Organization.* Vol. 1. Amsterdam: North Holland.

Sutton, John (1991) *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration.* Cambridge: MIT Press.

Sutton, John (1998) *Technology and market structure : theory and history*. Cambridge: MIT Press.

Thompson, Aileen J. (2002) "Import Competition and Market Power: Canadian Evidence." *North American Journal of Economics and Finance*. 13: 40-55.

Table 1
Hirschman-Hirfindahl Indexes for Manufacturing Shipments
1997, Canada and U.S.

| NAICS | | U.S. | Canada | Ratio: Can./US |
|---|---|---|---|---|
| 311 | Food | 91 | 85 | 0.93 |
| 312 | Beverage & tobacco product | 777 | 847 | 1.09 |
| 313 | Textile mills | 94 | 142 | 1.51 |
| 314 | Textile product mills | 186 | 328 | 1.76 |
| 315 | Apparel | 101 | 62 | 0.62 |
| 316 | Leather & allied product | 167 | 313 | 1.87 |
| 321 | Wood product | 53 | 88 | 1.67 |
| 322 | Paper | 173 | 165 | 0.95 |
| 323 | Printing & related support activities | 38 | 207 | 5.40 |
| 324 | Petroleum & coal products | 350 | 1394 | 3.98 |
| 325 | Chemical | 77 | 153 | 2.00 |
| 326 | Plastics & rubber products | 30 | 96 | 3.18 |
| 327 | Nonmetallic mineral product | 52 | 224 | 4.31 |
| 331 | Primary metal | 97 | 457 | 4.69 |
| 332 | Fabricated metal product | 9 | 41 | 4.79 |
| 333 | Machinery | 55 | 56 | 1.00 |
| 334 | Computer & electronic product | 137 | 694 | 5.08 |
| 335 | Electrical equipment | 106 | 172 | 1.62 |
| 336 | Transportation equipment | 798 | 1115 | 1.40 |
| 337 | Furniture & related product | 56 | 85 | 1.52 |
| 339 | Miscellaneous | 33 | 121 | 3.65 |

Table 2
Concentration Ratios for Manufacturing Shipments
1997 Canada and United States

| NAICS | | 4 Firm Concentration Ratios | | | 8 Firm Concentration Ratios | | |
|---|---|---|---|---|---|---|---|
| | | U.S. | Canada | Can./US | U.S. | Canada | Can./US |
| 311 | Food | 14.30 | 11.92 | 0.83 | 22.00 | 19.73 | 0.90 |
| 312 | Beverage & tobacco product | 45.10 | 52.32 | 1.16 | 59.10 | 70.70 | 1.20 |
| 313 | Textile mills | 13.80 | 13.92 | 1.01 | 21.70 | 23.13 | 1.07 |
| 314 | Textile product mills | 22.80 | 30.15 | 1.32 | 31.90 | 43.70 | 1.37 |
| 315 | Apparel | 17.60 | 11.00 | 0.62 | 23.20 | 15.08 | 0.65 |
| 316 | Leather & allied product | 19.00 | 27.61 | 1.45 | 31.40 | 40.08 | 1.28 |
| 321 | Wood product | 10.50 | 12.19 | 1.16 | 16.70 | 20.60 | 1.23 |
| 322 | Paper | 18.50 | 18.31 | 0.99 | 31.10 | 28.04 | 0.90 |
| 323 | Printing & related support activities | 9.60 | 22.26 | 2.32 | 14.00 | 26.68 | 1.91 |
| 324 | Petroleum & coal products | 26.00 | 68.89 | 2.65 | 44.20 | 88.22 | 2.00 |
| 325 | Chemical | 11.90 | 18.17 | 1.53 | 18.20 | 28.63 | 1.57 |
| 326 | Plastics & rubber products | 8.20 | 14.84 | 1.81 | 11.40 | 20.98 | 1.84 |
| 327 | Nonmetallic mineral product | 9.10 | 23.11 | 2.54 | 16.40 | 34.21 | 2.09 |
| 331 | Primary metal | 13.80 | 35.64 | 2.58 | 22.30 | 49.92 | 2.24 |
| 332 | Fabricated metal product | 3.50 | 8.39 | 2.40 | 5.80 | 13.55 | 2.34 |
| 333 | Machinery | 11.50 | 10.44 | 0.91 | 15.60 | 15.44 | 0.99 |
| 334 | Computer & electronic product | 19.10 | 46.13 | 2.42 | 28.10 | 57.17 | 2.03 |
| 335 | Electrical equipment | 14.80 | 19.01 | 1.28 | 23.20 | 28.54 | 1.23 |
| 336 | Transportation equipment | 49.70 | 58.68 | 1.18 | 57.80 | 66.58 | 1.15 |
| 337 | Furniture & related product | 11.20 | 12.35 | 1.10 | 17.60 | 20.97 | 1.19 |
| 339 | Miscellaneous | 7.40 | 16.56 | 2.24 | 11.40 | 21.86 | 1.92 |

Table 3
Trend in HHI for Manufacturing Shipments
Canada and selected provinces,1997-2003

| NAICS | | Canada 2003/1997 | Canada 2003/1999 | Ontario 2003/1999 | Manitoba 2003/1999 |
|---|---|---|---|---|---|
| 311 | Food | 1.48 | 1.12 | 0.88 | 2.11 |
| 312 | Beverage & tobacco product | 1.12 | 0.93 | 1.05 | 1.16 |
| 313 | Textile mills | 1.12 | 0.91 | 0.93 | 0.87 |
| 314 | Textile product mills | 0.69 | 0.68 | 0.52 | 0.77 |
| 315 | Apparel | 0.80 | 1.05 | 0.59 | 1.26 |
| 316 | Leather & allied product | 0.91 | 0.93 | 1.21 | 0.4 |
| 321 | Wood product | 1.30 | 1.09 | 0.61 | 0.82 |
| 322 | Paper | 1.74 | 1.17 | 0.92 | 0.82 |
| 323 | Printing & related support activities | 1.09 | 0.87 | 0.7 | 0.97 |
| 324 | Petroleum & coal products | 1.04 | 0.99 | 1.09 | 1.03 |
| 325 | Chemical | 1.41 | 1.05 | 0.97 | 0.84 |
| 326 | Plastics & rubber products | 0.98 | 0.92 | 0.85 | 1.34 |
| 327 | Nonmetallic mineral product | 0.93 | 0.83 | 0.75 | 1.12 |
| 331 | Primary metal | 0.99 | 0.89 | 0.9 | 1.03 |
| 332 | Fabricated metal product | 0.96 | 0.82 | 0.96 | 0.49 |
| 333 | Machinery | 0.82 | 0.79 | 1.06 | 0.47 |
| 334 | Computer & electronic product | 0.52 | 0.38 | 0.47 | 1.76 |
| 335 | Electrical equipment | 1.31 | 0.91 | 0.82 | 1.36 |
| 336 | Transportation equipment | 0.83 | 0.84 | 0.89 | 0.85 |
| 337 | Furniture & related product | 0.69 | 0.79 | 0.8 | 0.96 |
| 339 | Miscellaneous | 0.40 | 0.35 | 0.36 | 0.21 |

Table 4
HHI by Province and Manufacturing Industry - Shipments
1999

| NAICS | | NFLD | PEI | NS | NB | Que | Ont | Man | Sask | Alt | BC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 311 | Food mfg | 796 | 1849 | 335 | 583 | 244 | 183 | 602 | 838 | 845 | 214 |
| 312 | Beverage & tobacco | 2893 | 6384 | 5798 | 3114 | 1111 | 1311 | 3685 | 5201 | 1566 | 1384 |
| 313 | Textile mills | | 5676 | 6627 | 3921 | 303 | 341 | 1814 | 7519 | 2904 | 3653 |
| 314 | Textile product mills | | 7863 | 5699 | 3434 | 805 | 617 | 1815 | 2606 | 812 | 1088 |
| 315 | Apparel mfg | 9128 | 5017 | 4297 | 2003 | 74 | 167 | 1541 | 2108 | 1879 | 371 |
| 316 | Leather & allied product | | | 6703 | | 485 | 1107 | 5228 | 2774 | 2370 | 1513 |
| 321 | Wood product mfg | 1306 | 5106 | 803 | 980 | 195 | 281 | 1287 | 1996 | 705 | 295 |
| 322 | Paper mfg | 4493 | 5155 | 4043 | 1763 | 569 | 366 | 1766 | 4195 | 1241 | 848 |
| 323 | Printing & related | 1111 | 2277 | 968 | 1007 | 499 | 217 | 579 | 1379 | 739 | 335 |
| 324 | Petroleum & coal | | | 9737 | 9899 | 2957 | 1970 | 2896 | 7321 | 2941 | 5717 |
| 325 | Chemical mfg | 4554 | 2644 | 1291 | 985 | 307 | 255 | 1263 | 2558 | 1251 | 356 |
| 326 | Plastics & rubber | 6002 | | 6586 | 994 | 213 | 131 | 792 | 1724 | 406 | 215 |
| 327 | Nonmetallic mineral | 1709 | 2877 | 1214 | 1314 | 252 | 335 | 638 | 808 | 1210 | 682 |
| 331 | Primary metal mfg | 5006 | | 9638 | 8583 | 1339 | 803 | 2644 | 9772 | 1362 | 2986 |
| 332 | Fabricated metal | 2632 | 2104 | 815 | 983 | 115 | 87 | 465 | 646 | 128 | 106 |
| 333 | Machinery mfg | 2950 | 1580 | 1074 | 1350 | 400 | 90 | 1524 | 658 | 250 | 252 |
| 334 | Computer & electronic | 6574 | | 1867 | 6072 | 2456 | 876 | 1543 | 2788 | 7001 | 1041 |
| 335 | Electrical equipment | 4161 | | 3598 | 7030 | 444 | 342 | 1816 | 5980 | 875 | 1360 |
| 336 | Transportation equipment | 7554 | 5696 | 2432 | 4474 | 2340 | 1362 | 1344 | 1304 | 561 | 3834 |
| 337 | Furniture & related | 4023 | 9569 | 2846 | 1131 | 103 | 172 | 2672 | 1388 | 909 | 199 |

Table 5
Market Size to Setup Cost Ratios and CR4, 1976

| Industry | U.S. | | Canada | | France | | Germany | | Italy | | Japan | | U.K. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S/setup | CR4 | S/setup | CR4 | S/setup | CR4 | S/setup | CR4 | S/setup | CR4 | S/setup | CR4 | S/setup | CR4 |
| Sugar | 128 | 46 | 41 | 92 | 46 | 81 | 40 | 60 | 31 | 72 | 49 | 42 | 41 | 94 |
| Bread | 4350 | 25 | 381 | 32 | 2845 | 5 | 3824 | 7 | 3015 | 4 | 1144 | 48 | 2114 | 58 |
| Processed meat | 5000 | 19 | 2810 | 50 | 745 | 23 | 1465 | 22 | 1245 | 11 | 1340 | 51 | | |
| Canned fruit and veg. | 3230 | 50 | 432 | 39 | 1569 | 40 | | | 93 | 80 | | | 480 | 81 |
| Frozen food | 556 | | 44 | 60 (a) | | | | | | | | | | |
| Margarine (b) | 455 | | 43 | 76 (a) | 79 | | 181 | | 34 | | 87 | | 154 | |
| Soft drinks | 910 | 89 | 282 | 51 | 16 | 70 | 89 | 57 | 20 | 84 | 53 | 88 | 47 | 48 |
| Confectionery | 1000 | 27 | 129 | 51 | 143 | 51 | 353 | 39 | 116 | 29 | 142 | 48 | 279 | 38 |
| Biscuits | 286 | 68 | 29 | 74 | 88 | 62 | 43 | 49 | 69 | 46 | 57 | 49 | 130 | 62 |
| Brewing | 181 | 81 | 22 | 99 (a) | 18 | 82 | 68 | 25 | 10 | 55 | 35 | 100 | 46 | 59 |

Notes:
(a) Values are for 1978.
(b) Canadian data are for vegetable oil mills

Table 6
R&D and Sales Manufacturing Industries
1998 Canada and United States

| NAICS | | Canada R&D/Sales % | U.S. R&D/Sales % |
|---|---|---|---|
| 311 | Food mfg | 0.12 | 0.44 |
| 312 | Beverage & tobacco product mfg | 0.12 | 0.60 |
| 321 | Wood product mfg | 0.14 | 1.80 |
| 324 | Petroleum & coal products mfg | 0.37 | 0.79 |
| 325 | Chemical mfg | 1.9 | 6.19 |
| 326 | Plastics & rubber products mfg | 0.45 | 2.16 |
| 327 | Nonmetallic mineral product mfg | 0.14 | 2.24 |
| 332 | Fabricated metal product mfg | 0.28 | 1.48 |
| 334 | Computer & electronic product mfg | 11.52 | 9.46 |
| 335 | Electrical equipment appliance & compone | 1.57 | 2.61 |
| 336 | Transportation equipment mfg | 1.27 | 3.60 |
| 337 | Furniture & related product mfg | 0.06 | 0.90 |