

THE CLASSIFICATION OF MANUFACTURING INDUSTRIES IN CANADA
ACCORDING TO THE MOBILITY OF THEIR PRODUCTS

by

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ABSTRACT

Industries may be classified as international, national or regional industries according to the geographical size of the market that establishments in the industry typically sell their products in. This thesis produces such a classification of Canadian manufacturing industry, based on firmer empirical evidence than previous attempts at classification have had. The classification is of importance in interregional planning as an indirect means of taking transportation problems into consideration.

The analysis involved developing classification criteria based on a number of descriptive statistics which tended to distinguish between industries of different types. It was necessary to determine what sorts of values of these statistics characterized industries of different types. The most important of the statistics used were derived from international or interprovincial trade statistics. It was also shown that the coefficient of determination of a regression of an industry's shipments on national or regional income may reveal the importance of international or interregional trade to that industry. This statistic is also shown to reveal some problems in the construction of interregional planning models which would utilize the classification.

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1. Introduction

This thesis reports on some work done to obtain statistical evidence which will allow the determination of the geographical size of markets for the products of manufacturing establishments in Canada. The classical economists were aware that the spatial extent of the market for the product of an establishment varied according to the physical characteristics of the product. Thus Karl Marx comments - "The more perishable a commodity and the sooner after its production it must therefore be consumed and hence sold, the more restricted is its capacity for removal from its place of production, the narrower therefore is the spatial sphere of its circulation." [8, p.128]. In modern times, the spatial differentiation of markets has been recognized in the concept of the economic base of a region. Here, the concept is based on the distinction between basic industries whose markets are primarily out of the region and nonbasic industries whose markets are primarily within the region [3, p.129 or 4, p.189]. This distinction has been refined so as to be useful in interregional analysis. With respect to a nation¹ subdivided into a number of regions, an industry is international if there is 'substantial' foreign trade in the products of the industry. 'Substantial' will be defined more specifically later. An example of an international industry for Canada would be the Pulp and Paper Industry. An industry such as the Toilet Preparations Industry whose establishments tend to sell their products throughout the whole of Canada is a national industry. Such industries should not be 'substantial' exporters and should be effectively free from foreign competition. Finally regional industries

are those whose establishments sell mainly in the regions in which they are located, for example breweries.

This classification was first introduced by Leontief and Isard, [6, pp.93-181], and plays a role in their 'balanced regional model'. This is an input-output based method for calculating regional outputs by industry given a set of regional final demands.² More recently, the classification has been used by Mennes, Tinbergen and Waardenburg,[9], to develop a linear programming type planning model in which the objective is to calculate the optimal means of reaching desired regional income targets through the expansion in each region of the outputs of the various industries. The role of the classification is to constitute "a useful first approximation to the solution of problems of transportation", [9, p.6]. This model will hereafter be referred to as the MTW model. The objective of the MTW model is clearly very important in the Canadian context where the reduction of regional disparities in per capita income is considered an important goal of federal government policy, [2, p.1]. Moreover, once the classification has been obtained, the remaining data requirements of the MTW model are not too severe.³ For example, input-output coefficients are not required (although they could be incorporated in the model if available). It would seem then to be a feasible project to try to implement the MTW model in Canada.⁴

This thesis is intended to be a contribution towards that implementation. It focusses on the first requirement of the model which is to have a classification of industries into international, national and

regional industries. Previous attempts at classification (discussed in section three) have been quite crude or based on intuition. This has been due to a lack of relevant data, particularly data on interregional trade. In Canada, however, such data is available for manufacturing industries for the year 1967.⁵ Thus it is possible to derive a classification for manufacturing industries in Canada⁶ based on much firmer statistical evidence than previously and this has been the main aim of this thesis. The form of the classification is discussed in detail in the next section. In section 3, the results of this study are given and compared with other efforts at classification. Section four discusses an important assumption of the MTW model and its relevance for the classification problem (essentially the nation (region) should have a constant marginal propensity to consume the products of a national (regional) industry with respect to income). A subsidiary aim of this paper has been to test the validity of this assumption, first because it can provide an additional criterion for determining the appropriate classification where the main criteria do not give a clearcut result. Secondly because identification of cases where this assumption is invalid can lead to modifications in the MTW model which should produce more realistic results.

The fifth section discusses the problem of disaggregating industry groups into subgroupings displaying better homogeneity with respect to size of markets and how this affected the course of the analysis. The next several sections detail the statistical analysis on which the classification is based, while the final section gives the conclusions of this thesis.

2. The Form of the Classification

The following definition of the classification can be found in essence in either Leontief, [6, pp.93-95], or in Mennes et. al., [9, p.5]. The definition necessarily contains some vague terms. The matter of vagueness will be discussed after the definition.

An industry will be said to be 'compatible' with the nation if the products of the industry are, in the main, neither exported from or imported into the nation. An industry will be international then, if it is not compatible with the nation. Suppose now that the nation has been subdivided into regions. An industry will be said to be 'compatible' with this subdivision if (a) this industry is compatible with the nation⁷ and (b) the products of this industry are mainly consumed in the same region in which they are produced. Alternatively one could say (in place of (b)) that there should be little interregional trade in the products of this industry. An industry will be national then, if it is compatible with the nation but not with the subdivision of the nation into regions. A regional industry will be an industry compatible with the subdivision.

Clearly an industry may be regional with respect to a subdivision of the nation into a few large regions but national with respect to a subdivision into smaller regions. A refinement of the definition of regional industries allows such cases to be distinguished. Suppose that we have a hierarchy of subdivisions of the nation into regions. These subdivisions should be ranked 1 to n so that the regions of the $(k+1)^{\text{th}}$ subdivision are subregions of the regions of the k^{th} subdivision. Then a regional industry of the k^{th} order is defined to be a regional industry

compatible with the k^{th} subdivision but not with the $(k+1)^{\text{th}}$ subdivision. Note that each regional industry has a unique order.

The above definition of 'compatible' could be made precise by disallowing any international or interregional trade at all. This would however make the definition essentially vacuous in the sense that almost all industries would have to be classified as international. There are two reasons for this. First there is the existence of border trade. Products which are traded only over short distances may be traded a short distance over a border. Secondly, industries (as defined by the Standard Industrial Classification) are not usually completely homogeneous with respect to mobility of products. In the Dairy Products Industry, for example, liquid milk is usually sold locally because of its perishability while powdered milk can be sold in international markets.⁸ Thus a meaningful definition cannot exclude all international or interregional trade. However, it would be quite arbitrary to specify a priori what level of trade should be allowed in the definition of 'compatible'. It is proposed instead, that if the classification is indeed a useful analytical concept, there should be clearly differentiated groups corresponding to each level of the classification. Thus the cutoff levels are chosen out of the statistical analysis itself, with a view to producing groups in the classification that are distinguished from each other (with respect to mobility of products) as much as possible.⁹ Of course, the ultimate usefulness of this classification will depend on the context in which it is employed. The context will have a feedback

on the classification. The classification obtained here might be considered to be a first approximation to the classification needed for a model. Implementation of the model may require, however, modification of the classification to suit the model and/or the model to suit the classification. This has been mentioned in the introduction with respect to the MTW model.

One other point should be made. The place of an industry in the classification may change over time. On the one hand, the growth of local markets may reach a point where it becomes cheaper to satisfy local demand from plants established in the region, than to import supplies from other regions. Thus, before 1950, cement was imported into the Atlantic Provinces from Quebec, while during the 1950's two cement plants were established in the region to cater to local demand,[12]. On the other hand, technological change in an industry could, through the creation of new economies of scale, make production oriented to a regional market obsolete.¹⁰

For the application of the above definition to Canada, industries are defined as in the Standard Industrial Classification Manual (1970 revision, SC 12-501). The regions used are the traditional groupings of provinces. A hierarchy of four subdivisions was used as presented in Table 1 below. Some parts of the country (the Yukon, the Northwest Territories and in Subdivision 4 - P.E.I.) are excluded from these subdivisions because of their economically small size.

TABLE I

The Hierarchy of Regional Subdivisions

Subdivision 1.

Region1 = Eastern Region = Atlantic Provinces, Quebec, Ontario.

Region2 = Western Region = Prairie Provinces, British Columbia.

Subdivision 2.

Region1 = Atlantic Provinces

Region2 = Quebec

Region3 = Ontario

Region4 = Prairie Provinces

Region5 = British Columbia

Subdivision 3.

Regions1, 2, 3 as in subdivision 2.

Region4 = Manitoba

Region5 = Saskatchewan

Region6 = Alberta

Region7 = British Columbia

Subdivision 4.

Nine regions corresponding to the provinces of Canada
excluding Prince Edward Island because of its small size.

These subdivisions have special characteristics which may lead to a different classification of industries than for some other country of a similar gross national product and population. In any of these subdivisions there is a considerable disparity in gross regional products and except for subdivision 1, in area. The small size of some regions relative to others may cause some industries to be national which would be regional in a country divided into more equally sized regions. The inclusion of subdivision 3 in the hierarchy illustrates this point. Originally, it was not planned to use this subdivision, but in the course of the analysis a couple of regional industries were found to be compatible with each of the Prairie Provinces but not with any of the Atlantic Provinces. The Atlantic Provinces have a smaller total area than Saskatchewan and all have a smaller gross provincial product than Saskatchewan. Contrary to the above tendency, high transportation costs caused by the long distances and geographical barriers may lead to some industries being regional in Canada which might be national in a more compact country.

3. Classification Results

The classification obtained in this thesis is given over the page in Table 2. One can see that international industries tend to be characterized by high technology or a specialized Canadian resource base in comparison to the intranational (national plus regional) industries. Among the intranational industries, the regional industries appear to be those characterized either by perishability or a high bulk to value ratio. It is interesting to note that international industries accounted for 47% of total shipments by manufacturing industries in Canada in 1973. The corresponding figure for national industries was 35% and for regional industries 17% (7%, 5%, 3%, 2% for regional industries of order 1, 2, 3 and 4 respectively). These figures signify that a nonvacuous classification has been obtained, although the distinction made between regional industries of order 2, 3 and 4 does not appear to be very useful with respect to the Canadian macro-economy.

The classification obtained here can be compared to classifications used in other studies (of other countries). The first of these was obtained by Isard, who was looking at the American economy in 1939, [6, ch.5]. Isard did not have to worry about international industries. To try to distinguish between national and regional industries he collected data on production by industry and by state. Then he estimated consumption by industry and by state.

The surplus (deficit) of production over consumption was calculated for each state and these surpluses were summed without regard to sign.

TABLE II

Classification of Canadian Manufacturing Industries
by the Mobility of Their Products

International Industries

SIC Code*	Name
102	Fish Products Industry
105	Flour and Breakfast Cereal Products Industry
1083	Vegetable Oil Mills
1092,1094	Distilleries, Wineries
17	Leather Industries
18nec ⁺	Textile Industries n.e.c.
23	Knitting Mills
251,252	Sawmills, Planing, Shingle, Veneer and Plywood Mills
271	Pulp and Paper Mills
29	Primary Metal Industries
31	Machinery Industries
32nec	Transportation Equipment Industries n.e.c.
335	Communications Equipment Manufacturers
357	Abrasives Manufacturers
372,373,378	Manufacturers of Mixed Fertilizers, Plastics, Synthetic Resins and Industrial Chemicals
39	Miscellaneous Manufacturing Industries

National Industries

SIC Code	Name
1011	Slaughtering and Meat Processors
103	Fruit and Vegetable Processing
1071	Biscuit Manufacturers
1081	Confectionary Manufacturers

1089	Miscellaneous Food Processors
15	Tobacco Products Industries
16	Rubber and Plastic Products Industries
186,187	Carpet, Mat, Rug, Canvas Products, Cotton and Jute Bag Industry
24	Clothing Industries
26	Furniture and Fixture Industries
272,274	Asphalt Roofing Manufacturers, Miscellaneous Paper Converters
28	Printing, Publishing and Allied Industries
30nec	Metal Fabricating Industries n.e.c.
324	Truck Body and Trailer Manufacturers
33nec	Electrical Products Industries n.e.c.
35nec	Non-Metallic Mineral Products Industries n.e.c.
37nec	Chemical Industries n.e.c.

Regional Industries

SIC Code	Name	Order
1012	Poultry Processors	1
106	Feed Industry	1
1082	Cane and Beet Sugar Processors	1
1091	Soft Drink Manufacturers	1
25nec	Wood Industries n.e.c.	1
273	Paper Box and Bag Manufacturers	1
302	Fabricated Structural Metal Industry	1
352	Cement Manufacturers	2
36	Petroleum and Coal Products Industries	2
104	Dairy Products Industry	3
354	Concrete Products Manufacturers	3
1072	Bakeries	4
1093	Breweries	4
355	Ready-Mix Concrete Manufacturers	4

- * Standard Industrial Classification Code, 1970. See SC 12-501
 - + The notation nec means that part of the industry group not elsewhere classified.
-

The statistic obtained by dividing this sum by the industry's national output was taken to be representative of the amount of interstate trade in the products of the industry. This estimate could be very much on the low side because a balance between production and consumption could conceal large interstate trade flows. Industries were then ranked according to the magnitude of the above ratio. A regional industry of high order will have a low ratio while a national industry may have a high ratio. Gaps in the list were taken to suggest divisions between different classes. A rough idea about classification was then obtained by combining empirical knowledge with observation of the gaps in this list of ratios and in a similar list of ratios derived from census regions instead of states. The change in the ratio from states to census regions was also used. These rough ideas were then used as a starting point for a number of experiments with the 'balanced regional model'. In the first experiment industries are divided into two numerically equal groups as regional and national industries (two regions only are used). The division is roughly based on the ratio of the sum of surpluses to national output for census regions. The results obtained were not very good but Isard states that the experimentation allowed him to deduce that an

industry where the ratio is more than 15% should not usually be considered regional (as it causes the model to give poor results). Using this figure only one of the twentyfive manufacturing sectors can be considered regional - Non-Metallic Mineral Products. In succeeding experiments he also takes Printing and Publishing and Iron and Steel Foundries to be regional initially but on reconsideration drops Printing and Publishing and Non-Metallic Mineral Products as having too much of a national character. Iron and Steel Foundries is also dropped in the end because the final choice of the division of the United States into two regions (at the Mississippi River) does not give a good balance of production and consumption in this industry (although other choices would have).

Isard's work on the classification problem is the only attempt so far to provide empirical evidence for a comprehensive classification. The classification obtained in this thesis is based in part on similar methodology. The ratios used by Isard have been converted to exports:output and imports:consumption ratios because the data is available to do so. The data also allows for considerably more disaggregation than that available to Isard. This has allowed for more homogeneity with respect to mobility of products and hence has led to the identification of more regional industries. As well, the gaps in the list of ratios have turned out to have a lower limit in the 10 - 15% range. This supports Isard's contention above.

The results of the two studies are not strictly comparable because

of the different levels of aggregation and the different sizes of the markets involved. Nevertheless Isard's result that Non-metallic Mineral Products and the Printing and Publishing Industry have a mixed character are supported by this study. The first case is clear from the classification table above. The evidence in the second case does not appear in this table but will appear in the course of the analysis (see p.21). Iron and Steel Foundries, however, appears to be international in Canada (it is included in 29 Primary Metal). This is due to products being imported from the United States and reflects the small size of the Canadian market relative to even regional markets in the U.S..

Another classification has been produced by Mennes et. al. to go along with their model, [9, pp.314-317]. This classification is intended to be valid for any country. It classifies the 3 digit industries defined by the "International Standard Industrial Classification 1958" of the United Nations. They provide no empirical evidence for their classification but state that it is based on a study of Japanese data at the international vs. intranational level and on hunch at the national vs. regional level. Because of the intended universality of their classification, very little in the way of manufacturing industry is considered to be intranational. Their results were as follows:

National

- 329 Miscellaneous Petroleum and Coal Products
- 331 Structural Clay Products
- 339 Non-Metallic Mineral Products

Regional

206 Bakery Products

209 Miscellaneous Food (perishable products only)

The results of this thesis (based on a different industrial classification) do not contradict these findings of MTW. But the results here show that the MTW classification is extremely restrictive as far as Canada is concerned, and hence probably with respect to other countries too. That is, much less in the way of manufacturing industry is classified as national or regional than could be. One feels MTW have been overly conservative in their classification when one sees breweries and cement classified as international industries.

A third classification has been produced for Mexico by R. Carrillo-Arronte, [1], with respect to a subdivision of Mexico into 10 regions. He states that his classification is based on a rule of thumb which involves tracing the 'normal' or major elements in each activity but he doesn't provide any evidence to support his classification. Carrillo-Arronte has worked through some modified forms of the MTW model for Mexico so has had some feedback from his results to help him with the classification. His regional manufacturing industries are Slaughtering, Dairy Products, Grain Mills and Bakeries. Non-Metallic Mineral Products and Basic Metal Industries (e.g. Primary Metal) are national industries. The inclusion of Slaughtering and Grain Milling in the regional part of the classification reflects the importance of peasant agriculture in the Mexican economy. Basic Metal Industries

are international in Canada because Canada has special resource endowments here. Carrillo-Arronte's classification of Dairy Products, Bakeries and Non-Metallic Mineral Products is consistent with the classification obtained here. The reason that this thesis has found more regional and national industries is because this study has a greater amount of disaggregation and because Canada is much more economically developed than Mexico.

There is one other partial study of the classification problem by L. H. Klaassen, [5]. Klaassen proposes an indirect method for testing an industry for compatibility with a subdivision of the nation into regions. The locational pattern of an industry depends on the geographical distribution of demand for its output and also on the locational pattern of the industries from which it obtains its inputs. Thus he regresses regional output on regional demand and regional production of inputs (where the coefficients are supposed to weight the importance of each factor so are restricted to sum to 1). An industry is regional when this gives a good explanation of regional output (e.g. a high R^2) and when regional demand is a much more important determinant of regional output than regional production of inputs. This method has not been applied in this thesis because of the availability of interprovincial trade statistics. An industry is judged to be regional here if there is little interregional trade in its products. This guarantees that regional output and regional demand are nearly the same and so will guarantee that Klaassen's method will give the same result.

Klaassen applied his method to three industries in the United States. He concluded that the combination of the Optical, Ophthalmic and Photographic Equipment Industries was national. The Electronic Components Industry and the Glass and Glass Products Industry were regional.¹¹ The first two of these do not exist as separate industries in Canada so his results are not comparable to those here. The Glass and Glass Products Industry has not been separated out here but is a part of 35nec Non-Metallic Mineral Products n.e.c.. Considered by itself (which was not done because of its small size), the Glass and Glass Products Industry would have to be classified either national or international here. The different result is presumably due again to the relatively small size of the Canadian market.

4. The MFW Assumption

The MFW model usually contains an assumption of the form:

"For each national or regional product the increase in demand is proportional to the increase in national or regional income.", [9, p.54].

At the national level, for example, this means that an increase in gross national product would lead to a proportional increase in the sales of the national industry - the proportion being independent of the amount of the increase. It appears to be useful to trace the relationship of this assumption to the assumption that for any industry an increase in gross national product would lead to a proportional increase in consumption of the products of this industry. (This second assumption would be true if the input-output assumptions were true and the relative proportions of final demand between industries were constant.)

The second assumption can be written in statistical form as:

$$(1) \quad \Delta Q - \Delta X + \Delta M_c + \Delta M_{nc} = a \Delta Y + \epsilon$$

where ΔQ = change in sales, ΔY = change in gross national product,

ΔX = change in exports,

ΔM_c = change in imports of products in which there is
competition between foreign and domestic suppliers,

ΔM_{nc} = change in imports of products for which there is no
significant domestic production,

ϵ = a random disturbance.

An example of noncompetitive imports would be processed tropical fruits in the Fruit and Vegetable Processing Industry.

The distinction between competitive and noncompetitive imports is important for our classification. This classification is intended to apply to Canadian industries. These industries may be defined by taking the corresponding international definitions and then excluding those products not produced in Canada. From this perspective, the distinction between international and intranational industries becomes a question of the size of exports and competitive imports relative to national production.

Now, it is presumably as reasonable as the assumption expressed by equation (1) to write

$$(2) \quad \Delta M_{nc} = b \Delta Y + \sigma$$

where σ is another random disturbance. Combining (1) and (2) one obtains

$$(3) \quad \Delta Q = (a - b) \Delta Y + \Delta X - \Delta M_c + \epsilon - \sigma$$

or $(3') \quad \Delta Q = (a - b) \Delta Y + \omega$

where $\omega = \Delta X - \Delta M_c + \epsilon - \sigma.$

It would seem then that a time series regression of ΔY on ΔQ might give some indication of the importance of exports and competitive imports relative to national production. The coefficient of determination (R^2) for such a regression will measure the extent to which ω is independent of (orthogonal to) ΔY over the period in question.¹² This measurement is relative to ΔQ so if ω was small relative to ΔQ a high R^2 would be obtained. On the other hand, a high R^2 could be obtained regardless of the relative magnitudes of ω and ΔQ provided that ω largely followed the same trend as ΔY , again over the period in question.

Now if this period contained significant fluctuations in the economic position of Canada relative to the rest of the world, we would expect an important part of ΔX and ΔM_c and hence ω to be independent of ΔY in this period. A high R^2 could then only be attributed to the fact that ΔX and ΔM_c (and ϵ and σ) were small relative to ΔQ . Thus in such a period a high R^2 would be positive evidence of the intranationality of this industry. In any case, a high R^2 indicates that ϵ is small relative to ΔQ so that the MTW assumption is valid, thus the proposed application of the classification again justifies looking at R^2 in this way.

A low R^2 indicates that ω is large relative to ΔQ . This might be due to the fact that exports or competitive imports are important in an industry. It could, however, also be due to the fact that ϵ or σ was large relative to ΔQ . A large ϵ for example, means large random disturbances in the output of the industry. This could be due to structural change in the industry or links to... an unstable industry such as the construction industry or to other factors.¹³ In summary, R^2 will be taken to be a descriptive statistic which, treated with care, can aid in resolving some difficult cases of classification. In addition, the computation of R^2 allows for the identification of cases where the MTW assumption fails and hence points to places where the MTW model will require modification.

In practise, the regression of ΔQ on ΔY did not prove to be as satisfactory in distinguishing between international and intranational industries as regressing Q on a constant and Y apparently because random disturbances in Q are large relative to the changes that occur in Q

in a year. This means that ω tends to be dominated by ϵ so that the regression does not pick up the effects of changes in exports or in competitive imports.

Putting in time, equation (3) is

$$(4) \quad Q_t - Q_{t-1} = (a - b)(Y_t - Y_{t-1}) + (X_t - X_{t-1}) - (M_{ct} - M_{ct-1}) + \epsilon_t - \sigma_t$$

Summing the first t of these equations:

$$(5) \quad Q_t - Q_0 = (a - b)(Y_t - Y_0) + (X_t - X_0) - (M_{ct} - M_{c0}) + \epsilon_1 + \dots + \epsilon_t - \sigma_1 - \dots - \sigma_t$$

or (6)
$$Q_t = Q_0 - (a - b) Y_0 - X_0 + M_{c0} + (a - b) Y_t + X_t - M_{ct} + \dots$$

or (7)
$$Q_t = d + (a - b) Y_t + X_t - M_{ct} + \dots$$

The remarks above concerning R^2 and equation (3) could equally be made to equation (7) and since (7) is equivalent to (3), the connection between R^2 and the MFW assumption is preserved.

These R^2 can also be computed at the regional level when one tries to distinguish between national and regional industries (and regional industries of different orders). In this case, however, the existence of noncompetitive imports into one region from another means that the industry is national. High R^2 for all regions may indicate that the industry consists of two subindustries, one of which is regional and one of which is national. In the smaller regions, only the regional component exists, thus giving a high R^2 . In the larger regions, the national component gives a high R^2 because its output is correlated

with national income which is correlated with the income of the large regions. This is what appears to happen in the Printing and Publishing Industry, for example. Unfortunately the SIC subdivision of this industry group does not correspond with the mobility subdivision so the whole industry group must be classified as national. Thus, in practise, R^2 does not turn out to be useful at these levels of classification, as a means of distinguishing between national and regional industries.

5. The General Course of the Analysis

In the subsequent sections, manufacturing industries or groups of such industries are assigned to various orders in the classification on the basis of certain descriptive statistics and/or other information.

The computation of these statistics for all industries in the SIC would be an impossible task due to the large number of industries and the large amount of data manipulation involved (indeed, the data required is not necessarily available when the number of firms in an industry is small).

The procedure followed here was instead to start with the twenty industry groups and to see which of these could be classified as intranational. If an industry group could not be classified as intranational, an attempt was made to split the group into two subgroups, one of which would be clearly intranational. The other subgroup and any groups which proved to be impossible to split in this way were classified as international. For example, 25 Wood was split into two subgroups. One of these - 251,252 Sawmills, Planing, Shingle, Veneer and Plywood Mills consisted of the export oriented industries in this group and was classified international. The other subgroup 25nec Wood n.e.c. then satisfied the criteria for intranational industries.

The intranational groups or subgroups were then tested to see if they could be classified as regional. If not, an attempt was again made to find a split of which one (or more) part(s) would be clearly regional. If such a split was made, it was then necessary to go back and test whether the parts were still intranational before testing them for regionality. It was at this stage that 10 Food and Beverages

was split into its nine three digit industries because the industry group as a whole was not clearly regional. On testing these industries for intranationality, 102 Fish Products and 105 Flour and Breakfast Cereal Products had to be added to the international category. Moreover 109 Beverages was further split into 1092, 1094 Distilleries, Wineries which was international and 1091, 1093 Soft Drinks, Breweries which was intranational. This subgroup and the other three digit food industries could then be tested for regionality. Where these industries also had a mixed national and regional character further splitting into four digit industries was attempted. Thus 101 Meat and Poultry Products, 107 Bakery Products and 108 Miscellaneous Food were split. Each such four digit industry had to be rechecked for intranationality. One, 1083 Vegetable Oil Mills failed this test.

Having obtained a list of regional industries or groups of industries, it was then necessary to determine the order. Further splitting of the remaining groups was found to be desirable in some cases not clearly belonging to one order or the other. Thus 1091 Soft Drinks and 1093 Breweries were separated. The parts obtained from these splits had to be retested for intranationality and regionality of course.

The final classification list, then, consists of industry groups, industry subgroups or individual industries. As described above, an industry group was split when the parts appeared to have more homogeneity with respect to mobility of products than the whole. For the sake of

brevity, the account below of the stages of the classification will treat all the splits as having been made at once although , as just described, this was not the case.

Originally it was intended not to consider industry subgroups whose 1973 shipments were less than one half billion dollars. Data problems and the desire to increase homogeneity led however to the relaxation of this restriction in some cases. Industries 357, 1071, 1083, 352 and 354 thus had shipments of less than three hundred million dollars.

6. Finding Intranational Industries

Two criteria are applied here to try to distinguish intranational from international industries. The first of these is similar to the method of Isard discussed in section three. There he calculated (indirectly) surpluses of production over consumption and used the ratio of the sum of surpluses to national production as an aid to classification. At the international level, however, there is direct data on trade flows so that one can replace the surplus to sales ratios by exports:sales and imports:consumption ratios. These two ratios will be denoted by X/Q and M/C ($C = Q + M - X$). Unfortunately data on exports and imports for Canada is published by commodity class rather than industry of origin (SC 65-202 and SC 65-203). This made it necessary to draw up a table of correspondence between commodity classes and industry groups. A commodity class was assigned to the industry group which was the principal producer of the commodities in the class.¹⁴ Then exports and imports were estimated by summing exports and imports of the corresponding commodity classes. Because this is a long and tedious exercise it was done for only one year 1973. The results are given in Tables 3 and 4 below, where industry groups are listed in increasing order of their 1973 X/Q or M/C ratio.¹⁵ A second column in Table 3 gives X/Q ratios for 1967. These are derived from a Statistics Canada survey on the destination of shipments of manufacturers in 1967 (SC 31-504). As the authors state in their summary of results, their estimates of exports tend to be low, one reason being that the survey is based on

TABLE III

Exports to Sales Ratios for Manufacturing Industry Groups

SIC Code	Name	X/Q	
		1973	1967
23	Knitting Mills	.03	.00
28	Printing, Publishing and Allied	.03	.01
26	Furniture and Fixtures	.05	.02
18	Textiles	.05	.06
24	Clothing	.06	.02
30	Metal Fabricating	.06	.05
17	Leather	.08	.04
16	Rubber and Plastic Products	.08	.06
35	Non-Metallic Mineral Products	.09	.05
15	Tobacco Products	.09	.08
10	Food and Beverages	.10	.07
36	Petroleum and Coal Products	.11	.00
33	Electrical Products	.15	.12
37	Chemicals and Chemical Products	.20	.10
39	Miscellaneous	.21	.07
29	Primary Metal	.41	.23
31	Machinery	.42	.24
25	Wood	.49	.37
27	Paper and Allied	.51	.46
32	Transportation Equipment	.67	.34

TABLE IV

Imports to Consumption Ratios for Manufacturing Industry Groups

SIC Code	Name	M/C for 1973
15	Tobacco Products	.03
27	Paper and Allied	.07
36	Petroleum and Coal Products	.07
10	Food and Beverages	.09
24	Clothing	.10
26	Furniture and Fixtures	.10
25	Wood	.12
30	Metal Fabricating	.14
28	Printing, Publishing and Allied	.15
35	Non-Metallic Mineral Products	.15
29	Primary Metal	.25
16	Rubber and Plastic Products	.26
18	Textiles	.27
23	Knitting Mills	.27
17	Leather	.29
37	Chemicals and Chemical Products	.29
33	Electrical Products	.34
39	Miscellaneous	.54
32	Transportation Equipment	.70
31	Machinery	.71

first destination of shipments rather than final destination of shipments. Nevertheless, these 1967 estimates serve as a check of the reasonableness of the 1973 estimates. One can see that except in the case of 18 Textiles, where the estimates are essentially the same, the 1967 estimates fall below the 1973 estimates and tend to follow the same pattern. 29 Primary Metal, 25 Wood and 32 Transportation Equipment are given by the authors of the 1967 survey as examples where their estimates of exports are low. The 1967 estimates for 36 Petroleum and Coal Products, 37 Chemicals and Chemical Products and 39 Miscellaneous were checked from 1967 data on exports by commodity classes. The figures obtained were .03, .17 and .18 respectively, again indicating the lowness of the survey estimates.

Looking at the 1973 X/Q ratios one sees a large gap between 39 Miscellaneous at .21 and 29 Primary Metal at .41. The last five groups 29 Primary Metal, 31 Machinery, 25 Wood, 27 Paper and Allied and 32 Transportation Equipment with X/Q greater than 40% clearly form a separate class which should be characterized as export oriented.¹⁶ These industry groups must thus be classified as international. The first twelve groups down to 36 Petroleum and Coal Products at .11 appear to belong together as a class so .11 will be taken as the cutoff point below which exports will not be regarded to form a significant part of a group's shipments. The remaining three intermediate cases 33 Electrical Products, 37 Chemicals and Chemical Products and 39 Miscellaneous will be regarded as having mixed characteristics with respect to exporting which we will try to separate out later.

The M/C ratios are higher on the average than the X/Q ratios. Eight industry groups which accounted for 31% of Canadian consumption of and 44% of imports of manufactured goods in 1973 have M/C at least 10% higher than X/Q. These are 16 Rubber and Plastic Products, 17 Leather, 18 Textiles, 23 Knitting Mills, 28 Printing, Publishing and Allied, 31 Machinery, 33 Electrical Products, and 39 Miscellaneous. On the other hand, three industry groups which accounted for 14% of Canadian consumption of manufactured goods in 1973 have M/C at least 10% less than X/Q. These three groups accounted for 37% of exports of manufactured goods in 1973. They are 25 Wood, 27 Paper and Allied and 29 Primary Metal. These figures illustrate the dependence of the Canadian economy on the export of semiprocessed goods in exchange for finished products.

There is a clear gap in the M/C list from 35 Non-Metallic Mineral Products at .15 to 29 Primary Metal at .25. The M/C ratio here includes both competitive and noncompetitive imports. Recalling from section four that only low competitive imports are required for intranationality, it seems reasonable to take .15 as the cutoff point below which competitive imports are not important. In any case when we look at the second criterion we will see that the choice of .15 as opposed to .10 does not make any difference to the final results. For the industry groups with M/C greater than .24 it is not clear whether competitive imports are important or not.

For an intranational industry, both exports and competitive imports should be unimportant. Thus combining the above remarks

we have the following first classification results.

<u>International</u>		<u>Intranational</u>	
25	Wood	10	Food and Beverages
27	Paper and Allied	15	Tobacco Products
29	Primary Metal	24	Clothing
31	Machinery	26	Furniture and Fixtures
32	Transportation Equipment	28	Printing, Publishing and Allied
		30	Metal Fabricating
		35	Non-Metallic Mineral Products
		36	Petroleum and Coal Products

Unclassified

16	Rubber and Plastic Products
17	Leather
18	Textiles
23	Knitting Mills
33	Electrical Products
37	Chemicals and Chemical Products
39	Miscellaneous

The second criterion which has been used as an aid to classification has been discussed in section four. If Q is regressed on a constant and Y for each industry group, then a high R^2 is evidence of intranationality. How high R^2 should be and whether this test does tend to distinguish between international and intranational industries can be determined by examining the R^2 obtained for those industries we have already classified.

For the purposes of these regressions data was collected for the years 1966 - 74.¹⁷ The period was kept short to try and avoid the effects of structural change on the economy. This works against the desirable condition of a period in which there were considerable fluctuations in Canada's economic position vis-a-vis the rest of the world. On the other hand, the fact that Canada was forced to unpeg the dollar in 1970 indicates that such fluctuations did exist.

A run on annual data was made and also a run on semiannual data with a seasonal dummy¹⁸ because this increased the degrees of freedom from 7 to 15 and could get shorter term fluctuations to affect the results of the regression. The use of shorter periods has appeared to work because the semiannual R^2 distinguishes better between international and intranational industries than the annual R^2 . It should be noted that there are some slight discontinuities in some of the data on shipments due to changes in the SIC definitions in 1970. Major discontinuities, which affect only 16 Rubber and Plastic Products, 18 Textiles and 39 Miscellaneous, have been corrected for.¹⁹ Table 5 gives the values of R^2 obtained in both the semiannual and annual cases. Industry groups are listed in order of declining semiannual R^2 .

One sees in Table 5 that the intranational industries do not fall below the international industries with two exceptions. These two exceptions have explanations. A change in accounting procedures in the Tobacco Products Industry in 1969²⁰ has led to a discontinuity in the data on shipments for this industry while the Petroleum and Coal Products

TABLE V

Coefficient of Determination between Shipments and GNP

SIC Code	Name	S.A.R ^{2*}	A.R ²⁺	Class. #
28	Printing, Publishing and Allied	.99	.99	A
24	Clothing	.99	.99	A
39	Miscellaneous	.98	.99	
16	Rubber and Plastic Products	.98	.99	
35	Non-Metallic Mineral Products	.97	.97	A
30	Metal Fabricating	.97	.97	A
10	Food and Beverage	.96	.96	A
33	Electrical Products	.96	.96	
23	Knitting Mills	.95	.99	
18	Textiles	.95	.98	
26	Furniture and Fixtures	.94	.96	A
32	Transportation Equipment	.94	.97	E
31	Machinery	.93	.94	E
17	Leather	.93	.95	
29	Primary Metal	.93	.94	E
37	Chemicals and Chemical Products	.93	.93	
15	Tobacco Products	.92	.96	A
27	Paper and Allied	.89	.89	E
36	Petroleum and Coal Products	.86	.86	A
25	Wood	.80	.87	E

* S.A.R² means the R² from the run on semiannual data.

+ A.R² means the R² from the run on annual data.

Class. means the classification assigned to this industry group above on page 31. A = intranational, E = international.

has been subject to massive price increases on its raw materials. The table shows then that the semiannual R^2 does tend to distinguish between intranational and international industries. In light of the remarks made in section four, 16 Rubber and Plastic Products may be classified as intranational ($X/Q = .08$). 39 Miscellaneous has $X/Q = .21$, however, and the high R^2 may be due to the miscellaneousness, i.e. a large number of effects tending to cancel each other out. This group is classified as international on the basis of X/Q . 33 Electrical Products still appears to have mixed characteristics. 23 Knitting Mills and 18 Textiles have been subject to strong structural changes during the period in question, a fact which is evident from a comparison of the price indices of these groups with the national price index.²¹ This is partly due to the growing popularity of double knit and manmade fabrics, changes which have originated abroad. Both these groups should thus be classified as international. Finally 17 Leather and 37 Chemicals and Chemical Products should also be classified as international. There is evidence of import competition for Leather²² and Chemicals and Chemical Products has $X/Q = .20$, too high for an intranational industry. In conclusion, on the basis of Table 5 we choose to use a semiannual R^2 greater than .96 as evidence of an intranational industry and we have obtained the following additional classification results.

	<u>International</u>		<u>Intranational</u>
39	Miscellaneous	16	Rubber and Plastic
23	Knitting Mills		Products
18	Textiles		
17	Leather		<u>Unclassified</u>
37	Chemicals and Chemical Products	33	Electrical Products

The next stage of the analysis is to split some of these industry groups into subgroups or individual industries which will have better homogeneity with respect to mobility of products than the group taken as a whole. Section five commented on the procedure by which these splits were arrived at. Table 6, over the page, gives the X/Q and M/C ratios computed for these splits.

Again the 1967 X/Q figures either are close to the 1973 figures or lie below them (with the exception of 102 Fish Products). The only discrepancy which needs investigation in view of the 10% cutoff figure on this statistic is 1083 Vegetable Oil Mills. However, a calculation from the commodity statistics gives $X/Q = .22$ for 1967 indicating that the survey estimate is far too low.

We now classify the industry subgroups listed in Table 6 with the standards developed for industry groups in mind. Subgroups with X/Q greater than .10 will be classified as international as being export oriented. The two lowest such cases are 1083 Vegetable Oil Mills at .18 and 105 Flour and Breakfast Cereal Products at .23. A little extra attention will be given to these two cases.

TABLE VI

X/Q and M/C Ratios for some Industry Subgroups

SIC Code	Name	X/Q		M/C
		1973	1967	1973
1011	Slaughtering and Meat Processors	.09	.04	.08
1012	Poultry Processors	.01	.01	.02
102	Fish Products	.44	.57	.13
103	Fruit and Vegetable Processors	.09	.04	.24
104	Dairy Products	.05	.02	.04
105	Flour and Breakfast Cereal Products	.23	.17	.05
106	Feed Manufacturers	.03	.02	.01
1071	Biscuit Manufacturers	.08	.03	.04
1072	Bakeries	.01	.00	.01
1081	Confectionery Manufacturers	.06	.02	.23
1082	Cane and Beet Sugar Processors	.07	.01	.05
1083	Vegetable Oil Mills	.18	.07 ⁺	.31
1089	Miscellaneous Food Processors	.05	.04	.09
1091	Soft Drink Manufacturers	.00	.00	.01
1092,1094	Distilleries, Wineries	.43	.48	.28
1093	Breweries	.01	.01	.01
186,187	Carpet, Mat, Rug, Canvas Products, Cotton and Jute Bag Industries	.01	.02	.13
18nec	Textiles n.e.c.	.06	.06	.29
251,252	Sawmills, Planing, Shingle, Veneer and Plywood Mills	.64	.47	.17
25nec	Wood n.e.c.	.06	.07	.05

271	Pulp and Paper Mills	.68	.65	.09
272,274	Asphalt Roofing Manufacturers, Miscellaneous Paper Converters	.05	.03	.10
273	Paper Box and Bag Manufacturers	.01	.00	.02
302	Fabricated Structural Metal Industry	.00	.02	.01
30nec	Metal Fabricating n.e.c.	.07	.06	.16
324	Truck Body and Trailer Manufacturers	.01	.02	.15
32nec	Transportation Equipment n.e.c.	.72	.35	.74
335	Communications Equipment	.29	.29	.46
33nec	Electrical Products n.e.c.	.08	.06	.29
352	Cement Manufacturers	.09	.03	.02
354	Concrete Products Manufacturers	.06	.00	.00
355	Ready-Mix Concrete Manufacturers	.00	.01 ⁺	.00
357	Abrasives Manufacturers	.66	.63	.49
35nec	Non-Metallic Mineral Products n.e.c.	.09	.03	.28
372,373,378	Manufacturers of Mixed Fertilizers, Plastics, Synthetic Resins, Industrial Chemicals	.39	.17	.39
37nec	Chemicals and Chemical Products n.e.c.	.05	.04	.22

+ due to the confidentiality of some data, these numbers are only upper bounds on the real figures.

All other cases have X/Q greater than .28 and require no further comment.

Industry subgroups with X/Q less than .10 and M/C less than .17 will be classified as intranational. The borderline cases on M/C are 186,187 Carpets etc. at .13, 30nec Metal Fabricating n.e.c. at .16 and 324 Truck Body and Trailer Manufacturers at .15. These will be watched in the second test. All other subgroups have low exports and M/C from .22 to .28. These cases remain unclassified. Thus the following results have been obtained.

	<u>International</u>		<u>Intranational</u>
102	Fish Products	1011	Slaughtering, Meat
105	Flour, Breakfast Cereal	1012	Poultry Processors
1083	Vegetable Oil Mills	104	Dairy Products
1092,1094	Distilleries, Wineries	106	Feed
251,252	Sawmills etc.	1071	Biscuits
271	Pulp and Paper Mills	1072	Bakeries
32nec	Transportation Equip. n.e.c.	1082	Sugar
335	Communications Equip.	1091	Soft Drinks
357	Abrasives	1093	Breweries
372,373,378	Mixed Fertilizer etc.	186,187	Carpets etc.
		25nec	Wood n.e.c.
		272,274	Paper n.e.c.
		273	Paper Box and Bag
		302	Fab. Structural Metal

	<u>Unclassified</u>		<u>Intranational</u>
103	Fruit and Vegetable	30nec	Metal Fabricating n.e.c.
1081	Confectionery	324	Truck Body and Trailer
18nec	Textiles n.e.c.	352	Cement
33nec	Electrical Products n.e.c.	354	Concrete Products
35nec	Non-Metallic Min. Products	355	Ready-Mix Concrete
37nec	Chemicals n.e.c.	1089	Miscellaneous Food

For further evidence, regressions were run for these subgroups as was done for industry groups. The results are given in Table 7 on the next page. The values of R^2 calculated for this table generally agree with those calculated for industry groups. There are five cases of intranational subgroups having abnormally low R^2 . These cases appear to be explainable. 106 Feed Manufacturers is subject to competition from Agriculture as grain may be substituted for some of the products of this industry.²³ 1072 Bakeries is affected by changes in the price of wheat flour and also there have been statistical problems with estimating the shipments of the many small establishments in this industry.²⁴ 1082 Cane and Beet Sugar Processors has been affected by extraordinary increases in the price of imported raw cane sugar.²⁵ (This case is similar to the case of Petroleum Products.) The data for 1089 Miscellaneous Food Processors has a discontinuity in it due to the change in the Standard Industrial Classification. Prior to 1970, Macaroni Manufacturers were not included in this industry. Finally 302 Fabricated Structural Metal is unstable because of its links to the construction industry,

TABLE VII

Coefficient of Determination between Shipments and GNP
for some Industry Subgroups

SIC Code	Name	S.A.R ^{2*}	A.R ²	Class.
1011	Slaughtering and Meat Processors	.94	.95	A
1012	Poultry Processors	n.a.	.94	A
102	Fish Products	n.a.	.89	E
103	Fruit and Vegetable Processors	.96	.96	
104	Dairy Products	.95	.96	A
105	Flour and Breakfast Cereal Products	n.a.	.43 ⁺	E
106	Feed Manufacturers	n.a.	.91	A
1071	Biscuit Manufacturers	.96	.96	A
1072	Bakeries	n.a.	.92 ⁺	A
1081	Confectionery Manufacturers	.97	.97	
1082	Cane and Beet Sugar Processors	.76	.81	A
1083	Vegetable Oil Mills	.89	.89	E
1089	Miscellaneous Food Processors	.92	.92	A
1091	Soft Drink Manufacturers	n.a.	.99	A
1092,1094	Distilleries, Wineries	.98	.97	E
1093	Breweries	.98	.99	A
186,187	Carpet, Mat, Rug, Canvas Products, Cotton and Jute Bag Industries	.97	.98	A
18nec	Textiles n.e.c.	.94	.98	
251,252	Sawmills, Planing, Shingle Veneer and Plywood Mills	n.a.	.78	E
25nec	Wood n.e.c.	n.a.	.94	A

271	Pulp and Paper Mills	.86	.86	E
272,274	Asphalt Roofing Manufacturers, Miscellaneous Paper Converters	.93	.94	A
273	Paper Box and Bag Manufacturers	.96	.96	A
302	Fabricated Structural Metal Industry	.77	.76	A
30nec	Metal Fabricating n.e.c.	.98	.98	A
324	Truck Body and Trailer Manufacturers	n.a.	.96	A
32nec	Transportation Equipment n.e.c.	n.a.	.95	E
335	Communications Equipment	.82	.84	E
33nec	Electrical Products n.e.c.	.98	.98	
352	Cement Manufacturers		.93	A
354	Concrete Products Manufacturers	.95 [#]	.94	A
355	Ready-Mix Concrete Manufacturers		.95	A
357	Abrasives Manufacturers	.76	.77	E
35nec	Non-Metallic Mineral Products n.e.c.	.98	.99	
372,373,378	Manufacturers of Mixed Fertilizers, Plastics, Synthetic Resins Industrial Chemicals	.86	.86	E
37nec	Chemicals and Chemical Products n.e.c.	.97	.97	

* for the notation see Table 5, p.33.

+ for the period 1966 - 73 only as 1974 data not available.

this figure is for the three industries 352, 354, 355 combined.

n.a. data not available for semiannual regression. Annual data
taken from SC 31-203.

A = intranational

E = international

particularly to major projects such as Expo 67.

On the other hand, of the ten subgroups already known to be international, only two have high R^2 . The stability of overseas demand for the products of 1092 Distilleries and 32nec Transportation Equipment n.e.c. possibly results from the nature of the product in the first case, and the Autopact agreement with the U.S. in the second case.

One continues then to feel justified in using the semiannual R^2 as an additional statistic to determine classification. Turning to the unclassified cases, 103 Fruit and Vegetable Processors, 1081 Confectionery Manufacturers, 33nec Electrical Products n.e.c., 35nec Non-Metallic Mineral Products n.e.c. and 37nec Chemicals and Chemical Products n.e.c. all have semiannual R^2 ranging from .96 to .98 and so are classified as intranational. The remaining case 18nec Textiles n.e.c. comprises the major part of 18 Textiles ($R^2 = .94$). It is felt that the comments made concerning 18 Textiles above should apply here so 18nec is classified international.

Finally, concerning the borderline cases on the X/Q and M/C statistics, the semiannual R^2 confirms that these were properly classified except perhaps in the case of 324 Truck Body and Trailer Manufacturers. This industry has, however, been subject to exceptionally rapid growth in recent years (see SC42-217) which may explain why the annual R^2 is not higher (e.g. due to structural change).

7. Finding Regional Industries

The above analysis produced a list of 31 intranational industry subgroups or groups. The next stage is to distinguish between those which are national and those which are regional of some order. This is equivalent to determining which ones are compatible with the subdivision of Canada into Eastern and Western Regions. Available for this purpose are the results of the 1967 Survey on interprovincial trade by industry (SC 31-504). From this it is possible to compute shipments from the West to the East (denoted WE) and from the East to the West (EW). It is also possible to compute shipments originating in the West (WQ) and in the East (EQ) (which include exports to other countries). The statistics WE/WQ and EW/EQ are then similar for the regions to the X/Q statistic for the nation. Similarly one can compute shipments²⁶ whose first destination is the West (WC) and shipments whose first destination is the East (EC). The ratios EW/WC and WE/EC are similar to M/C. The four ratios WE/WQ, EW/WC, EW/EQ and WE/EC form a basis for deciding whether interregional shipments are important for a particular industry.

Unfortunately, some of the data needed is confidential. In such cases, however, it has been possible in most cases to find satisfactory upper and lower bounds for the missing data and thus to calculate a range within which the desired statistic lies. The example of 106 Feed Manufacturers will illustrate the procedure. In calculating WE, the following shipments are confidential; Manitoba to PEI and

New Brunswick, Alberta to Ontario and B.C. to Quebec and Ontario. The sum of the two unknown shipments into Ontario can be obtained by subtracting shipments from other provinces into Ontario from total shipments into Ontario because these figures are given. A lower bound for the other three unknown shipments is 0. The two unknown shipments into Quebec are from B.C. and P.E.I.. The sum of these two unknown shipments can be obtained by subtracting known shipments into Quebec from total shipments into Quebec. This sum gives an upper bound for shipments from B.C. to Quebec. Similarly if known shipments originating in Manitoba are subtracted from total shipments originating in Manitoba an upper bound for shipments from Manitoba to P.E.I. plus New Brunswick is obtained. This is a relatively easy example. Other cases required much more complicated manipulations. Because of the necessity of taking residuals and because data on the Atlantic Provinces and the Yukon and Northwest Territories is most often confidential, it was easiest to include the Yukon and the Northwest Territories in the East.

The statistics WQ/NQ and WC/NC (where $NQ = WQ + EQ$ and $NC = WC + EC$) have also been computed. Where these are obviously disparate, the industry has been classified as national and no attempt has been made to estimate the other statistics. This avoids some of the data problems.

A look at the interregional trade ratios in Table 8 on the next page reveals two definite groups. One group of thirteen has all ratios less than .15. Each member of another group of seventeen has its

TABLE VIII

Trade Ratios for Western and Eastern Regions

SIC Code	WQ/NQ	WC/NC	WE/WQ	EW/WC	EW/EQ	WE/EC
1011	.40	.26	.35	.02	.01	.20
1012	.22	.20	.08-.09	.01	.00	.02
103	.15-.19	.27	.09-.32	.45-.57	.13-.18	.02-.07
104	.21	.22	.01	.04	.01	.00
106	.21	.22	.00-.01	.05	.01	.00
1071	.02-.15	.24	.00-3.05	.65-.95	.15-.26	.00-.08
1072	.21	.21	.01	.02	.00	.00
1081	.01-.04	.24				
1082	n.a.	.25				
1089	.16	.26	.10-.79	.39-.87	.11-.24	.02-.18
1091	.19	.21	.00	.08-.09	.02	.00
1093	.24	.24	.01-.06	.00-.07	.00-.02	.00-.02
15	0	.18				
16	.04	.20				
186,187 ⁺	.25-.26	.31	.02-.04	.18	.08	.01-.02
24	.11	.23	.37	.71	.18	.05
25nec	.34	.32	.11-.12	.06	.02-.03	.06-.07
26	.13	.23	.02-.06	.43-.50	.11-.13	.00-.01
272,274	.07-.08	.16	.01-.20	.47-.64	.08-.11	.00-.02
273	.15-.16	.17	.01-.07	.11	.02	.00-.01
28	.14	.18	.04	.27-.28	.06	.01
302	.27	.32	.00-.02	.14-.15	.06	.00-.01
30nec	.12	.22	.05-.06	.46-.47	.11	.01
324	.26-.27	.34	.01-.05	.27-.29	.12-.13	.00-.02

33nec	.04-.06	.24				
352	.35-.37	.35-.37	.00-.02	.00-.10	.00-.06	.00-.02
354	.21	.22	.00	.04-.05	.01	.00
355	.34	n.a.	0	0	0	0
35nec	.14	.21	.02-.05	.35-.37	.08-.09	.00-.01
36	.29	.29		.03-.05	.01-.02	.01-.02
37nec	.05-.06	.22	.03-.04			

+ these figures are for 187 only

n.a. data required for calculation not available

maximum ratio at least .27. This group includes all industries for which the ratios were not calculated due to the disparity between WQ/NQ and WC/NC.²⁷ There is one additional case, 1082, for which the ratios are not available. This gap will be taken to be the dividing line with the first group being classified as regional industries and the second as national industries. This division provides two clearly distinct groups and this distinction would be lost if any of the industries in the first group were classified as national. Of course, no industry is perfectly homogeneous with respect to mobility of products, so classifying an industry as regional means only that this is the predominant form of the mobility of the products of this industry.

A study of 1082 Cane and Beet Sugar Refiners was made by the

Food Prices Review Board in 1974 and 1975: The results of a survey of nine major retailers indicated that there was no trade between Eastern and Western Regions in refined sugar, [11, p. 15]. Thus this industry should be classified as regional.

We have then the following list

	<u>National</u>		<u>Regional</u>
1011	Slaughtering, Meat	1012	Poultry Processors
103	Fruit and Vegetable	104	Dairy Products
1071	Biscuits	106	Feed
1081	Confectionery	1072	Bakeries
1089	Miscellaneous Food	1082	Sugar
15	Tobacco Products	1091	Soft Drinks
16	Rubber and Plastic Prods.	1093	Breweries
186,187	Carpets, etc.	25nec	Wood n.e.c.
24	Clothing	273	Paper Box and Bag
26	Furniture and Fixtures	302	Fab. Str. Metal
272,274	Paper n.e.c.	352	Cement
28	Printing, Publishing	354	Concrete Products
30nec	Metal Fabricating	355	Ready-Mix Concrete
324	Truck Body and Trailers	36	Pet., Coal Prods.
33nec	Electrical Products nec.		
35nec	Non-Metallic Mn. Prods. nec.		
37nec	Chemicals n.e.c.		

It should be pointed out that these results are based on 1967 data which may in some cases no longer give a valid picture of interprovincial trade. For example, 324 Truck Body and Trailers has clearly been undergoing structural change recently, due to the growing popularity of campers and mobile homes. The West's share of the output of this industry increased from approximately 28% in 1967 to approximately 40% for 1969 - 71 and then declined to 35% in 1973.

For regional industries, the MTW assumption (section four) is that the increase in demand for the product of a regional industry is proportional to the increase in regional income. This was tested by regressing regional shipments on a constant and regional personal income for the period 1965 - 73.²⁸ Unfortunately, much of the data required was confidential, particularly for those national industries concentrated in Quebec and Ontario.²⁹ The results obtained for those industries classified above as regional were:

SIC Code	Name	West R^2	East R^2
1012	Poultry Processors	.89	.91
104	Dairy Products	.99	.98
106	Feed	.91	.83
1072	Bakeries	.87	.94
1082	Sugar	insufficient data	
1091	Soft Drinks	.98	.99
1093	Breweries	.98	.99
25nec	Wood n.e.c.	.95	.95

273	Paper Box and Bag	.98	.99
302	Fabricated Str. Metal	.57	.61
352	Cement	insufficient data	
354	Concrete Products	.83	.87
355	Ready-Mix Concrete	.91	.87
36	Petroleum, Coal Prods.	insufficient data	

It seems that the MTW assumption does not always or in most cases hold. The industries which have at least one R^2 below .90 appear to fall in this category. 302 Fabricated Structural Metal, 352 Cement, 354 Concrete Products, and 355 Ready-Mix Concrete are linked to the construction industry. 106 Feed Manufacturers, 1072 Bakeries, 1082 Sugar and 36 Petroleum and Coal Products are dependent on the price of a raw material which is set internationally. 1012 Poultry Processors competes with the Meat Processing Industry. Thus in all these cases, there are strong factors other than the current level of regional income which determine output so that the MTW assumption is unreasonable.

It was only possible to look at five national industries.

SIC Code	Name	West R^2	East R^2
1011	Slaughtering, Meat	.96	.89
26	Furniture and Fixtures	.90	.95
28	Printing, Publishing	1.00	.99
30nec	Metal Fabricating n.e.c.	.98	.98
324	Truck Body and Trailers	.99	.91

All that can be deduced from these figures is that 28 Printing, Publishing and Allied and 30 nec Metal Fabricating n.e.c. contain regional subindustries which are not identified by the Standard Industrial Classification.³⁰ This was discussed at the end of section four.

8. Determining the Order of Regional Industries

An industry is regional of order k if it is compatible with the subdivision of order k but not with the subdivision of order $k + 1$. Thus, we continue by determining in sequence which regional industries are compatible with the subdivision of order two, the subdivision of order three and the subdivision of order four. For each region in the subdivision and each industry to be considered, the statistics X/Q and M/C are calculated from the 1967 survey data (where possible). Here X means shipments from the region to other parts of Canada and M means shipments from other parts of Canada into the region. Q means total shipments originating in the region and C total shipments from Canadian sources into the region. For the subdivision of order two, the values of these statistics are given in Table 9.

TABLE IXTrade Ratios for the Subdivision of Order Two⁺

SIC Code	ATL.	QUE.	ONT.	PRAR.	B.C.
1012	.04-.09	.08	.06	.19	.06
	.33-.37	.05	.07	.07	.05
104	.04	.04	.09	.03	.02
	.13	.08	.03	.06	.09

106	.00- .01 .31- .32	.05 .07	.10 .02	.03- .04 .05	.04 .12
1072	.00 .08	.05 .04	.04 .03	.03 .03- .04	.03 .04
1082	n.a.				
1091	0 .19- .20	.09 .09	.15 .06	.05 .09	.00- .01 .16- .17
1093	.00- .06 .02- .05	.03- .04 .02	.01 .03	.02- .06 .00- .03	.00- .01 .00
25nec	.43- .58 .49- .55	.19 .12	.09 .16	.15- .19 .19- .24	.30 .10
273	.00- .02 .51- .71	.28 .13	.12- .13 .14	.03- .09 .23- .34	.07- .21 .09- .12
302	.00 .52- .54	.20 .19	.25 .08	.01- .02 .22- .23	.17- .18 .16
352	0 .07- .09	.11 .01	.00- .09 .06- .08	n.a. n.a.	n.a. n.a.
354	.00 .14	.-0 .01	.02 .04	.00- .01 .02- .03	.00- .01 .10
355	0 0	.02 .01	.01 .01	.02- .04 0	0 .02- .06

36	.00-.06	.17	.07	.10-.14	.01-.02
	.03-.10	.07	.14	.02-.07	.10-.11

+ for each industry, the first line is X/Q and the second M/C.

n.a. data not available

The data again divides these industries into two groups or perhaps into two groups with two intermediate cases 1091 and 36. Industries 1012 Poultry Products, 106 Feed, 25nec Wood n.e.c., 273 Paper Box and Bag and 302 Fabricated Structural Metal all have at least one trade ratio greater than .30 so are not compatible with this subdivision and will be classified as regional industries of order one. 104 Dairy Products, 1072 Bakeries, 1093 Breweries, 352 Cement, 354 Concrete Products, and 355 Ready-Mix Concrete have all trade ratios below .15 and will be assumed to be compatible with the second order subdivision.³¹ .15 has been used as the borderline in the previous section. In any case, the only two ratios close to this borderline are the M/C ratios for the Atlantic Provinces in industries 104 and 354 (.13 and .14 respectively). These figures can be expected to fall however as the Atlantic economy grows. This is apparent from the M/C figures for the larger regions (see p.6). Thus the classification is not that dependant on the specific choice of borderline.

Looking now at 36 Petroleum and Coal Products, the survey data shows that those ratios over .10 are largely composed of a trade flow

from Quebec to Ontario and another flow from Alberta to B.C.. This appears to be border trade (see p.5) caused by the small number of firms in this industry in relation to the size of the market. This industry will be classified as compatible with the second order subdivision on the grounds that border trade can tend to be neglected as far as the classification is concerned.

The other case on which there is data is 1091 Soft Drink Manufacturers. Here about half of the imports of the Atlantic Provinces originate in Ontario and about half of B.C.'s imports come from Ontario and Quebec indicating the existence of national products in this industry. On the other hand, a high R^2 in all regions indicates the presence of a subindustry compatible with the subdivision of order two (perhaps concentrates are national and bottled products are regional). This case is fuzzy then due to a lack of homogeneity with respect to mobility of products. Since I can't make a case for the compatibility of the whole industry with the subdivision of order two, it will be classified as regional of order one.

The case in which there is no data is 1082 Cane and Beet Sugar Processors. In view of the fact that the one sugar refinery in the Atlantic Provinces is a major supplier of refined sugar in both Quebec and Ontario, this industry must be classified as regional of order one, [11]. The classification is thus that 1012 Poultry Products, 106 Feed, 1082 Sugar, 1091 Soft Drinks, 25nec Wood n.e.c., 273 Paper Box and Bag, and 302 Fabricated Structural Metal are regional of order one.

104 Dairy Products, 1072 Bakeries, 1093 Breweries, 352 Cement, 354 Concrete Products, 355 Ready-Mix Concrete and 36 Petroleum and Coal Products are compatible with the order two subdivision.

To test the *MPW* assumption, shipments originating in a region were regressed on a constant and regional personal income for those industries for which the data allowed this. The resulting R^2 are given below.

SIC Code	R^2				
	ATL.	QUE.	ONT.	PRAR.	B.C.
1012	.83	.97	.87	.88	.95
104	.99	.98	.94	.99	.99
106	.82	.85	.81	.90	.97
1072	.94	.97	.83	.93	.72
1091	.95	.98	.99	.96	.99
1093	.95	.98	.93	.95	.96
25nec	.90	.98	.92	.95	.92
354	.91	.76	.88	.70	.91
355	.82	.37	.97	.82	.95

Apart from 1091, two industries 104 and 1093 have high R^2 in all regions. These two are both compatible with the subdivision of order two. The other industries compatible with the second order subdivision do not appear to satisfy the *MPW* assumption. The reasons for this were discussed on page 49 with the exception of 25nec Wood n.e.c.. This industry had an R^2 of .95 for both East and West Regions.

One would expect fluctuations in the price of lumber to have an effect on shipments here as well as links to the construction industry.

Nevertheless we seem to have an example here of how interregional trade can affect R^2 . With respect to the East - West subdivision there was little interregional trade and hence a relatively high R^2 . When interregional trade becomes important with respect to the five region subdivision, some regions then have low R^2 .

Finally the seven industries compatible with the subdivision of order two must be tested for order three compatibility, and those declared compatible of order three tested for order four compatibility. Trade ratios are listed in Table 10 for each of the Prairie and Atlantic Provinces except P.E.I.. The ratios for the other provinces were given in Table 9. It is not necessary to worry about these again as we have already decided that these industries are compatible with Quebec, Ontario and B.C..

The subdivision of order three consists of the Atlantic Region plus the other six provinces. 36 Petroleum and Coal Products is apparently not compatible with this subdivision. For example $X/Q = .24$ for Alberta. Although the survey data is inadequate 352 Cement appears to be incompatible with this subdivision as well. Survey data indicates shipments in this industry into Saskatchewan from both Manitoba and Alberta. There are five cement plants in the Prairies owned by two companies, [10, p.24,26]. Inland Cement Industries has plants in each of the three provinces. Canada Cement Lafarge has plants in all provinces

TABLE XTrade Ratios for Atlantic and Prairie Provinces⁺

SIC Code	NFLD.	N.S.	N.B.	MAN.	SASK.	ALB.
104	.25- .56	.04	.17	.05	.05	.05
	.20- .52	.19	.27	.09	.09	.06
1072	0	.00	.06	.07	.02	.05
	.06	.08	.09	.04	.09	.05
1093	0	n.a.	n.a.	.09	0	.00-.02
	0	n.a.	n.a.	.01	.01	.02-.04
352	n.a.	n.a.	.16-1.00	n.a.	n.a.	n.a.
	n.a.					
354	0	.00-.12	.18	.00	.00	.01
	.00-.26	.27-.36	.16	.07	.05	.02
355	0	.08	0	0	0	.03-.09
	0	0	.00-.13	0	0	0
36	0	n.a.	0	.11	.14	.24
	n.a.	n.a.	n.a.	.15	.14	.07

+ for each industry. the first line is X/Q and the second is M/C.

n.a. data not available

except Saskatchewan and Newfoundland so apparently is involved in all market areas of the country. It appears then that Lafarge competes with Inland in Saskatchewan from its plants in Manitoba and Alberta. Thus 36 Petroleum and Coal Products and 352 Cement should be classified regional of order two.

The remaining five industries are clearly compatible with the order three subdivision. The order four subdivision divides the Atlantic Region into its provinces (excluding P.E.I.). 104 Dairy Products and 354 Concrete Products are not compatible with this subdivision and so are regional of order three while 1072 Bakeries and 355 Ready-Mix Concrete are compatible and so are regional of order four. This leaves 1093 Breweries for which there is no data for Nova Scotia and New Brunswick. Survey data indicates that trade between these two and Quebec is not important,³² and the only other trade is with each other and with P.E.I.. There were five breweries in these two provinces in 1967. Oland's Ltd. and Mosehead Breweries have plants both in Nova Scotia and New Brunswick while the fifth brewery (in Nova Scotia) closed in 1970 (see SC 32-205). Since the two main companies have plants in both provinces, it appears that the plants were producing for provincial markets. Thus, in the absence of other evidence, this industry is classified as regional of the fourth order. This completes the classification - the final list may be found on page 10.

Finally the R^2 obtained for these last two subdivisions were:

SIC Code	R^2					
	NFLD.	N.S.	N.B.	MAN.	SASK.	ALB.
104	.94	.99	.97	.92	.57	.98
1072	.91	.03	.88	.26	.08	.98
1093	n.a.	n.a.	n.a.	.93	.59	.96
354	n.a.	n.a.	n.a.	.58	.01	.74
355	.45	.72	.97	.65	.01	.84

The low figures for Saskatchewan are due to oscillations in the province's personal income caused presumably by good and poor crop years. Otherwise, it appears that 104 Dairy Products and 1093 Breweries still tend to obey the MTW assumption.

9. Conclusions

This study has produced a classification of Canadian manufacturing industry into international, national and regional industries. This classification is based on firmer empirical evidence than has been achieved in other studies. This has been due to the existence of data on interprovincial trade in Canada, the sort of data which was unavailable to other researchers. At the international vs. intranational level it has also been due to the use of the R^2 , obtained from a regression of an industry's output on GNP, as a statistic which may reflect the mobility of the products of the industry.

The examination of the R^2 statistic has also led to certain conclusions about the validity of the MTW assumption. It appears that construction related industries will require some special treatment within the MTW model because the MTW assumption seems to fail here. The MTW assumption may also fail when there are extreme price fluctuations for an industry's output as has recently happened with the Petroleum and Coal Products Industry. The effects of such price changes on the results of the MTW model should be investigated.

The next stage in implementing the MTW model would be to extend the classification to the rest of the economy. Here interprovincial trade figures are not available. Primary industries will mainly be classified as international either because they export their product directly or because their product is the raw material for an export based industry. An example of the second case is Logging whose

output is dependent on the state of the export market for Sawmills and the Pulp and Paper Industry. Many tertiary industries are easily classifiable. For example, Federal Administration is national while Provincial and Local Administration are regional of order four. Others such as Services to Business Management are more difficult to classify. The use of R^2 as done in this thesis may be of some assistance in classifying these cases.

FOOTNOTES

1. A nation means here the union of any group of regions, not necessarily a nation in the political sense.
2. A brief discussion may be found in Isard, [4, pp. 345-349].
3. The data requirements are cost figures expressing the costs of increasing the output of each industry in each region per unit of output. Secondly, ratios between increases in demand and increases in income for each national industry and by region for each regional industry, [9, p.54].
4. Some experiments with these models have been made with respect to Mexico, [1].
5. Statistics Canada 31-504. Hereafter, Statistics Canada is referred to as SC.
6. Primary and tertiary industries have not been examined due to time constraints. Most regional industries are probably found in the tertiary sector.
7. Condition (a) is given to rule out the possibility of there being significant imports (from outside the nation) of the products of this industry.
8. The classification could be applied to commodity classes as well as to industries. This might be better because commodity classes are likely to be more homogeneous with respect to their mobility than the products of an industry. However, no data on interprovincial trade by commodity class is available.
9. The cutoff levels must however still be low. A figure of 10% was kept in mind as being representative of being low.
10. A comparison of the classification obtained here with a classification for the United States may reveal cases where such a change is likely.
11. Electronic components is identified as regional with respect to a subdivision of the U.S. into five regions, the Glass and Glass Products Industry is regional with respect to a subdivision into seven regions.
12. R^2 is defined here as $1 - (SSE/SST)$ which is not the same as SSR/SST because there is no constant term in this regression.

13. Another factor observed in this study was a reliance on raw materials whose prices had drastically fluctuated in world markets. Examples are the Petroleum and Coal Products Industry and Cane and Beet Sugar Processors.
14. Statistics Canada has such a correspondence list but it has not yet been published. My correspondence list was derived by comparing the definitions in the SIC Manual, 1970 Revision (SC 12-501) with the Export and Import Commodity Classifications (SC 12-521 and SC 12-524). While it is probably not exactly the same as the Statistics Canada version, doubtful cases were generally not important classes.
15. Data on shipments by industry group was taken from SC 31-520.
16. According to a Statistics Canada Economic Use Classification (SC 31-001) all these groups contain substantial export based industries.
17. Some runs were made using a shorter period than this, but this didn't appear to improve the ability of the test to distinguish between international and intranational.
18. Monthly data on shipments by industry group was obtained from SC31-001, SC 31-519 and SC 31-520. Quarterly data on GNP was obtained from SC 13-001.
19. This involved, for data prior to 1970, adding shipments for Plastics Fabricators n.e.s. to Rubber Products and subtracting shipments for Linoleum and Coated Fabrics from Textiles. Then Miscellaneous was adjusted by subtracting Plastics Fabricators n.e.s. and adding Linoleum and Coated Fabrics.
20. See SC 32-225, 1969.
21. The price index for both groups remained essentially constant for the period 1966 - 1972 in comparison to the steady rise in the national price index. See SC 62-002.
22. See the general comments in SC 33-203, 1971.
23. See SC32-214, 1968.
24. See SC 32-203, 1973.
25. See SC 32-222 for the time series of cost of raw materials and supplies.
26. These include all shipments originating in Canada, but excludes imports from abroad.

27. 186,187 is also included in this group. The addition of 186 to the figures calculated would apparently substantially increase the EW/WC ratio. 186 comprises about two thirds of the shipments of this subgroup. The only interregional figure available for 186 indicates that B.C. receives half of its shipments from Ontario.
28. Data on annual shipments by industry by province was obtained from SC 31-203, 31-204, 31-205, 31-206 and 31-208. Data on provincial personal income was Statistics Canada data but was obtained from provincial publications. Personal income was used because complete figures on gross provincial products were not available from the same sources. Later a run was made using some GPP estimates derived by D. Maki, [7], but these gave essentially the same results. 1974 data was not obtainable so the period was shifted back one year to 1965 - 1973.
29. In some cases, where there were missing figures, data on shipments was divided between regions on the basis of the number of missing firms in each region. This was only done when the missing data was small compared to the available data for each region, e.g. less than 10%.
30. The 1967 survey data for the individual industries in these groups has been scanned to try and identify any of them which would fall in the regional group. The only one which does is 308 Machine Shops and this was felt to be too small to be worth separating out.
31. Concerning the missing ratios for 352 Cement, one can show with a good deal of certainty that X/Q for B.C. and M/C for the Prairies are less than 10%. The remaining two ratios depend on the extent of shipments from Alberta to B.C.. Since this is probably border trade, these are probably less than 10% also.
32. Shipments from the Maritimes to Quebec form at most 2% of Quebec consumption. Shipments from Quebec to Nova Scotia and New Brunswick forms at most 9% of their consumption and the real figure is probably half of this

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