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INTERDEPENDENCE OF INDUSTRIES AND ECONOMIC DEVELOPMENT:
THE NON-FUEL MINERAL INDUSTRY IN THE CANADIAN CONTEXT

by

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A THESIS

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ABSTRACT

This study ranks a large number of industries in the Canadian economy as to their stimulation of economic development. While a broad cross-section of industries are examined, particular emphasis is placed on the non-fuel mineral industry. The method of analysis is similar to that employed in a number of other studies but differs in that the openness of the Canadian economy to trade is specifically taken into account. The theory employed is based upon interindustry relationships and the primary tool of analysis is the input-output table.

A number of ranking methods are employed and changes in ranking examined. The rankings are repeated removing biases due to trade. The relationship of the non-fuel mineral industries and the industry aggregation are analyzed. The ranking of the individual industries within each non-fuel mineral industry sector is tested for consistency between the level of processing and ranking.

The alternative ranking methods demonstrate variance between and within the sectors of the non-fuel mineral industry. A need is demonstrated for rankings to be based upon highly disaggregated industrial information. It is found that there is a gap between the development stimulative impact of many industries and the domestic fulfillment of that impact; and that there is little relationship between the ranking of industries based upon industrial interrelationships and employment creation.

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CHAPTER I

INTRODUCTION

Utilizing interindustry relationships industries may be ranked in terms of their stimulative impact on economic development.

A.O. Hirschman pioneered this type of analysis through the development of the concepts of backward and forward linkage.⁽¹⁾ A number of empirical studies have ranked and compared these relationships in various countries.⁽²⁾ Several arguments have been put forward claiming the superiority of a total linkage ranking.⁽³⁾

In the present study sixty-six industries in the Canadian economy are ranked as to their ability to stimulate economic development. Several ranking methods are contrasted removing biases due to the openness of the Canadian economy. The components of the non-fuel mineral industry are analyzed in relation to a broad cross-section of Canadian industries. The relationship between the ranking position and level of processing for each component industry is compared.

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1. Albert O. Hirschman, The Strategy of Economic Development, Yale University Press, New Haven, 1958.
 2. Hollis B. Chenery, Tsunehiko Watanabe, "International Comparisons of the Structure of Production", Econometrica, Volume 26, 1958.
 3. Pan A. Yotopoulos, Jeffery B. Nugent, "A Balanced-Growth Version of the Linkage Hypothesis: A Test", Quarterly Journal of Economics, Vol. LXXXVII, May 1973.

THEORETICAL MODEL

The analytical framework employed draws upon the theoretical and empirical works of a number of authors including: A.O. Hirschman, H.B. Chenery and T. Watanabe, P.A. Yotopoulos and J.B. Nugent.

Hirschman⁽¹⁾ defines the shortage of investment decision making ability as the constraining factor to economic development. The development process is similar to the assembly of a jigsaw puzzle. The efficient sequence of assembly depends upon the pieces already in place and the pressures exerted by them.

Each new investment, or piece of the development puzzle, is made easier not only by the number of pieces already in place but also by the type of pressure exerted by them. The two basic types of investment are social overhead capital and directly productive activities. Social overhead capital is characterized as being services provided by the state which are basic to the carrying on of a great variety of economic activities. It is the provision of a wide range of services such as health care, education, highways and port installations, which cannot be imported. These investments cannot be associated with any one specific activity, rather they are diversified investments in the general growth of the economy. Development may take place either by the availability of excess social overhead capital inducing investment in directly productive activities or by directly productive activities inducing investment in overhead capital, if it is in short supply.⁽²⁾

1. A.O. Hirschman, op. cit., p. 81.

2. A.O. Hirschman. op. cit., p. 88.

Directly productive activities are any type of industry which utilizes primary inputs in combination with non-primary inputs in the production of commodities or services. Industries exert pressures which induce investment in other industries. The pressures exerted by the industries in an economy are backward and forward linkages. Backward linkage is the measure of the stimulation of the industries in an economy caused by any non-primary activity, inducing attempts to supply through domestic production, the inputs needed in that activity. Backward linkage is a measure of derived demand. Forward linkage is the measure of the stimulation of industries in an economy to utilize the domestic production of an activity as an input, rather than that production flowing to final demand. Forward linkage is a measure of output utilization.

The nature, size and interaction of these linkages at any point in time to a large degree act to direct both the direction and speed of economic development. The pressure exerted by an industry's backward linkage is on other industries in the economy to provide its non-primary inputs. As such backward linkage is a source of demand for the output of other industries and provides a stimulus to invest in those industries. The greater the demand by an industry for the output of other industries, the greater the stimulus to invest in those industries. Hirschman considers the pressure of demand to be a much more powerful stimulus than that of forward linkage.⁽³⁾ Forward linkage is the pressure of output utilization which is not an independent inducement mechanism; it is a powerful reinforcement of backward linkage. The domestic availability

3. A.O. Hirschman, op. cit., p. 116.

of the non-primary inputs of any industry provides a stimulus to invest in that industry, however, there must be a demand for the industry's output.

This study is concerned with the ranking of industries in the Canadian economy as to their stimulation of economic development. Given this orientation and the fact that social overhead capital cannot be associated with any one directly productive activity, the analysis is based upon the inducement of investment in industries caused by other industries.

Investment decisions that are taken as a result of both backward and forward linkages are particularly easy to take, since they are caught in a pincer movement of availability of non-primary inputs and demand for outputs. Industries may be ranked as to their stimulation of economic development utilizing the values of their linkages. The type of industry which has the greatest development stimulus, and consequently the highest ranking, is one which has high backward and forward linkages.

Employing the linkage concepts, Chenery and Watanabe analyzed the interdependence of industries in a number of countries.⁽⁴⁾ They utilized input-output tables and the relative importance of forward and backward linkages to rank the interdependence of industries in a four way classification. Industries with high values for both linkages were given the highest ranking and those with low values for each linkage the lowest. Given the relative importance of the two linkages; industries with high backward and low forward linkages were ranked above those with the

4. H.B. Chenery, T. Watanabe, op. cit., p. 492.

opposite characteristics. The ranking of industries based upon this linkage relationship is referred to as the combined linkage ranking. The findings of Chenery and Watanabe indicate a natural hierarchy of sectors uniform in each country analyzed, corresponding closely with levels of processing.

Using the same criteria the industries within each of the four classes were ranked. The complete ranking then enabled Hirschman to assign priorities to specific industries in the development process.

Yotopoulos and Nugent suggest that a superior ranking to that of combined linkages is a ranking of total linkages.⁽⁵⁾ The total linkage of an industry measures the total output induced in the economy by the output of any one specific industry. This linkage measure is superior in that it captures both the direct and indirect output induced; in so doing it measures not only the total impact of backward linkage but to some degree forward linkages. It also permits cardinal measurement as opposed to the ordinal measurement of the combined linkages. Also defined is the employment linkage effect. The value of this linkage measures the effect on total employment, both direct and indirect, of a unit output of an industry. This linkage effect is of interest if the impact of an industry's production on the specific primary factor of labour is of particular concern.

This study evaluates the combined linkage ranking, total linkage and employment linkage rankings for a number of industries in the Canadian economy. Both the combined and total linkages are ranked,

5. P.A. Yotopoulos, J.B. Nugent, Economics of Development Empirical Investigations, Harper and Row, New York, 1972, p. 299.

notwithstanding the claimed superiority of the total linkage. The total linkage is derived from the input-output inverse table and as such depends upon the inputs of all industries. It is therefore difficult to isolate differences associated with particular industries. The values of imports and exports by industry are adjusted so as to take into account the openness of the Canadian economy and the linkages again ranked. The rankings are compared with each other so as to see if the results of the various ranking methods differ significantly or if the treatment of trade alters the conclusion. The mineral industry, which is neatly broken into stages of processing, is analyzed.

CHAPTER III

METHODOLOGY

The 1971 Canadian national input-output tables, as developed by Statistics Canada, are the primary tools of analysis.⁽¹⁾ These very large tables are rectangular rather than of the more traditional square configuration. The 191 industries and 587 commodities have been reduced to 66 and 137 respectively for the present analysis. The aggregation appears as an appendix. The two key assumptions normally associated with input-output analysis are required:

- 1) The industry technology assumption requires that each industry utilizes commodity and primary factor inputs in fixed proportions. The proportions are common for each commodity produced by the industry.

$$u_{ij} = b_{ij} g_j$$

the input of the i th commodity into the j th industry, u_{ij} , is a proportion b_{ij} of the output of the j th industry g_j

where $i = 1, \dots, 137$

$j = 1, \dots, 66$

$$y_{kj} = h_{kj} g_j$$

the input of the k th primary input into the j th industry, y_{kj} , is a proportion, h_{kj} , of the output of the j th industry g_j

where $k = 1, \dots, 5$.

1. Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy, 1961, The Queen's Printer, Ottawa, 1969. This publication defines the concepts and methodology utilized in the 1971 tables.

ii) The market share assumption requires that the demand for domestically produced commodities is allocated among industries according to fixed market shares and that imports of each commodity are proportional to domestic use of the commodity.

$$v_{ji} = d_{ji} \cdot q_i$$

the j th industry's output of the i th commodity, v_{ji} , is a fixed share, d_{ji} , of the total amount of the i th commodity produced in domestic industries q_i .

$$m_i = \nu_i \left(\sum_j u_{ij} + \sum_{il} f_{il} \right)$$

the imports of the i th commodity, m_i , are a fixed proportion, ν_i , of intermediate demand for the i th commodity in all industries, $\sum_j u_{ij}$, plus the domestic final demand for the i th commodity, $\sum_{il} f_{il}$.

Domestic final demand includes: personal consumption, change in inventory, investment, and government purchases. Total final demand includes domestic final demand and exports.

The technology assumption rules out the possibility of either economies of scale or capacity limits. Implicit in the market share assumption is that exports of any commodity are produced by domestic industries, although imported commodities may be indirectly embodied.

in exports to the extent that producing industries import their intermediate inputs.

The forward and backward linkages are derived from two empirical tables which form the basis of the input-output inverse table. Both tables demonstrate the interrelationships of commodities and industries. To evaluate the backward and forward linkages it is necessary to square the two tables, that is to have an equivalent number of industries and commodities. There is little difficulty in accomplishing this in that the 66 x 137 aggregation was developed so as to allow squaring to take place. In the majority of cases each commodity is produced by only one industry and in all of the other cases there is an industry which clearly is the major producer. The squaring of the two tables produces 66 x 66 tables from which forward and backward linkages are derived.

Forward linkage is derived from the "disposition by commodity" table. This table shows the disposition of the total availability of each commodity, whether the source is domestic or foreign. The commodity is sold either to industries as intermediate inputs or to final demand. Forward linkage is the proportion of the total disposition of each commodity which is sold by domestic producers to industries as intermediate inputs.

$$q_i + m_i = \sum_j u_{ij} + \sum_i^{-f} \mu_{i1} + x_i$$

where x_i is the value of commodity i exported

$$L_i^f = \frac{\sum_j u_{ij} - \sum_j \mu_i u_{ij}}{q_i + m_i}$$

where L_i^f is the forward linkage of commodity i produced by industry j

$$i = 1, \text{ --- } 66$$

$$j = 1, \text{ --- } 66$$

Since there is a direct one to one relationship between industries and commodities, the forward linkage of a commodity is that of the corresponding industry.

The backward linkage is derived from the "intermediate use of goods and services" table. This table shows the use by industry of commodities as intermediate inputs, as well as each industry's use of primary inputs. Primary inputs are from domestic sources whereas intermediate inputs are from both imports and domestic producers.

$$g_j = \sum_i u_{ij} + \sum_k v_{kj}$$

$$L_j^b = \frac{\sum_i u_{ij} - \sum_i \mu_i u_{ij}}{g_j}$$

The backward linkage of any industry, L_j^b , is the proportion of the total input requirement of that industry which is purchased from domestic industries.

Total linkage is derived from the inverse table. The mathematical expression of the inverse table as developed by Statistics Canada (2) is

$$[I - D (I - \hat{A} - \hat{G} - \hat{B})^{-1} B] \bar{D} e$$

- I is the identity matrix.
- D is the domestic market share matrix.
- B is the industry technology matrix.
- \hat{A} is a diagonal matrix whose elements are the ratio of imports to use
- \hat{G} is a diagonal matrix whose elements are the ratio of government production to use.
- \hat{B} is a diagonal matrix whose elements are the ratio of inventory withdrawals to use.
- \bar{D} is a matrix which converts demands specified in the commodity space into demands specified in the industry space.
- e is a final demand specified in the commodity space.

The present study is concerned with the impact of industrial production, as a result, \hat{A} and \hat{B} are given null values. Final demand, e, is specified as a domestic demand of one million dollars of each of the 137 commodities, resulting in 137 separate runs of the model. The model indicates the gross domestic output induced directly and indirectly in each industry resulting from the final demand. Since there is a correlation between industries and commodities, the solutions give the total domestic output resulting from the production by each industry, on

2. Dominion Bureau of Statistics, op. cit., p. 151

all industries, of one million dollars of output. This value is the total linkage.

The total employment linkage is also derived from the inverse table. Independently of the input-output tables, the job output ratio by industry is calculated. That ratio when multiplied by the output induced in each industry, due to the final demand for each commodity, evaluates the number of man years of employment induced in each industry. The sum, over all industries, of the number of man years generated is the employment linkage.

CHAPTER IV

EMPIRICAL RESULTS

Combined Linkage Ranking

A two-way classification is utilized to assign the sixty-six industries to the four quadrants. The assignment is made based upon whether the value of each industry's forward and backward linkage is above or below the mean value of each linkage for all industries. The mean value of backward linkage is 42.99 per cent and that of forward linkage 51.00 per cent. Quadrant II, therefore, represents industries with both linkage values above the mean; Quadrant IV represents industries with both linkage values below the mean and Quadrant III those industries with only backward linkage values above the mean and Quadrant I only forward linkage values. Utilizing the same classification criteria and a number of iterations the industries assigned to each quadrant are ranked. The result, Table 1, is a first to sixty-sixth ranking of the industries as to development stimulation. Since this ranking is based upon the linkage relationships as they actually existed in 1971, it is referred to as the actual combined linkage ranking.

Quadrants I, II, and III should, due to the nature of the linkages, correspond to successive stages of processing. Quadrant I is referred to as Intermediate Primary Production, the industries are characterized by a low proportion of nonprimary inputs to the value of production and by a large proportion of output going to other industries. The various mining industries fit this definition. Quadrant II is referred to as Intermediate Manufacture, the industries are characterized by a high proportion of nonprimary inputs to the value of production and by a large proportion of output going to other industries. The casting, rolling, and extrusion of metals

industries fit this definition. Quadrant III is referred to as 'Final Manufacture, the industries are characterized by a high proportion of nonprimary inputs to the value of production and only a small proportion of output going to other industries, as final demand is high. The machinery and equipment industries fit this definition. The fourth quadrant, final primary production, contains industries which are relatively independent of other industries, providing a direct link between final demand and primary producers. Hereafter, the relationship between the rank of each industry and its correspondence with the relative rank of industries of higher or lower levels of processing, is referred to as the concept of successive stages of processing.

To a large extent Table 1 does not show this relationship. Quadrant II, with 19 top ranking industries comes closest to demonstrating the successive stage relationship. The majority of the top 19 industries are semi-manufactured products of the mineral and forestry industries, and as such are the intermediate stage of production. Also included in Quadrant II are a number of final demand goods which by definition are expected to be in Quadrant III, namely Heating Equipment, Concrete Products, Batteries and Other Petroleum and Coal Products. The Forestry industry is a primary or Stage I producer and would be expected to appear in Quadrant I.

Similar results are found in Quadrant III with the majority of industries being of the final demand type, but with a number of industries seemingly out of place. The Pulp and Paper as well as the Other Smelting and Refining industries are the first step of processing

the output of the primary forestry and mining industries respectively. They are more closely associated with intermediate manufacturing than with final demand and should therefore be expected to be in Quadrant II. Iron Mines is a primary industry and is expected to appear in Quadrant I.

In terms of the successive stages, Quadrant I should and does contain primary industries such as Agriculture and Fishing, Base Metal and Other Metal Mines, and Quarries and Sand Pits. These industries all produce primary products with relatively few non-primary inputs and their outputs require processing before final use. The majority of industries appearing in this Quadrant do not, however, correspond to this category. Industries such as Iron and Steel, Iron Foundries, Boiler and Plate Works, as well as a number of non-metallic mineral products, produce intermediate manufactures and as such should be in Quadrant II. The service and transportation industries are final demand oriented and consequently should be in Quadrant IV.

Quadrant IV, illustrating both low backward and forward linkages, shows some expected results with Miscellaneous Services and Operating Costs, Pipeline Transportation and Electric Power ranking near the bottom but again most of the other industries appear to be out of place. Mining industries such as Coal, Asbestos, Uranium and Gold, as primary intermediate producers should appear in Quadrant I. Final demand manufacturers such as Appliances and Communications, Miscellaneous Machinery and Equipment and Miscellaneous Transportation Equipment should be in Quadrant III. Aluminum Smelting and Refining should appear in Quadrant II.

In general, the ranking roughly corresponds with the concept of successive stages of processing. There are, however, a large number of industries apparently out of place. A number of mineral industries appear out of place and there is great variance in the ranking positions of industries of similar processing levels.

Total Linkage Ranking

The values of total linkage for the sixty-six industries are listed and ranked on Table 2. The top-ranking industry is Copper and Alloy Rolling, Casting, Extruding. A demand for the output of this industry results in a gross domestic output, both directly and indirectly, in the domestic economy of 2.506 times the value of the demand. The average value of the total linkage is 1.818 and the average difference between ranking positions is .019. The difference in value between consecutive ranking positions tends to be highest at the extremes and less than average for most of the industries.

The ranking by total linkage is comparable to that of combined linkage in that, with a number of exceptions, industries of the intermediate manufacture type rank highest and those of the final primary production type rank lowest. The Spearman rank order correlation between the two rankings is a significant (1) .7997. The correlation demonstrates a high correspondence between the two rankings but that there are a number of differences. The industries which appeared higher than expected in Quadrant II of the combined linkage all dropped in the ranking. The most significant declines are other Petroleum and Coal Products which drops from third place in the combined linkage ranking to eighteenth place in the total linkage ranking. Forestry dropping from twelfth to twenty-seventh and Concrete Products from

1. In all cases where this correlation is used throughout the paper the level of significance is .001.

Table 2

Actual Total And Actual Employment
Linkage Rankings

| Rank | Ind. No. | INDUSTRY | L ^c | Rank | Ind. No. | INDUSTRY | L ^c |
|------|----------|-------------------------------|----------------|------|----------|-------------------------------|----------------|
| 1 | 31 | Copper & Alloy R.C. & Ext. | 2.506 | 1 | 75 | Prof. Services to Business | 148.21 |
| 2 | 15 | Food Processing | 2,260 | 2 | 1 | Agriculture & Fishing | 143.63 |
| 3 | 47 | Electric Wire and Cable | 2.190 | 3 | 7 | Coal Mines | 119.37 |
| 4 | 51 | Ready-Mix Concrete | 2.176 | 4 | 15 | Food Processing | 98.49 |
| 5 | 19 | Misc. Wood Industries | 2.157 | 5 | 71 | Railway Transport | 98.19 |
| 6 | 29 | Other Smelting & Refining | 2.130 | 6 | 19 | Misc. Wood Industries | 94.55 |
| 7 | 26 | Steel Pipe & Tube Mills | 2.090 | 7 | 52 | Clay Products Mfgs. | 92.10 |
| 8 | 23 | Other Paper Products | 2.089 | 8 | 54 | Stone Products Mfgs. | 91.21 |
| 9 | 21 | Pulp and Paper | 2.058 | 9 | 73 | Misc. Serv. & Operating Costs | 90.56 |
| 10 | 49 | Lime | 2.053 | 10 | 66 | Repair Construction | 89.31 |
| 11 | 30 | Aluminum R.C. and Ext. | 2.045 | 11 | 2 | Forestry | 88.84 |
| 12 | 32 | Metal Cast, Roll, & Ext. | 2.006 | 12 | 3 | Gold Mines | 83.14 |
| 13 | 36 | Metal Stamp. Press. & Coat. | 2.002 | 13 | 38 | Hardware, Tool & Cutlery | 80.12 |
| 14 | 37 | Wire & Wire Products | 1.969 | 14 | 68 | Non-Residential Construction | 79.99 |
| 15 | 3 | Gold Mines | 1.947 | 15 | 35 | Ornamental & Arch. Metal | 78.33 |
| 16 | 35 | Ornamental & Arch. Metal | 1.937 | 16 | 23 | Other Paper Products | 77.91 |
| 17 | 39 | Heating Equip. Mfgs. | 1.936 | 17 | 45 | Mfgs. of Elect. Ind. Equip. | 77.59 |
| 18 | 59 | Other Petroleum & Coal Prod. | 1.928 | 18 | 44 | Appliances & Communications | 77.06 |
| 19 | 46 | Battery Mfgs. | 1.924 | 19 | 40 | Machine Shops | 76.42 |
| 20 | 67 | Residential Construction | 1.920 | 20 | 64 | Scient. & Prof. Equip. Mfgs. | 75.95 |
| 21 | 62 | Mfgs. of Ind. Chemicals | 1.907 | 21 | 50 | Concrete Prod. Mfgs. | 75.72 |
| 22 | 5 | Iron Mines | 1.897 | 22 | 49 | Lime Mfgs. | 75.12 |
| 23 | 69 | Other Construction | 1.875 | 23 | 27 | Iron Foundries | 75.06 |
| 24 | 41 | Misc. Metal Fabricating | 1.874 | 24 | 39 | Heating Equip. Mfgs. | 73.15 |
| 25 | 50 | Concrete Prod. Mfgs. | 1.870 | 25 | 41 | Misc. Metal Fab. | 72.87 |
| 26 | 68 | Non-Residential Construction | 1.868 | 26 | 69 | Other Construction | 72.58 |
| 27 | 2 | Forestry | 1.860 | 27 | 67 | Residential Construction | 72.53 |
| 28 | 54 | Stone Products Mfgs. | 1.858 | 28 | 46 | Battery Mfgs. | 71.61 |
| 29 | 58 | Petroleum Refineries | 1.851 | 29 | 14 | Services Incidental to Mining | 70.94 |
| 30 | 7 | Coal Mines | 1.843 | 30 | 33 | Boiler & Plate Works | 70.88 |
| 31 | 38 | Hardware, Tool & Cutlery | 1.838 | 31 | 42 | Misc. Machinery & Equip. | 70.49 |
| 32 | 40 | Machine Shops | 1.826 | 32 | 36 | Metal Stamp. Press. & Coat. | 70.19 |
| 33 | 55 | Other Non-Metallic Prod. Ind. | 1.817 | 33 | 37 | Wire & Wire Products | 69.72 |
| 34 | 52 | Clay Products Mfgs. | 1.806 | 34 | 12 | Other Non-Metal Mines | 67.17 |
| 35 | 4 | Uranium Mines | 1.805 | 35 | 51 | Ready-Mix Concrete | 69.12 |
| 36 | 25 | Iron & Steel Industry | 1.803 | 36 | 21 | Pulp and Paper | 68.99 |
| 37 | 33 | Boiler & Plate Works | 1.792 | 37 | 56 | Glass & Glass Prod. Mfgs. | 68.45 |
| 38 | 45 | Mfgs. of Elect. Ind. Equip. | 1.792 | 38 | 57 | Abrasive Mfgs. | 66.64 |
| 39 | 42 | Misc. Mach. & Equip. | 1.791 | 39 | 13 | Quarries & Sand Pits | 66.42 |
| 40 | 1 | Agriculture & Fishing | 1.788 | 40 | 34 | Fabricated Struct. Met. Ind. | 66.15 |
| 41 | 34 | Fabric. Struct. Metal Ind. | 1.787 | 41 | 70 | Water, Air & Other Transp. | 65.05 |
| 42 | 57 | Abrasive Mfgs. | 1.777 | 42 | 10 | Gypsum Mines | 63.24 |
| 43 | 48 | Cement Mfgs. | 1.765 | 43 | 11 | Salt Mines | 60.62 |
| 44 | 27 | Iron Foundries | 1.739 | 44 | 30 | Aluminum, R.C. & Ext. | 59.62 |
| 45 | 44 | Appliances & Communications | 1.735 | 45 | 32 | Metal Cast. Roll. & Ext. | 58.92 |
| 46 | 60 | Mfgs. of Mixed Fertilizers | 1.733 | 46 | 9 | Asbestos Mines | 58.49 |
| 47 | 53 | Refractories Mfgs. | 1.716 | 47 | 26 | Steel Pipe & Tube Mills | 57.49 |
| 48 | 11 | Salt Mines | 1.714 | 48 | 53 | Refractories Mfgs. | 56.56 |
| 49 | 70 | Water, Air & Other Transp. | 1.708 | 49 | 25 | Iron & Steel Industry | 55.76 |
| 50 | 9 | Asbestos Mines | 1.696 | 50 | 62 | Mfgs. of Ind. Chemicals | 55.02 |
| 51 | 64 | Scient. & Prof. Equip. Mfgs. | 1.695 | 51 | 31 | Copper & Alloy R.C. & Ext. | 54.18 |
| 52 | 43 | Misc. Transportation Equip. | 1.695 | 52 | 4 | Uranium Mines | 53.18 |
| 53 | 13 | Quarries and Sand Pits | 1.670 | 53 | 47 | Electric Wire & Cable | 52.94 |
| 54 | 66 | Repair Construction | 1.669 | 54 | 5 | Iron Mines | 52.66 |
| 55 | 56 | Glass & Glass Prod. Mfgs. | 1.617 | 55 | 60 | Mfgs. of Mixed Fertilizers | 52.13 |
| 56 | 14 | Services Inc. to Mining | 1.549 | 56 | 43 | Misc. Transportation Equip. | 50.85 |
| 57 | 8 | Petroleum & Gas Wells | 1.541 | 57 | 48 | Cement Mfgs. | 49.45 |
| 58 | 28 | Aluminum Smelting & Refining | 1.536 | 58 | 29 | Other Smelting & Refining | 49.12 |
| 59 | 6 | Base Metal & Other Met. Mines | 1.536 | 59 | 12 | Other Non-Metal Mines | 47.17 |
| 60 | 73 | Misc. Serv. & Operating Costs | 1.529 | 60 | 6 | Base Metal & Other Met. Mines | 46.22 |
| 61 | 71 | Railway Transport | 1.517 | 61 | 59 | Other petroleum & Coal Prod. | 41.23 |
| 62 | 10 | Gypsum Mines | 1.515 | 62 | 28 | Aluminum Smelt. & Refining | 39.81 |
| 63 | 12 | Other Non-Metal Mines | 1.467 | 63 | 74 | Electric Power | 31.39 |
| 64 | 72 | Pipeline Transport | 1.377 | 64 | 8 | Petroleum & Gas Wells | 30.08 |
| 65 | 75 | Prof. Services to Business | 1.334 | 65 | 58 | Petroleum Refineries | 29.45 |
| 66 | 74 | Electric Power | 1.261 | 66 | 72 | Pipeline Transport | 19.66 |

thirteenth to twenty-fifth.

Three industries which were assigned to Quadrant III in the combined linkage ranking increase their position. Pulp and Paper and Other Smelting and Refining were identified as intermediate manufacture type industries which appeared out of place in the initial ranking; they have improved in ranking from twenty-second to ninth and from twenty-third to sixth respectively.

The most obvious change is the increase in ranking of Food Processing from twenty-first to second. This change demonstrates the predominance of backward linkage effects over forward linkage effects in the measurement of total linkage. This industry notwithstanding, the ranking results in conclusions similar to those of the combined linkage ranking. The greatest development stimulus is derived from the intermediate manufacture type industries, particularly those of the mineral and forestry industries. The least development stimulus is derived from final primary production.

As was the case in the initial ranking there are a number of industries of very similar type, such as the various mining industries, which have great variance as to ranking position.

Employment Linkage Ranking

The values of employment linkage for the sixty-six industries are listed and ranked on Table 2. The top ranking industry is Professional Services to Business. A demand of one million dollars for the output of this industry results directly and indirectly in a requirement of 148.21

man years of labour in the domestic economy. The average value of employment linkage is 69.20 and the average difference in value between consecutive ranking positions is 1.98. The difference in value between consecutive ranking positions tends to be highest at the ranking extremes and less than average for most of the industries.

There is very little similarity between the employment linkage ranking and that of combined linkage or total linkage. The Spearman rank order correlation between the employment and combined linkage rankings is .0669 and between employment and total linkage ranking .1525. The only industry which consistently ranks high in all three rankings is Miscellaneous Wood Industries. Otherwise, there does not appear to be a pattern relating the first two rankings with the employment ranking.

The type of industry which ranks high or low in terms of combined or total linkage ranking does not correspond with similar ranking levels of employment linkages. Those industries which are most stimulative to economic development under the criteria of combined or total linkages are generally not the most stimulative in terms of employment.

Potential Linkage Rankings

The fact that the combined actual linkage and total linkage rankings only loosely correspond to the successive stage concept, and that there is great variance between the rankings of similar industries, may be partially explained by the treatment of imports. The importation of intermediate goods is considered a linkage from the domestic economy. The values of both the backward and forward linkages are reduced by the

value of imports as are the total and employment linkages. This is especially true for certain industries whose intermediate inputs come from non-competing imports. Aluminum Smelting and Refining is a good example, appearing very low in the actual rankings due to the high level of imports of bauxite and alumina for which there is no economic Canadian source. This study is analyzing the stimulative effect of industries in the Canadian economy on that economy. The fact that a portion of the linkages at any point in time is lost to foreign markets biases the results. The rankings are intended to show the stimulus on economic development, not whether that stimulus is being acted upon.

The existence of gaps between the potential values of linkages and the actual values of those linkages, in any country at a particular point in time, is not necessarily a sign of poor economic performance. A number of factors mitigate against the domestic fulfillment of linkages including: factor endowment, economies of scale, industrial organization and trade barriers. (2)

Given the "industry technology assumption" and the "industry market share assumption" the import coefficients are manipulated so as to simulate the domestic production of all intermediate goods. The value of the imports of intermediate inputs is adjusted to zero.

$$\sum_i \mu_i u_{ij} = 0$$

2. Donald J. McCulla; John E. Stahl, Quantitative Impact of Minerals on Canadian Economic Development: A Partial Analysis, Mineral Bulletin MR 173, Ministry of Supply and Services Canada, Ottawa, 1977, p.7.

All linkages are revalued with the import adjustment and are referred to as potential linkages of each type as apposed to the earlier rankings which are referred to as actual.

Potential Combined Linkage Ranking

The potential backward linkage, L_j^{bp} , is the portion of total inputs into each industry purchased from industries. The potential forward linkage, L_i^{fp} , is the portion of the total disposition of each commodity which is sold to industries as intermediate inputs.

$$L_j^{bp} = \frac{\sum_i u_{ij}}{g_j}$$

$$L_i^{fp} = \frac{\sum_j u_{ij}}{q_i + m_i}$$

These linkages are evaluated and ranked utilizing the same criteria as used for the actual linkages. The mean value of the potential backward linkage is 50.76 per cent and the mean value of the potential forward linkage is 63.47 per cent. Both of these values are considerably higher than those of the actual ranking.

The potential ranking shown in Table 3 more closely corresponds to the concept of successive stages than does the actual ranking, although exceptions do once again appear. Changes in the ranking are all in the anticipated direction verifying the removal of the importation bias exhibited in the actual ranking.

Quadrant II, again contains 19 industries most of which produce intermediate manufacture products. Some final demand commodities such as Heating Equipment and Battery Manufacturers are still included in this quadrant, however Forestry, a primary producer has moved to Quadrant I, where it is expected to appear.

Final demand manufacturers such as Appliances and Communications, Miscellaneous Transportation Equipment and Miscellaneous Machinery and Equipment have moved from Quadrant IV to Quadrant III.

Quadrant IV has lost six industries in the potential ranking. Petroleum and Gas Wells, Gold, Gypsum and Coal Mines all primary producers, have moved to Quadrant I. The overall potential ranking shows the top ten industries to be producers of semi-fabricated mineral products, illustrating the high development stimulus of these industries.

Potential Total Linkage

Table 4 shows the ranking of the 66 industries in terms of the potential total linkage. These values are developed from an additional 137 runs of the input-output model with no imports allowed. The average value of the total linkage is 2.140 and the average difference between ranking positions is .024. In comparison with the potential combined linkage ranking there are few changes. The Spearman rank order correlation is high at .8216. Gold Mines move from last position in the combined linkage ranking to twenty-fifth in the total linkage ranking and Miscellaneous Transportation Equipment moves up from twenty-fifth to third position. Semi-fabricated products still dominate the top positions, while primary resource and service industries remain near the bottom.

Table 4

Potential Total and Potential Employment
Linkage Rankings

| Rank | Ind. No. | INDUSTRY | L ^{TP} | Rank | Ind. No. | INDUSTRY | L ^{EP} |
|------|----------|-------------------------------|-----------------|------|----------|-------------------------------|-----------------|
| 1 | 31 | Copper & Alloy R.C. & Ext. | 2.906 | 1 | 75 | Prof. Serv. to Business | 151.73 |
| 2 | 47 | Electric Wire & Cable | 2.678 | 2 | 1 | Agriculture & Fishing | 151.72 |
| 3 | 43 | Misc. Transportation Equip. | 2.578 | 3 | 7 | Coal Mines | 130.33 |
| 4 | 30 | Aluminum R.C. & Ext. | 2.574 | 4 | 15 | Food Processing | 109.93 |
| 5 | 26 | Steel Pipe & Tube Mills | 2.549 | 5 | 19 | Misc. Wood Industries | 103.62 |
| 6 | 15 | Food Processing | 2.512 | 6 | 71 | Railway Transport | 102.46 |
| 7 | 32 | Metal Cast. Roll. & Ext. | 2.487 | 7 | 52 | Clay Products Mfgs. | 100.73 |
| 8 | 59 | Other Petroleum & Coal Prod. | 2.483 | 8 | 54 | Stone Products Mfgs. | 98.64 |
| 9 | 58 | Petroleum Refineries | 2.464 | 9 | 66 | Repair Construction | 97.22 |
| 10 | 23 | Other Paper Products | 2.388 | 10 | 2 | Forestry | 95.45 |
| 11 | 19 | Misc. Wood Industries | 2.386 | 11 | 73 | Misc. Serv. & Oper. Costs | 95.29 |
| 12 | 46 | Battery Mfgs. | 2.384 | 12 | 38 | Hardware, Tool & Cutlery | 94.40 |
| 13 | 36 | Metal Stamp. Press & Coat. | 2.370 | 13 | 3 | Gold Mines | 93.69 |
| 14 | 39 | Heating Equipment Mfgs. | 2.368 | 14 | 35 | Ornamental & Arch. Met. Ind. | 92.95 |
| 15 | 51 | Ready-Mix Concrete | 2.366 | 15 | 44 | Appliances, & Communications | 92.79 |
| 16 | 29 | Other Smelting & Refining | 2.362 | 16 | 45 | Mfgs. Elect. Ind. Equip. | 92.22 |
| 17 | 35 | Ornamental & Arch. Metal Ind. | 2.341 | 17 | 68 | Non-Residential Construction | 92.09 |
| 18 | 37 | Wire & Wire Products | 2.323 | 18 | 64 | Scient. & Prof. Equip. Mfgs. | 90.89 |
| 19 | 49 | Lime | 2.315 | 19 | 40 | Machine Shops | 90.04 |
| 20 | 57 | Abrasive Mfgs. | 2.291 | 20 | 39 | Heating Equip. Mfgs. | 89.53 |
| 21 | 21 | Pulp and Paper | 2.284 | 21 | 23 | Other Paper Prod. | 88.76 |
| 22 | 41 | Misc. Metal Fab. | 2.269 | 22 | 27 | Iron Foundries | 88.44 |
| 23 | 62 | Mfgs. of Ind. Chemicals | 2.256 | 23 | 42 | Misc. Mach. & Equip. | 88.10 |
| 24 | 42 | Misc. Machinery & Equip. | 2.256 | 24 | 46 | Battery Mfgs. | 87.73 |
| 25 | 3 | Gold Mines | 2.233 | 25 | 41 | Misc. Metal Fab. | 87.55 |
| 26 | 38 | Hardware, Tool & Cutlery | 2.207 | 26 | 49 | Lime | 86.07 |
| 27 | 25 | Iron & Steel Industry | 2.205 | 27 | 33 | Boiler & Plate Works | 86.00 |
| 28 | 67 | Residential Construction | 2.198 | 28 | 36 | Metal Stamp. Press & Coat. | 83.94 |
| 29 | 28 | Aluminum Smelting & Refining | 2.192 | 29 | 57 | Abrasive Mfgs. | 83.87 |
| 30 | 40 | Machine Shops | 2.184 | 30 | 67 | Residential Construction | 83.54 |
| 31 | 33 | Boiler & Plate Works | 2.181 | 31 | 69 | Other Construction | 83.16 |
| 32 | 68 | Non-Residential Construction | 2.172 | 32 | 50 | Concrete Prod. Mfgs. | 83.13 |
| 33 | 45 | Mfgs. Elect. Ind. Equip. | 2.169 | 33 | 37 | Wire & Wire Products | 82.69 |
| 34 | 34 | Fab. Struct. Metal Ind. | 2.154 | 34 | 43 | Misc. Transp. Equip. | 82.42 |
| 35 | 69 | Other Construction | 2.136 | 35 | 56 | Glass & Glass Prod. Mfgs. | 79.19 |
| 36 | 5 | Iron Mines | 2.136 | 36 | 34 | Fab. Struct. Metal Ind. | 78.83 |
| 37 | 27 | Iron Foundries | 2.134 | 37 | 55 | Other Non-Metallic Prod. Ind. | 77.87 |
| 38 | 7 | Coal Mines | 2.124 | 38 | 32 | Metal Cast. Roll. & Ext. | 77.61 |
| 39 | 44 | Appliances & Communications | 2.120 | 39 | 21 | Pulp & Paper | 77.33 |
| 40 | 53 | Refractories Mfgs. | 2.097 | 40 | 14 | Serv. Incidental to Mining | 76.85 |
| 41 | 64 | Scient. & Prof. Equip. Mfgs. | 2.073 | 41 | 30 | Aluminum R.C. & Ext. | 76.36 |
| 42 | 50 | Concrete Prod. Mfgs. | 2.059 | 42 | 51 | Ready-Mix Concrete | 76.22 |
| 43 | 54 | Stone Products Mfgs. | 2.054 | 43 | 26 | Steel Pipe & Tube Mills | 75.01 |
| 44 | 55 | Other Non-Metallic Prod. Ind. | 2.054 | 44 | 13 | Quarries & Sand Pits | 72.96 |
| 45 | 52 | Clay Products Mfgs. | 2.038 | 45 | 25 | Iron & Steel Mills | 72.54 |
| 46 | 2 | Forestry | 2.036 | 46 | 70 | Water, Air & Other Transp. | 71.99 |
| 47 | 4 | Uranium Mines | 2.024 | 47 | 10 | Gypsum Mines | 71.35 |
| 48 | 1 | Agriculture & Fishing | 2.006 | 48 | 53 | Refractories Mfgs. | 70.43 |
| 49 | 48 | Cement Mfgs. | 1.949 | 49 | 47 | Electric Wire & Cable | 68.08 |
| 50 | 60 | Mfgs. of Mixed Fertilizers | 1.930 | 50 | 31 | Copper & Alloy R.C. & Ext. | 67.87 |
| 51 | 70 | Water, Air & Other Transp. | 1.905 | 51 | 62 | Mfgs. of Ind. Chemicals | 66.89 |
| 52 | 9 | Asbestos Mines | 1.899 | 52 | 9 | Asbestos Mines | 66.29 |
| 53 | 56 | Glass & Glass Prod. Mfgs. | 1.890 | 53 | 11 | Salt Mines | 66.17 |
| 54 | 66 | Repair Construction | 1.869 | 54 | 5 | Iron Mines | 61.79 |
| 55 | 11 | Salt Mines | 1.862 | 55 | 4 | Uranium Mines | 61.39 |
| 56 | 13 | Quarries & Sand Pits | 1.851 | 56 | 29 | Other Smelting & Refining | 60.49 |
| 57 | 6 | Base Metal & Other Met. Mines | 1.759 | 57 | 28 | Aluminum Smelting & Refin. | 59.57 |
| 58 | 10 | Gypsum Mines | 1.712 | 58 | 60 | Mfgs. of Mixed Fertilizers | 59.19 |
| 59 | 14 | Services Incid. to Mining | 1.703 | 59 | 48 | Cement Mfgs. | 56.59 |
| 60 | 73 | Misc. Serv. & Operating Costs | 1.643 | 60 | 59 | Other Petroleum & Coal Prod. | 56.49 |
| 61 | 71 | Railway Transport | 1.635 | 61 | 6 | Base Metal & Other Met. Mines | 53.08 |
| 62 | 12 | Other Non-Metal Mines | 1.627 | 62 | 12 | Other Non-Metal Mines | 52.03 |
| 63 | 8 | Petroleum & Gas Wells | 1.615 | 63 | 58 | Petroleum Refineries | 44.09 |
| 64 | 72 | Pipeline Transport | 1.458 | 64 | 74 | Electric Power | 38.52 |
| 65 | 74 | Electric Power | 1.396 | 65 | 8 | Petroleum & Gas Wells | 33.77 |
| 66 | 75 | Prof. Serv. to Business | 1.394 | 66 | 72 | Pipeline Transport | 22.98 |

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In comparison with the actual total linkage the rank order correlation is .8395, and Copper and Alloy Rolling, Casting and Extruding maintains the first position in both rankings. The actual total linkage ranked Miscellaneous Transportation Equipment fifty-second, this changes to third position in the potential ranking. Aluminum Smelting and Refining moves from fifty-eighth to twenty-ninth in the potential ranking. The rankings do correspond in that semi-fabricated products maintain the top positions, again providing the greatest development stimulus.

Table 5 is a cardinal measure of the development stimulating effect lost due to the importation of intermediate inputs. The difference in value between actual and potential total linkages is measured and the industries ranked in descending order of lost impact. The highest ranking industry is Miscellaneous Transportation Equipment which loses 882,278 dollars of impact for each million dollars of production, due to imports of intermediate goods.

The change in ranking due to the domestic replacement of imports is apparent when the present ranking is compared with the total linkage rankings. The rank order correlation between the present ranking and the actual total linkage ranking is a relatively insignificant .4298 whereas the correlation between it and the potential total linkage ranking is .7843. Of the ten highest ranking industries only one appears in the top ten of the actual total ranking, however, six appear in the top ten of the potential total ranking.

Table 5

Total Linkage Impact Lost To Imports
Due To 1 Million Dollars Production
By Each Industry

| Rank | Industry | | Value \$ |
|------|----------|----------------------------------|-------------|
| | No. | Name | |
| 1 | 43 | Misc. Transportation Equip. | |
| 2 | 28 | Aluminum Smelting and Refining | 882,278 |
| 3 | 58 | Petroleum Refineries | 656,696 |
| 4 | 59 | Other Petroleum & Coal Prod. | 612,826 |
| 5 | 30 | Aluminum Roll. Cast, Ext. | 555,039 |
| 6 | 57 | Abrasive Mfgs. | 528,880 |
| 7 | 47 | Electrical Wire and Cable | 514,191 |
| 8 | 32 | Metal Roll. Cast. & Ext. | 488,456 |
| 9 | 42 | Misc. Machinery and Equipment | 481,782 |
| 10 | 46 | Battery Mfgs. | 465,803 |
| 11 | 26 | Steel Pipe & Tube Mills | 459,926 |
| 12 | 39 | Heating Equipment Mfgs. | 458,611 |
| 13 | 35 | Ornamental & Arch. Metal Ind. | 431,866 |
| 14 | 25 | Iron and Steel Industry | 403,410 |
| 15 | 31 | Copper and Alloy Coat. & Ext. | 402,342 |
| 16 | 41 | Misc. Metal Fabricating | 399,879 |
| 17 | 27 | Iron Foundries | 395,273 |
| 18 | 33 | Boiler and Plate Works | 394,564 |
| 19 | 44 | Appliances and Communications | 388,600 |
| 20 | 53 | Refractories Mfgs. | 385,349 |
| 21 | 45 | Mfgs. of Elect. Ind. Equipment | 381,059 |
| 22 | 64 | Scient. & Prof. Equipment Mfgs. | 378,001 |
| 23 | 38 | Hardware & Tool & Cutlery Mfgs. | 377,373 |
| 24 | 36 | Metal Stamp. Press. & Coat. Ind. | 369,208 |
| 25 | 34 | Fabricated Struct. Metal Ind. | 367,750 |
| 26 | 40 | Machine Shops | 366,996 |
| 27 | 37 | Wire and Wire Products | 357,497 |
| 28 | 62 | Mfgs. of Industrial Chemicals | 353,624 |
| 29 | 68 | Non-Residential Construction | 349,260 |
| 30 | 23 | Other Paper Products | 303,796 |
| 31 | 03 | Gold Mines | 298,390 |
| 32 | 56 | Glass and Glass Products Mfgs. | 286,201 |
| 33 | 07 | Coal Mines | 263,118 |
| 34 | 67 | Residential Construction | 281,137 |
| 35 | 49 | Lime Mfgs. | 278,128 |
| 36 | 69 | Other Construction | 261,713 |
| 37 | 15 | Food Processing | 261,047 |
| 38 | 05 | Iron Mines | 252,437 |
| 39 | 55 | Other Non-Metallic Products Ind. | 238,458 |
| 40 | 29 | Other Smelting & Refining | 237,341 |
| 41 | 52 | Clay Products Mfgs. | 232,456 |
| 42 | 19 | Misc. Wood Industries | 232,843 |
| 43 | 21 | Pulp and Paper | 228,120 |
| 44 | 06 | Base Metal & Other Metal Mines | 225,317 |
| 45 | 01 | Agriculture and Fishing | 223,682 |
| 46 | 04 | Uranium Mines | 218,327 |
| 47 | 09 | Asbestos Mines | 218,206 |
| 48 | 66 | Repair Construction | 203,978 |
| 49 | 60 | Mfgs. of Mixed Fertilizers | 200,218 |
| 50 | 10 | Gypsum Mines | 197,535 |
| 51 | 70 | Water, Air & Other Transp. | 197,382 |
| 52 | 54 | Stone Products Mfgs. | 196,264 |
| 53 | 51 | Ready-Mix Concrete Mfgs. | 195,910 |
| 54 | 50 | Concrete Products Mfgs. | 189,704 |
| 55 | 48 | Cement Mfgs. | 188,085 |
| 56 | 13 | Quarries and Sand Pits | 184,026 |
| 57 | 02 | Forestry | 181,104 |
| 58 | 12 | Other Non-Metal Mines | 176,545 |
| 59 | 14 | Serv. Incid. to Mining | 160,676 |
| 60 | 11 | Salt Mines | 153,864 |
| 61 | 74 | Electric Power | 147,311 |
| 62 | 71 | Railway Transport | 135,940 |
| 63 | 73 | Pipeline Transport | 118,662 |
| 64 | 72 | Misc. Services & Oper. Costs | 113,947 |
| 65 | 08 | Petroleum & Gas Wells | 81,513 |
| 66 | 75 | Prof. Services to Business | 74,829 |
| | | | 60,437 |

This ranking delineates those industries which are losing the greatest value of impact to foreign suppliers. It is therefore a cardinal measure of the difference between the stimulative effect of an industry and the domestic fulfillment of that stimulation.

Potential Employment Linkage Ranking

Table 4 lists and ranks the values of the potential employment linkage. The Spearman rank correlation between this ranking and the potential combined and total ranks are an insignificant .0428 and .0885 respectively. The lack of a relationship between the potential employment linkage ranking and the other two potential rankings corresponds with a similar finding for the actual rankings.

A very strong direct relationship exists between the potential and actual employment rankings. The Spearman rank order correlation between the two is .9683. Fewer significant changes occur from the actual to the potential employment linkage rankings than from actual to potential in the other rankings. The difference in mean values is 11.27 man-years. While significant changes in value take place, the ranking is not as sensitive to importation of intermediate goods as are the other rankings.

Exclusion of Exports

The potential linkages ranked the industries on the basis of the domestic production of all intermediate goods. A bias in the results due to importation was thus removed. A further bias due to exports still remains. Exports are a component of final demand and as such reduce the value of forward linkage for the majority of industries, particularly primary producers and intermediate manufacturers.

That exports are not a sign of poor economic performance is not questioned. For the same reasons discussed in terms of importation, exports may be beneficial. Rather, the removal of exports in the ranking procedure is to complete the measure of the stimulative effect of each industry, not whether that effect is acted upon.

The only linkage measure effected by the export adjustment is forward linkage. Forward linkage is valued so as to measure the portion of the domestic disposition of each commodity sold to industries as intermediate inputs.

$$L_i^{fp1} = \frac{\sum_j u_{ij}}{q_i + m_i - X_i}$$

The forward linkage of each industry is evaluated and ranked in combination with the potential backward linkage on Table 6. The mean value of the forward linkage is 77.94 per cent. The high mean value and the distribution of individual values moves the majority of industries out of Quadrants III and IV.

The most obvious feature of the ranking is that a final demand commodity, Other Petroleum and Coal Products, is the highest ranking industry. Other than this first industry, the ranking corresponds more closely to the successive stage concept than does any other ranking.

The Spearman rank order correlation between this ranking and the actual combined linkage ranking is .7640 and with the potential combined linkage ranking it is .9424. The correlation between the present ranking and the actual total linkage ranking is .7069 and with the potential total

linkage ranking it is .7867. All of the correlations are significant. The very high correlation with the potential combined linkage is caused by the dominance of the backward linkage in the ranking criteria.

While all of the correlations are significant, differences with the present ranking exist. In general, differences tend to be in the direction of the industries more closely aligning with the concept of successive stages of processing.

Quadrant II contains largely intermediate manufacturing industries. Aside from the highest ranking industry, the top seventeen industries are all of this type. Of the industries seemingly out of place; Heating Equipment Manufacturers, Battery Manufacturers, and Other Paper Products, are producers of products which do not require further processing and would be expected to be in Quadrant III. Iron Mines is a primary producer and would be expected to be in Quadrant I.

All of the industries in Quadrant III produce commodities requiring little further processing and are consequently in this Quadrant.

The first four industries in Quadrant I are more closely associated with intermediate manufacturing and consequently with Quadrant II. There are also a number of industries more closely associated with the other two Quadrants. The majority of primary intermediate producers are, however, found in this Quadrant.

The industries in Quadrant IV are to a large extent those associated with Quadrant's I and III. The majority of the primary final product producers are found in Quadrant I, particularly the service and

transportation industries.

The present combined linkage ranking aligns more closely with the type of industries associated with each Quadrant. There still remains, however, a number of industries apparently out of place. More important than the association with particular Quadrants is that the rankings have a close relationship with the concept of stages of processing.

The correlation between the present combined linkage ranking and actual employment linkage is .2303 and with potential employment linkage it is .1565. As was the case with each of the other non-employment rankings there is no apparent significant correlation with the employment rankings.

Biases Due to Final Demand

Two components of final demand, other than exports, have the potential to bias the valuation of forward linkage.

The inclusion of the purchase of commodities as capital goods in final demand has the potential to reduce the value of forward linkage. This bias is discussed by Chenery and Watanabe, (3) and by Hirschman (4) in terms of the machinery and equipment industries. In the present aggregation there are eight industries which sell in excess of 10 per cent of their domestic output as investment goods. These industries include four manufacturing industries, the three construction industries and Services Incidental to Mining. The actual combined linkage ranking was

3. H.B. Chenery, T. Watanabe, op. cit., p. 491.

4. A.O. Hirschman, op. cit., p. 107.

revalued considering sales of commodities as capital goods to be intermediate inputs. This revaluation of the forward linkage produced only minor changes. The construction industries all moved up the ranking to Quadrant II from Quadrant III. The other five industries remained in the same Quadrants.

While it is possible to measure the value of output sold as capital goods, the model employed does not assign these goods to specific industries as inputs. As a result it is not possible to square the aggregation and combined linkage rankings are not comparable with total and employment linkage rankings. Given the minor nature of the ranking changes and the problem of ranking comparability, capital goods are assigned to final demand.

A change in inventory is considered to be a component of final demand. If the year 1971 is for any reason an anomaly in terms of changing inventory, for any industry the forward linkage for that industry may be biased upward or downward. In the present aggregation for those industries which have a change in inventory, that value on average represents approximately 1.5 per cent of the disposition of output. On inspection, the only industry which changes its ranking position significantly with different methods of dealing with inventories is Asbestos Mines. In the potential combined linkage rankings, with exports removed, Asbestos Mines ranks sixty-second. The value of forward linkage and positive change in inventory are both approximately seven millions of dollars.

If change in inventory is not included in final demand this industry moves from Quadrant IV to Quadrant I. Other than this one change in ranking, for one ranking method, different methods of dealing with change in inventory do not significantly alter the results. Due to the above, and the fact that any method other than that employed disrupts the comparability of actual and potential, changes in inventory are considered a component of final demand.

CHAPTER V

THE NON-FUEL MINERAL INDUSTRY

The non-fuel mineral industry is composed of three sectors. These sectors are ferrous metals, non-ferrous metals, and non-metallic minerals. Each sector can be analyzed as containing successive stages of processing. The two metals sectors are each divided into three stages and the non-metallic minerals industries are divided into two stages. Since there is no domestic mining of alumina bearing ores, the aluminum industry is considered a subsector of the non-ferrous metals industries with two stages.

The mineral sectors and the industries relating to each stage are listed on Table 7. This table also lists the ranking position of each industry relative to the industry aggregation and the eight ranking methods. These industries represent very high and very low ranking positions for all methods. The industries are very mobile in that, with the exception of the employment linkage, ranking positions vary greatly with the treatment of imports and exports. A minimum of four non-fuel mineral industries appear in the top ten positions of all the non-employment rankings. In four instances the first ranking position is held by an industry of this type. At least three of the bottom ten positions in all of these rankings are held by non-fuel mineral industries.

The preceding has demonstrated the ranking of the non-fuel mineral industries relative to the sixty-six industry aggregation. Table 8 shows the ranking of each industry within the sectors. While the ranking positions of these industries relative to the whole aggregation, proved to be very mobile, this is not shown in the Table. Each non-fuel

Table 7

Non-Fuel Mineral Industry Linkage
Rankings By Sector

| SECTOR | | | Actual Combined | Potential Combined | Potential Combined Less Exports | Actual Total | Potential Total | Actual Employment | Potential Employment |
|------------------------------|----|--------------------------------|--------------------|-----------------------|---------------------------------------|-----------------|--------------------|----------------------|-------------------------|
| Non-Ferrous Metals | | | | | | | | | |
| I | 6 | Base Metal & Other Metal Mines | 45 | 49 | 47 | 59 | 57 | 60 | 61 |
| II | 29 | Other Smelting & Refining | 23 | 23 | 10 | 6 | 16 | 58 | 36 |
| III | 31 | Copper & Alloy R.C. & Ext. | 5 | 6 | 5 | 1 | 1 | 31 | 50 |
| | 32 | Metal Roll. Cast. & Ext. | 18 | 7 | 9 | 12 | 7 | 45 | 38 |
| II | 28 | Aluminum Smelting & Refining | 64 | 32 | 24 | 58 | 29 | 62 | 57 |
| III | 30 | Aluminum R.C. & Ext. | 7 | 2 | 8 | 11 | 4 | 44 | 41 |
| Ferrous Metals | | | | | | | | | |
| I | 5 | Iron Mines | 25 | 33 | 25 | 22 | 34 | 54 | 54 |
| II | 25 | Iron & Steel Industry | 33 | 16 | 16 | 36 | 27 | 49 | 45 |
| III | 27 | Iron Foundries | 40 | 36 | 35 | 44 | 37 | 23 | 22 |
| | 26 | Steel Pipe & Tube Mills | 6 | 1 | 6 | 7 | 5 | 47 | 43 |
| | 33 | Boiler & Plate Works | 38 | 19 | 26 | 37 | 31 | 30 | 27 |
| | | | | | | | | | |
| Non-Metallic Minerals | | | | | | | | | |
| I | 9 | Asbestos Mines | 58 | 61 | 62 | 50 | 52 | 46 | 52 |
| | 10 | Gypsum Mines | 61 | 65 | 48 | 62 | 58 | 42 | 47 |
| | 11 | Salt Mines | 52 | 60 | 65 | 48 | 55 | 43 | 53 |
| | 43 | Quarries & Sand Pits | 41 | 47 | 53 | 53 | 56 | 39 | 44 |
| | 12 | Other Non-Metal Mines | 65 | 51 | 50 | 63 | 62 | 59 | 62 |
| II | 51 | Ready-Mix Concrete | 1 | 4 | 2 | 4 | 15 | 35 | 42 |
| | 48 | Cement Mfgs. | 32 | 41 | 41 | 43 | 49 | 57 | 59 |
| | 49 | Lime Mfgs. | 2 | 8 | 3 | 10 | 19 | 22 | 26 |
| | 50 | Concrete Mfgs. | 13 | 39 | 36 | 25 | 42 | 21 | 32 |
| | 52 | Clay Products Mfgs. | 39 | 43 | 44 | 34 | 45 | 7 | 7 |
| | 53 | Refractories Mfgs. | 51 | 18 | 17 | 47 | 40 | 48 | 48 |
| | 54 | Stone Products Mfgs. | 26 | 55 | 58 | 28 | 43 | 8 | 8 |
| | 56 | Glass & Glass Prod. Mfgs. | 43 | 42 | 45 | 55 | 53 | 37 | 35 |
| | 57 | Abrasives Mfgs. | 27 | 26 | 19 | 42 | 20 | 30 | 29 |
| | 55 | Other Non-Metallic Prod. Ind. | 31 | 37 | 37 | 33 | 44 | 34 | 37 |

mineral industry produces significant value added and no industry has a backward linkage to one specific industry of greater than fifty per cent. Given these two facts none of the industries are treated as satellite industries. (1)

The non-ferrous metals less aluminum demonstrate a clear relationship between the level of processing and development stimulus. The higher the level of processing the greater is the stimulus. This relationship is true of all eight rankings. The only anomaly occurs in the ranking of actual total linkage in which the Stage II industry ranks ahead of one Stage III industry. This anomaly notwithstanding the relationship is clear.

The aluminum industry, for which there is no domestic Stage I, shows the same relationship. In the case of seven rankings Stage III ranks above Stage II. The ranking of impact lost to imports is reversed due to the importation of the ores and concentrates by the Stage II industry.

The ferrous metals industries do not demonstrate the ranking consistency of the non-ferrous metals. One Stage III industry, Steel Pipe and Tube Mills, ranks first for all of the total and combined linkage rankings, however, another Stage III industry, Iron Foundries, ranks last for the same rankings. The treatment of trade is important for these industries. The actual combined and total linkage rankings show the Stage I industry ranked ahead of the Stage II industry. The potential rankings show the reverse relationship.

1. A.O. Hirschman, op. cit., p. 102.

Table 8
Non-Fuel Mineral Industry Linkage
Rankings Within Sectors

| STAGE | Sector | Actual Combined | Potential Combined | Potential Combined Less Exports | Actual Total | Potential Total | Actual Employment | Potential Employment | Imp. Loss |
|------------------------------|---|-----------------|--------------------|---------------------------------|--------------|-----------------|-------------------|----------------------|-----------|
| Non-Ferrous Metals | | | | | | | | | |
| I | Base Metal & Other Metal Mines | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| II | Other Smelting & Refining | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| III | Copper & Alloy R.C. & Ext. Metal Cast. Roll. & Ext. | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| | | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 |
| II | Aluminum Smelting & Refining | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| III | Aluminum Roll. Cast. & Ext. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Ferrous Metals | | | | | | | | | |
| I | Iron Mines | 2 | 4 | 3 | 2 | 4 | 5 | 5 | 5 |
| II | Iron & Steel Industry | 3 | 2 | 2 | 3 | 2 | 4 | 4 | 2 |
| III | Iron Foundries Steel Pipe & Tube Mills Boiler & Plate Works | 5 | 5 | 5 | 5 | 5 | 1 | 1 | 3 |
| | | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 |
| | | 4 | 3 | 4 | 4 | 3 | 2 | 2 | 4 |
| Non-Metallic Minerals | | | | | | | | | |
| I | Asbestos Mines | 13 | 14 | 14 | 11 | 10 | 12 | 12 | 7 |
| | Gypsum Mines | 14 | 15 | 10 | 14 | 14 | 10 | 10 | 8 |
| | Salt Mines | 12 | 13 | 15 | 10 | 12 | 11 | 12 | 15 |
| | Quarries & Sand Pits | 9 | 10 | 12 | 12 | 13 | 9 | 9 | 13 |
| | Other Non-Metal Mines | 15 | 11 | 11 | 15 | 15 | 15 | 15 | 14 |
| II | Lead-Mix Concrete | 1 | 1 | 1 | 1 | 1 | 6 | 8 | 10 |
| | Cement Mfgs | 7 | 7 | 7 | 8 | 9 | 14 | 14 | 12 |
| | Lime Mfgs. | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 4 |
| | Concrete Mfgs. | 3 | 6 | 5 | 3 | 5 | 3 | 5 | 11 |
| | Clay Products Mfgs. | 8 | 9 | 8 | 6 | 8 | 1 | 1 | 6 |
| | Refractories | 11 | 3 | 3 | 9 | 4 | 13 | 11 | 2 |
| | Stone Products Mfgs. | 4 | 12 | 13 | 4 | 6 | 2 | 2 | 9 |
| | Glass & Glass Products Mfgs. | 10 | 8 | 9 | 13 | 11 | 7 | 6 | 3 |
| | Abrasive Mfgs. | 5 | 4 | 4 | 7 | 3 | 8 | 4 | 1 |
| | Other Non-Metallic Prod. Ind. | 6 | 5 | 6 | 5 | 7 | 5 | 7 | 5 |

The ferrous metal's employment linkage rankings do not vary with the treatment of trade. These rankings alone show a direct relationship between the level of processing and ranking.

The rankings of non-metal industries show consistency in that with only a few exception the Stage II industries rank higher than the Stage I industries. Within the stages the rankings are extremely mobile. Aside from the two highest ranked industries, the combined and total linkage rankings change greatly with ranking methods. The Stage I employment rankings do not change in response to the removal of imports. This result is expected since these industries lose little impact due to imports. The Stage II employment rankings are responsive to imports and tend to lose more total impact to imports.

Summary of Non-Fuel Mineral Industry Ranking

In each sector one industry at the highest stage of processing consistently ranks highest. These three industries also rank high in the overall ranking of combined and total linkages. Other than this one industry in each sector no general statement in terms of ranking and the stages in each sector can be made.

The ranking of non-ferrous metals demonstrates a clear relationship between the level of processing and development stimulus. The second two stages consistently rank high in the overall rankings and are relatively insensitive to the treatment of trade.

The ranking of non-metallic minerals shows a clear relationship between the level of processing and development stimulus. The ranking of each industry varies greatly with each ranking method and the treatment of trade.

The ranking of ferrous metals does not consistently show a direct relationship between the level of processing and development stimulus. The ranking of most industries in the sector varies greatly with ranking methods and the treatment of trade.

CHAPTER VI

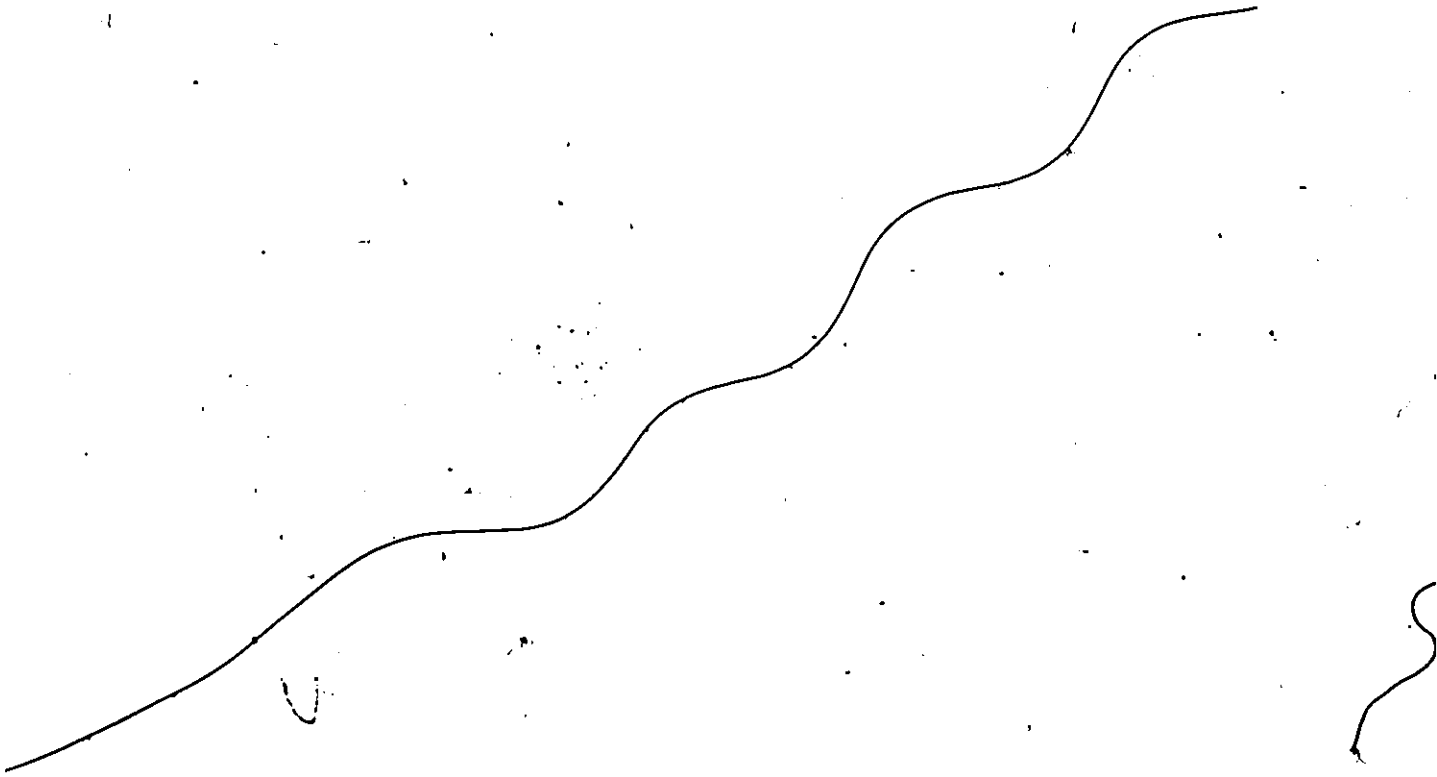
CONCLUSION

The development stimulating effect of sixty-six industries has been measured based upon their interindustry relationships. The changes in the ranking of these industries due to alternative treatments of trade demonstrate the sensitivity of rankings, in an open economy like that of Canada. A ranking of actual interindustry relationships is a measure of the domestic fulfillment of the stimulus produced by each industry, not the stimulus itself.

The differences in ranking due to trade highlight those industries which have a reduced stimulative impact on the economy resulting from the importing of intermediate goods reducing backward linkage, or the export of output reducing forward linkage. The existence of these gaps does not necessarily indicate poor economic performance. Gaps may exist for a number of reasons including: factor endowment, economies of scale, industrial organization and trade barriers. The advisability of a development policy directed toward the elimination of these gaps would depend upon the reasons for their existence for each specific industry.

The development stimulus of industries does not necessarily increase with processing to the intermediate manufacture level. The variance between and within the sectors of the non-fuel mineral industry demonstrates the need for conclusions, as to industrial rankings, to be based upon highly disaggregated industrial information.

The difference between the industrial rankings based upon employment and those of the other ranking methods points out a possible conflict in planning for economic development. Those industries which lead to the greatest economic diversification may not be the industries which result in the greatest employment creation. Depending upon the perceived development goals at any point in time this conflict may have significant planning implications.



APPENDIX

The Statistics Canada input-output tables are available in three standard levels of aggregation including:

| | | |
|--------|----------------|-----------------|
| Large | 191 industries | 602 commodities |
| Medium | 43 industries | 94 commodities |
| Small | 16 industries | 45 commodities |

This paper is a study of a broad cross-section of industries in the Canadian economy with emphasis on the non-fuel mineral industry. The two smaller standard aggregations are too aggregated for this purpose. The large aggregation is too large to allow for the number of manipulations required and to enable the reader to follow the changes due to different ranking methods. A special aggregation was developed utilizing 77 industries and 137 commodities. The following two appendices list the industries and commodities and relate them to the large standard aggregation by referring to the Statistics Canada input-output numbers associated with each.

The industry aggregation incorporates the greatest level of disaggregation available for the non-fuel mineral industry. It also includes the various levels of processing of several other industries including agriculture, fuels and forestry. The remainder of the aggregation represents the various manufacturing, service and construction industries. The 137 commodities were chosen so as to relate to the industry aggregation. To ensure that all commodity impacts were incorporated, an additional commodity was added to the aggregation. Commodity number 138 is a residual commodity referred to as "other non-primary inputs". The largest portion of this residual is non competing imports. These imports are products such as tropical fruit and natural rubber which are not produced in Canada and therefore have no industry representation.

The input-output inverse matrix is squared by allocating the commodities to industries. A commodity is allocated to an industry if that industry is responsible for more than 75 percent of its production. In most cases the relationship was much higher than this requirement, however, such a relationship was not found for eleven industries. The direct relationship was required for the evaluation of linkages, as a result, the aggregation used in the rankings includes 66 industries.

I-O AGGREGATION

Appendix A

Industries

| <u>ED #</u> | <u>Statistics Canada #</u> | <u>Industry Name</u> |
|-------------|---------------------------------------|--|
| 001 | 00100,00300 | Agriculture & Fishing |
| 002 | 00200 | Forestry |
| 003 | 00400 | Gold Mines |
| 004 | 00500 | Uranium Mines |
| 005 | 00600 | Iron Mines |
| 006 | 00700 | Base Metal & Other Metal Mines |
| 007 | 00800 | Coal Mines |
| 008 | 00900 | Petroleum & Gas Wells |
| 009 | 01000 | Asbestos Mines |
| 010 | 01100 | Gypsum Mines |
| 011 | 01200 | Salt Mines |
| 012 | 01300 | Other Non-Metal Mines |
| 013 | 01400 | Quarries & Sand Pits |
| 014 | 01500 | Services Incidental to Mining |
| 015 | 01600-03400 | Food Processing |
| 016* | 03500-03700 | Rubber Industries |
| 017* | 03800 | Plastic Fabricators, NES |
| 018 | 03900-05800 | Textile & Clothing |
| 019 | 05900-06400 | Misc. Wood Industries |
| 020* | 06500-06800 | Furniture |
| 021* | 06900 | Pulp & Paper |
| 022 | 07000 | Asphalt & Other Related Products |
| 023 | 07100,07200 | Other Paper Products |
| 024* | 07300,07400 | Printing & Publishing |
| 025 | 07500 | Iron & Steel Industry |
| 026 | 07600 | Steel Pipe & Tube Mills |
| 027 | 07700 | Iron Foundries |
| 028 | 07800 | Aluminum Smelting & Refining |
| 029 | 07900 | Other Smelting & Refining |
| 030 | 08000 | Aluminum Rolling, Casting & Extruding |
| 031 | 08100 | Copper & Alloy Rolling, Casting & Extruding |
| 032 | 08200 | Metal Rolling, Casting & Extruding NES |
| 033 | 08300 | Boiler & Plate Works |
| 034 | 08400 | Fabricated Structural Metal Industries |
| 035 | 08500 | Ornamental & Arch. Metal Industries |
| 036 | 08600 | Metal Stamping, Pressing, & Coating Industries |
| 037 | 08700 | Wire & Wire Products Manufacturers |
| 038 | 08800 | Hardware Tool & Cutlery Manufacturers |
| 039 | 08900 | Heating Equipment Manufacturers |
| 040 | 09000 | Machine Shops |
| 041 | 09100 | Misc. Metal Fabricating |
| 042 | 09200-09500 | Misc. Machinery & Equipment |
| 043 | 09600-10200 | Misc. Transportation Equipment |
| 044 | 10300,10400, 10500,10600, 11000 | Appliances & Communication |
| 045 | 10700 | Manufacturers of Electric Industrial Equipment |
| 046 | 10800 | Battery Manufacturers |
| 047 | 10900 | Manufacturers of Electric Wire & Cable |

| <u>ED#</u> | <u>Statistics Canada #</u> | <u>Industry Name</u> |
|------------|--|--|
| 048 | 11100 | Cement Manufacturers |
| 049 | 11200 | Lime Manufacturers |
| 050 | 11300 | Concrete Products Manufacturers |
| 051 | 11400 | Ready-Mix Concrete Manufacturers |
| 052 | 11500 | Clay Products Manufacturers |
| 053 | 11600 | Refractories Manufacturers |
| 054 | 11700 | Stone Products Manufacturers |
| 055 | 11800 | Other Non-Metallic Products Industries |
| 056 | 11900 | Glass & Glass Products Manufacturers |
| 057 | 12000 | Abrasive Manufacturers |
| 058 | 12100 | Petroleum Refineries |
| 059 | 12200 | Other Petroleum & Coal Products Industries |
| 060 | 12300 | Manufacturers of Mixed Fertilizers |
| 061* | 12400-12800 | Misc. Pharmacy & Medicines, Etc. |
| 062 | 12900 | Manufacturers of Industrial Chemicals |
| 063* | 13000 | Other Chemical Industries |
| 064 | 13100 | Scientific & Professional Equipment Manufacturers |
| 065* | 13200-13700 | Misc. Manufacturing Industries |
| 066 | 13800 | Repair Construction |
| 067 | 13900 | Residential Construction |
| 068 | 14000 | Non-Residential Construction |
| 069 | 14100-14600 | Other Construction |
| 070 | 14700, 14900, 15100-15400 | Water, Air & Other Transportation |
| 071 | 15000 | Railway Transport |
| 072 | 15500 | Pipeline Transport |
| 073 | 15600-16000, 16200-17500, 17700-18200, 18400-18600 18800-19000 | |
| 074 | 16100 | Misc. Services & Operating Costs |
| 075 | 17600, 18300 | Electric Power |
| 076* | 18700 | Professional Services to Business |
| 077* | 19100 | Transportation Margins Machinery Repair Service |

*These industries while included in the Input-Output Model runs are excluded from the ranking procedures since there is no clear industry-commodity relationship.

I-O AGGREGATION

Commodities

| <u>ED #</u> | <u>Statistics Canada #</u> | <u>Commodity Name</u> |
|-------------|----------------------------|--|
| 001 | 00100-02300 | Agricultural Products |
| 002 | 02400-02800 | Forestry Products |
| 003 | 02900-03000 | Fishing & Trapping Products |
| 004 | 03100 | Gold Ores |
| 005 | 03200 | Gold & Alloys in Primary Form |
| 006 | 03300 | Radio-active Ores & Concentrates |
| 007 | 03400 | Iron Ores & Concentrates |
| 008 | 03500 | Bauxite & Alumina |
| 009 | 03600 | Metal Ores & Concentrates, nes. |
| 010 | 03700 | Coal |
| 011 | 03800 | Crude Mineral Oils |
| 012 | 03900 | Natural Gas |
| 013 | 04000 | Other Crude Bituminous Substances |
| 014 | 04100 | Sulphur, Crude & Refined |
| 015 | 04200 | Asbestos, Unmanufactured, Crude & Fibrous |
| 016 | 04300 | Gypsum |
| 017 | 04400 | Salt |
| 018 | 04500 | Peatmoss |
| 019 | 04600 | Clay & Other Crude Refractory Material |
| 020 | 04700 | Natural Abrasives & Industrial Diamond |
| 021 | 04800 | Crude Minerals, nes. |
| 022 | 04900 | Sand & Gravel |
| 023 | 05000 | Stone, Crude |
| 024 | 05100 | Services Incidental to Mining |
| 025 | 05200-12000 | Food Products |
| 026 | 12100-12300 | Tobacco Products |
| 027 | 19000-20300 | Wood Products |
| 028 | 20900-21900 | Pulp & Paper Products |
| 029 | 22100-22700 | Other Paper Products |
| 030 | 23500 | Ferro-alloys |
| 031 | 23600 | Iron, Steel Ingots |
| 032 | 23700 | Steel Blooms, Billets & Slabs |
| 033 | 23800 | Steel Castings |
| 034 | 23900 | Steel Bars & Rods |
| 035 | 24000 | Steel Plates, not Fabricated |
| 036 | 24100 | Carbon Steel Sheets, not coated |
| 037 | 24200 | Tinplate |
| 038 | 24300 | Galvanized Steel Sheet & Strip |
| 039 | 24400 | Rails & Railway Track Material Steel |
| 040 | 24500 | Coal Tar |
| 041 | 24600 | Natural and Synthetic Graphite & Carbon Products |
| 042 | 24700 | Mechanical Steel Tubing |
| 043 | 24800 | Off-Country Goods |
| 044 | 24900 | Line Pipe, Transport, Natural Gas & Oil |
| 045 | 25000 | Steel Pipes & Tubes, nes. |
| 046 | 25100 | Grinding Balls, Ingot Moulds, etc. |
| 047 | 25200 | Cast & Wrought Iron Pipe & Fittings |
| 048 | 25700 | Aluminum & Aluminum-Alloys Primary |
| 049 | 26100 | Aluminum Fluorides & Sodium Aluminum |

| <u>ED #</u> | <u>Statistics Canada #</u> | <u>Commodity Name</u> |
|-------------|----------------------------|--|
| 050 | 25300 | Nickel in Primary Forms |
| 051 | 25400 | Copper & Copper Alloys, Prime Forms, |
| 052 | 25500 | Lead, Primary Forms |
| 053 | 25600 | Zinc, Zinc Alloys Primary Forms |
| 054 | 25800 | Tin & Tin Alloys Primary Forms |
| 055 | 25900 | Precious Metal & Alloys Prime. Form |
| 056 | 26000 | Other Non-Ferrous Base Metals |
| 057 | 26200 | Inorganic Bases & Metal Oxides, nes. |
| 058 | 26300 | Scrap & Waste Materials, nes |
| 059 | 26400 | Aluminum & Aluminum Alloys, Castings |
| 060 | 26500 | Copper Products , Casting, Rolled & Extruded |
| 061 | 26600 | Copper Alloy, Products, Casting, Rolled & Extruded |
| 062 | 26700 | Lead & Lead Alloy Products Casting Rolled & Extruded |
| 063 | 26800 | Nickel & Nickel Alloy Fabricated Material |
| 064 | 26900 | Tin & Tin Alloy Fabricated Material |
| 065 | 27000 | Zinc Die Casting & Other Zinc Materials |
| 066 | 27100 | Solder inc. Block, Rods, Wire, etc. |
| 067 | 27200 | Plates, Steel, Fabricated |
| 068 | 27300 | Tanks |
| 069 | 27400 | Power Boilers |
| 070 | 27500 | Boilers, Marine Type |
| 071 | 27600 | Beams & Other Structural Steel |
| 072 | 27700 | Scaffolding Equipment, Demountable |
| 073 | 27800 | Prefab. Buildings and Structures, Mainly Metal |
| 074 | 27900 | Metal Products, nes. |
| 075 | 28000-28800 | Metal Stamp. Press. & Coat. Products |
| 076 | 28700-29200 | Wire & Wire Products |
| 077 | 29300-29900 | Hardware, Tool & Cutlery |
| 078 | 30000-30400 | Heating Equipment |
| 079 | 30500 | Custom Metal Working |
| 080 | 30600-31300 | Misc. Metal Fabricated Products |
| 081 | 31400-31500 | Agricultural Machinery |
| 082 | 31600-32500 | Misc. Machinery & Equipment |
| 083 | 33400-33700 | Motor Vehicles |
| 084 | 33800-34000 | Truck Bodies & Trailers |
| 085 | 34100-34400 | Motor Vehicle Parts & Accessories |
| 086 | 34500-34700 | Railroad Rolling Stock |
| 087 | 34800-35000 | Shipbuilding & Repair Equipment |
| 088 | 35100-35200 | Misc. Transportation Equipment |
| 089 | 35300-35400 | Small Electrical Appliances |
| 090 | 35500-35600 | Major Electric & Non. Appliances |
| 091 | 35800-36300 | Communications Equipment |
| 092 | 36400-36800 | Electric Industrial Equipment |
| 093 | 36900 | Batteries |
| 094 | 37000 | Wire & Cable Insulated |
| 095 | 37100 | Aluminum Wire & Cable, not insulated |
| 096 | 37200-37400 | Misc. Electrical Products |
| 097 | 37500 | Cement |
| 098 | 37600 | Lime |
| 099 | 37700 | Concrete Basic Products |

| <u>ED #</u> | <u>Statistics Canada #</u> | <u>Commodity Name</u> |
|-------------|----------------------------|---|
| 100 | 37800 | Sand Lime Bricks & Blocks |
| 101 | 37900 | Ready-Mix Concrete |
| 102 | 38000-38200 | Clay Products |
| 103 | 38300 | Refractories |
| 104 | 38400-38500 | Stone Products |
| 105 | 38600-38700, | |
| | 38900 | Other Non-Metallic Products |
| 106 | 38800 | Asbestos Products |
| 107 | 39000-39200 | Glass & Glass Products |
| 108 | 39300 | Abrasive Basic Products |
| 109 | 39400-40000, | |
| | 40200 | Petroleum Refinery Products |
| 110 | 40100 | Asphalt & Coal Oils, nes. |
| 111 | 40300 | Fertilizers |
| 112 | 41600-47400 | Industrial Chemicals |
| 113 | 49600-50300 | Scientific & Professional Equipment |
| 114 | 52200 | Repair Construction |
| 115 | 52300 | Residential Construction |
| 116 | 52400 | Non-Residential Construction |
| 117 | 52500 | Road, Highway & Airstrip Construction |
| 118 | 52600 | Gas & Oil Facility Construction |
| 119 | 52800 | Railway Telephones & Telegraph Construction |
| 120 | 52900 | Other Engineering Construction |
| 121 | 53000 | Air Transportation |
| 122 | 53100-53200 | Services Incidental to Transportation |
| 123 | 53300-53400 | Water Transportation |
| 124 | 53500 | Railway Transportation |
| 125 | 53600 | Truck Transportation |
| 126 | 54000 | Pipeline Transportation |
| 127 | 54100 | Highway & Bridge Maintenance |
| 128 | 54600 | Electric Power |
| 129 | 54700 | Gas Distribution |
| 130 | 54800 | Coke |
| 131 | 55000-55200 | Wholesale Trade |
| 132 | 55300 | Retailing Margins |
| 133 | 56000 | Government Royalties on Natural Resources |
| 134 | 55400-55600, | Financial Inst. & Real Estate |
| | 55800-55900 | |
| 135 | 56600 | Services to Business Management |
| 136 | 58300 | Transportation Margins |
| 137 | 58700 | Purchased Repair Services for Machinery & Equipment |
| 138 | Residual | Other Non-Primary Products |

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