NORTHERN POLICY INSTITUTE | INSTITUT DES POLITIQUES DU NORD

Research Paper No. 28 | March 2019

Income and Employment Multipliers for 20 Industries in 11 Census Divisions in Northern Ontario

By Dr. Bahktiar Moazzami

Who We Are

Some of the key players in this model, and their roles, are as follows:

Board: The Board of Directors sets strategic direction for Northern Policy Institute. Directors serve on operational committees dealing with finance, fundraising and governance, and collectively the Board holds the CEO accountable for achieving our Strategic Plan goals. The Board's principal responsibility is to protect and promote the interests, reputation, and stature of Northern Policy Institute.

President & CEO: Recommends strategic direction, develops plans and processes, and secures and allocates resources to achieve it.

Advisory Council: A group of committed individuals interested in supporting, but not directing, the work of Northern Policy Institute. Leaders in their fields, they provide advice on potential researchers or points of contact in the wider community.

Research Advisory Board: A group of academic researchers who provide guidance and input on potential research directions, potential authors, and draft studies and commentaries. They are Northern Policy Institute's formal link to the academic community.

Peer Reviewers: Ensure specific papers are factual, relevant and publishable.

Authors and Research Fellows: Provide independent expertise on specific policy areas as and when needed.

Standing engagement tools (general public, government stakeholders, community stakeholders): Ensure Northern Policy Institute remains responsive to the community and reflects THEIR priorities and concerns in project selection.

President & CEO

Charles Cirtwill

Board of Directors

Dawn Madahbee Leach (Chair)
Dr. Heather Murchison (Northwest Vice-Chair)
Louise Paquette (Northeast Vice-Chair)
Pierre Bélanger (Treasurer)
Dr. Brian Tucker (Secretary)
Terry Bursey
Dave Canfield
Jean Pierre Chabot
Dr. Harley d'Entremont
Alex Freedman
Diana Fuller Henninger
Emilio Rigato
Asima Vezina
Charles Cirtwill (President & CEO)

Advisory Council

Michael Atkins
Kim Jo Bliss
Dr. Michael DeGagné
Don Drummond
Ronald Garbutt
Jean Paul Gladu
Audrey Gilbeau
Peter Goring
Dr. George C. Macey
Allyson Pele
Ogimaa Duke Peltier
Peter Politis
Tina Sartoretto
Bill Spinney
David Thompson

Research Advisory Board

Dr. Randy Battochio (Chair)
Dr. John Allison
Dr. Hugo Asselin
Dr. Gayle Broad
George Burton
Dr. Robert Campbell
Dr. Iain Davidson-Hunt
Dr. Livio Di Matteo
Dr. Morley Gunderson
Leata Ann Rigg
S. Brenda Small
J.D. Snyder
Dr. Lindsay Tedds

This report was made possible through the support of our partner, Northern Ontario Heritage Fund Corporation. Northern Policy Institute expresses great appreciation for their generous support but emphasizes the following: The views expressed in this commentary are those of the author and do not necessarily reflect the opinions of the Institute, its Board of Directors or its supporters.

Author's calculations are based on data available at the time of publication and are therefore subject to change.

Edited by Mark Campbell.

Published by Northern Policy Institute
874 Tungsten St.
Thunder Bay, Ontario P7B 6T6

ISBN: 978-1-989343-07-4

About the Author

Dr. Bahktiar Moazzami

Dr. Moazzami has taught Economics and Econometrics at Lakehead University since 1988. He is well known for his research activities particularly related to Northern Ontario.

He has written many reports on Northern Ontario's economic development challenges and opportunities. He was commissioned by the Ministry of Northern Development and Mines to undertake a comprehensive study of Northern Ontario's economy as a part of the research conducted for the Growth Plan for Northern Ontario. Included in the study were the identification of growing, declining and emerging industrial clusters in the region.

Professor Moazzami has also written extensively on Northern Ontario's Indigenous people and Northern Indigenous economy. Dr. Moazzami's expertise and influence reaches beyond Lakehead University and Northern Ontario. He has been a regular guest speaker at the University of Waterloo's Economic Development Program.

Contents

This report estimates the multiplication effect of income and employment for ***20 industries in 11 census divisions in Northern Ontario***. The estimates provided in this report are the ***first set of such estimates*** produced for Northern Ontario regions.

Executive Summary

Economic impact analysis is the study of the effect of a change in the demand for goods and services on the level of economic activity in a given geographic area. Often, decision makers in both the private and public sector are interested in the economic impact, or the contribution to the local economy of certain local companies, their current operations, or investment projects. Private and public sector investment in a local economy will have different impacts based upon the industry or sector, the strength of regional interindustry linkages as well as the expenditure habits of consumers in the region. This report estimates the multiplication effect of income and employment for 20 industries in 11 census divisions in Northern Ontario. The estimates provided in this report are the first set of such estimates produced for Northern Ontario regions.

Multipliers are a central component to economic impact analysis. A multiplier seeks to explain the amount by which a change in expenditure (i.e. cash investment) is magnified or multiplied to determine the total final change in expenditures and income in the region in question. Multipliers typically are expressed in terms of output, jobs, or employment income per $1 of the initial investment (or expenditure or business revenue).

In order to estimate income multipliers, the author determines both the proportion of the initial investment which remains within the local community (m_1), as well as the proportion of future rounds of spending that will remain locally (m_2). m_1 examines the retention rates at the industry level, and m_2 examines overall propensity to consume locally at the regional level as a whole, based on characteristics of the local community.

In order to estimate employment multipliers (the number of man-years of employment generated as a result of an initial investment expenditure), the author uses the income multipliers by sector to determine what level of increased income would be required to generate an additional unit of employment. For example, a multiplier of 1.60 means that generating one hundred jobs (man-years of employment) in industry x within a region results in the total creation of 160 jobs in that region.

The paper demonstrates that:

Income multipliers are greatest in the following industries;

1. Retail Trade
2. Professional, Scientific, and Technical Services
3. Arts, Entertainment, and Recreation

These results are similar across the Northwest and Northeast.

Employment multipliers in the Northeast are greatest in the following industries;

1. Mining, Quarrying, Oil and Gas Extraction
2. Utilities
3. Professional, Scientific, and Technical Services

In the Northwest, the highest multipliers include investment in:

1. Utilities
2. Transportation and Warehousing
3. Professional, Scientific and Technical Services

Part I: Introduction

When individuals, firms, or organizations make changes in their expenditures, a series of changes in incomes and expenditures of economic agents is induced. For example, assume a firm producing product A increases its investment in industry A to expand its production. This new investment results in an increase in demand for the goods and services that industry A requires to expand its output of product A. Experiencing higher demand and income, the input providers increase their private consumption and place additional orders for inputs necessary to produce the goods and services required by industry A. These changes in turn generate additional revenues and incomes for other businesses dealing with the producers of product A. Experiencing higher demand, these businesses place new orders with their suppliers and those suppliers place new orders with their suppliers, and so on.

It seems intuitive that the sum of all these changes is larger than the initial change in the expenditures for product A. The multiplier is the amount by which a change in expenditure is magnified or multiplied to determine the total final change in expenditures and income in the region in question. For example, an income multiplier of 1.50 implies that an initial increase in real expenditures of $100 causes total income in the whole region to increase by $150.

The size of the regional multiplier depends on various factors:

1. The structure of the industry in which the initial investment is made. The backward and forward linkages between the industry and the rest of the economy impacts the size of the multiplier.

2. The strength of the overall interindustry linkages in the regional economy. If interindustry relationships are weak (i.e., the forward and backward linkages are not strong), most of the increased demand for goods and services required as inputs to industry A will be imported and thus the overall impact on the regional economy is smaller.

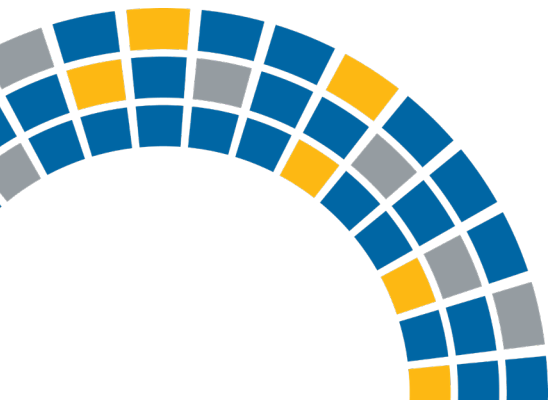
3. The expenditure habits of the consumers in the region. If those who experience increased income purchase most of their goods and services from outside their region, then the multiplier is diminished. The multiplier is smaller if the consumers spend their incomes on goods and services that use mostly imported inputs. Thus, the proportion of consumer spending that directly or indirectly leaks out of a region plays an important role in determining the size of the multiplier.

The objective of this report is to provide accurate and reliable estimates of income and employment multipliers for 20 industries in 11 census divisions in Northern Ontario. The estimates provided in this report are the first set of such estimates produced for Northern Ontario regions.
To estimate various multipliers, we have incorporated the following information:

1. Detailed industry structure in each region

2. Detailed consumer expenditure patterns in each region

3. Average level of wages and income by detailed industry in various regions



Part II: Key Concepts in Economic Impact Analysis

Economic impact analysis is the study of the effect of a change in the demand for goods and services on the level of economic activity in a given geographic area. This change in economic activity is typically measured by business output (sales), value added (gross regional product), employment (number of jobs), and labour income (earnings).

Frequently, we are interested in the economic impact, or the contribution to the local economy, of certain local companies, their current operations, and/or investment projects.

Traditionally, economic impact analysis involves the estimation of three distinct types of expenditure and production activity that capture the various rounds of expenditures and economic activity described briefly above. They are commonly referred to as 'direct impacts,' 'indirect impacts,' and 'induced impacts,' and can be defined as follows:

- Direct impacts refer to immediate economic outcomes occurring as the result of activity related to the operations or the project being evaluated (such as operations of a local company or its investment projects). These immediate outcomes include business output or revenues/ sales, employment of workers, their employment earnings, value-added, and tax revenues.

- Indirect impacts refer to the spin-off economic activities that result from purchases of production inputs, or goods and services, by those businesses that generated the direct effects described in the previous bullet. These purchases of production inputs enable production activities and employment at the supplier firms which, in turn, create output at other firms further down the production chain, thus bringing about additional business output, employment, and earnings.

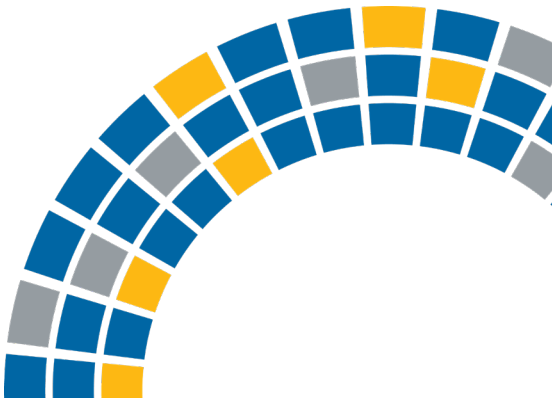
- Induced impacts represent the increase in business output, employment, and earnings over and above the direct and indirect impacts, generated by re-spending of employment income from direct and indirect employment.. Induced impacts are thus changes in output, employment, and earnings that are the result of personal (household) spending for goods and services by employees of the business that generated the direct effect, and employees of all other firms comprise the indirect impact.

- The total economic impact is the sum of the direct, indirect, and induced effects of the company or the project being evaluated.

Indirect and induced impacts are often referred to as 'multiplier effects,' since they increase the overall economic impacts of the original activity and expenditure that initiated all subsequent rounds of spending and effects described above.

Multipliers typically are expressed in terms of output, jobs, or employment income per $1 of the initial investment (or expenditure or business revenue). For example, an output multiplier is the increase in business output for all industries per $1 of initial expenditure. A multiplier of 2.0 for an industry means that a company's investment or expenditure of $1 for products in its industry (or an increase of $1 in revenues in this company) increases business revenues across the entire economy by $2.

It should be noted that the magnitude of multipliers depends on the geographic area within which the impact is estimated. Typically, the smaller the geographic area, the smaller the multiplier will be because of the weaknesses in the forward and backward industrial linkages in the area. For example, local or regional multipliers will usually be smaller than provincial multipliers because the multipliers are determined by the geographic location of purchases at subsequent rounds of spending. The smaller the geographic area (and thus less active and less diversified in terms of economic structure), the smaller the proportion of production inputs and consumer goods that could be provided from within that area. The expenditures that 'leak out' of the local geographic area reduce the magnitude of the multiplier.



Part III: Key Concepts in Multiplier Estimation

John Maynard Keynes introduced the term multiplier into the economic literature. He used the term to refer to the amplifying effect of an initial stimulus to an economy as it gives rise to increased spending and re-spending generating income and employment well above the initial stimuli. In general, the term regional multiplier is defined as the ratio of the total income or employment effect on a regional economy of an initial investment or expenditure, financed from outside the community, to the size of its direct impacts. New economic activity is generally site-specific and the proportion of spending and re-spending that generates a local multiplier effect will vary with the hierarchical level of community in which the activity is located.

As mentioned above, one expects the size of the multipliers to be larger in larger regions compared to smaller communities since interindustry linkages are weaker in smaller areas and therefore spending leakages tend to be greater in smaller communities. In other words, it is incorrect to apply national or provincial multipliers to estimate the impact of an investment or a project in a smaller region such as a census division or subdivision. There is a need to estimate region-specific multipliers that take into account the industrial structure as well as purchasing habits of the residents of the local communities.

There are different approaches to estimating multipliers. The input-output approach is generally preferred if sufficient resources are available. However, input-output tables are not available at the sub-provincial levels and sufficient resources are not usually available to develop such tables at the regional levels. In the absence of input-output tables at local levels, researchers have adopted three broad approaches to estimating regional multipliers.

The first approach is to use shortcut techniques for estimating input-output coefficients at the regional levels. This approach ranges from various non-survey methods (such as use of national coefficients at the local level) to attempts to estimate multipliers on the basis of local purchase coefficients (Drake 1977; Stevens and Trainer 1976). However, the reliability of the shortcut input-output techniques remains questionable (Park et al. 1981).

The second approach is based on the Keynesian expenditure multipliers either by approximation of local spending habits (Archibald 1967; Brown et al. 1967) or by use of some survey of local expenditure patterns along with published statistics (Creig 1971; Brownrigg 1973; McCuire 1983; Glasson et al. 1988). In practice, as we will see below, the Keynesian approach takes only partial account of the total effects of expenditure injections into the economy and does not usually produce multipliers disaggregated by sector.

The third approach employs economic base multipliers that divide the economy into export and service sectors. A survey of local firms can be used to identify export and service sectors. However, survey costs often cause investigators to use shortcut techniques such as minimum requirements or location quotient techniques (Richardson 1985), which render the result sensitive to the level of aggregation used by investigators. In principle, the economic base approach captures the indirect and induced impacts of the initial stimuli. However, similar to the Keynesian approach, it does not often produce disaggregated sectoral multipliers.[1]

The methodology used in this report is similar to the earlier studies on the impact of an organization such as a college or university on the local economy (Wilson and Raymond 1973; Wilson 1977; Rioux and Schofield 1990). Those studies examined the impact of spending on an industry, such as education, in a small regional economy. This is the objective of this present report.

[1] Disaggregated sectoral multipliers can be estimated if survey data are employed. See Mulligan and Cibson 1984a.

Assume that X dollars of investment are made in a community. Let us assume that fraction ai of X is spent in the local economy on goods and services produced in sector i, with i = 1, 2, 3... n. The local expenditures increase the demand for local goods and services, generating additional revenues aiX for the local businesses in industry i. These revenues will then be used to purchase inputs necessary to produce product i. Some inputs will have to be imported from other communities and only a fraction of the investment expenditures, say bi, will appear as local income. The immediate impact of the new investment expenditures, as measured in terms of local income, will thus be equal to:

$$b_1 a_1X + b_2 a_2X + ... + b_n a_nX = X. \sum b_i . a_i = m_1 X \qquad (1)$$

$$\text{where } m_1 = \sum b_i a_i$$

In equation (1), m_1 is the proportion of the initial investment expenditures that stay in the local economy. m_1 is an inner product of two vectors and therefore is a scalar. The income expressed in equation (1) induces a second round of spending generating additional income for the local businesses, which in turn induces the next round of spending.

Let us assume that the propensity to spend locally, or the proportion of income spent in the local economy, is stable in all rounds of spending and that it is the same proportion, m_2, for all residents of the affected community. The dollar amount of the second round of spending remaining in the local economy will then be equal to $m_2(m_1 X)$. The dollar amount of the third round of spending remaining in the local economy will be $m_2(m_2m_1X)$, the dollar amount of the fourth round of spending will be $m_2(m_2^2m_1X)$, and so on.

The total impact on the local economy of the initial investment of X dollars can be expressed as:

$$Y = X + m_1 X + m_1m_2X + m_1m_2^2X + ... = X.\{(1+m_1 - m_2)/(1-m_2)\} = X. K \quad (2)$$

Where Y is local income and $K = \{(1+m_1 - m_2)/(1-m_2)\}$.[2]

K is referred to as the regional multiplier. Estimated K will be multiplier specific to the community and sector in which the initial investment has occurred. As mentioned above, m_2 is the average propensity to consume locally. In other words, it is the value corresponding to m_1 at subsequent rounds of spending in the local economy as a whole. m_2 is based on the characteristics of the entire community. It is defined as: $m_2 = P. G$, where:

- P is vector of shares of each dollar of consumption expenditures spent on different sectors of the entire community that remain in the community.
- G is the vector of portions of household income for the entire community which are spent on different sectors of the local economy. Similar to m_1, m_2 is an inner product of two vectors and therefore is a scalar.

The above formulation of an impact multiplier depends on both m_1 and m_2. These variables reflect the degree to which expenditures remain in the local economy in the first and subsequent rounds of spending respectively. We note that if $m_1 = m_2$, the multiplier is defined as $1/(1-m_2)$, which is the simplest version of the standard multiplier used in many economic impact studies. One might ask which one of these two variables has more influence over the multiplier. The answer depends on the relative sizes of these variables. One can show that:

$$\partial K/\partial m_1 = 1/(1-m_2)$$

$$\partial K/\partial m_2 = m_1/(1-m_2)2$$

$$(\partial K/\partial m_2)/(\partial K/\partial m_1) = m_1/(1- m_2)$$

Where ∂ stands for partial derivative. Therefore, the multiplier, K, is more sensitive to changes in m_2 if $m_1/(1-m_2)$ is greater than 1. Alternatively, the multiplier is more sensitive to changes in m_2 if m_1 is greater than $(1-m_2)$ and more sensitive to m_1 if m_1 is less than $(1-m_2)$. m_1 depends on the characteristics of the sector or sectors receiving the investment, but m_2 reflects the consumption spending pattern of the residents as well as the interindustry structure of the local economy. The implementation of the above theoretical principles will require estimation of m_1 and m_2.

[2] Note that one can expand the left side of equation (2) as $X + m_1 X + m_1m_2X + m_1m_2^2X + ... = X(1+ m_1 + m_1m_2 + m_1m_2^2 + ...)$. Note that $m1 + m_1m_2 + m_1m_2^2 + ...$ is a geometric progression with m_2 being less than unity. Therefore, it equals $m_1/(1-m_2)$. Adding 1 becomes equal to $\{(1+m_1 - m_2)/(1-m_2)\}$.

Part IV: Estimation of Local Multipliers

Estimation of m_1

Estimation of m_1 requires values for the proportions a_i and b_i for each sector or industry where the new investment takes place. If investment is made in only one sector, say i^{th} sector, as is the assumption in the present study, then the value of a_i corresponding to the i^{th} sector equals unity and zero elsewhere. If investment or expenditures are distributed among more than one sector of the economy, then elements in a_i show the shares of expenditures going into each sector.

Estimation of b_i's is more challenging. The best source of b_i's would be a survey of local businesses to determine the sources of their inputs and supplies. Such a survey is, however, prohibitively expensive. Various studies have used a payroll-to-sales ratio as a proxy for b_i (see for example Rioux and Schofield 1990; Wilson and Raymond 1973). Following these earlier studies, this study employs a payroll-to-sales ratio to obtain estimates of b_i's.[3] As an alternative proxy, we also used payroll-to-Gross Regional Product (GRP).

All calculations were done using a detailed four-digit North American Industrial Classification System (NAICS). Payroll by sector is estimated using data from the 2011 National Household Survey on earnings and employment for each census division under investigation. Results were aggregated to obtain payroll by two-digit NAICS. Sales by sector are estimated based on provincial sales and regional share of provincial employment in each industry. We note that labour income underestimates local value-added and thus our payroll-to-sales estimates tend to underestimate local value-added. As mentioned above, as an alternative to payroll-to-sales, we also calculated payroll-to-GRP. GRP is, in turn, estimated based on provincial GDP and regional share of provincial employment in each industry. Use of GRP as a proxy for sales underestimates the value of sales. On the other hand, to the extent that non-labour income is part of local value-added, labour income underestimates local value-added. These two factors can indeed cancel each other out when one averages the resulting estimate of m_1 based on the two alternative estimates.[4]

Tables 1 through 4 show the estimates of b_i's for two-digit industries in various Census Divisions in Northern Ontario.

[3] As discussed above, b is the fraction of investment expenditures that stays in the community as local income (wages and salaries) and is best approximated by local wages and salaries (payroll) to sales and/or payroll to GDP.

[4] The final multipliers reported in this report are based on the average of the two sets of estimates obtained using the two alternative methods of obtaining m_1.

Table 1: Local Income Content of a Dollar of Expenditure by Industry and Geography (Share of GDP in N.E.O.)

Industry (NAICS)	Algoma	Cochrane	Greater Sudbury	Manitoulin	Nipissing	Parry Sound	Sudbury	Timiskaming	NEO
All industries	0.457	0.451	0.440	0.356	0.466	0.412	0.402	0.440	0.449
Agriculture, forestry, fishing, and hunting [11]	0.314	0.417	0.418	0.407	0.262	0.218	0.414	0.322	0.353
Mining, quarrying, and oil and gas extraction [21]	0.280	0.332	0.293	0.163	0.416	0.227	0.250	0.325	0.308
Utilities [22]	0.334	0.398	0.327	0.330	0.333	0.384	0.243	0.314	0.345
Construction [23]	0.380	0.440	0.445	0.269	0.414	0.395	0.351	0.442	0.415
Manufacturing [31-33]	0.448	0.456	0.357	0.288	0.473	0.270	0.501	0.397	0.457
Wholesale trade [41]	0.330	0.416	0.398	0.228	0.349	0.320	0.268	0.490	0.367
Retail trade [44-45]	0.531	0.533	0.605	0.462	0.527	0.573	0.471	0.557	0.552
Transportation and warehousing [48-49]	0.547	0.516	0.576	0.478	0.344	0.473	0.490	0.443	0.545
Information and cultural industries [51]	0.323	0.276	0.310	0.253	0.290	0.239	0.314	0.237	0.298
Finance and insurance [52]	0.353	0.279	0.323	0.200	0.327	0.347	0.244	0.314	0.320
Real estate and rental and leasing [53]	0.064	0.082	0.079	0.068	0.065	0.057	0.050	0.056	0.069
Professional, scientific, and technical services [54]	0.682	0.637	0.658	0.508	0.640	0.534	0.430	0.504	0.638
Management of companies and enterprises [55]	0.070	0.010	0.089	0.010	-	-	-	-	0.076
Administrative and support, waste management, and remediation services [56]	0.288	0.321	0.356	0.166	0.340	0.224	0.552	0.310	0.325
Educational services [61]	0.668	0.662	0.712	0.632	0.666	0.632	0.598	0.682	0.680
Health care and social assistance [62]	0.710	0.734	0.743	0.605	0.756	0.714	0.640	0.725	0.729
Arts, entertainment, and recreation [71]	0.891	0.710	0.581	0.501	0.467	0.591	0.418	0.449	0.677
Accommodation and food services [72]	0.456	0.533	0.595	0.260	0.493	0.484	0.542	0.480	0.517
Other services (except public administration) [81]	0.682	0.689	0.762	0.480	0.706	0.627	0.703	0.561	0.695
Public administration [91]	0.508	0.507	0.494	0.339	0.537	0.522	0.425	0.480	0.500

Table 2: Local Income Content of a Dollar of Expenditure by Industry and Geography (Share of GDP in N.W.O.)

Industry (NAICS)	Thunder Bay	Kenora	Rainy River	N.W.O.
All industries	0.460	0.467	0.453	0.463
Agriculture, forestry, fishing, and hunting [11]	0.484	0.435	0.355	0.443
Mining, quarrying, and oil and gas extraction [21]	0.297	0.347	0.256	0.316
Utilities [22]	0.345	0.304	0.408	0.350
Construction [23]	0.445	0.358	0.356	0.414
Manufacturing [31-33]	0.354	0.489	0.475	0.388
Wholesale trade [41]	0.367	0.325	0.327	0.347
Retail trade [44-45]	0.565	0.627	0.544	0.578
Transportation and warehousing [48-49]	0.601	0.639	0.550	0.608
Information and cultural industries [51]	0.271	0.307	0.207	0.276
Finance and insurance [52]	0.340	0.322	0.258	0.330
Real estate and rental and leasing [53]	0.060	0.077	0.047	0.066
Professional, scientific, and technical services [54]	0.703	0.736	0.544	0.704
Management of companies and enterprises [55]	0.010	0.010	0.001	0.059
Administrative and support, waste management, and remediation services [56]	0.311	0.319	0.294	0.314
Educational services [61]	0.667	0.614	0.619	0.661
Health care and social assistance [62]	0.704	0.729	0.776	0.717
Arts, entertainment, and recreation [71]	0.645	0.726	0.502	0.647
Accommodation and food services [72]	0.498	0.411	0.502	0.475
Other services (except public administration) [81]	0.772	0.726	0.659	0.751
Public administration [91]	0.511	0.398	0.416	0.466

Table 3: Local Income Content of a Dollar of Expenditure by Industry and Geography (Share of Output in N.E.O.)

Industry (NAICS)	Algoma	Cochrane	Greater Sudbury	Manitoulin	Nipissing	Parry Sound	Sudbury	Timiskaming	N.E.O.
Agriculture, forestry, fishing, and hunting [11]	0.118	0.168	0.171	0.162	0.110	0.098	0.153	0.125	0.139
Mining, quarrying, and oil and gas extraction [21]	0.190	0.219	0.200	0.108	0.238	0.151	0.163	0.175	0.205
Utilities [22]	0.253	0.297	0.302	0.420	0.263	0.342	0.175	0.288	0.277
Construction [23]	0.180	0.150	0.200	0.096	0.189	0.159	0.184	0.130	0.171
Manufacturing [31-33]	0.093	0.183	0.289	0.383	0.307	0.200	0.234	0.233	0.120
Wholesale trade [41]	0.200	0.275	0.252	0.268	0.225	0.215	0.217	0.300	0.236
Retail trade [44-45]	0.328	0.331	0.371	0.288	0.326	0.354	0.297	0.352	0.341
Transportation and warehousing [48-49]	0.208	0.244	0.258	0.257	0.231	0.232	0.253	0.221	0.242
Information and cultural industries [51]	0.150	0.162	0.200	0.166	0.164	0.135	0.495	0.161	0.179
Finance and insurance [52]	0.504	0.237	0.317	0.205	0.294	0.312	0.263	0.310	0.287
Real estate and rental and leasing [53]	0.158	0.078	0.085	0.090	0.075	0.070	0.064	0.049	0.079
Professional, scientific, and technical services [54]	0.423	0.417	0.419	0.326	0.410	0.342	0.276	0.323	0.405
Management of companies and enterprises [55]	0.060	0.010	0.080	0.006	0.010	-	-	-	0.070
Administrative and support, waste management, and remediation services [56]	0.183	0.203	0.234	0.205	0.214	0.147	0.350	0.244	0.210
Educational services [61]	0.585	0.580	0.632	0.554	0.584	0.553	0.524	0.597	0.596
Health care and social assistance [62]	0.551	0.588	0.590	0.471	0.595	0.548	0.506	0.572	0.573
Arts, entertainment, and recreation [71]	0.510	0.480	0.581	0.460	0.467	0.591	0.418	0.449	0.677
Accommodation and food services [72]	0.223	0.264	0.275	0.125	0.237	0.258	0.254	0.229	0.250
Other services (except public administration) [81]	0.565	0.571	0.632	0.398	0.585	0.520	0.582	0.465	0.576
Public administration [91]	0.181	0.181	0.215	0.132	0.200	0.195	0.164	0.169	0.192

Table 4: Local Income Content of a Dollar of Expenditure by Industry and Geography (Share of Output in N.W.O.)

Industry (NAICS)	Kenora	Rainy River	Thunder Bay	N.W.O.
Agriculture, forestry, fishing, and hunting [11]	0.165	0.125	0.196	0.172
Mining, quarrying, and oil and gas extraction [21]	0.236	0.174	0.193	0.208
Utilities [22]	0.309	0.306	0.273	0.284
Construction [23]	0.147	0.146	0.204	0.182
Manufacturing [31-33]	0.221	0.174	0.156	0.169
Wholesale trade [41]	0.213	0.205	0.226	0.215
Retail trade [44-45]	0.391	0.341	0.346	0.357
Transportation and warehousing [48-49]	0.251	0.289	0.237	0.241
Information and cultural industries [51]	0.175	0.124	0.173	0.171
Finance and insurance [52]	0.289	0.340	0.302	0.299
Real estate and rental and leasing [53]	0.082	0.051	0.074	0.074
Professional, scientific, and technical services [54]	0.459	0.349	0.454	0.450
Management of companies and enterprises [55]	0.001	-	0.010	0.051
Administrative and support, waste management, and remediation services [56]	0.213	0.187	0.198	0.200
Educational services [61]	0.538	0.543	0.598	0.579
Health care and social assistance [62]	0.535	0.587	0.568	0.561
Arts, entertainment, and recreation [71]	0.254	0.502	0.645	0.647
Accommodation and food services [72]	0.235	0.297	0.244	0.246
Other services (except public administration) [81]	0.602	0.546	0.640	0.622
Public administration [91]	0.142	0.158	0.189	0.171
Public administration [91]	0.511	0.398	0.416	0.466

Estimation of m_2

In determining the value of m_2, which measures the proportion of each dollar of consumption spending paid to local factors of production in subsequent rounds of expenditures, most authors have used the economic base method (Rioux and Schofield 1990), which divides the local economy into two sectors: (1) the basic sector and (2) the service sector.[5]

The basic, or base, sector is comprised of industries whose output is exported to other communities, or whose ultimate markets lie outside of the region. Quasi-base sectors are sectors supported by funds from outside the region. They include federal and provincial public administration, health care, tourism, and education. Local input suppliers to the exporting industries are also included in the base. For example, if firm A sells its entire output locally to firm B and the latter exports all it produces, firm A is part of the base sector because its ultimate market is outside the region.

The service sector, also referred to as a non-base sector, consists of that portion of total economic activity in which the ultimate market is local, or whose output is consumed solely in the local economy. Examples of non-base industries include the retail sector, local banking, and financial services. These sectors depend on income and wealth generated in the base and quasi-base sectors and they can only expand if new income is generated in the base and quasi-base sectors.

This breakdown of the local economy reflects the distinct sources of demand facing the two sectors.

Assuming that income is proportional to employment, the proportion of income spent locally is equal to the ratio of non-basic or service employment (SE) to total employment (TE). If it is also assumed that average and marginal propensities to spend locally are equal, then m_2 can be *approximated* by the ratio of SE to TE in the community.

Therefore, to estimate m_2, one has to identify base and non-base employment in the various communities under investigation.

[5] See Tiebout (1962). Some of the empirical studies employing the economic base model are Rioux and Schofield (1990) and Mulligan and Gibson (1984). Each of these studies contains a brief discussion of the economic base model.

Methods of Identifying Base and Non-Base Sectors

1. Judgment Method

In this approach, basic regional employment is assumed to consist of all jobs in agriculture, mining, manufacturing, transportation, and non-local government. Service employment then consists of construction, communication, utilities, trade, and local government. If the economy is sufficiently simplistic and the analyst sufficiently knowledgeable about the firm's ultimate market, identification of base and non-base activity can be reasonably accurate. If the researcher has sufficient knowledge of the local economy, he or she can remove portions of sectors from the economic base. For example, agriculture supplying only the local market should be removed from the base. Similarly, small manufacturing firms can also be removed from the base if their final demand comes from the local market.

2. Survey Method

In a more complex regional economy the analyst must turn to more complex means to identify base and non-base employment. One obvious alternative is to ascertain total employment of various regional establishments and identify the division of sales to markets inside and outside the region. Employment in each firm is then allocated to the base and non-base sectors corresponding with the firm's division of sales. The problem with this method, aside from sampling problems and errors, is potential confusion between immediate purchasers and ultimate markets. This problem generally intensifies with a larger economy, since technical linkages between establishments usually become more complex as the economy expands. In a complex economic climate, firms usually do not have detailed information about their markets beyond their immediate wholesalers.

3. Location Quotient Method

One common approach to identifying a region's economic base is the location quotient index (LQ). This index is a simple ratio of an industry's share of local employment relative to the industry's share of national employment:

$$LQi = (Ri/TE)/(Ni/N)$$

where Ri and Ni are regional and national (or provincial) employment in sector 'i', respectively, and TE and N are the regional and national (provincial) employment totals.

In essence, this index indicates the regional importance of the industry relative to its national or provincial importance. When the value of the index is one, local production per capita is equal to the provincial production per capita. Therefore, local production is just sufficient to satisfy local consumption. Thus, the locality neither exports nor imports the good or service in question. An index value greater than one indicates exports of that good or service from the region. An index value smaller than one indicates that local production is not enough to satisfy local demand, leading to importation of the good or service. It is possible to eliminate overlap in the LQ index by subtracting the local economy from the national or provincial economies. The subtraction is necessary to prevent a downward bias in the resulting quotients, particularly for specialized industries.

Total basic employment and service employment can be thus calculated as:

$$BE = \sum R \{(R_i/TE) - (N_i/N)\} \text{ for all } (R_i/TE) > (N_i/N) \qquad (3)$$

And

$$SE = TE - BE$$

An alternative and a more accurate estimate of m_2 can be obtained if one has information on the average consumption spending by industry of households in the communities under investigation. Information on household expenditure patterns coupled with the estimates of the local value-added content of expenditures by industry can be used to estimate m_2. This is the approach taken in this study. For the sake of comparison, we also estimated m_2 based on location quotient methodology. Results were similar. Appendix I shows the estimates of household expenditure patterns in various census divisions in Northern Ontario in 2016. Table 5 shows two sets of estimates for m_2. The estimates in the second column use the local value-added figures based on GRP. The estimates in the third column are based on the local value-added content estimated using output shares.

Table 5: Share of Each Dollar of Consumption Spending Paid to Local Factors of Production

Region	m_2 (GRP-based)	m_2 (Output-based)
Algoma	0.387	0.220
Cochrane	0.356	0.212
Greater Sudbury	0.380	0.271
Manitoulin	0.325	0.203
Nipissing	0.357	0.252
Parry Sound	0.393	0.279
Sudbury	0.329	0.242
Timiskaming	0.373	0.266
N.E.O.	**0.373**	**0.265**
Thunder Bay	0.366	0.260
Kenora	0.407	0.240
Rainy River	0.353	0.264
N.W.O.	**0.375**	**0.266**

Employment Multiplier

To estimate the employment multiplier, we follow the procedure suggested by Davis (1990). The number of man-years of employment generated as a result of an initial investment expenditure can be estimated from the income multiplier by calculating the increase in income that is required to generate an additional unit of employment. In other words, the employment multiplier, Me, for sector i can be constructed from the income multiplier, My, for sector i as follows:

$$Me = (My - 1)(Yi/YT) + 1$$

Where Yi is the average annual earnings in sector i and YT is the average annual employment income in the community. For example, assume that income multiplier My in sector i equals 1.5 and the average annual earnings in that sector (Yi) equal $40,000 while the average annual earnings in the community (YT) receiving the investment equal $20,000. Therefore, a job created in sector i results in a rise in income of $60,000 (1.5 x $40,000), which is the equivalent of one $40,000 annual income job in sector i and a $20,000 annual income job in the community. Thus, one job in sector i results in another job elsewhere in the community resulting in an employment multiplier of 2.[6]

[6] Me = (1.5 -1)($40,000/$20,000) + 1 = 2

Part V: Income and Employment Multipliers in Northern Ontario Regions

The final estimates reported in this part of the research are based on the average of the two sets of estimates obtained using the two measures of local value-added content discussed above. Table 6 shows the income multipliers by industry and geography in Northeastern Ontario.

Table 6: Income or Value-Added Multipliers by Industry and Census Division (N.E.O.)

Industry (NAICS)	Algoma	Cochrane	Greater Sudbury	Manitoulin	Nipissing	Parry Sound	Sudbury	Timiskaming
11 Agriculture, forestry, fishing, and hunting	1.335	1.213	1.290	1.340	1.278	1.247	1.284	1.342
21 Mining, quarrying, and oil and gas extraction	1.356	1.397	1.470	1.201	1.386	1.292	1.413	1.378
22 Utilities	1.442	1.377	1.430	1.400	1.435	1.419	1.426	1.447
23 Construction	1.431	1.437	1.496	1.281	1.449	1.436	1.352	1.440
31-33 Manufacturing	1.427	1.470	1.486	1.476	1.575	1.361	1.272	1.475
41 Wholesale trade	1.403	1.349	1.410	1.354	1.423	1.412	1.435	1.411
44-45 Retail trade	1.653	1.624	1.610	1.558	1.629	1.492	1.336	1.482
48-49 Transportation and warehousing	1.586	1.555	1.642	1.553	1.423	1.551	1.293	1.503
51 Information and cultural industries	1.364	1.317	1.387	1.311	1.336	1.291	1.385	1.299
52 Finance and insurance	1.626	1.367	1.410	1.292	1.392	1.432	1.346	1.425
53 Real estate and rental and leasing	1.158	1.099	1.100	1.112	1.101	1.096	1.0850	1.082
54 Professional, scientific, and technical services	1.567	1.529	1.575	1.620	1.547	1.677	1.353	1.621
55 Management of companies and enterprises	1.057	1.000	1.071	1.100	1.110	1.090	1.100	1.060
56 Administrative and support, waste management, and remediation services	1.358	1.378	1.390	1.265	1.286	1.287	1.311	1.334
61 Educational services	1.530	1.510	1.490	1.490	1.450	1.419	1.391	1.516
62 Health care and social assistance	1.540	1.540	1.470	1.450	1.450	1.419	1.348	1.516
71 Arts, entertainment, and recreation	1.727	1.552	1.867	1.410	1.676	1.819	1.456	1.664
72 Accommodation and food services	1.521	1.581	1.490	1.292	1.543	1.419	1.255	1.538
81 Other services (except public administration)	1.758	1.725	1.730	1.642	1.780	1.721	1.351	1.764
91 Public administration	1.536	1.509	1.510	1.360	1.386	1.419	1.283	1.497

Table 6 shows the estimated income (or value-added or GDP) multipliers of $1 of investment expenditures in different sectors of Northeastern Ontario's economy. For example, it shows that $1,000 of investment in the construction industry generates $1,431 in income in Algoma District. The same multiplier for the Greater Sudbury region is 1.496, implying that a $1,000 investment in construction would result in $1,496 of income in the Greater Sudbury region.

Table 7 shows the income multipliers by industry and geography in Northwestern Ontario.

Table 7: Income or Value-Added Multipliers by Industry & Geography (N.W.O.)

Industry	Rainy River	Thunder Bay	Kenora
11 Agriculture, forestry, fishing, and hunting	1.358	1.420	1.334
21 Mining, quarrying, and oil and gas extraction	1.315	1.366	1.311
22 Utilities	1.414	1.458	1.407
23 Construction	1.373	1.430	1.399
31-33 Manufacturing	1.331	1.387	1.334
41 Wholesale trade	1.390	1.410	1.415
44-45 Retail trade	1.649	1.682	1.514
48-49 Transportation and warehousing	1.618	1.637	1.334
51 Information and cultural industries	1.244	1.332	1.230
52 Finance and insurance	1.428	1.437	1.381
53 Real estate and rental and leasing	1.071	1.098	1.107
54 Professional, scientific, and technical services	1.471	1.613	1.604
55 Management of companies and enterprises	1.010	1.020	1.000
56 Administrative and support, waste management, and remediation services	1.353	1.381	1.280
61 Educational services	1.514	1.535	1.530
62 Health care and social assistance	1.514	1.535	1.540
71 Arts, entertainment, and recreation	1.725	1.871	1.779
72 Accommodation and food services	1.401	1.500	1.501
81 Other services (except public administration)	1.697	1.730	1.670
91 Public administration	1.427	1.450	1.429

Table 7 shows the estimated income (or value-added or GDP) multipliers of $1 of investment expenditures in different sectors of Northwestern Ontario's economy. For example, it shows that $1,000 of investment in the manufacturing industry generates $1,331 of income in Rainy River District. The same multiplier for Thunder Bay District is 1.387, implying that a $1,000 investment in the manufacturing sector would result in $1,387 of income in Thunder Bay District.

Table 8 shows the employment multipliers by industry and geography in Northeastern Ontario.

Table 8: Employment Multiplier by Industry & Geography (Northeastern Ontario)

Industry (NAICS)	Algoma	Cochrane	Greater Sudbury	Manitoulin	Nipissing	Parry Sound	Sudbury	Timiskaming
Agriculture, forestry, fishing, and hunting [11]	1.20	1.17	1.25	1.23	1.13	1.08	1.24	1.18
Mining, quarrying, and oil and gas extraction [21]	1.59	1.70	1.75	1.25	1.77	1.42	1.62	1.72
Utilities [22]	1.78	1.70	1.74	1.88	1.78	1.94	1.59	1.77
Construction [23]	1.42	1.45	1.51	1.24	1.47	1.48	1.32	1.51
Manufacturing [31-33]	1.61	1.55	1.57	1.49	1.71	1.35	1.40	1.55
Wholesale trade [41]	1.42	1.40	1.56	1.32	1.45	1.46	1.38	1.49
Retail trade [44-45]	1.39	1.33	1.44	1.40	1.36	1.34	1.19	1.30
Transportation and warehousing [48-49]	1.60	1.49	1.63	1.62	1.42	1.56	1.41	1.43
Information and cultural industries [51]	1.34	1.31	1.34	1.32	1.34	1.25	1.41	1.24
Finance and insurance [52]	1.77	1.33	1.49	1.26	1.45	1.58	1.30	1.48
Real estate and rental and leasing [53]	1.15	1.09	1.12	1.15	1.09	1.09	1.08	1.07
Professional, scientific, and technical services [54]	1.74	1.62	1.68	1.78	1.69	1.79	1.31	1.64
Management of companies and enterprises [55]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Administrative and support, waste management, and remediation services [56]	1.19	1.20	1.28	1.20	1.18	1.13	1.32	1.24
Educational services [61]	1.65	1.57	1.67	1.71	1.55	1.54	1.44	1.66
Health care and social assistance [62]	1.58	1.57	1.59	1.52	1.53	1.50	1.36	1.60
Arts, entertainment, and recreation [71]	1.64	1.35	1.45	1.25	1.31	1.53	1.19	1.30
Accommodation and food services [72]	1.19	1.23	1.27	1.07	1.21	1.19	1.11	1.20
Other services (except public administration) [81]	1.55	1.49	1.58	1.41	1.59	1.53	1.27	1.47
Public administration [91]	1.69	1.60	1.62	1.44	1.53	1.61	1.32	1.62

Table 8 shows employment multipliers by industry in various census divisions in Northeastern Ontario. For example, generating one job (a man-year of employment) in the construction industry results in 1.42 man-years of employment in the Algoma District. The same employment multiplier for the Greater Sudbury region is 1.51 suggesting that the creation of 100 jobs in the construction sector of Greater Sudbury would result in the creation of 151 jobs in that region.

Table 9 shows the employment multipliers by industry and geography in Northwestern Ontario.

Table 9: Employment Multiplier by Industry & Geography (Northwestern Ontario)

Industry (NAICS)	Kenora	Rainy River	Thunder Bay
Agriculture, forestry, fishing, and hunting [11]	1.32	1.24	1.36
Mining, quarrying, and oil and gas extraction [21]	1.61	1.44	1.58
Utilities [22]	1.64	1.90	1.81
Construction [23]	1.35	1.34	1.47
Manufacturing [31-33]	1.50	1.53	1.44
Wholesale trade [41]	1.36	1.37	1.46
Retail trade [44-45]	1.36	1.45	1.41
Transportation and warehousing [48-49]	1.39	1.64	1.69
Information and cultural industries [51]	1.19	1.12	1.32
Finance and insurance [52]	1.42	1.39	1.49
Real estate and rental and leasing [53]	1.10	1.04	1.09
Professional, scientific, and technical services [54]	1.83	1.51	1.83
Management of companies and enterprises [55]	n.a.	n.a.	n.a.
Administrative and support, waste management, and remediation services [56]	1.17	1.19	1.21
Educational services [61]	1.58	1.59	1.67
Health care and social assistance [62]	1.55	1.60	1.59
Arts, entertainment, and recreation [71]	1.54	1.36	1.53
Accommodation and food services [72]	1.19	1.19	1.19
Other services (except public administration) [81]	1.51	1.49	1.58
Public administration [91]	1.46	1.50	1.56

Table 9 shows employment multipliers by industry in various census divisions in Northwestern Ontario. For example, generating one job (a man-year of employment) in the transportation industry results in 1.64 man-years of employment in Rainy River District. The same employment multiplier for Thunder Bay District is 1.69, suggesting that creating 100 jobs in Thunder Bay's transportation sector would result in the creation of 169 jobs in that district.

References

Archibald, G.C. 1967. "Regional Multiplier Effects in the U.K." Oxford Economic Papers. XIX: 22-45.

Brown, A., H. Lind, and J. Bowers. 1967. "The Green Paper on the Development Areas." National Institute Economic Review.

Brownrigg, M. 1973. "The Economic Impact of a New University." Scottish Journal of Political Economy. XX 2: 123-139.

Creig, M.A. 1971. "The Regional Income and Employment Multiplier Effects of a Pulp Mill and Paper Mill." Scottish Journal of Political Economy. XVIII: 31-49.

Davis, H. Craig. 1990. Regional Economic Impact Analysis and Project Evaluation. Vancouver: University of British Columbia Press.

Drake, R.L. 1977. "A Short-Cut to Estimates of Regional Input-Output Multipliers: Methodology and Evaluation." International Regional Science Review. 1: 1-17.

Glasson, J., D. Van De Wea, and B. Barrett. 1988. "A Local Income and Employer Multiplier Analysis of a Proposed Nuclear Power Station at Hinkley Point in Somerset." Urban Studies. 24(3): 248-261.

McCuire, A. 1983. "The Regional Income and Employment Impacts of Nuclear Power Stations." Scottish Journal of Political Economy. 30(4): 264-274.

Mulligan, G.F., and L.J. Gibson. 1984. "A Note on Sectoral Multipliers in Small Communities." Growth and Change. 15(4) 984: 3-7.

Park, S.H., M. Mohtadi, and A. Kubursi. 1981. "Errors in Regional Non-Survey Input-Output Models Analytic and Simulation Results." Journal of Regional Science. 21(3): 321-37.

Richardson, H.W. 1985. "Input-Output and Economic Base multipliers: Looking Backward and Forward." Journal of Regional Science. 25: 607-62.

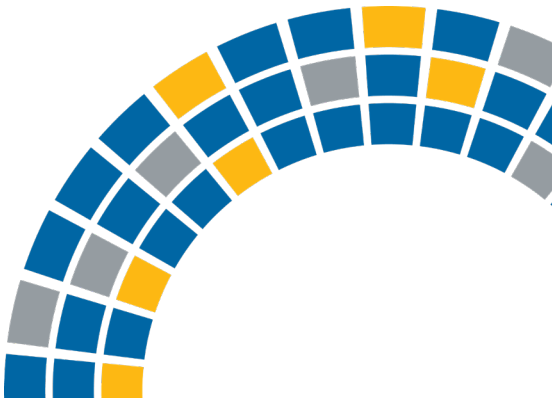
Rioux, J.J.M., and J.A. Schofield. 1990. "Economic Impact of a Military Base on its Surrounding Economy: The Case of CFB Esquimalt, Victoria, British Columbia." Canadian Journal of Regional Science. 13(1): 47-61.

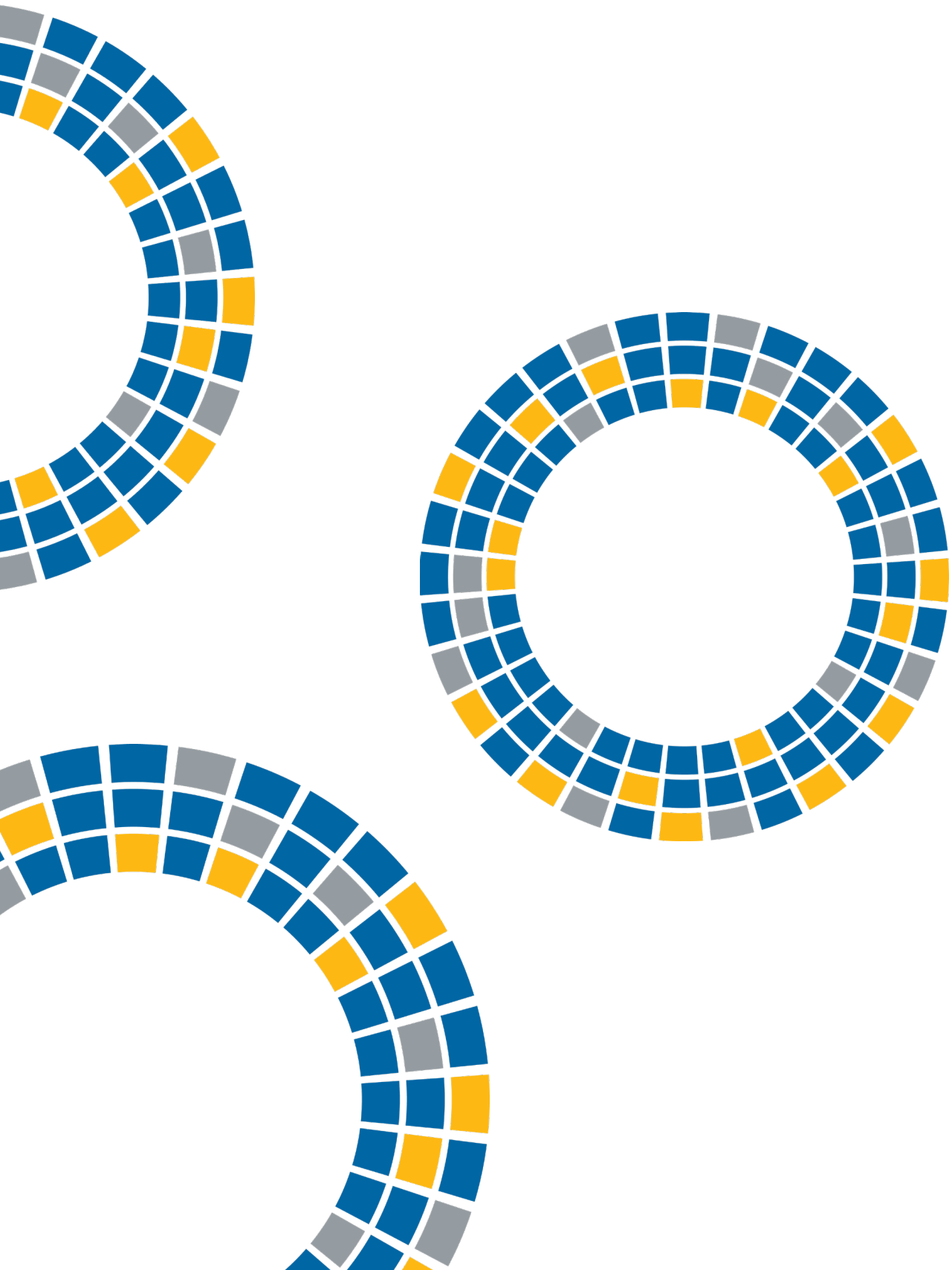
Stevens, B.H., and G.H. Trainer. 1976. "The Generation of Error in Regional Input-Output Impact Models." Regional Science Research Institute Working Paper A1-76. Amherst, Massachusetts.

Tiebout, Charles M. 1962. "The Community Economic Base Study." New York.

Wilson J.H., and R. Raymond. 1973. "The Economic Impact of a University Upon the Local Community." Annals of Regional Science. VII, 2: 430-442.

Wilson, J.H. 1977. "Impact Analysis and Multiplier Specification." Growth and Change. VIII, 3: 42-46.





About Northern Policy Institute

Northern Policy Institute is Northern Ontario's independent think tank. We perform research, collect and disseminate evidence, and identify policy opportunities to support the growth of sustainable Northern Communities. Our operations are located in Thunder Bay and Sudbury. We seek to enhance Northern Ontario's capacity to take the lead position on socio-economic policy that impacts Northern Ontario, Ontario, and Canada as a whole.

Related Research

Community Labour Market Reports
Amandine Martel and José-Karl Noiseux

Economic Zones of Northern Ontario
Charles Conteh

Northern Projections – Human Capital Series
James Cuddy & Dr. Bahktiar Moazzami

To stay connected or get involved, please contact us at:
1 (807) 343-8956 info@northernpolicy.ca www.northernpolicy.ca

NORTHERN POLICY INSTITUTE | INSTITUT DES POLITIQUES DU NORD

northernpolicy.ca