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The Economic Impact of Agriculture in Canada: A Three Dimensional Perspective

Prepared for
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Introduction

It is a well-founded and generally accepted assertion that the contribution of the agricultural sector to the Canadian economy is substantive but not substantial. What are contentious are the exact boundaries (what activities it should include) of this sector and the magnitudes of its importance (contributions to GDP, employment, exports, manufacturing activity, etc.). The issues are both conceptual and empirical.

It seems that at the national level, farm incomes have been decreasing in real terms, whether measured since 1970, 1960, or 1950, and whether measured as net cash income, or as net realized income after accounting for deprecation of assets.[i] The sales of agricultural products fell for the first time in the new millennium, in 2003, to $35.9 billion, down 11.6% mainly due to a large decline in livestock receipts. The Prairie Provinces experienced a collective decline in sales of agricultural products of 21.1% as they were hit by the BSE crises and back-to-back droughts in 2001 and 2002.[ii] This has presented a problem for Canadian Agri-Food Policy Institute (CAPI) and other stakeholders with interest in a healthy and efficient agricultural sector.

The main purposes of this study are:

- to identify and quantify the contributions of the agricultural sector to the economy at large;
- to identify and quantify its contributions to the rural economies of Canada using case studies in three jurisdictions; one in Ontario, one in Saskatchewan and one in Alberta;
- to identify and quantify the sectoral backward and forward linkages of agriculture in the economy at large and in four provincial economies (Ontario, Saskatchewan, Alberta and Manitoba) and,
- to identify and quantify the productivity performance of agriculture over time at the national and selected provinces.

Two perspectives will be used to delineate the role of the agricultural sector in the rural (local county or region), provincial and national economies. First, a two dimensional macroeconomic perspective that includes contributions to Gross Domestic Product (GDP) and employment by sector is developed to position the agricultural activity within the rural and the entire economy. Second, a sectoral perspective based on input output tables is employed to position the agricultural sector within the structure and composition of production in the three selected rural economies, as well as the provincial and national economies. Shares, intensities, multipliers and linkage coefficients are generated to gauge the agricultural sector's linkages to other sectors and its role in the local and broader economies within a comparative framework that allowed the use of these indicators to compare the agricultural sector's performance and structure with other sectors in the national, provincial and rural economies.

Background

It is difficult to imagine a secure, balanced or thriving economy that does not produce a proportion of its food and feed, despite the high cost this may impose on other sectors and activities. There isn't a single advanced economy, with the possible exception of Australia and New Zealand that does not subsidize or protect its farmers. Issues of efficiency typically take a back seat position to issues of security of supply and sustaining a rural way of life. Unfortunately, there does not exist a single or a collection of indicators that adequately capture this fact. It is necessary, therefore, to take a broad perspective to evaluate alternative definitions of this sector that go beyond the rudimentary metrics of tonnes produced or dollars earned.

Income accounts provide aggregate measures of the contributions of economic sectors and activities in terms of value added, employment, expenditures and other relevant indices. While these aggregate indices are very useful in defining the overall contribution of a given sector, they provide little or truncated information on the way the sector or activity relates to other sectors in the economy. Furthermore, these indices are rarely defined for smaller regional geographies below the provincial boundaries and are of limited use in identifying the crucial and critical links the agricultural sector provides for the development of rural or regional economic capacities. It is also true that the provincial income accounts use very narrow definitions of agricultural activity. It is typically restricted to marketable final goods. It excludes important non-market activities, such as auto consumption or production within integrated firms. Imputations of these values are typically made but generally underestimate the true values of these magnitudes.

In this study we have adopted a multi-dimensional framework to capture the many contributions that the agricultural sector makes to the economy at large (at the provincial level) in four major provinces of Canada (Alberta, Saskatchewan, Manitoba and Ontario) but particularly the rural economies of Canada:

- A macroeconomic perspective which identifies the agricultural activity within the overall structure of the economy.

- A sectoral perspective which positions the agricultural sector within the inter-industrial structure of the regional and also the provincial economy, both as a utility generator and as a cost of production and distribution.

- A spatial perspective that links the agricultural activity to regional and rural development and sub-regional economic interactions.

A thorough analysis of the contributions of agriculture to the rural economy within which it is situated is also undertaken in three selected rural areas—Oxford County in Ontario, Brandon Manitoba and Lethbridge Alberta. Indicators such as Gross Domestic Product (value added) at factor cost (value of output before it reaches the market), as well as employment levels generated directly by the agricultural sector and those sustained indirectly (inclusive of some induced impacts) in the rural economy are identified and quantified and their implications analyzed and evaluated.

Approach

Each economic system has a complicated internal structure that determines its performance. The study of this internal structure has become indispensable to the proper understanding and management of the economy. This is perhaps why, over the past few decades, the internal economic framework of a large number of economies has been described by many techniques such as "input-output" analysis and/or process analysis.

Inter-industry tables (or process schedules) are now widely used accounting frameworks for the analysis of sectoral linkages.[iii] In this framework, sectoral relationships appear in a web of interconnectedness since each sector is considered to buy its input requirements from many sectors and sell its outputs to several other sectors and compete for some scarce factors with other sectors. In the "open" version of the system, each sector sells to an "autonomous sector" which has no output of its own. This "autonomous sector" represents final demand. The tables reveal the indirect relationships of an economic system and facilitate the economic justification and interpretation of these indirect relationships and their consequences.

In this study, a detailed analysis of sectoral interdependencies within the rural economy and the resulting economic implications for the agriculture sector are based on the most recent inter-provincial input/output tables (1999). In particular, the characteristics of the agricultural sector and its impact on rural/provincial economic structures will be examined. These include:

- the various primary and induced income and employment multipliers for agricultural activity;
- the nature and extent of indirect and induced links among the various sectors of the economy with the agricultural sector;
- the position of the agricultural sector within the different types of productive sectors classified according to their input uses and output distribution;
- the nature and extent of backward linkages among sectors connected to the agricultural sector;
- the nature and extent of forward linkages among sectors and the agricultural sector;

Input-output analysis quantifies the linkages that an industry has with other industries in the economy. Specifically, an industry may buy or sell directly from only a few industries, but its customers and suppliers may be intricately connected to other unrelated industries. As a result, this industry may have a profound influence on the economy through its indirect relations with other industries. Take the example of production of wheat. This requires seeds that come from agriculture, machinery from industry, energy from the mines and refineries, fertilizers and pesticides from the chemical industries and labour. These define **the direct requirements** to sustain the production of wheat. But the supply of fertilizers requires energy, chemicals, labour

and machinery and the production of machinery requires steel, plastics, energy and skilled labour. The sum total of these outputs and their successive requirements define **the indirect requirements**. At every stage of production incomes are paid to workers and other factors of production. These incomes after taxes are spent on consumption bundles that require deliveries of output. The sum total of these deliveries is referred to as the induced effects. When the direct, indirect and induced effects are summed we derive the total effects of a given change in the output of a given sector.

A primary objective of this study is also to capture and quantify the impacts of an export base sector (agriculture) on the rural economy. The export sector brings "new money" to the community and these new resources drive new rounds of economic activity in proportion to the response of other local rural sectors to the demands on their output and services arising from the indirect demands of the sectors supplying the export base. Equally relevant are also the new demands that higher and new incomes generated by the direct and indirect increases in output will sustain in the community. These are typically referred to as the induced impacts. At each round of impact a fraction of the demand created in the local/rural area is met by imports that represent a leakage. The smaller and less diversified a region is the larger are the leakages and the smaller the proportion of total demand increases are met from within the local area.

Economic impact analysis is a useful mathematical tool capable of quantifying the patterns and magnitudes of income and employment generation that a given input/output structure of an economy could support. It is one of several social accounting systems that can be used to evaluate programs, projects and activities in terms of a suite of non-market criteria. Impact analysis is typically predicated on three fundamental propositions.

- Regardless of the inherent value of primary activities such as the creation of employment or healthy and reasonably priced food, these activities generate socio-economic consequences that are recognised and deemed important by communities and policy makers. These impacts go beyond the customary outcomes of profits or returns on investment.

- Theses socio-economic impacts are quantifiable and can be measured and compared within the same platform.

- Economic impacts are only partially captured by assessing the outcomes generated by initial expenditures. The economy is a complex whole of interdependent and interacting activities, there are significant indirect and induced impacts associated with each direct expenditure. These indirect and induced impacts are often larger than the direct impacts. But total impacts depend crucially on leakages and the capacity of local sectors to meet the increased demands driven by export activities.

The Economic Impact Model

The impact model that will be used in this project is a special application of a generic regional impact model (RIM: Canada) developed by Econometric Research Limited. It is a unique model that captures the economic impact of different activities at the local level, the provincial level

and the national level. The model is based on a novel technology that integrates input-output analysis and location theory. The system has already been applied to the study of the economic impact of Tobacco Agriculture in South-western Ontario, The Economic Impact of the Canadian Wheat Board on the Prairie Region, Great Whale Project in Quebec and several large investment projects in New York, the economic Impact of Casino Windsor, Casino Niagara and RAMA, the economic impact of large real estate developments in Ottawa and Windsor, the economic impact of Hamilton Harbour, horseracing and breeding in Ontario, and several proposed manufacturing and tourism projects in Alberta, British Columbia and Ontario.

The model utilises a large set of economic and technical databases for Canada that are regularly published by Statistics Canada.[iv] A short list includes the inter-provincial input output tables, employment by sector, taxes by type of tax and the level of government collecting it, prices of products, energy used in physical and energy units, etc.

Some of the key impact indicators generated by these models are defined below to assist the reader in interpreting the results of the economic impact analysis:

Value Added (Gross Provincial Income) – This figure represents net output generated by the initial expenditures in the region. It is typically the sum of wages, rent, interest and profits in addition to indirect business taxes and depreciation minus subsidies. This is different from gross output which represents the sales of the sector which includes the value of the output of its suppliers. Gross output typically double counts the activities of other sectors beyond the sector delivering the final output.

Employment – This refers to the total person years (full-time equivalent jobs) generated by an increase in output.

Taxes – Our impact system generates a large number of taxes (income taxes, GST, liquor and tobacco taxes, etc.) each of which is linked with the level of government receiving it. For example, the Federal government receives the proceeds from the GST tax, the Provincial government receives the tobacco and liquor tax and the Local government receives the property and business tax.

Multipliers – These are summary measures that represent the division of the total impacts (direct, indirect and induced) by the initial expenditures. For example, the income multiplier associated with the total construction expenditures on a plant or a warehouse is calculated by dividing the total income (value added) impact by the initial construction expenditures. The only exception is that of the employment multiplier where total employment is divided by direct employment in order to preserve the common units.

For all of the impact measures a three dimensional perspective is presented that distinguishes between direct, indirect and induced values.

The Macroeconomic Perspective: How Important is Agriculture in the Total Economy?

Provincial income accounts provide aggregate measures of the contributions of economic sectors and activities in terms of value added, employment, expenditures and other relevant indices. While these aggregate indices are very useful in defining the overall contribution of a given sector, they provide little and truncated information on the way the sector or activity relates to other sectors in the economy. Furthermore, these indices are rarely defined for smaller regional geographies below the provincial boundaries and are of limited use in identifying the crucial and critical links the agriculture sector provides for the development of regional manufacturing capacities.

It is necessary, therefore, to adopt a framework that is multi-dimensional to capture the many contributions that the agriculture sector makes to the economy and to provide a better perspective on its linkages with other sectors.

In this study, a thorough analysis of the contributions of agriculture to the overall economy is made using Gross Provincial Products (GPP) at factor cost (value of provincial output before it reaches the market), agriculture's employment shares, and the contributions it makes to exports and to the food manufacturing base. We did not limit the analysis to the direct effects and went further to include the indirect and induced effects. We focused first on the Canadian impacts and then on the main agricultural provinces (Alberta, Saskatchewan, Manitoba and Ontario).

Agriculture in Canada contributes directly $8.7 billion to Net Domestic Product (NDP is the GDP minus depreciation). When its total effects are taken into consideration, it contributes $16 billion. It directly employs 160,541 persons in full time equivalent jobs but can legitimately clam credit for a much larger employment impact. More than 357,521 Canadians owe their full-time equivalent jobs to agriculture either directly or through agriculture's indirect and induced effects (Table 1 and Figure 1). Indeed, some of these jobs are filled by seasonal migrant workers; however, the overwhelming majority of these jobs are staffed by Canadians, particularly those arising out of the indirect and induced effects of the agricultural activity.

An interesting result that may not be fully recognized, Ontario generates larger agricultural income than any of the highly visible agricultural provinces in Canada. This is surely the result of Ontario's larger population base. Ontario's NPP (net provincial product which is equal to GPP minus depreciation) is augmented annually by over $2 billion directly and by $3.6 billion when agriculture's indirect and induced effects are taken into consideration. While this represents less than 1% (actually 0.84 of one percent of the total Ontario NPP), it is still a higher absolute contribution than in any other province. Moreover, about 86,915 Ontarians owe their full time equivalent jobs to agriculture, of these 45,356 are considered direct jobs in agriculture.

The contribution of agriculture to NPP (income) of the provinces that are considered to sustain large agricultural activities falls short, in terms of absolute magnitude, of the corresponding values in Ontario. But in relative terms, the income contributions of agriculture represent larger

shares of the total NPP of the respective provinces than is the case in Ontario (Table 1 and Figure 1). In Manitoba, agriculture contributes about $1 billion to its NPP or about 3.3% of the total. In Alberta agriculture makes a total contribution of about $3 billion or 2.7% of overall NPP, and in Saskatchewan the total contribution of agriculture to NPP is about $2.5 billion or 8.7%.[v]

As a percent of exports, agriculture products account for 10.5% of Manitoba's total exports, 4.83% of Alberta's and less than 1% of Ontario's, but when the share of agriculture in the exports of food and beverage is taken into account, these shares rise significantly.

A clearer picture emerges when the agriculturally sustained employment numbers are considered. In Manitoba a total of 25,292 full time equivalent jobs are credited to agricultural impacts. In Alberta over 68,598 Albertans owe their full time equivalent jobs to agriculture and in Saskatchewan, another 57,027 full time jobs are sustained by agriculture in the province. While it is true that some of the direct employment in the provinces is filled by migrant seasonal workers, the majority of the jobs are staffed by local residents and again particularly those arising from the indirect and induced effects of the provincial agricultural activity.

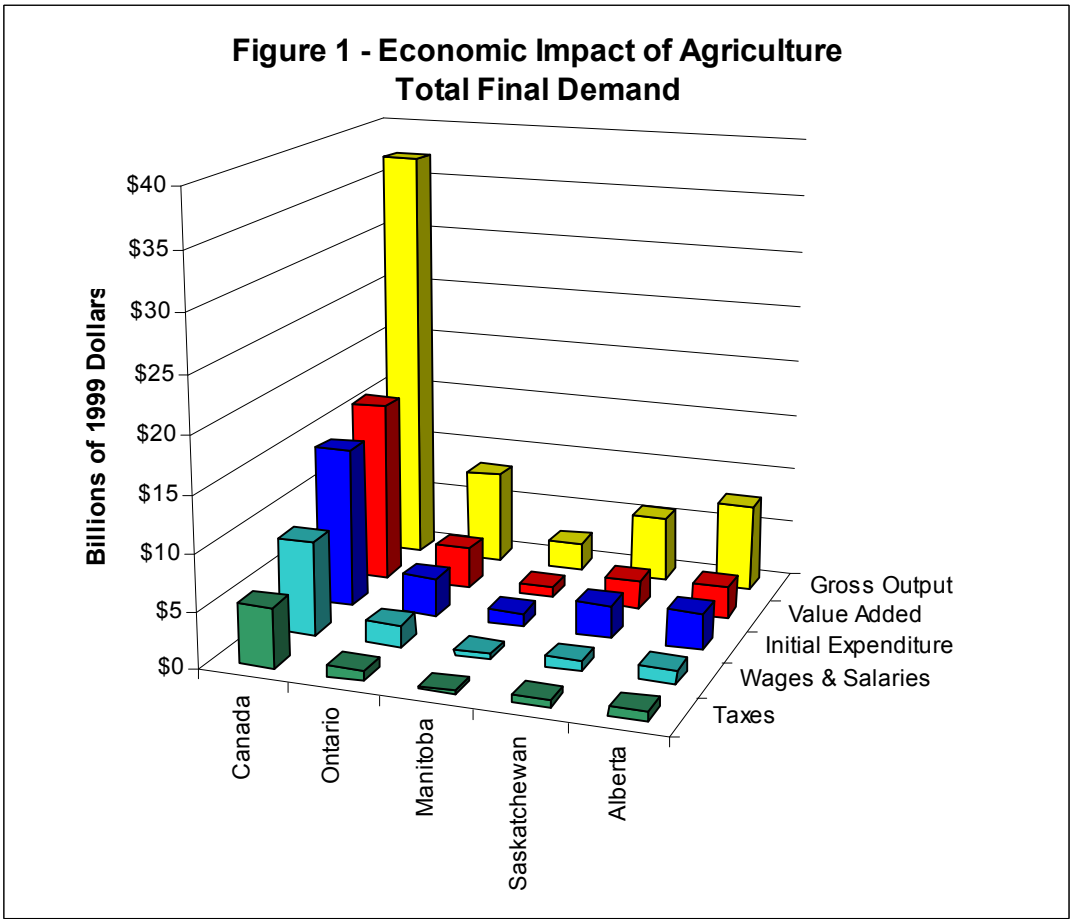
The sector is not known for high wages or incomes. Actually, as mentioned earlier, real farm incomes have been declining over the years. Nonetheless, through the indirect and induced effects, the relatively low wages in direct agricultural activity are raised significantly when the total impacts of the sector are taken into account. A total $8.3 billion is shown to represent the total labour incomes sustained by the activity in Canada.

Table 1
Economic Impact of Agriculture
Total Final Demand
(Millions of 1999 Dollars)

	Canada	Ontario	Manitoba	Saskatchewan	Alberta
Initial Expenditure	$14,132	$3,433	$1,229	$2,937	$3,214
Value Added					
Direct *	$8,787	$2,007	$662	$1,665	$1,538
Indirect & Induced	$7,300	$1,603	$321	$797	$1,384
Total	$16,087	$3,610	$983	$2,462	$2,922
Multiplier	1.14	1.05	0.80	0.84	0.91
Gross Output					
Direct	$14,132	$3,433	$1,229	$2,937	$3,214
Indirect & Induced	$23,085	$4,814	$1,235	$2,828	$4,458
Total	$37,217	$8,247	$2,464	$5,765	$7,672
Multiplier	2.63	2.40	2.00	1.96	2.39
Wages & Salaries					
Direct	$2,340	$624	$129	$321	$317
Indirect & Induced	$5,993	$1,309	$304	$581	$882
Total	$8,333	$1,933	$433	$902	$1,199
Employment					
Direct	160,541	45,356	13,856	32,358	31,596
Indirect & Induced	196,980	41,559	11,436	24,669	37,003
Total	357,521	86,915	25,292	57,027	68,598
Multiplier	2.23	1.92	1.83	1.76	2.17
Taxes					
Federal	$3,040	$500	$158	$321	$443
Provincial	$1,674	$334	$60	$169	$223
Local	$569	$67	$19	$79	$75
Total	$5,284	$901	$236	$569	$741
Imports					
From Other Provinces	$1,470	$282	$200	$460	$502
From Other Countries	$1,508	$646	$120	$243	$349
Total	$2,978	$928	$320	$703	$851

Source: Econometric Research Limited

*: Calibrated to the values in 1999 obtained from Statistics Canada: Catalog No. 21-017-XIE



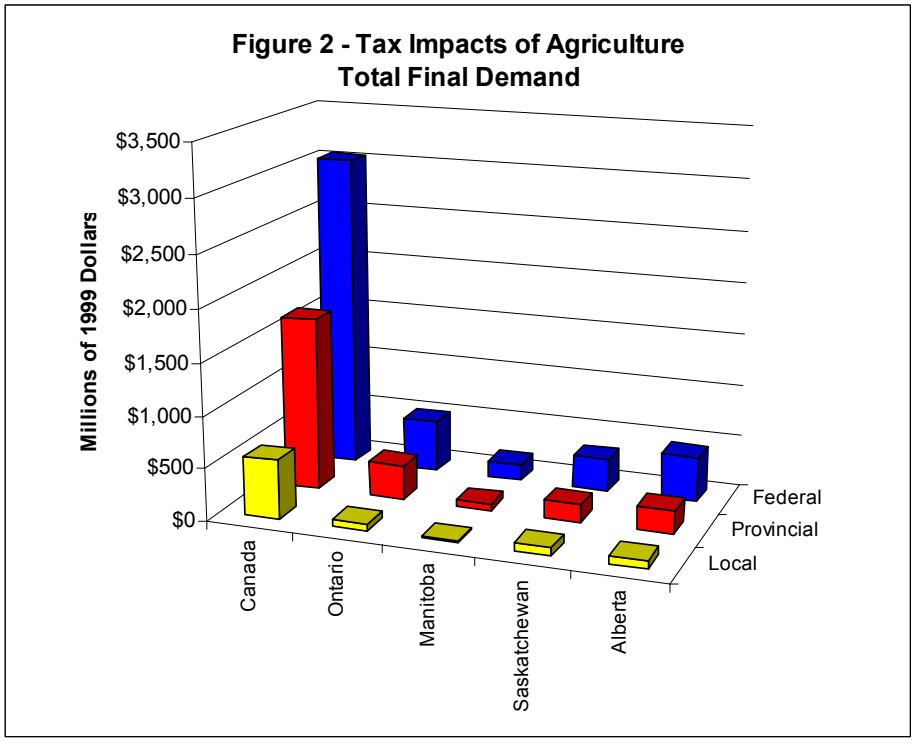
The sector is acknowledged to be a major recipient of government subsidies. It is quite revealing that through its indirect and induced impacts agriculture is actually a net positive contributor to federal, provincial and local tax revenues. So much so that the total tax impacts of this sector in Canada exceed $5.2 billion. Indeed, the federal government derives the largest share of these revenues with $3 billion, the provincial governments collectively account for about $1.7 billion and the remaining $0.6 billion are shared by local governments.

This picture is not different at the provincial levels albeit with some interesting variations. Ontario and Alberta make the largest tax contributions on the agricultural impacts with $901 million and $741 million respectively (Table 2 and Figure 2). At the federal level personal income taxes, corporate profit taxes and GST make the largest contributions to federal revenues and in the provinces, personal income taxes and indirect business taxes show the highest yield with the exception of Manitoba.

Table 2
Tax Impacts of Agriculture
Total Final Demand
(Millions of 1999 Dollars)

	Canada	Ontario	Manitoba	Saskatchewan	Alberta
Federal					
Personal Income Tax	$1,210	$361	$64	$127	$207
Goods & Services Tax	$613	$64	$30	$64	$78
Corporate Profit Taxes	$644	$72	$34	$68	$76
Employment Insurance	$287		$15	$31	$41
CPP Contributions	$286		$15	$31	$41
Provincial					
Personal Income Tax	$765	$178	$36	$88	$104
Indirect Business Tax	$283	$94	$2	$23	$47
Corporate Profit Taxes	$333	$49	$17	$31	$45
Tobacco & Liquor Tax	$224	$13	$1	$19	$17
Workmans Comp.	$69		$4	$8	$10
Local					
Property & Bus. Tax	$569	$67	$19	$79	$75
Total	$5,283	$898	$237	$569	$741

Source: Econometric Research Limited



The Sectoral Perspective:
Is Agriculture Just Another Sector?

Each economic system has a complicated internal structure that determines its performance. The study of this internal structure has become indispensable to the proper understanding and management of the economy. This is perhaps why, over the past few decades, the internal economic framework of a large number of countries has been described by many techniques such as "input-output" analysis and/or process analysis.[vi]

Inter-industry tables (or process schedules) are now widely used accounting frameworks for the analysis of sectoral linkages. In this framework, sectoral relationships appear in a web of interconnectedness since each sector is considered to buy its input requirements from many sectors and sell its outputs to several other sectors. In the "open" version of the system, each sector sells to an "autonomous sector" which has no output of its own. This "autonomous sector" represents final demand. The linkage tables in this section reveal the indirect relationships of an economic system and facilitate the economic justification and interpretation of these indirect relationships and their consequences.

In this study, a detailed analysis of sectoral interdependencies and the resulting economic implications for the agricultural sector are based on the most recent Statistics Canada Inter-provincial Input-output Tables for 1999 and ERL's Regional Impact Model (RIM). In particular, the characteristics of the agricultural sector and its impact on Canada's, Ontario's, Manitoba's, Alberta's and Saskatchewan's industrial structures have been examined using RIM. These include:

- the various primary and induced income and employment multipliers for the agricultural sector at the provincial and local areas levels;
- the nature and extent of indirect and induced links among the various sectors of the economy with the agricultural sector;
- the position of the agricultural sector within the different types of productive sectors classified according to their input uses and output distribution;
- the nature and extent of backward linkages among sectors connected to the agricultural sector;
- the nature and extent of forward linkages among sectors and the agricultural sector;
- the determination of measures of dispersion of the various coefficients of linkages; and
- the identification of "key" sectors of the economy in relation to agriculture.

The Structure of the Sectoral Indices

The objective here is to position the agricultural sector within the overall structure of production of the three chosen provinces (Ontario, Manitoba and Alberta) for the most recent year for which inter-provincial input output tables were constructed. The sectoral perspective is examined by using traditional output and income multipliers, direct value added and labour income (wages and unincorporated income) coefficients, jobs per million dollar of output, the share of labour in total income of the sector and average labour productivity.[vii] Thirty three sectors are evaluated within the same platform using these indicators.

The income and output multipliers are indicators of sectoral efficiency in generating output and income per one dollar of final demand. Industries (sectors) with high-income multipliers are those that typically generate large incomes when the demand for their output increases. They may do so through high direct income from their production or through the relationships they maintain indirectly with sectors that are efficient in generating income per unit of output.

A high value added coefficient is indicative of a high degree of internal processing. A sector that ships raw materials without any further processing typically has low value added coefficients. Alternatively, sectors with high value added per unit of output are those that purchased inputs that are processed and significant value is added through the use of labour, capital and entrepreneurship.

A high labour income share in value added reveals the labour intensity of the production process of the sector. Refined petroleum, for example, uses few workers and as such should show a low share of labour income per unit of output or in value added.

Finally, high employment content per million dollars of output designates the sector as a significant contributor to employment generation in the province. Alternatively, this is often consistent with low average labour productivity in the sector.

The agriculture sector in 1999 appears to have had the following general characteristics:

- Below average output multipliers
- Average income multipliers
- Low labour income share in value added
- Relatively high employment content, and
- Relatively low average labour productivity

In the discussion below we will use a sample of the sectoral indices to position the agricultural sector within the Canadian and the three chosen provincial structures of production as represented by the Input Output systems for 1999/2000. We begin with cost of agricultural commodities as a fraction of total cost of production.

Agricultural Cost Intensities in Canada's and Provincial Structures of Production

Input-output analysis quantifies the linkages that an industry has with other industries in the province. Specifically, a sector may buy or sell directly from only a few industries, but its customers and suppliers may be intricately connected to other unrelated industries. As a result, this sector may have a profound influence on the economy through its indirect relations with other industries even when its direct links are limited and concentrated in a few sectors.

The impact of agricultural cost on the competitiveness of industries in the domestic and international markets is a concern in Canada. The five sets of input output tables for Canada, Ontario, Alberta, Manitoba and Saskatchewan for 1999 respectively provide invaluable information on the intensity of agricultural cost in the value of output of different industries. The input output system of accounts defines the agricultural industry in a highly aggregated sense, but still useful in identifying and quantifying its links and cost structures. The "agricultural cost intensity" for an industry is the cost of agricultural inputs as a percentage of the total cost of its output derived from the columns of the inverse matrix.

General Agricultural Performance Indicators

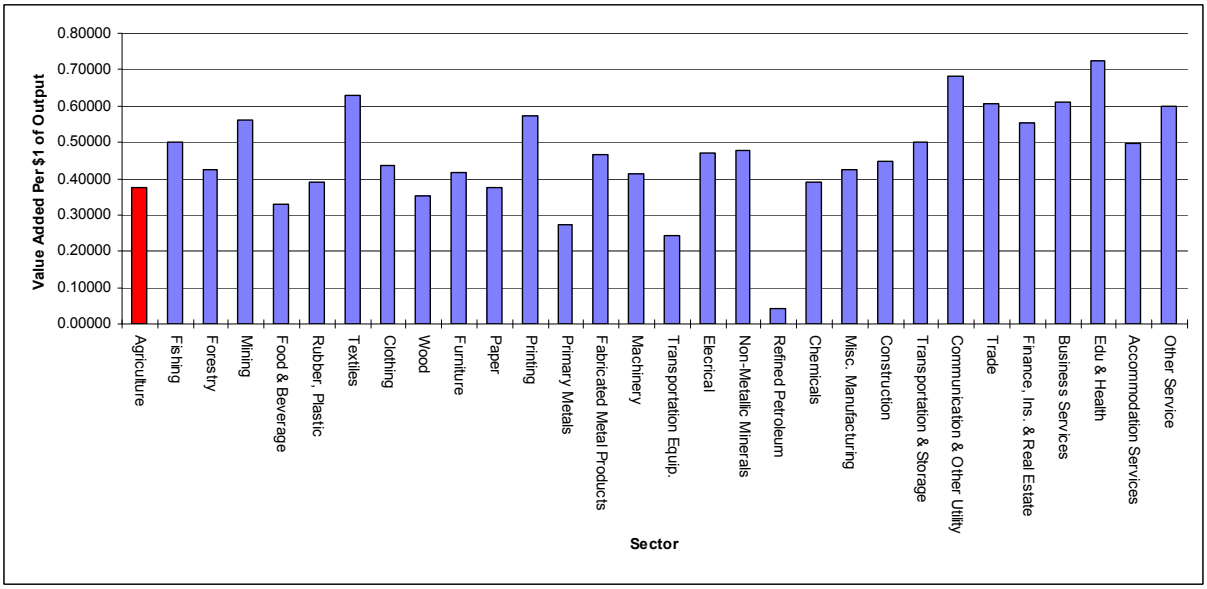
It is clear that in 1999, that the agricultural sector in Ontario is a labour intensive sector with 13.9 jobs per $1 million of expenditure, has a relatively low income multiplier with an average degree of processing captured by an average direct value added coefficient of 0.375 (Table 3 and Figure 3). This is because agricultural goods are typically final goods involving limited processing before delivery to markets.

Table 3
General Economic Indicators, Ontario, 1999

Sector	Output Multipliers	Income Multipliers	Direct Value Added	Wage Value Added	Unincorporated Income	Labour Income	Share of Labour Value Added	Employment Coefficients	Employment Per Million $	Average Labour Productivity
Agriculture	2.34807	0.96555	0.37483	0.12584	0.0285	0.15436	41.2%	0.0000139	13.9	$71,991
Fishing	2.41568	1.09180	0.50000	0.39583	0.0208	0.41667	83.3%	0.0000380	38.0	$26,316
Forestry	2.66718	1.10161	0.42517	0.23299	0.0499	0.28288	66.5%	0.0000052	5.2	$192,065
Mining	2.16314	1.09367	0.56075	0.26123	0.0034	0.26465	47.2%	0.0000061	6.1	$163,222
Food & Beverage	2.40548	0.92259	0.32934	0.14080	0.0010	0.14180	43.1%	0.0000036	3.6	$275,750
Rubber, Plastic	1.89310	0.75795	0.39011	0.11597	-	0.11597	29.7%	0.0000097	9.7	$102,668
Textiles	2.02241	1.09633	0.62921	0.35131	0.0022	0.35356	56.2%	0.0000117	11.7	$85,752
Clothing	2.25677	1.02058	0.43474	0.29354	0.0042	0.29772	68.5%	0.0000173	17.3	$57,832
Wood	2.65899	1.07884	0.35163	0.24495	0.0079	0.25285	71.9%	0.0000053	5.3	$189,041
Furniture	2.40121	1.04504	0.41886	0.26409	0.0038	0.26785	63.9%	0.0000082	8.2	$121,710
Paper	2.41738	0.99453	0.37708	0.22301	-	0.22301	59.1%	0.0000041	4.1	$246,783
Printing	2.26648	1.14549	0.57274	0.33839	0.0048	0.34321	59.9%	0.0000118	11.8	$84,971
Primary Metals	2.61272	0.94664	0.27401	0.19387	0.0002	0.19404	70.8%	0.0000027	2.7	$367,928
Fabricated Metal Products	2.38567	1.06920	0.46710	0.29644	0.0038	0.30023	64.3%	0.0000064	6.4	$156,080
Machinery	2.12523	0.91007	0.41360	0.22853	0.0009	0.22942	55.5%	0.0000043	4.3	$232,821
Transportation Equip.	2.38766	0.76474	0.24172	0.12711	0.0002	0.12727	52.7%	0.0000020	2.0	$510,100
Elecrical	2.06694	0.95114	0.46894	0.26585	0.0003	0.26618	56.8%	0.0000085	8.5	$117,656
Non-Metallic Minerals	2.17987	1.01319	0.47883	0.25468	0.0014	0.25607	53.5%	0.0000056	5.6	$178,325
Refined Petroleum	2.12494	0.51659	0.04021	0.04407	0.0002	0.04431	110.2%	0.0000006	0.6	$1,801,276
Chemicals	2.21931	0.90831	0.39079	0.18964	0.0002	0.18987	48.6%	0.0000030	3.0	$337,470
Misc. Manufacturing	2.16841	0.94317	0.42631	0.25740	0.0020	0.25942	60.9%	0.0000125	12.5	$80,300
Construction	2.41139	1.10021	0.44777	0.34980	0.0570	0.40681	90.9%	0.0000079	7.9	$126,075
Transportation & Storage	2.45753	1.15300	0.50132	0.33424	0.0317	0.36595	73.0%	0.0000093	9.3	$107,988
Communication & Other Utility	1.73207	1.01060	0.68247	0.22710	0.0001	0.22718	33.3%	0.0000042	4.2	$239,899
Trade	2.42194	1.26696	0.60613	0.45906	0.0253	0.48438	79.9%	0.0000131	13.1	$76,116
Finance, Ins. & Real Estate	2.09890	1.06015	0.55280	0.18092	0.0921	0.27301	49.4%	0.0000033	3.3	$305,679
Business Services	2.47152	1.27562	0.60856	0.40458	0.0591	0.46366	76.2%	0.0000094	9.4	$106,027
Edu & Health	2.48254	1.41436	0.72465	0.31113	0.3633	0.67443	93.1%	0.0000637	63.7	$15,703
Accommodation Services	2.46100	1.15770	0.49610	0.38031	0.0186	0.39892	80.4%	0.0000203	20.3	$49,160
Other Service	2.51001	1.32200	0.59880	0.51618	0.0057	0.52187	87.2%	0.0000071	7.1	$140,491
Operating, Office	2.37919	0.62752	-	-	-	-	0.0%	0.0000223	22.3	$44,906
Travel, Entertain. & Advert.	2.92979	0.92791	-	-	-	-	0.0%	0.0000055	5.5	$182,558
Transportation Margins	2.96799	0.92757	-	-	-	-	0.0%	0.0000082	8.2	$122,290

Source: Econometric Research Limited

Figure 3
Comparative Sectoral Data, Ontario, 1999



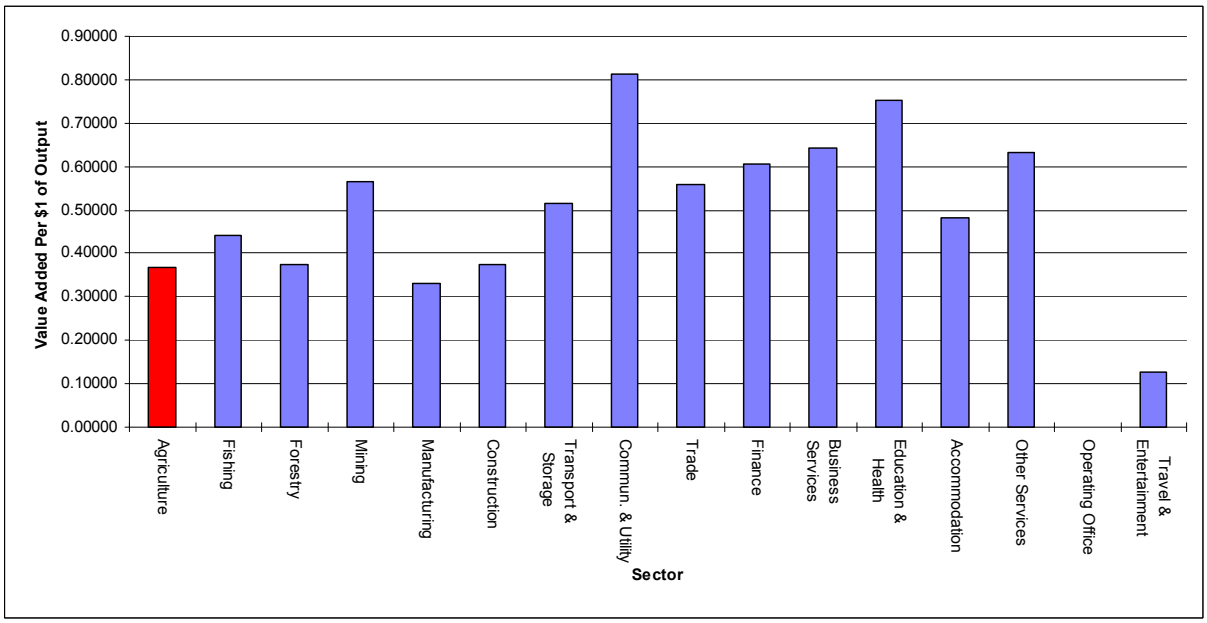
A similar picture is observed in Manitoba where agriculture again shows a relatively high labour content per $1 million of final demand, relatively low income multipliers, an average direct value added coefficient and a reasonable average labour productivity (Table 4 and Figure 4). For all of the performance indicators in Table 4, Manitoba has lower performance levels in agriculture than Ontario but is not very much different than Alberta.

Table 4
General Economic Indicators, Manitoba, 1999

Sector	Output Multipliers	Income Multipliers	Direct Value Added	Wage Value Added	Unincorporated Income	Labour Income	Share of Labour Value Added	Employment Coefficients	Employment Per Million $	Average Labour Productivity
Agriculture	2.00256	0.81314	0.36776	0.05951	0.0346	0.09414	25.6%	0.0000113	11.3	$88,496
Fishing	1.84737	0.72855	0.44000	0.04000	0.0800	0.12000	27.3%	0.0000197	19.7	$50,821
Forestry	2.21563	0.89968	0.37405	0.18321	0.0458	0.22901	61.2%	0.0000047	4.7	$214,270
Mining	1.89712	1.01772	0.56561	0.32739	0.0013	0.32866	58.1%	0.0000028	2.8	$361,533
Manufacturing	2.08310	0.81914	0.32961	0.20739	0.0013	0.20866	63.3%	0.0000051	5.1	$194,363
Construction	2.06739	0.88409	0.37530	0.27560	0.0497	0.32530	86.7%	0.0000079	7.9	$126,598
Transport & Storage	2.03122	1.02771	0.51602	0.33089	0.0301	0.36102	70.0%	0.0000095	9.5	$105,731
Commun. & Utility	1.38484	0.99425	0.81310	0.18828	-	0.18828	23.2%	0.0000035	3.5	$286,615
Trade	2.07759	1.08886	0.55978	0.36477	0.0246	0.38936	69.6%	0.0000163	16.3	$61,342
Finance	1.80898	1.01889	0.60668	0.16381	0.1308	0.29459	48.6%	0.0000034	3.4	$295,247
Business Services	2.03874	1.14491	0.64121	0.38801	0.0761	0.46409	72.4%	0.0000110	11.0	$90,506
Education & Health	2.17198	1.33837	0.75396	0.30941	0.3616	0.67102	89.0%	0.0000672	67.2	$14,884
Accommodation	2.13836	1.02876	0.48192	0.36162	0.0332	0.39483	81.9%	0.0000208	20.8	$48,160
Other Services	2.17043	1.22703	0.63291	0.54091	0.0047	0.54565	86.2%	0.0000059	5.9	$168,464
Operating Office	2.02516	0.44995	0.00000	0.00000	-	0.00000	N/A	-	0.0	N/A
Travel & Entertainment	2.38892	0.80924	0.12832	0.08497	0.0075	0.09249	72.1%	0.0000128	12.8	$78,143
Transportation Margins	2.61023	0.81812	-	-	-	-	N/A	-	0.0	N/A

Source: Econometric Research Limited

Figure 4
Comparative Sectoral Data, Manitoba, 1999



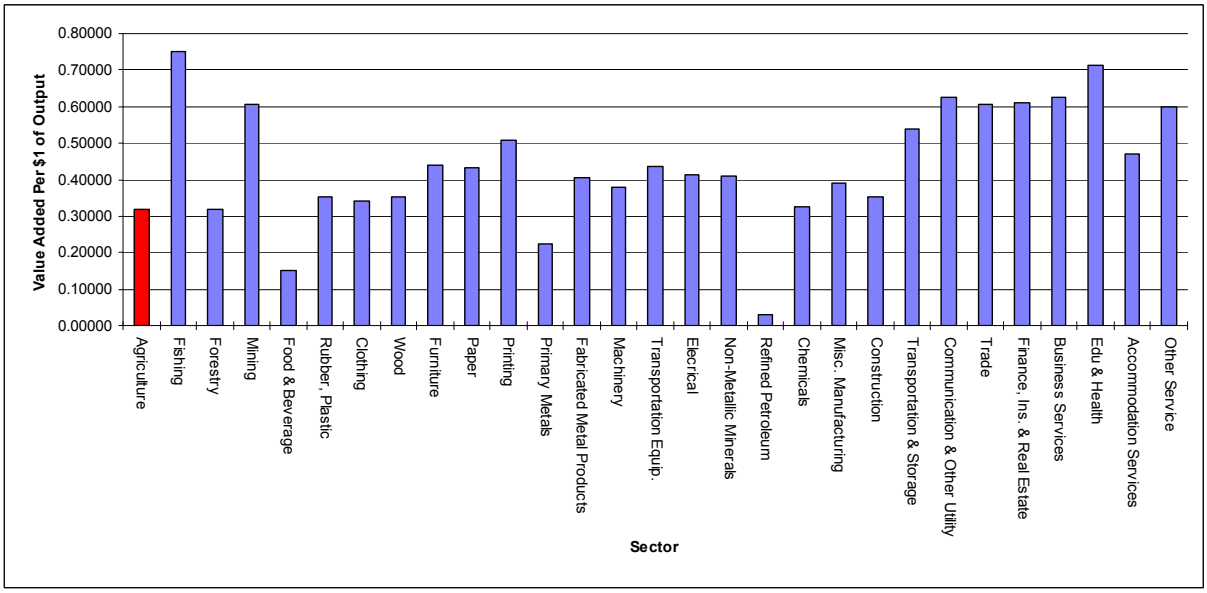
Agriculture in Alberta again shows a low jobs per million signifying that Alberta's agriculture is perhaps less labour intensive (or more capital intensive) than Ontario and Manitoba, a reasonable income multiplier but a low direct value added coefficient (Table 5 and Figure 5).

Table 5
General Economic Indicators, Alberta, 1999

Sector	Output Multipliers	Income Multipliers	Direct Value Added	Wage Value Added	Unincorporated Income	Labour Income	Share of Labour Value Added	Employment Coefficients	Employment Per Million $	Average Labour Productivity
Agriculture	2.38957	0.87463	0.31954	0.05244	0.0328	0.08527	26.7%	0.0000098	9.8	$101,927
Fishing	2.44336	1.33092	0.75000	0.25000	0.5000	0.75000	100.0%	-	0.0	N/A
Forestry	2.55338	0.91266	0.31963	0.19787	0.0320	0.22983	71.9%	0.0000067	6.7	$149,091
Mining	1.82684	0.97023	0.60840	0.13250	0.0024	0.13491	22.2%	0.0000022	2.2	$452,755
Food & Beverage	2.74529	0.80624	0.15314	0.08002	0.0002	0.08027	52.4%	0.0000032	3.2	$309,636
Rubber, Plastic	2.08730	0.81294	0.35362	0.16289	-	0.16289	46.1%	0.0000091	9.1	$110,351
Clothing	2.01977	0.82127	0.34254	0.21571	0.0001	0.21585	63.0%	0.0000090	9.0	$111,212
Wood	2.46443	0.96482	0.35281	0.21418	-	0.21418	60.7%	0.0000036	3.6	$274,221
Furniture	2.12580	0.94134	0.43971	0.26215	-	0.26215	59.6%	0.0000112	11.2	$89,331
Paper	2.08314	0.88253	0.43169	0.09353	-	0.09353	21.7%	0.0000025	2.5	$404,171
Printing	2.18939	1.05316	0.50977	0.34180	-	0.34180	67.0%	0.0000103	10.3	$97,002
Primary Metals	2.17275	0.73001	0.22333	0.14841	-	0.14841	66.5%	0.0000018	1.8	$550,934
Fabricated Metal Products	2.00645	0.84696	0.40421	0.25915	0.0191	0.27820	68.8%	0.0000094	9.4	$106,808
Machinery	1.88730	0.78036	0.38054	0.25106	0.0001	0.25112	66.0%	0.0000066	6.6	$151,816
Transportation Equip.	2.09667	0.94068	0.43474	0.38302	-	0.38302	88.1%	0.0000240	24.0	$41,642
Elecrical	1.62346	0.70193	0.41353	0.21197	-	0.21197	51.3%	0.0000045	4.5	$222,128
Non-Metallic Minerals	2.15873	0.91826	0.41021	0.17459	0.0001	0.17468	42.6%	0.0000051	5.1	$196,955
Refined Petroleum	2.78907	0.93615	0.03219	0.02646	-	0.02646	82.2%	0.0000003	0.3	$3,006,615
Chemicals	2.20009	0.83648	0.32691	0.05778	-	0.05778	17.7%	0.0000017	1.7	$590,388
Misc. Manufacturing	2.01550	0.84605	0.39201	0.29316	-	0.29316	74.8%	0.0000082	8.2	$121,718
Construction	2.27978	0.95679	0.35153	0.27192	0.0355	0.30737	87.4%	0.0000052	5.2	$191,703
Transportation & Storage	2.24322	1.12288	0.53893	0.30126	0.0357	0.33697	62.5%	0.0000083	8.3	$120,989
Communication & Other Utility	1.63796	0.92691	0.62387	0.11703	0.0003	0.11732	18.8%	0.0000029	2.9	$343,194
Trade	2.26758	1.20332	0.60744	0.42326	0.0202	0.44342	73.0%	0.0000137	13.7	$72,746
Finance, Ins. & Real Estate	1.95039	1.05697	0.61104	0.16594	0.1310	0.29692	48.6%	0.0000031	3.1	$318,827
Business Services	2.25971	1.20288	0.62580	0.42334	0.0395	0.46281	74.0%	0.0000099	9.9	$100,730
Edu & Health	2.20794	1.27401	0.71429	0.40413	0.1686	0.57270	80.2%	0.0000796	79.6	$12,567
Accommodation Services	2.37389	1.06163	0.47003	0.34859	0.0068	0.35542	75.6%	0.0000178	17.8	$56,048
Other Service	2.36316	1.24853	0.59956	0.49543	0.0058	0.50119	83.6%	0.0000242	24.2	$41,370
Operating, Office	1.95269	0.43625	-	-	-	-	0.0%	-	0.0	N/A
Travel, Entertain. & Advert.	2.74637	0.84886	-	-	-	-	0.0%	0.0000113	11.3	$88,425
Transportation Margins	2.88980	0.94934	-	-	-	-	0.0%	-	0.0	N/A

Source: Econometric Research Limited

Figure 5
Comparative Sectoral Data, Alberta, 1999



Agricultural Cost Intensities and Value Added Contributions

Agriculture contributes inputs to many sectors' output. The fraction of agricultural cost per $1 dollar of output directly and indirectly required from agriculture are referred to as the agriculture cost intensities and are displayed in tables 6,7 and 8 and figures 6,7 and 8 to show the relative magnitudes of agriculture cost intensities by industry. The results are sorted from high to low. It is clear that in Ontario (Table 6 and Figure 6) agricultural inputs are the largest item of material cost in agricultural production with $0.18. Food & beverage is second with $0.15. Even forestry, accommodation, meals and cafeteria and construction require agricultural inputs in their production processes, either directly or through purchased inputs.

Sectors exhibiting higher agricultural inputs in their operations are typically sectors that have relatively high value added coefficients.

Sectors with extensive dependence on agriculture are also high- income contributors to the economy

It is quite revealing that most of the Ontario export industries are among those sectors with relatively high agricultural cost intensities. When the export sectors are aggregated, the agricultural cost intensity of Ontario exports is about 1%. This is not high but still meaningful and is pale in comparison to other provinces' similar shares.

In Manitoba, agriculture absorbs $0.176 of its material cost per dollar from agriculture, logging and forestry is second and food and beverage (manufacturing) is third. Many other sectors show relatively high agricultural cost intensities such as construction, accommodation and meals, trade, etc. Sectors showing high agricultural cost intensities have average direct value added contribution (Table 7 and Figure 7).

Agriculture in Alberta is the main supplier of food and beverage and with $0.475 of agriculture per $1 dollar of production. Agriculture takes back seat to food and beverages with a cost intensity of $0.278. Logging and forestry is third with a cost intensity of $0.10 per $1 of output. It is also true that some of the high income contributors in Alberta are also sectors with relatively high agricultural cost intensity.

Table 6
Agriculture Intensities and Value Added, Ontario, 1999

	Grain Intensities	Other Agriculture Intensities	Total Agriculture Cost Shares	Value Added Coefficients
Agriculture	0.0335	0.1444	0.1778	0.3748
Food & Beverage	0.0172	0.1280	0.1452	0.3293
Forestry	-	0.0481	0.0481	0.4252
Accommodation & Food Services	-	0.0106	0.0106	0.4961
Construction	-	0.0046	0.0046	0.4478
Operating, Office	-	0.0023	0.0023	-
Trade	0.0002	0.0001	0.0003	0.6061
Other Service	-	0.0002	0.0002	0.5988
Transportation & Storage	-	0.0000	0.0000	0.5013
Fishing	-	-	-	0.5000
Mining	-	-	-	0.5607
Rubber, Plastic	-	-	-	0.3901
Textiles	-	-	-	0.6292
Clothing	-	-	-	0.4347
Wood	-	-	-	0.3516
Furniture	-	-	-	0.4189
Paper	-	-	-	0.3771
Printing	-	-	-	0.5727
Primary Metals	-	-	-	0.2740
Fabricated Metal Products	-	-	-	0.4671
Machinery	-	-	-	0.4136
Transportation Equip.	-	-	-	0.2417
Elecrical	-	-	-	0.4689
Non-Metallic Minerals	-	-	-	0.4788
Refined Petroleum	-	-	-	0.0402
Chemicals	-	-	-	0.3908
Misc. Manufacturing	-	-	-	0.4263
Communication & Other Utility	-	-	-	0.6825
Finance, Insurance & Real Estate	-	-	-	0.5528
Business Services	-	-	-	0.6086
Edu & Health	-	-	-	0.7247
Travel, Entertainment & Advertising	-	-	-	-
Transportation Margins	-	-	-	-
Exports	0.0007	0.0062	0.0069	N/A

Source: Econometric Research Limited

Figure 6
Agriculture Costs per Dollar of Total Cost, Ontario, 1999

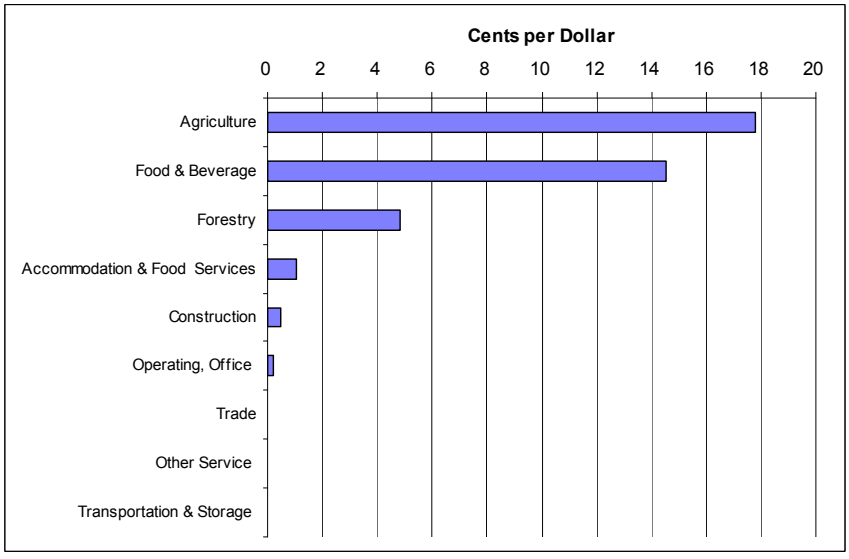


Table 7
Agriculture Intensities and Value Added, Manitoba, 1999

	Grain Intensities	Other Agriculture Intensities	Total Agriculture Cost Shares	Value Added Coefficients
Agricultural	0.0466	0.1295	0.1761	0.3678
Logging and Forestry	-	0.0793	0.0793	0.3740
Manufacturing	0.0086	0.0627	0.0713	0.3296
Accommodation and Food	-	0.0106	0.0106	0.4819
Operating Office, Cafeteria	-	0.0035	0.0035	-
Construction	-	0.0029	0.0029	0.3753
Trade	0.0005	0.0003	0.0007	0.5598
Other Services	-	0.0004	0.0004	0.6329
Fishing and Trapping	-	-	-	0.4400
Mining	-	-	-	0.5656
Transportation and Storage	-	-	-	0.5160
Communication and Utilities	-	-	-	0.8131
Finance, Insurance and Real Estate	-	-	-	0.6067
Business Services	-	-	-	0.6412
Education and Health	-	-	-	0.7540
Travel and Entertainment	-	-	-	0.1283
Transportation Margins	-	-	-	-
Exports	0.0404	0.0646	0.1049	N/A

Source: Econometric Research Limited

Figure 7
Agriculture Costs per Dollar of Total Cost, Manitoba, 1999

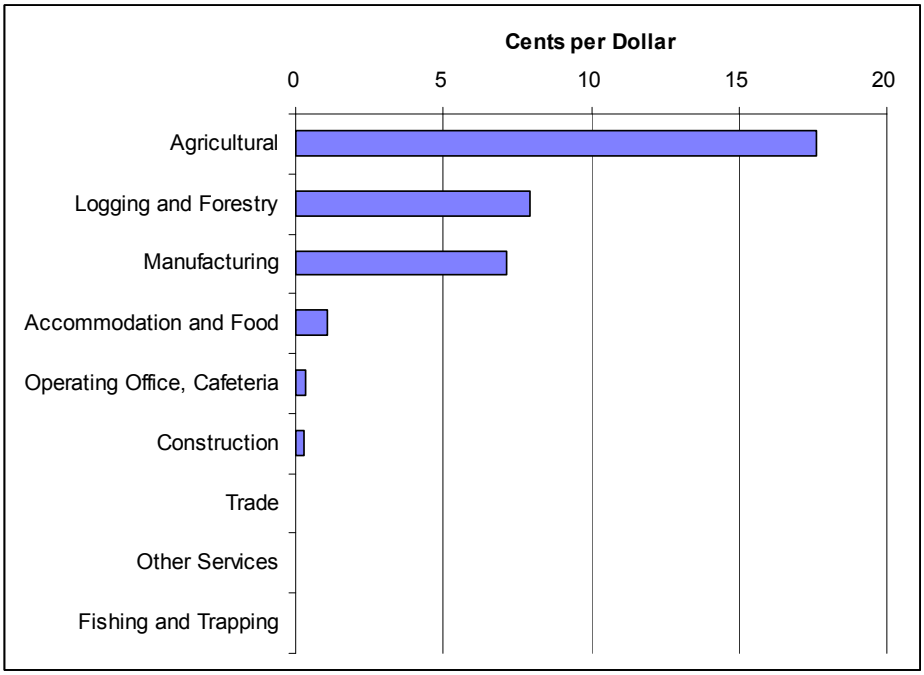
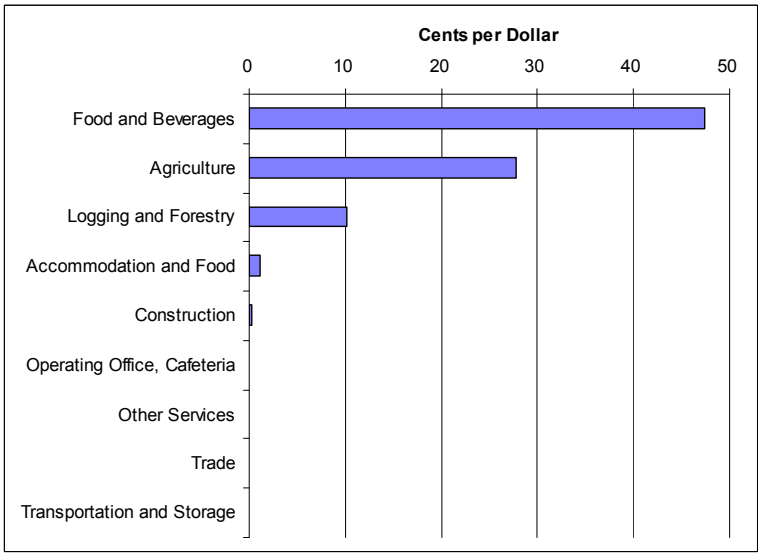


Table 8
Agriculture Intensities and Value Added, Alberta, 1999

	Grain Intensities	Other Agriculture Intensities	Total Agriculture Cost Shares	Value Added Coefficients
Food and Beverages	0.0234	0.4513	0.4747	0.1531
Agriculture	0.0449	0.2327	0.2776	0.3195
Logging and Forestry	-	0.1023	0.1023	0.3196
Accommodation and Food	-	0.0110	0.0110	0.4700
Construction	-	0.0029	0.0029	0.3515
Operating Office, Cafeteria	-	0.0020	0.0020	-
Other Services	-	0.0013	0.0013	0.5996
Trade	0.0004	0.0001	0.0005	0.6074
Transportation and Storage	-	0.0001	0.0001	0.5389
Fishing and Trapping	-	-	-	0.7500
Mining	-	-	-	0.6084
Rubber, Plastic	-	-	-	0.3536
Clothing	-	-	-	0.3425
Wood Industries	-	-	-	0.3528
Furniture and Fixtures	-	-	-	0.4397
Paper Products	-	-	-	0.4317
Printing and Publishing	-	-	-	0.5098
Primary Metals	-	-	-	0.2233
Fabricated Metal	-	-	-	0.4042
Machinery	-	-	-	0.3805
Transportation Equipment	-	-	-	0.4347
Electrical	-	-	-	0.4135
Non-Metallic Minerala	-	-	-	0.4102
Refined Petroleum	-	-	-	0.0322
Chemicals	-	-	-	0.3269
Misc Manufacturing	-	-	-	0.3920
Communication and Utilities	-	-	-	0.6239
Finance, Insurance and Real Estate	-	-	-	0.6110
Business Services	-	-	-	0.6258
Education and Health	-	-	-	0.7143
Travel and Entertainment	-	-	-	-
Transportation Margins	-	-	-	-
Exports	0.0204	0.0279	0.0483	N/A

Source: Econometric Research Limited

Figure 8
Agriculture Costs per Dollar of Total Cost, Alberta, 1999



The Forward and Backward Linkages of Agriculture

Hirschman defines a key sector as one with high forward and backward linkages with other domestic sectors.[viii] Hirschman's definition, however, does not impose any restrictions on variability of these connections. This is a crucial issue, since a sector can have extensive links to only one sector. We argue that the spread of these links over many sectors matters. This is why in this study we define a key sector as one with large backward and forward links to many sectors. We gauge the linkages of a specific sector by the magnitude and the spread of its interactions with other sectors (e.g. purchases from and sales to other sectors). Variability is measured by the lack of concentration of these purchases or supplies in a small subset of sectors.

As a result, our definition of a key sector is similar to that of Hirschman's, but imposes restrictions on the variability of these linkages that is not a criterion for Hirschman..

For the time period of 1999, in tables 9-14 (see Appendix A), we present a two-way classification of forward and backward linkages and their respective distributions for Ontario, Manitoba and Alberta. Obviously the sectors that fall under high (backward links) u_j and low (variability) v_j reveal a high absorption rate from a large number of sectors in the economy. Similarly, sectors with high (forward links) u_i and low (variability) v_i show high forward linkages with a large supply network.[ix]

The sectors that possess both high u_i and low v_i, and high u_j and low v_j are key sectors in the economy. Surprisingly, only the food and beverages sector qualify for the key sector designation in Ontario, Manitoba (hidden in manufacturing) and Alberta. This sector in all three provinces is shown to have high dependence on agriculture. This suggests that even though agriculture may not qualify directly as a key sector, the fact that it supports and sustains a key sector gives it a special importance and role in the economy.

In 1999, agriculture was one of the sectors that showed lower than average forward linkages and a high coefficient of variation, signifying that it supplied a small number of sectors with its services in both Ontario and Manitoba. It had low backward linkages and a high coefficient of variation indicating a low absorption rate of the products of only a few sectors in both Ontario and Manitoba. By way of contrast, the agriculture sector in Alberta had a high forward linkage coefficient with low variation and a high backward linkage but with high variation. It almost qualified as a key sector in the Alberta economy and which we refer to as a quasi key sector (Tables 13 and 14).

While only one sector qualified for the key sector status in Ontario and Manitoba in 1999, other sectors may be deemed key sectors if we were to relax the strict conditions (a) and (b) (see Appendix A). There are many possible candidates that may have qualified as key sectors but did not because of a slight violation of one of the conditions in (a) and (b) even though they rank better than average on the rest. Some of the candidates are the very sectors that have high agricultural cost intensities such as forestry and accommodation and meals.

It should be noted that the key sector status should not be judged outside the full appreciation of the many indicators that were used in this study. The focus of this section is on the way the agricultural sector is a critical link in the production chains of the provinces, particularly Alberta and indirectly Ontario and Manitoba.

Table 9
Forward Linkages and Coefficients of Variation, Ontario, 1999

Sectors with Low Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
13	Primary Metals	3.36	0.90
20	Chemicals	2.88	0.94
24	Communication & Other Utility	2.64	0.90
28	Edu & Health	3.27	0.75

Sectors with High Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
5	Food & Beverage	2.29	1.20
16	Transportation Equip.	3.35	1.05
19	Refined Petroleum	2.40	1.06
23	Transportation & Storage	1.57	2.09
25	Trade	1.13	2.19
26	Finance, Insurance & Real Estate	0.67	4.05
27	Business Services	1.17	2.30
29	Accommodation & Food Services	2.45	1.01
30	Other Service	2.02	1.25
32	Travel, Entertainment & Advertising	1.82	1.35
33	Transportation Margins	2.17	1.11

Sectors with Low Forward Linkage and High Coefficient of Variation

#	Sector Name	V_i	U_i
1	Agriculture	3.58	0.82
2	Fishing	5.62	0.43
3	Forestry	4.41	0.61
4	Mining	4.04	0.62
6	Rubber, Plastic	4.09	0.59
7	Textiles	5.02	0.49
8	Clothing	5.00	0.49
9	Wood	4.62	0.59
10	Furniture	5.10	0.49
11	Paper	3.79	0.74
12	Printing	4.09	0.60
14	Fabricated Metal Products	3.65	0.70
15	Machinery	4.27	0.61
17	Elecrical	4.18	0.63
18	Non-Metallic Minerals	4.76	0.54
21	Misc. Manufacturing	4.68	0.54
22	Construction	3.54	0.68
31	Operating, Office	3.40	0.70

Source: Econometric Research Limited

Table 10
Backward Linkages and Coefficients of Variation, Ontario, 1999

Sectors with Low Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
8	Clothing	2.62	0.96
12	Printing	2.58	0.96

Sectors with High Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
2	Fishing	2.40	1.03
3	Forestry	2.39	1.14
9	Wood	2.45	1.13
10	Furniture	2.44	1.02
14	Fabricated Metal Products	2.56	1.02
22	Construction	2.40	1.03
28	Edu & Health	2.46	1.06
29	Accommodation & Food Services	2.51	1.05
30	Other Service	2.54	1.07
31	Operating, Office	2.40	1.01
32	Travel, Entertainment & Advertising	2.18	1.25
33	Transportation Margins	2.53	1.26

Sectors with Low Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
1	Agriculture	2.93	1.00
4	Mining	2.74	0.92
6	Rubber, Plastic	3.02	0.81
7	Textiles	2.86	0.86
15	Machinery	2.87	0.90
17	Elecrical	2.99	0.88
18	Non-Metallic Minerals	2.77	0.93
19	Refined Petroleum	2.90	0.90
20	Chemicals	2.92	0.94
21	Misc. Manufacturing	2.74	0.92
24	Communication & Other Utility	3.29	0.74
26	Finance, Insurance & Real Estate	3.54	0.89

Sectors with High Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
5	Food & Beverage	2.77	1.02
11	Paper	2.74	1.03
13	Primary Metals	2.75	1.11
16	Transportation Equip.	3.51	1.02
23	Transportation & Storage	2.80	1.05
25	Trade	2.73	1.03
27	Business Services	2.82	1.05

Source: Econometric Research Limited

Table 11
Forward Linkages and Coefficients of Variation, Manitoba, 1999

Sectors with Low Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
14	Other Services	2.03	1.00
15	Operating Office	2.03	0.95
16	Travel & Entertainment	2.15	0.92

Sectors with High Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
5	Manufacturing	1.20	1.87
7	Transport & Storage	1.83	1.42
9	Trade	1.32	1.48
10	Finance	0.98	2.18
11	Business Services	1.73	1.17

Sectors with Low Forward Linkage and High Coefficient of Variation

#	Sector Name	V_i	U_i
1	Agriculture	2.67	0.88
2	Fishing	3.97	0.49
3	Forestry	3.84	0.61
4	Mining	3.29	0.61
6	Construction	2.84	0.68
8	Commun. & Utility	2.60	0.73
12	Education & Health	3.05	0.65
13	Accommodation	2.48	0.80
17	Transportation Margins	3.38	0.57

Source: Econometric Research Limited

Table 12
Backward Linkages and Coefficients of Variation, Manitoba, 1999

Sectors with Low Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
2	Fishing	2.13	0.90
4	Mining	2.13	0.92
11	Business Services	2.14	0.99
15	Operating Office	2.05	0.98

Sectors with High Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
3	Forestry	2.09	1.08
6	Construction	1.92	1.01
9	Trade	2.11	1.01
12	Education & Health	1.86	1.06
13	Accommodation	1.92	1.04
14	Other Services	1.97	1.06
16	Travel & Entertainment	1.73	1.16
17	Transportation Margins	1.90	1.27

Sectors with Low Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
1	Agriculture	2.41	0.97
7	Transport & Storage	2.20	0.99
8	Commun. & Utility	2.86	0.67
10	Finance	2.73	0.88

Sectors with High Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
5	Manufacturing	2.36	1.01

Source: Econometric Research Limited

Table 13
Forward Linkages and Coefficients of Variation, Alberta, 1999

Sectors with Low Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
18	Refined Petroleum	3.02	0.85
23	Communication & Other Utility	2.71	0.91

Sectors with High Forward Linkage and Low Coefficient of Variation

#	Sector Name	V_i	U_i
1	Agriculture	2.64	1.44
4	Mining	1.87	1.66
5	Food & Beverage	2.78	1.02
19	Chemicals	2.90	1.01
22	Transportation & Storage	1.92	1.83
24	Trade	1.22	2.10
25	Finance, Insurance & Real Estate	0.83	3.36
26	Business Services	1.34	2.06
28	Accommodation & Food Services	2.43	1.07
29	Other Service	2.17	1.21
30	Operating, Office	1.64	1.53
31	Travel, Entertainment & Advertising	2.11	1.21

Sectors with Low Forward Linkage and High Coefficient of Variation

#	Sector Name	V_i	U_i
2	Fishing	5.56	0.45
3	Forestry	4.37	0.64
6	Rubber, Plastic	4.57	0.56
7	Clothing	5.27	0.48
8	Wood	3.90	0.70
9	Furniture	5.15	0.49
10	Paper	4.04	0.67
11	Printing	4.63	0.55
12	Primary Metals	3.84	0.70
13	Fabricated Metal Products	4.03	0.65
14	Machinery	4.43	0.58
15	Transportation Equip.	5.39	0.47
16	Elecrical	4.24	0.66
17	Non-Metallic Minerals	4.90	0.55
20	Misc. Manufacturing	5.00	0.50
21	Construction	3.52	0.71
27	Edu & Health	3.65	0.69
32	Transportation Margins	3.59	0.69

Source: Econometric Research Limited

Table 14
Backward Linkages and Coefficients of Variation, Alberta, 1999

Sectors with Low Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
6	Rubber, Plastic	2.73	0.94
9	Furniture	2.63	0.96
11	Printing	2.59	0.99
12	Primary Metals	2.75	0.98
15	Transportation Equip.	2.66	0.94
17	Non-Metallic Minerals	2.75	0.97
20	Misc. Manufacturing	2.76	0.91
27	Edu & Health	2.63	0.99

Sectors with High Backward Linkage and Low Coefficient of Variation

#	Sector Name	V_j	U_j
2	Fishing	2.36	1.10
3	Forestry	2.44	1.15
5	Food & Beverage	2.67	1.24
8	Wood	2.46	1.11
18	Refined Petroleum	2.53	1.26
21	Construction	2.48	1.03
24	Trade	2.79	1.02
28	Accommodation & Food Services	2.53	1.07
29	Other Service	2.59	1.06
31	Travel, Entertainment & Advertising	2.26	1.24
32	Transportation Margins	2.56	1.30

Sectors with Low Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
4	Mining	3.28	0.82
7	Clothing	2.82	0.91
10	Paper	2.86	0.94
13	Fabricated Metal Products	2.89	0.90
14	Machinery	3.02	0.85
16	Elecrical	3.83	0.73
19	Chemicals	2.98	0.99
23	Communication & Other Utility	3.42	0.74
25	Finance, Insurance & Real Estate	3.55	0.88
30	Operating, Office	2.90	0.88

Sectors with High Backward Linkage and High Coefficient of Variation

#	Sector Name	V_j	U_j
1	Agriculture	3.25	1.08
22	Transportation & Storage	2.89	1.01
26	Business Services	2.93	1.02

Source: Econometric Research Limited

Productivity and Efficiency in the Agricultural Sector in Canada and the Provinces.

Governments are under intense pressure to open up agriculture to competition, deregulate the sector and dismantle the subsidies and the institutions that supported and shored farmers' income. The World Trade Organization (WTO) most recent meetings in Doha (November, 2001) and Cancun (September, 2003) were characterized by incessant demands by developing countries that agriculture be brought under the world trading regime regulated by WTO. This could only mean that competition will intensify and the cost effectiveness of the sector will become crucial to its success.

Productivity increases are typical in the agricultural sector. In many ways the agricultural sector is believed to be a victim of its increased productivity over the year. Higher productivity means lower costs which could eventually bring down prices. This is why the analysis of productivity of the sector and its sub-components is critical. Indeed, labour productivity is only one aspect of the efficiency of the sector but is still quite revealing of the trends and problems of the sector.

Several tables and figures are devoted to the presentation of labour productivity per hour over the period 1997-2003 in Canada and the four main agricultural provinces by five subcomponents. A table and graph are devoted to each jurisdiction to display its productivity estimates. The five subcomponents are:[x]

- Crop and animal production
- Greenhouse, nursery and floriculture
- Crop production except greenhouse, nursery and floriculture
- Animal aquaculture
- Animal production except aquaculture

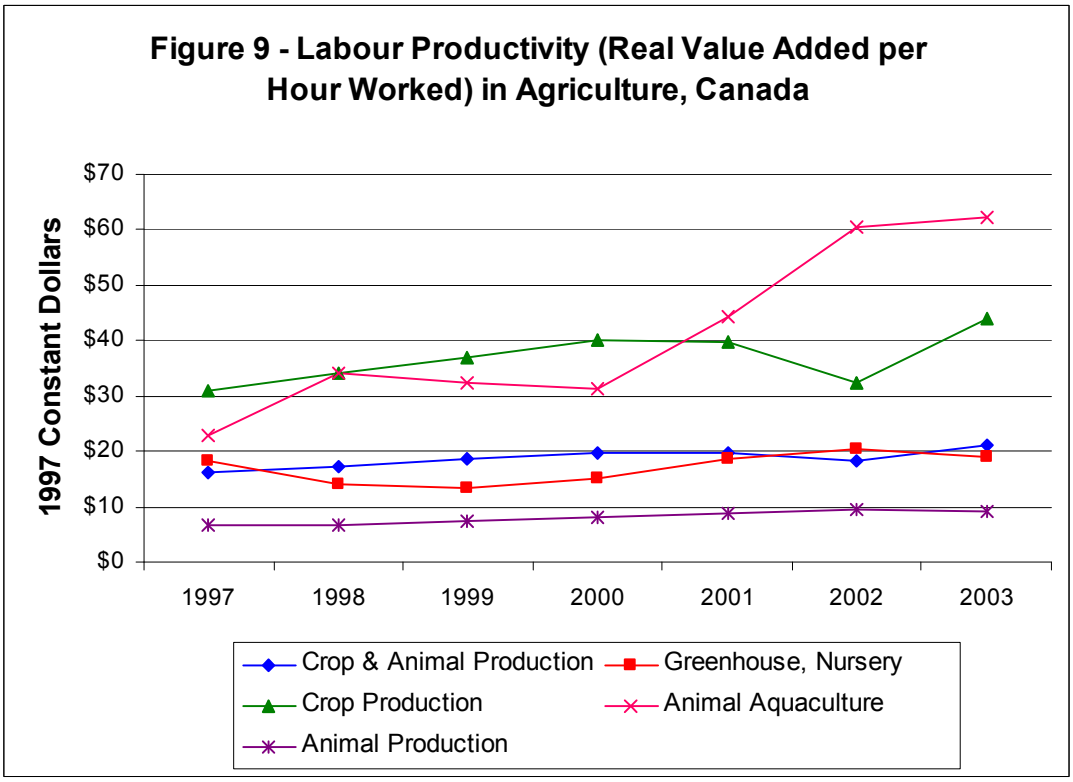
Productivity in Agriculture: Canada

Animal aquaculture shows the highest labour productivity per hour worked. The trend is positive throughout the period almost tripling over the six year period. Positive productivity growth is also associated with cop production (except for greenhouse, nursery and floriculture. Actually positive growth rates in productivity are noted for all the agricultural subcomponents between 1997 and 2003. But some growth rates are modest and limited such as those in animal production and greenhouse, nursery and floriculture.

Table 15 - Labour Productivity (Real Value Added per Hour Worked) in Agriculture , Canada 1997 Constant Dollars

	1997	1998	1999	2000	2001	2002	2003
Crop and Animal Production	$16.25	$17.08	$18.67	$19.61	$19.55	$18.29	$21.19
Greenhouse, Nursery and Floriculture Production	$18.25	$14.09	$13.49	$14.97	$18.57	$20.31	$19.10
Crop Production (except Greenhouse, Nursery and Floriculture)	$30.92	$34.11	$36.76	$40.08	$39.61	$32.45	$44.01
Animal Aquaculture	$22.94	$34.04	$32.51	$31.21	$44.26	$60.35	$62.27
Animal Production (except Animal Aquaculture)	$6.64	$6.76	$7.36	$8.15	$8.96	$9.46	$8.97

Source: Statsitics Canada



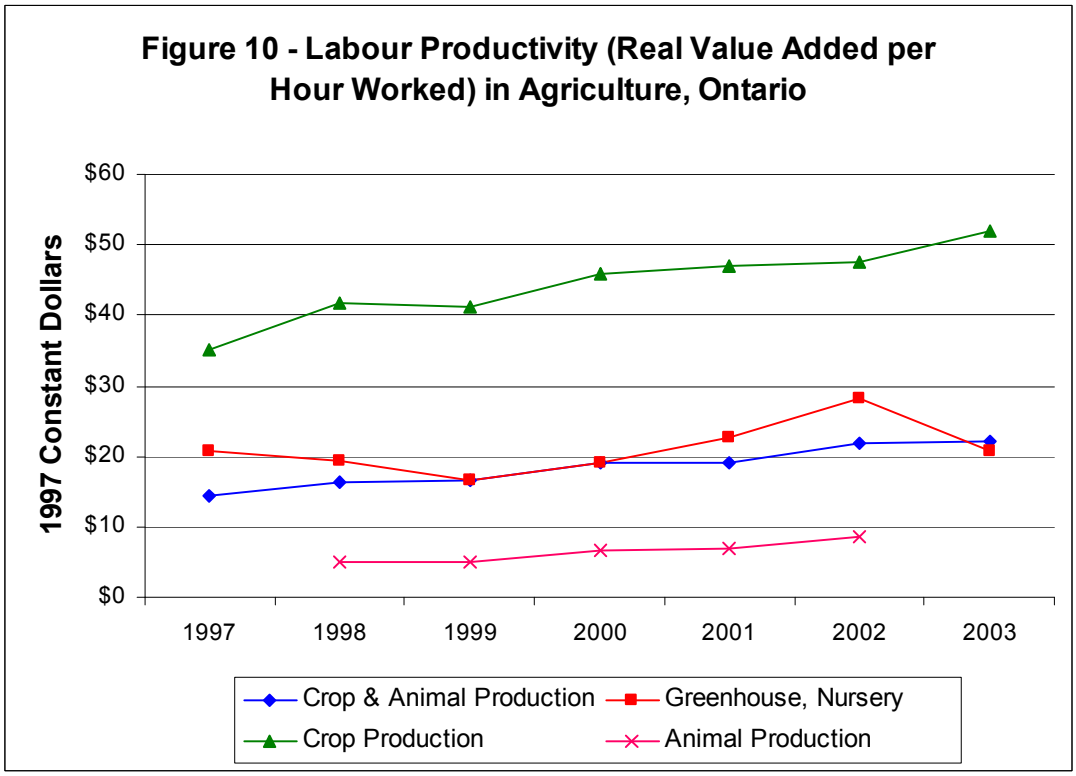
Productivity in Agriculture: Ontario

Ontario's productivity growth in agriculture is limited. The highest labour productivity per hour is in crop production which is also higher than the Canadian average by about $7 per hour. Productivity in other subcomponents is almost stagnant and not much different than the corresponding average Canadian rates.

Table 16 - Labour Productivity (Real Value Added per Hour Worked) in Agriculture, Ontario 1997 Constant Dollars

	1997	1998	1999	2000	2001	2002	2003
Crop and Animal Production	$14.45	$16.26	$16.45	$19.10	$19.19	$21.91	$22.01
Greenhouse, Nursery and Floriculture Production	$20.74	$19.22	$16.45	$19.21	$22.68	$28.22	$20.76
Crop Production (except Greenhouse, Nursery and Floriculture)	$34.99	$41.88	$41.21	$46.01	$47.06	$47.42	$51.91
Animal Aquaculture	na	na	na	na	na	na	na
Animal Production (except Animal Aquaculture)	$4.68	$4.94	$4.86	$6.58	$7.04	$8.51	na

Source: Statsitics Canada



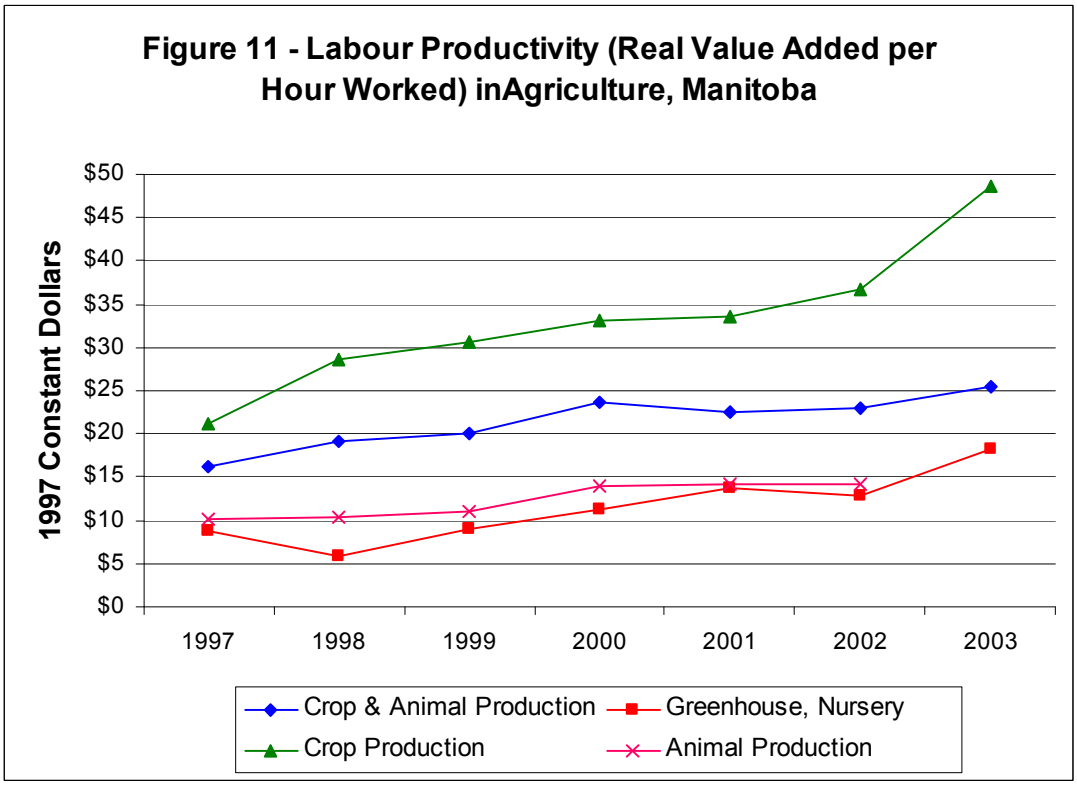
Productivity in Agriculture: Manitoba

Labour productivity growth in agriculture in Manitoba is typically positive for all subcomponents. Moreover, the levels are also higher than the corresponding Canadian average values for all subcomponents except greenhouse, nursery and floriculture. There were no data for animal aquaculture which suggests that this activity is not a major one in Manitoba's agricultural sector.

Table 17 - Labour Productivity (Real Value Added per Hour Worked) in Agriculture, Manitoba 1997 Constant Dollars

	1997	1998	1999	2000	2001	2002	2003
Crop and Animal Production	$16.18	$19.20	$20.01	$23.73	$22.61	$23.03	$25.51
Greenhouse, Nursery and Floriculture Production	$8.89	$5.91	$9.02	$11.20	$13.72	$12.82	$18.31
Crop Production (except Greenhouse, Nursery and Floriculture)	$21.26	$28.60	$30.64	$33.03	$33.57	$36.64	$48.67
Animal Aquaculture	na	na	na	na	na	na	na
Animal Production (except Animal Aquaculture)	$10.09	$10.30	$10.96	$14.04	$14.21	$14.09	na

Source: Statsitics Canada



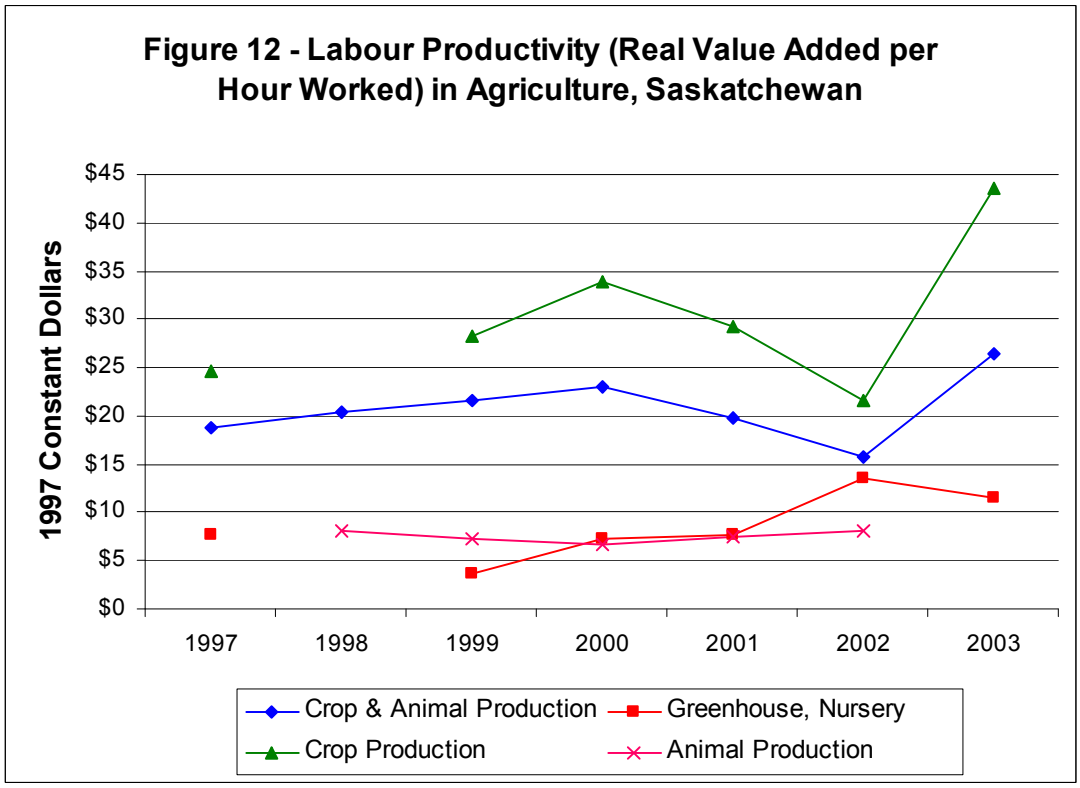
Productivity in Agriculture: Saskatchewan

The labour productivity per hour in crop and animal production in Saskatchewan exceeds that of Canada's and shows higher rates of growth than that of other provinces. In almost all other components Saskatchewan's productivity performance is below average.

Table 18 - Labour Productivity (Real Value Added per Hour Worked) in Agriculture, Saskatchewan 1997 Constant Dollars

	1997	1998	1999	2000	2001	2002	2003
Crop and Animal Production	$18.78	$20.31	$21.59	$22.99	$19.83	$15.68	$26.45
Greenhouse, Nursery and Floriculture Production	$7.59	na	$3.61	$7.18	$7.69	$13.44	$11.40
Crop Production (except Greenhouse, Nursery and Floriculture)	$24.70	na	$28.35	$33.93	$29.34	$21.49	$43.57
Animal Aquaculture	na	na	na	na	na	na	na
Animal Production (except Animal Aquaculture)	$6.81	$8.16	$7.37	$6.57	$7.51	$8.13	na

Source: Statsitics Canada



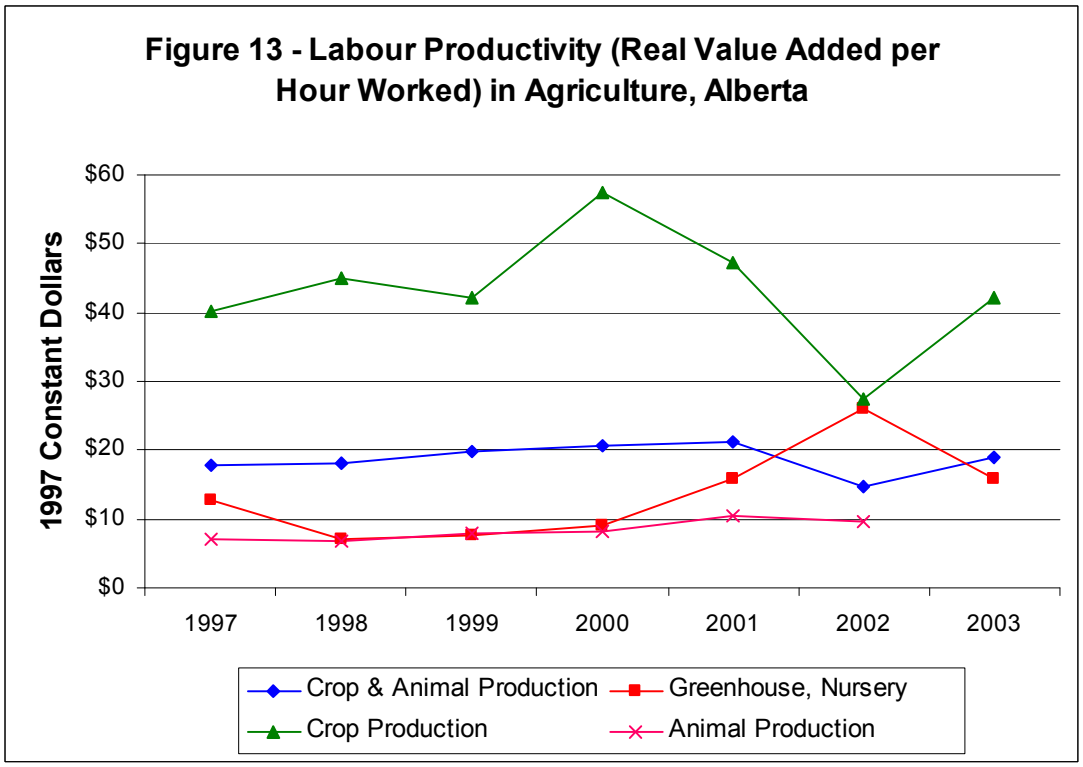
Productivity in Agriculture: Alberta

Surprisingly labour productivity indices in agriculture in Alberta without exception fall below the Canadian average during the latter part of the period under consideration. Up until 2001, Alberta had a higher level of labour productivity per hour than Canada in crop and animal production. In both 2002 and 2003, Alberta's labour productivity per hour worked in crop and animal production fell short of Canada's. It is also observed that there are considerable variations of labour productivity for most subcomponents over the period as Figure 13 clearly reveals, particularly towards the latter part of the period. Oil price increases and US embargoes on Canadian Beef must have had some impact on these developments.

Table 19 - Labour Productivity (Real Value Added per Hour Worked) in Agriculture, Alberta 1997 Constant Dollars

	1997	1998	1999	2000	2001	2002	2003
Crop and Animal Production	$17.75	$18.19	$19.73	$20.65	$21.26	$14.79	$18.98
Greenhouse, Nursery and Floriculture Production	$12.81	$6.95	$7.76	$9.09	$15.95	$26.01	$15.95
Crop Production (except Greenhouse, Nursery and Floriculture)	$40.05	$45.04	$42.30	$57.53	$47.13	$27.57	$42.31
Animal Aquaculture	na	na	na	na	na	na	na
Animal Production (except Animal Aquaculture)	$7.06	$6.88	$7.89	$8.29	$10.61	$9.54	na

Source: Statsitics Canada



The Rural Perspective: Agriculture and the Rural Economy

There are many communities in Canada whose economic fortunes are tied closely to one dominant industry. These dominant industries are typically dependent on extraction of natural resources or are in the general class of primary sectors.

Rural communities are typically dependent agriculture which constitutes their basic sector. More recently, however, there has been a growing belief that farming and rural communities have become disconnected from one another (John Smithers et al. 2004).[xi] This perception of disconnect is related to the underestimation or lack of realization of the contributions of agriculture to the local rural communities and to environmental issues.

Early studies of the contributions of agriculture have used the concept of a basic sector.[xii] This concept is rooted in the notion of an export sector that generates "new" money in the community in contrast with other sectors that simply recirculate "old" money. The basic sector is commonly identified using location quotients. When a sector shows a higher proportion of employment or output in the total employment or output of the community than in the larger economy (province or nation), it is considered to be an export sector. The presumption here is that the sector is bigger than the market enclosure where it is located.
The use of input output systems generalized the notion of a well identified basic sector driving the local economy (literally as the locomotive or engine of growth) to any sector that responds to any exogenously determined demand whether from outside its boundary or even from within its boundary.

There is no doubt that agriculture in many communities is not simply or exclusively restricted to meet local demands.[xiii] Invariably, agriculture generates large surpluses that are shipped beyond the jurisdiction that produces them. In that manner agriculture is unquestionably a basic (export) sector meeting external demands and bringing new money into the community. Non-basic sectors simply arise to service the basic sector's demand and the demands of those earning income from it. That is why the ratio of total output (or employment) of a community to the output or employment directly produced by or employed in the basic sector is used as the multiplier value of the sector on the economy at large. It translates any change in direct demand into a total impact. Unfortunately this procedure works well when there is only one basic sector and fails when more than one basic sector is present. When more than one basic sector exists in the local economy, it leads to an exaggeration of the impact of the basic sector and reduces its credibility. Consider the case of a community that has more than one basic (export) sector, then the issue arises as to proper share of each of the two basic sectors in the total income or employment of the community. The simple division of the total by the direct contributions of a basic sector will no longer be valid in this case because the contributions of the other basic sector are not excluded.

A far more credible solution of this problem is offered by the input output system but one that is tied to a local economic base model. This is precisely the structure of our RIM model.[xiv] In what follows we will apply RIM to three locations in Canada in order to identify and quantify the economic contributions of agriculture to the overall economies of three designated rural areas. We

have chosen Oxford County in Ontario, Brandon in Manitoba and Lethbridge in Alberta as case studies.

A common feature of all the results in tables 20-22 is that the direct effects are poor estimates of the total effects. It is also true that local community impacts are far below the total provincial impacts as impacts are not fully retained by the small agricultural economies because of leakages. These leakages arise because rural economic structures have many empty sectoral boxes. A good portion of their demands are met by importing from jurisdiction outside the local economy and these are paid for by exporting surplus products (typically agricultural products or natural resources).

There is a general tendency in small economies dependent on a limited economic base to under-estimate the extent of dependence on the dominant basic sector.[xv] The general feeling is that if one does not work in the basic sector then one is immune from any variations in that sector. Nothing could be farther from the truth than this. It is commonly the case that all sectors in the economy are interconnected and that if the direct effects do not impact a particular group, they are nevertheless impacted through the indirect and induced effects. A drastic decline in farm income influences the price of the house of the physician and the income of the accountant. The real message from the results to follow is that the community is an integrated whole.

Oxford County Ontario

The location and a general profile of Oxford County in Ontario are presented below by way of setting the background against which the RIM system is used to delineate agricultural activity in the County.

The County is decidedly agricultural with a revealed comparative advantage in this sector derived by comparing agricultural employment in the County to the corresponding numbers in Ontario. Agriculture and resource based activities in the County account for 10.2% of total County employment. The corresponding share in Ontario is 4.28%. The contributions of agriculture to valued added in the County are estimated to exceed the employment shares given the demonstrated high productivity of agriculture in the County.

An increase in demand for agricultural products in Oxford County in Ontario will sustain an income of over a million in Ontario of which $561.5 thousand will be retained in Oxford County. This is twice as large as the direct income impact of $254 thousand. Sales in the community will rise to $1.2 million and 7.4 person years of employment will be sustained directly in agricultural activities and another 5.2 person years outside agriculture but within the County. All levels of government will collect tax revenues on these impacts. Due to increased agricultural activity, as much as $277.7 thousand would be collected (Table 20 and figures 14 and 15).

Characteristics	Oxford County	Ontario
Population in 2001 (1)	99,270	11,410,046
Population in 1996 (2)	97,142	10,753,573
1996 to 2001 population change (%)	2.2	6.1
Total private dwellings	38,555	4,556,240
Population density per square kilometre	48.7	12.6
Land area (square km)	2,039.44	907,655.5

Characteristics	Oxford County			Ontario		
	Total	Male	Female	Total	Male	Female
Earnings						
All persons with earnings (counts) (49)	54,800	29,695	25,105	6,319,535	3,311,105	3,008,425
Average earnings (all persons with earnings ($))	30,662	37,343	22,737	36,186	42,719	26,894
Worked full year, full time (counts) (49)	31,350 R	19,630	11,725	3,627,045 R	2,061,355	1,465,690
Average earnings (worked full year, full time ($))	41,448	46,676	32,697	47,299	53,937	37,962

Characteristics	Oxford County			Ontario		
	Total	Male	Female	Total	Male	Female
Unpaid Work						
Persons reporting hours of unpaid work [34]	71,940	34,445	37,495	8,229,410	3,886,440	4,342,975
Persons reporting hours of unpaid housework [35]	71,140	33,870	37,270	8,112,435	3,812,780	4,299,655
Persons reporting hours looking after children, without pay [36]	31,280	13,915	17,365	3,448,335	1,515,125	1,933,210
Persons reporting hours of unpaid care or assistance to seniors [37]	15,510	6,190	9,315	1,641,305	676,295	965,015
Labour Force Indicators						
Participation rate [38]	68.3	76.0	60.9	67.3	73.4	61.5
Employment rate [39]	64.4	71.8	57.3	63.2	69.1	57.6
Unemployment rate [40]	5.8	5.5	6.0	6.1	5.8	6.5
Industry [42]						
Total - Experienced labour force [41]	52,190	28,545	23,650	5,992,765	3,173,280	2,819,490
Agriculture and other resource-based industries	5,325	3,550	1,770	191,020	135,925	55,090
Manufacturing and construction industries	15,930	11,995	3,935	1,316,590	979,715	336,870
Wholesale and retail trade	7,820	3,855	3,965	950,730	484,505	466,230
Finance and real estate	2,335	800	1,540	401,445	171,350	230,096
Health and education	6,635	1,095	5,540	902,990	212,830	690,165
Business services	6,760	4,000	2,760	1,145,910	674,075	471,835
Other services	7,390	3,245	4,145	1,084,090	514,875	569,210

Table 20
Economic Impatcs per Million Dollar of Agriculture Final Demand in Ontario (2005 Dollars)

	Ontario	Oxford
Initial Expenditure	$1,000,000	$1,000,000
Value Added		
Direct	$254,029	$254,029
Indirect & Induced	$798,830	$307,520
Total	$1,052,859	$561,549
Multiplier	1.05	0.56
Gross Output		
Direct	$1,000,000	$1,000,000
Indirect & Induced	$1,402,627	$234,565
Total	$2,402,627	$1,234,565
Multiplier	2.40	1.23
Wages & Salaries		
Direct	$128,743	$128,743
Indirect & Induced	$436,045	$178,956
Total	$564,788	$307,699
Employment		
Direct	7.4	7.4
Indirect & Induced	14.8	5.2
Total	22.2	12.6
Multiplier	3.00	1.70
Taxes		
Federal	$156,001	$84,754
Provincial	$102,252	$52,475
Local	$19,476	$8,343
Total	$277,729	$145,572
Imports		
From Other Provinces	$84,806	$42,650
From Other Countries	$194,835	$97,977
Total	$279,641	$140,627

Source: Econometric Research Limited

Figure 14 - Economic Impacts per Million Dollar of Agriculture Final Demand in Ontario

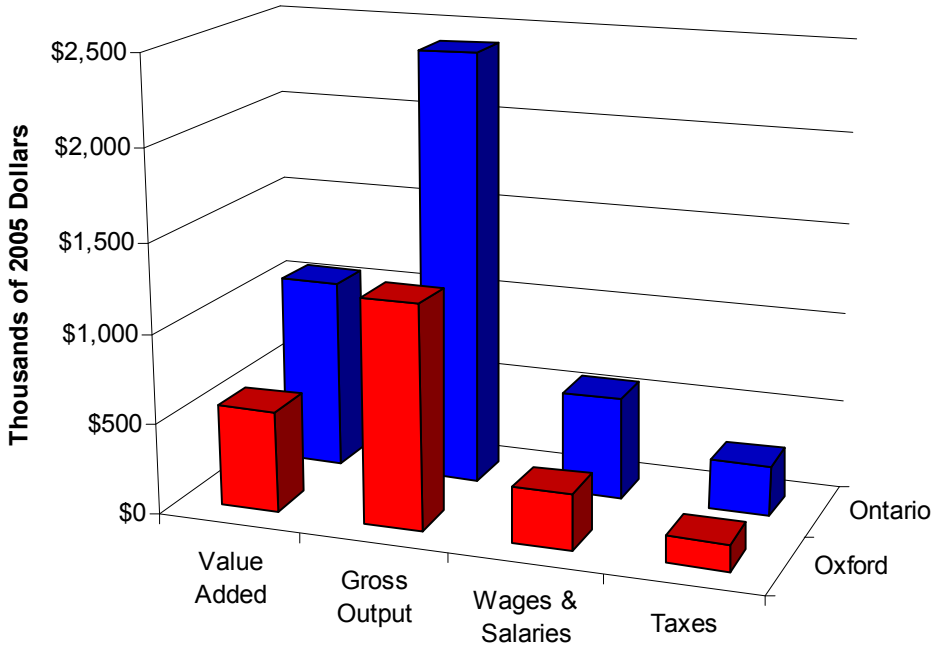
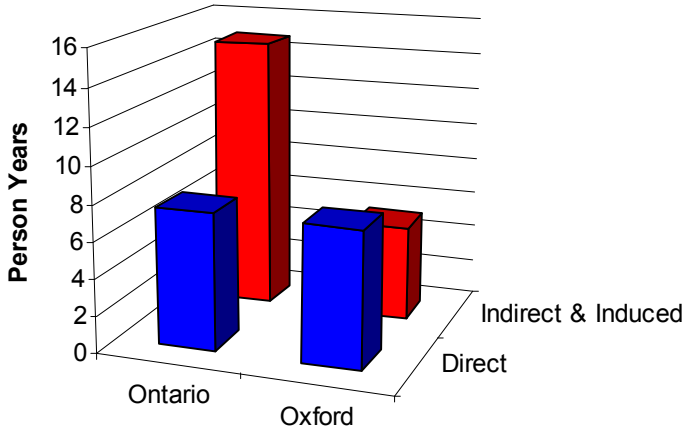


Figure 15 - Employment Impacts per Million Dollar of Agriculture Final Demand in Ontario



Brandon Manitoba

Agriculture is an important sector in Brandon County in Manitoba. However, agricultural employment in the County is only 4.2% whereas it exceeds 8.4% in Manitoba. The choice on the County was made on the basis of its integrated economy within which agriculture operates in the province.

A similar $1 million increase in agricultural final demand in Brandon Manitoba will sustain a total provincial income of $797 thousand and a local income impact of $521.7 thousand. The total income impact in Manitoba is less than the one generated in Ontario because of the diversified structure of the Ontario economy. But what is interesting is that Brandon derives a larger share of the provincial impacts. This is indicative of a larger catchment's area and potential in Brandon vis-à-vis Manitoba than Oxford vis-à-vis Ontario. Fewer jobs are created in total but the local area gets a larger share of these new jobs (Table 21 and figures 16 and 17).

Characteristics	Brandon	Manitoba
Population in 2001 (1)	41,037	1,119,583
Population in 1996 (2)	40,581	1,113,898
1996 to 2001 population change (%)	1.1	0.5
Total private dwellings	17,966	477,086
Population density per square kilometre	63.5	2.0
Land area (square km)	646.38	551,937.8

Characteristics	Brandon			Manitoba ⚠		
	Total	Male	Female	Total	Male	Female
Earnings						
All persons with earnings (counts) [48]	23,465	11,940	11,515	609,575	320,670	288,900
Average earnings (all persons with earnings ($))	25,218	30,712	19,520	27,178	32,312	21,480
Worked full year, full time (counts) [49]	12,550 [B]	7,280	5,270	337,100 [B]	197,990	139,115
Average earnings (worked full year, full time ($))	34,431	39,166	27,802	36,729	41,163	30,433

Characteristics	Brandon			Manitoba ⚠		
	Total	Male	Female	Total	Male	Female
Unpaid Work						
Persons reporting hours of unpaid work [34]	30,105	13,890	16,220	799,085	379,720	419,365
Persons reporting hours of unpaid housework [35]	29,775	13,670	16,100	787,905	372,485	415,415
Persons reporting hours looking after children, without pay [36]	12,075	5,205	6,875	348,445	153,570	194,870
Persons reporting hours of unpaid care or assistance to seniors [37]	6,055	2,230	3,820	180,275	74,120	106,160
Labour Force Indicators						
Participation rate [38]	69.1	76.8	63.3	67.3	73.6	61.4
Employment rate [39]	65.3	71.7	59.6	63.3	69.0	57.9
Unemployment rate [40]	5.5	6.4	5.8	6.1	6.3	5.7
Industry [42]						
Total - Experienced labour force [41]	22,325	11,475	10,845	577,340	307,465	269,875
Agriculture and other resource-based industries	940	675	265	48,700	36,350	12,350
Manufacturing and construction industries	3,495	2,760	735	96,660	74,340	22,315
Wholesale and retail trade	3,745	1,940	1,805	84,185	44,790	39,400
Finance and real estate	1,140	485	655	28,780	11,140	17,635
Health and education	5,005	1,285	3,720	114,265	28,220	86,050
Business services	2,960	1,870	1,095	87,955	55,825	32,135
Other services	5,035	2,460	2,575	116,800	56,800	60,005

Table 21
Economic Impatcs per Million Dollar of Agriculture Final Demand in Manitoba (2005 Dollars)

	Manitoba	Brandon
Initial Expenditure	$1,000,000	$1,000,000
Value Added		
Direct	$277,902	$277,902
Indirect & Induced	$519,045	$243,772
Total	$796,947	$521,674
Multiplier	0.80	0.52
Gross Output		
Direct	$1,000,000	$1,000,000
Indirect & Induced	$1,003,974	$315,164
Total	$2,003,974	$1,315,164
Multiplier	2.00	1.32
Wages & Salaries		
Direct	$85,729	$85,729
Indirect & Induced	$263,155	$142,789
Total	$348,884	$228,518
Employment		
Direct	9.5	9.5
Indirect & Induced	7.8	1.9
Total	17.3	11.4
Multiplier	1.82	1.20
Taxes		
Federal	$134,655	$88,105
Provincial	$57,094	$37,209
Local	$15,878	$10,389
Total	$207,627	$135,703
Imports		
From Other Provinces	$169,286	$111,207
From Other Countries	$101,947	$67,098
Total	$271,233	$178,305

Source: Econometric Research Limited

Figure 16 - Economic Impacts per Million Dollar of Agriculture Final Demand in Manitoba

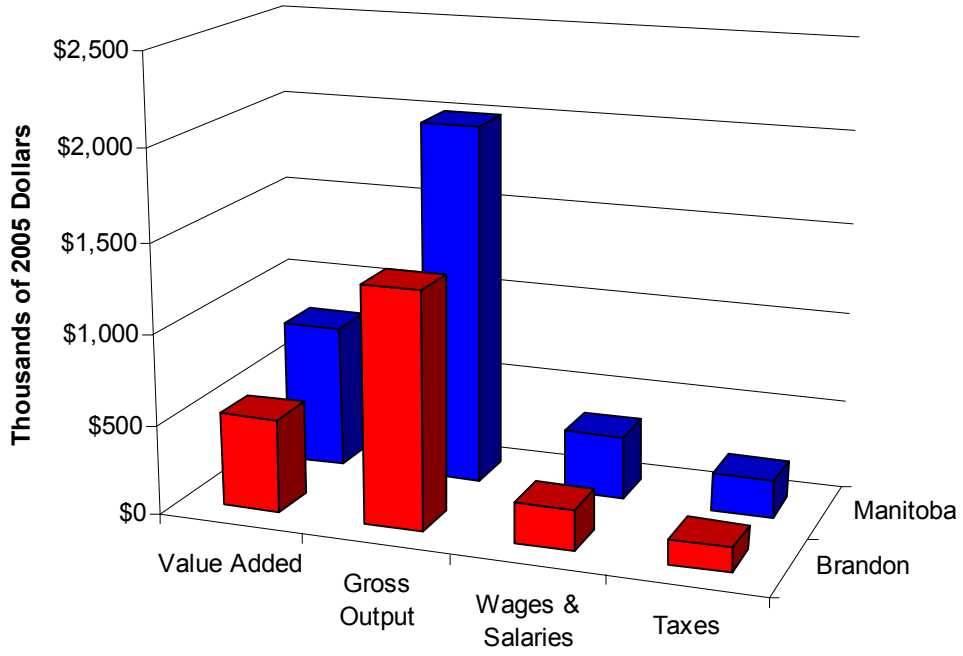
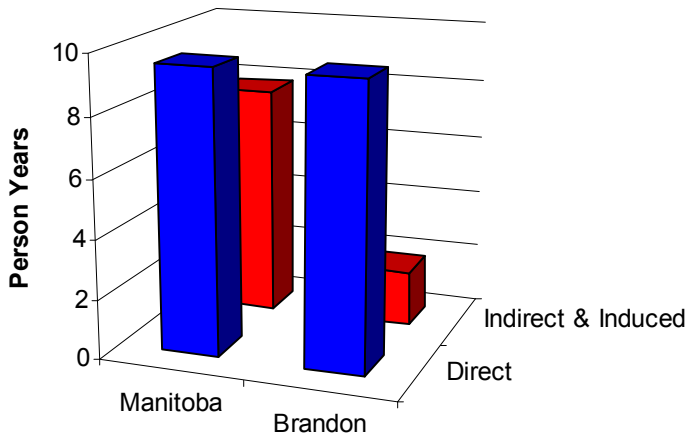


Figure 17 - Employment Impacts per Million Dollar of Agriculture Final Demand in Manitoba



Lethbridge Alberta

In Lethbridge County in Alberta, agriculture and resource based activities represent over 38.9% of total County employment. The corresponding employment shares in Alberta are only 10.9%. Agriculture and resource based activities in Lethbridge County are almost four times the provincial average. This why it is easy to claim that agriculture is a leading and critical industry in the County.

Impacts province-wide or locally in Alberta are in between those calculated for Manitoba and Ontario. Income generated province wide is larger than that in Manitoba but lower than that in Ontario. But the local impact is far larger than both that of Oxford County in Ontario and that of Brandon Manitoba. The local employment impact is less than Brandon's but higher than that of Oxford. It is these variations that highlight the need for local models. The standard practice of dealing with local areas as if they are miniatures of larger areas could be misleading.

Characteristics	Lethbridge County	Alberta
Population in 2001 (1)	9,930	2,974,807
Population in 1996 (2)	9,251	2,696,826
1996 to 2001 population change (%)	7.3	10.3
Total private dwellings	2,916	1,171,841
Population density per square kilometre	3.5	4.6
Land area (square km)	2,838.84	639,987.1

Characteristics	Lethbridge County			Alberta		
	Total	Male	Female	Total	Male	Female
Earnings						
All persons with earnings (counts) (48)	5,145	2,895	2,250	1,768,440	944,130	824,315
Average earnings (all persons with earnings ($))	26,369	31,616	19,624	32,603	40,797	23,218
Worked full year, full time (counts) (49)	2,785 R	1,890	895	936,180 R	565,705	370,475
Average earnings (worked full year, full time ($))	36,264	38,887	27,623	44,130	61,133	33,437

Characteristics	Lethbridge County			Alberta		
	Total	Male	Female	Total	Male	Female
Unpaid Work						
Persons reporting hours of unpaid work (34)	6,410	3,190	3,225	2,134,305	1,030,975	1,103,325
Persons reporting hours of unpaid housework (35)	6,300	3,110	3,195	2,104,395	1,010,605	1,093,780
Persons reporting hours looking after children, without pay (36)	3,325	1,485	1,835	919,765	408,355	511,405
Persons reporting hours of unpaid care or assistance to seniors (37)	1,665	695	965	397,880	162,420	235,460
Labour Force Indicators						
Participation rate (38)	74.8	86.3	62.7	73.1	79.6	66.6
Employment rate (39)	73.0	84.5	60.8	69.3	75.5	63.1
Unemployment rate (40)	2.5	2.1	3.1	5.2	5.1	5.2
Industry (42)						
Total - Experienced labour force (41)	5,125	3,065	2,060	1,681,985	913,385	768,595
Agriculture and other resource-based industries	1,995	1,510	485	184,105	134,380	49,725
Manufacturing and construction industries	720	590	125	264,940	213,885	51,055
Wholesale and retail trade	625	280	345	258,740	133,770	124,970
Finance and real estate	130	35	95	84,335	34,640	49,695
Health and education	650	85	570	259,050	58,095	200,955
Business services	515	320	195	316,265	190,780	125,490
Other services	495	245	250	314,545	147,825	166,715

Table 22
Economic Impatcs per Million Dollar of Agriculture Final Demand in Alberta (2005 Dollars)

	Alberta	Lethbridge
Initial Expenditure	$1,000,000	$1,000,000
Value Added		
Direct	$273,772	$273,772
Indirect & Induced	$632,969	$273,513
Total	$906,741	$547,285
Multiplier	0.91	0.55
Gross Output		
Direct	$1,000,000	$1,000,000
Indirect & Induced	$1,387,640	$427,900
Total	$2,387,640	$1,427,900
Multiplier	2.39	1.43
Wages & Salaries		
Direct	$80,298	$80,298
Indirect & Induced	$289,032	$144,189
Total	$369,330	$224,487
Employment		
Direct	8.2	8.2
Indirect & Induced	9.8	3.5
Total	18.0	11.7
Multiplier	2.20	1.43
Taxes		
Federal	$146,484	$84,354
Provincial	$75,487	$43,881
Local	$25,288	$14,700
Total	$247,259	$142,935
Imports		
From Other Provinces	$161,430	$98,673
From Other Countries	$114,639	$67,698
Total	$276,069	$166,371

Source: Econometric Research Limited

Figure 18 - Economic Impacts per Million Dollar of Agriculture Final Demand in Alberta

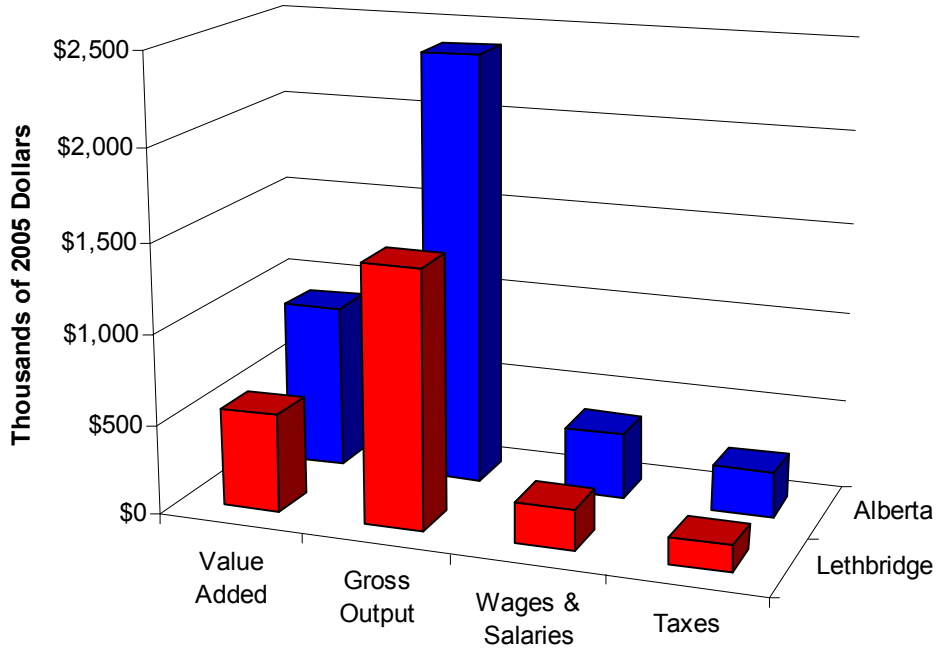
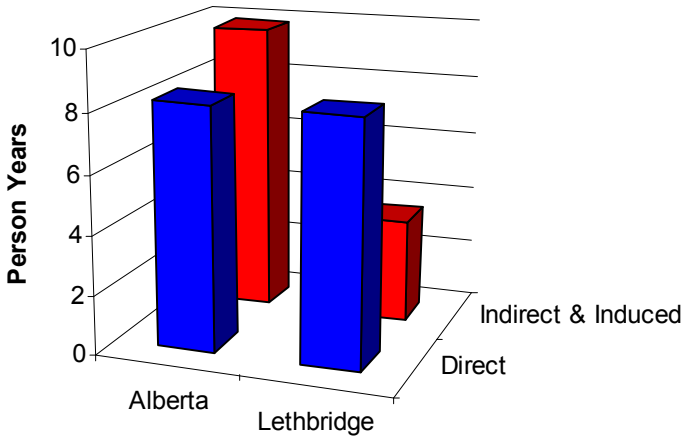


Figure 19 - Employment Impacts per Million Dollar of Agriculture Final Demand in Alberta



Conclusion

Agriculture in Canada is not performing as it should and could. The recent historical record shows that at the national level, farm incomes have been decreasing in real terms, whether measured since 1970, 1960, or 1950, and whether measured as net cash income or as net realized income after accounting for deprecation of assets.

The sales of agricultural products fell for the first time in the new millennium and the Prairie Provinces experienced a collective decline in sales of agricultural products as they were hit by the BSE crises and back-to-back droughts in 2001 and 2002.

Agriculture in Canada makes many substantive contributions. These may not be substantial but in some provinces agriculture is the main sector. In Canada agriculture contributes directly $8.7 billion to Net Domestic Product (NDP is GDP minus depreciation) and when its total effects are taken into consideration, it contributes $16 billion. It directly employs 160,541 persons in full time equivalent jobs but can legitimately claim credit for a much larger employment impact.

More than 357,521 Canadians owe their full-time equivalent jobs to agriculture either directly or through agriculture's indirect and induced effects. Indeed, some of these jobs are filled by seasonal migrant workers; however, the overwhelming majority of these jobs are staffed by Canadians, particularly those employment impacts arising out of the indirect and induced effects of the agricultural activity.

Ontario generates larger agricultural income than any of the highly visible agricultural provinces in Canada. Ontario's NPP (net provincial product which is equal to GPP minus depreciation) is augmented annually by over $2 billion directly and by $3.6 billion when agriculture's indirect and induced effects are taken into consideration. While this represents less than 1% (actually 0.84 of one percent of the total Ontario NPP), it is still a higher absolute contribution than in any other province. Moreover, about 86,915 Ontarians owe their full time equivalent jobs to agriculture, of these 45,356 are considered direct jobs in agriculture.

The contribution of agriculture to NPP of the provinces that are considered to sustain large agricultural activities falls short, in terms of absolute magnitude, of the corresponding values in Ontario. But in relative terms, the income contributions of agriculture represent larger shares of the total NPP of the respective provinces than is the case in Ontario. In Manitoba, agriculture contributes about $1 billion to its NPP or about 3.3% of the total. In Alberta agriculture makes a total contribution of about $3 billion or 2.7% of overall NPP, and in Saskatchewan the total contribution of agriculture to NPP is about $2.5 billion or 8.7% of total NPP.

As a percent of exports, agriculture products account for 10.5% of Manitoba's total exports, 4.83% of Alberta's and less than 1% of Ontario's, but when the share of agriculture in the exports of food and beverage is taken into account, these shares rise significantly.

In Manitoba a total of 25,292 full time equivalent jobs are associated with agricultural impacts. In Alberta over 68,598 Albertans owe their full time equivalent jobs to agriculture and in

Saskatchewan, another 57,027 full time jobs are sustained by agriculture in the province. While it is true that some of the direct employment in the provinces is filled by migrant seasonal workers, the majority of the jobs are staffed by local residents and again particularly those arising from the indirect and induced effects of the provincial agricultural activity.

The sector is not known for high wages or incomes. Actually real farm incomes have been declining over the years as noted above. Nonetheless, through the indirect and induced effects, relatively low wages in direct agricultural activity are raised significantly when the total impacts of the sector are taken into account. A total $8.3 billion is shown to represent the total labour incomes sustained by the activity in Canada.

It is clear that in 1999, that the agricultural sector in Ontario is a labour intensive sector with 13.9 jobs per $1 million of expenditure, has a relatively low income multiplier with an average degree of processing captured by an average direct value added coefficient of $0.375 on every dollar of output.

When the agricultural sector is positioned within the overall structure of production of the three provinces (Ontario, Manitoba and Alberta) it is possible to compare its performance with other sectors in the economy and to trace its impacts on the performance of other sectors. This is crucial because a sector may buy or sell directly from only a few industries, but its customers and suppliers may be intricately connected to other unrelated industries. As a result, this sector may have a profound influence on the economy through its indirect relations with other industries even when its direct links are limited and concentrated in a few sectors.

The agriculture sector in Canada appears to have had the following general characteristics in comparison with other sectors in the economy:

- Below average output multipliers, which means that for every dollar of expenditure more than a dollar of output is produced.
- Average income multipliers, which implies that for every dollar of expenditure more than a dollar of income results.
- Low labour income share in value added, indicating that agriculture is more capital intensive than other industries
- Relatively high employment content, which means that per million dollar of agriculture final demand a high level of employment, is generated and
- Relatively low average labour productivity when measured as valued added per employee, indicating that employment rises faster than value added.

Agriculture contributes inputs to a few sectors' output, but requires inputs from many sectors. The fraction of agricultural cost per $1 dollar of output directly and indirectly required from agriculture is referred to as the agriculture cost intensity. In Ontario agricultural inputs are the largest item of material cost in agricultural production with $0.18. This means that for every dollar of output from agriculture a total of $0.18 is required from agriculture directly and indirectly. Food & beverage processing is second with $0.15 – this is based on the demand of the food and beverages sector for agricultural inputs. Even forestry, accommodation, meals and

cafeteria and construction require agricultural inputs in their production processes, either directly or through purchased inputs.

In 1999, agriculture was one of the sectors that showed lower than average forward linkages and a high coefficient of variation, signifying that it supplied a small number of sectors with its output in both Ontario and Manitoba. The forward linkages measure the direction of output from agriculture to other producing industries that sue it as inputs in their production processes. It had low backward linkages and a high coefficient of variation indicating a low absorption rate of the products of only a few sectors as inputs in its production of agricultural goods and services in both Ontario and Manitoba. By way of contrast, the agriculture sector in Alberta had a high forward linkage coefficient with low variation and a high backward linkage but with high variation. This suggests that agriculture is more integrated into the structures of production of Alberta than in either Ontario or Manitoba. It almost qualified as a key sector in the Alberta economy and which we refer to as a quasi-key sector. A key sector is one where it supplies its output to many sectors and absorbs inputs from many sectors that are typically well spread over these sectors with very little concentration.

Productivity increases are typical in the agricultural sector. In many ways the agricultural sector is believed to be a victim of its increased productivity over the year. Higher productivity means lower costs which could eventually bring down prices. This is why the analysis of productivity of the sector and its sub-components is critical. Indeed, labour productivity is only one aspect of the efficiency of the sector but is still quite revealing of the trends and problems of the sector. Animal aquaculture shows the highest labour productivity (Value added) per hour worked. The trend is positive throughout the period almost tripling over the six year period. Positive productivity growth is also associated with cop production (except for greenhouse, nursery and floriculture). Actually positive growth rates in productivity are noted for all the agricultural subcomponents between 1997 and 2003. But some growth rates are modest and limited such as those in animal production and greenhouse, nursery and floriculture.

There are many communities in Canada whose economic fortunes are tied closely to one dominant industry. These dominant industries are typically dependent on extraction of natural resources or are in the general class of primary sectors. Rural communities are typically dependent on agriculture which constitutes their basic sector. More recently, however, there has been a growing belief that farming and rural communities have become disconnected from one another. This perception of disconnect is related to the underestimation or lack of realization of the contributions of agriculture to the local rural communities and to environmental issues. Agriculture takes its own importance at the rural level where its contributions to income and employment are multiples of the corresponding contributions at the provincial or national levels. This was particularly evident in Lethbridge Alberta and Oxford Ontario. Example of jobs created through backward linkages includes jobs in farm implements, chemical and fertilizer industries and many services industries.

Appendix A

The Mathematical Structure of the Indicators

A number of indicators were used to gauge the productivity, efficiency and connectivity of the agricultural sector to the rest of the economy. In what follows we present a detailed accounting of the equations and coefficients used in the analysis in the body of the report.

The Agricultural Sector Industrial Linkages

To evaluate the direct and indirect relations an industry has with other industries, we have to evaluate the "matrix multiplier" $(I-A)^{-1}$. This is so since the gross output levels (x's) required to sustain a given vector of final demand (f) in the open model is determined by the following equation system:

(1) $$x = (I - A)^{-1} f$$

If the inverse of (I-A) matrix exists, it may be expressed by means of binomial expansion:

$$(I - A) = I^{-1} + (-1)I^{-2}(-A) + \frac{(-1)(-2)}{2!} I^{-3}(-A)^2 + \frac{(-1)(-2)(-3)}{3!} I^{-4}(-A)^3 + \ldots$$

(2) $$= I + IA + IA^2 + IA^3 + \ldots$$

$$= I + A + A^2 + A^3 + A^4 + \ldots$$

$$= \sum_{k=0}^{\infty} A^k$$

The inverse matrix, $(I-A)^{-1}$, indicates the total direct plus indirect output required per unit of final demand. The series in (2) simply explains the general composition of this total output requirement. The first term, I, accounts for the one unit of output to be delivered to final demand. The second term, A, indicates the direct input required to produce this unit of final demand. The next term, A^2, indicates first-round indirect inputs required to produce the direct input A, etc. Due to the fact that the elements of the A matrix satisfy the Hawkins-Simon condition $a_{ij}^{(k)}$ decreases as k increases and the $(I-A)^{-1}$ is approximated by the sum of the powers of A.

If we represent the elements of the $(I-A)^{-1}$ matrix by c_{ij}'s, the sum of the column elements of the $(I-A)^{-1}$

$$(3) \qquad \sum_{i=1}^{n} c_{ij} = c^{*}{}_{j}$$

indicates the total input requirements (direct plus indirect) for a unit increase in the final demand for industry j. This is so since from (1) we have,

$$x = (I - A)^{-1} f$$

If we replace the vector f in (1) by another column vector e_j whose entries are all zeros except in the j'th position where we have one, we obtain

$$(4) \qquad \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ . \\ x_n \end{bmatrix} = \begin{bmatrix} c_{11} & . & . & . & c_{1n} \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ c_{n1} & . & . & . & c_{nn} \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ . \\ . \\ 0 \end{bmatrix} = \begin{bmatrix} c_{ij} \\ . \\ . \\ . \\ . \\ . \\ c_{nj} \end{bmatrix}$$

The total output effect in (3) is obviously the sum of the column vector $[c_{1j}, c_{2j},.....c_{nj}]$ in (4). This total output effect of a dollar increase in the final demand in sector j takes into account only the repercussions of the initial change in the final demand for that sector. But the repercussions of the initial unit change in sector j's final demand does not terminate here. In fact there is an additional income generated in the process of producing an extra dollar of output j and this is bound to induce more consumption and consequently more production.

To evaluate the overall effect (direct plus indirect plus induced) within the input-output framework, we have to relate consumption to value added in such a way that consumption may be considered as the "input" necessary to produce the "output" of income. In other words, we have to treat households as a production sector.

Let us define a matrix B such that

$$(5) \qquad B = \left[\begin{array}{c|c} A & c^{*} \\ \hline h & o \end{array}\right]$$

where

h represents a row vector of value added per unit of output in each sector.

c* is a column vector of average propensity to consume per industry, the typical $c_i^* = c_i/n$ where n is total income and c_i is consumption from industry I.

A is the technical coefficient matrix. The input-output system will now appear as:

(6) $$(I - B)x^* = f^*$$

where $x^* = \begin{bmatrix} x \\ \eta \end{bmatrix}$ and $f^* = \begin{bmatrix} f^a \\ o \end{bmatrix}$ where f^a is f exclusive of consumption. In a less compact form (6) appears as follows:

(71) $$\left[\begin{array}{c|c} I - A & -c^* \\ \hline -h & 1 \end{array}\right]\begin{bmatrix} x \\ \eta \end{bmatrix} = \begin{bmatrix} f^a \\ o \end{bmatrix}$$

The solution of this system, if it exists, is represented by (8):

(8) $$\begin{bmatrix} x \\ \eta \end{bmatrix} = \left[\begin{array}{c|c} I - A & -c^* \\ \hline -h & 1 \end{array}\right]^{-1}\begin{bmatrix} f^a \\ o \end{bmatrix}$$

If we denote the elements of the $(I - B)^{-1}$ matrix by b_{ij}'s, the sum of the column elements

(9) $$\sum_{i=1}^{n} b_{ij} = b^*_j \quad \text{for all j = 1,...,n}$$

indicates the total direct plus indirect plus induced effects per dollar increase in the final demand of the j'th industry. It is interesting to note that the last row of the $(I-B)^{-1}$ matrix represents the "output" households must produce per dollar of final demand of each industry. Since the "output" of households is exactly the income earned by households, the last row in fact indicates the total income generated from one dollar of final demand of each industry. It includes not only the direct and indirect effects but also the induced income effects. This follows from the fact that we included households in the production sectors which enable us to take into account increases in consumption due to increases in income.

The total direct output effects per dollar increase in the final demand of the j'th industry are then:

(10) $$\beta_j = a^*_j = \sum_{i=1}^{n} a_{ij} \quad \text{for all j = 1,...,n}$$

where a_{ij} is the amount of resources I needed to produce one dollar's worth of output j.

A matter related to the direct, indirect and induced output effects of a dollar increase in the final demand of a given sector, is the income effects of that change. The mapping of output into income in the input-output context turns out to be a simple matter, since the information needed to carry the mapping is part of the input-output system.

Income and Employment Multipliers in the Provincial Economy

The macro "Keynesian" multipliers and in particular the income multipliers are simply the overall total of direct and indirect effects of a dollar increase in final demand. This summing of direct and indirect income effects is quite similar to the summing of the direct and indirect output effects in the input-output context discussed in the preceding section. In fact, it is also possible to use input-output techniques to evaluate the income effects due to a change in final demand. By its very nature macroeconomics is concerned with the economy at large but strictly at the most general level and this is also true of its income multipliers. The question of what industries will produce the extra output when final demand is increased is irrelevant to the macroeconomic perspective. Input-output analysis deals with smaller components of the economy than macroeconomics and its emphasis is on individual sectors, not the national total. In this way the agricultural sector is seen as a subcomponent of a larger system of interacting sectors.

Starting with the input-output system in (1) we may change the gross output vector into total income n.

(11) $$\eta = h(I - A)^{-1} f$$

The vector of incomes generated directly and indirectly by a dollar increase in the final demand of the various sectors will then be

(12) $$\eta = h(I - A)^{-1}$$

Similarly, we can calculate what we shall refer to as the simple "employment" multipliers:

(13) $$m = w(I - A)^{-1}$$

where w is a row vector of the employment coefficients per unit of output.

The above simple income and "employment" multipliers take into account only the income generated by the total production requirements of one dollar's worth of output in sector j. But as we have already noted earlier, the repercussions of the initial change in the final demand do not end here. We have, therefore, constructed another set of multipliers which we shall call induced multipliers.

Let $Q = (I - B)^{-1}$ and Q* be the sub-matrix of Q which is formed by deleting the last column and row of Q. Then,

(14) $\eta^* = hQ^*$ and $m^* = wQ^*$

indicates the vectors of induced income and employment multipliers, respectively.

Is Agriculture A Key Sectors in the Ontario Economy?

Hirschman defines a key sector as a sector with high forward and backward links with other domestic sectors. Hirschman's definition, however, does not impose any restrictions on variability of the linkages. This is a crucial issue, because a sector can have very large links to only one sector. Far more important here is the spread of these links over many sectors. That is why we define the key sector to be one with large backward and forward links to many sectors. We gauge the links of a specific sector by the magnitude and the spread of its purchases from and sales to other sectors. Variability is measured by the lack of concentration of these purchases or supplies in a small subset of sectors.

The averages of the total input requirements for a unit increase in the final demand for the j'th sector

(15) $\frac{1}{n}\sum_{i=1}^{n} c_{ij} = \frac{1}{n} c^*_j \qquad (j=1,...n)$

are interpreted by Rasmussen "... as an estimate of the direct and indirect increase in output to be supplied by an industry chosen at random if the final demand for the products of industry j (j=1..n) increases by one unit."

A similar interpretation has been suggested by Rasmussen regarding the set of averages

(16) $\frac{1}{n}\sum_{i=1}^{n} c_{ij} = \frac{1}{n} c_i^* \qquad (i=1,...n)$

These sets in their present form are not suitable for making inter-sectoral comparisons and for this purpose the set of averages are normalized by the overall average defined as:

(17) $\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij} = \frac{1}{n^2}\sum_{j=1}^{n} c^*_j = \frac{1}{n^2}\sum_{i=1}^{n} c_i^*$

Let us consider the following indices

$$(18) \qquad u_j = \frac{\left[\frac{1}{n} c^*_j\right]}{\left[\frac{1}{n^2}\right]} \sum_{j=1}^{n} c^*_j$$

and

$$(19) \qquad u_i = \frac{\left[\frac{1}{n} c_i^*\right]}{\left[\frac{1}{n^2}\right]} \sum_{i=1}^{n} c_i^*$$

u_j and u_i were interpreted by Rasmussen as the "index of Power of Dispersion and the Index and Sensitivity of Dispersion". Recently Hazari interpreted them as measures of Hirschman's backward and forward linkages.

Since the average

$$(20) \qquad \bar{u} = \sum_{j=1}^{n} \frac{u_j}{n} = \sum_{i=1}^{n} \frac{u_i}{n}$$

it implies for any sector with $u_i > \bar{u}$, that its output will have to increase more than others for a unit increase in the final demand of the whole system. Similarly, for any sector j with $u_j > \bar{u}$ {u bar}, it implies that sector j absorbs more than the average of the whole system of outputs of other sectors, and visa versa, if $u_j < \bar{u}$. Hazari justifiably notes that the indices in (18) and (19) are based on the method of averaging and, therefore, influenced by extreme values and may give misleading results. He also devised two other indices to be used in conjunction with u_j and u_i. The first is:

$$(21) \qquad v_j = \frac{\left[\left(\frac{1}{n-1}\right)\left[\sum_{i=1}^{n}\left(c_{ij} - \frac{1}{n} c^*_j\right)^2\right]\right]^{\frac{1}{2}}}{\frac{1}{n} c^*_j}$$

which is equivalent to the standard deviation of the $\sum c_{ij}$ divided by their average. This is known as the coefficient of variation index. Similarly,

(22) $$vi = \frac{\left[\left(\frac{1}{n-1}\right)\left[\sum_{j=1}^{n}\left(c_{ij} - \frac{1}{n}c_i^*\right)^2\right]\right]^{\frac{1}{2}}}{\frac{1}{n}c_i^*}$$

A high v_j may be interpreted as indicating that a particular industry draws heavily on one or a few sectors and a low v_j as a sector drawing evenly from other sectors. Similarly, one can interpret that v_i's in the same way.

Adopting Hazari's criterion, a key sector is one which has:

(a) both u_i and u_j greater than $\bar{u}$

and

(b) both v_i and v_j are low relative to their averages.

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