ALBERTA'S CHANGING INDUSTRIAL STRUCTURE: IMPLICATIONS FOR OUTPUT AND INCOME VOLATILITY

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SUMMARY
The counterpart to the economic cycle is the policy cycle. Whenever there is a downturn in the Alberta economy because of slumping oil and gas prices, politicians of all persuasions, from Peter Lougheed to Rachel Notley, have called for policies to diversify the economy, on the assumption that expanding other sectors of the economy will insulate Alberta's economy against volatile oil and gas prices.

However, just because a sector is not directly part of the oil and gas extraction sector, does not necessarily make it counter-cyclical. In fact, the sectors that have been promoted in the name of diversification are often linked to the oil and gas extraction sector and follow the same boom-bust cycle. In other words, the government's attempts to subsidize certain sectors in the name of "diversification" do not insulate the provincial economy from fluctuations in oil and gas prices and may even exacerbate the economic cycle.

Missing in the discussion is an appreciation of how changes in the structure of the Alberta economy have affected output and income volatility. In the last 20 years, sectoral output shares have become more diversified in Alberta, and this has contributed to a 21 per cent reduction in aggregate output volatility over that period. Successive governments have tried promoting manufacturing as a way to diversify the economy, but manufacturing is the third most volatile sector, and its volatility is linked closely with the boom-bust cycles of the oil and gas extraction sector. So, increasing manufacturing, including petrochemical manufacturing, will actually make output volatility worse, not better. In fact, a one standard deviation increase in average per capita output in the oil and gas extraction sector is associated with in a 9.45-per cent increase in average per capita output in the chemical manufacturing subsector, suggesting the same boom-and-bust relationship between the two sectors. It is not the only sector like that: 16 other sectors in Alberta are linked to the same boom-bust cycle as the oil and gas sector.

The more important diversification issue in the province is not output volatility, but the volatility of labour income. In the last 20 years, labour income has become increasingly concentrated in Alberta's two most volatile sectors, oil and gas extraction and construction. As a result, volatility of aggregate labour income in Alberta increased by 40 per cent during that period. Rather than trying to change Alberta's industrial mix by subsidizing industries that may only contribute to more volatility of economic output, a more sensible government approach would be to adopt policies that address the problem of labour-income volatility. That would include finding ways to expand unemployment insurance for Alberta workers, as the current federal government policy actually provides fewer supports to unemployed Albertans than it does to residents of other regions.

Average weekly earnings of Albertans were 20 per cent higher than national average weekly earnings over the 2012 to 2016 period. However, maximum annual insurable earnings under EI are determined based on national average weekly earnings. Higher-wage earners should have the opportunity to enrol in a voluntary supplemental EI program, and if the federal government does not want to provide it, the provincial government could. Additionally, the government can promote self-insurance among workers by expanding tax-sheltered savings products, like tax-free savings accounts, so workers can accumulate back-up funds when labour incomes are high, to help sustain them during downturns. Finally, the provincial government needs to abandon its pro-cyclical spending patterns. That means spending less money when oil revenues are high, to avoid exacerbating labour and material shortages, and maintaining spending, rather than forced cutbacks, during downturns in the economy. That, of course, would require a great deal more political discipline than the easier and more fashionable attempts to subsidize output diversification.

1. INTRODUCTION

Resource-dependent economies around the world are adopting economic diversification policies because of the sharp downturn in oil, natural gas, and mineral prices.[1] Nowhere is this more prominent than in Alberta, where plummeting oil prices have hurt the Alberta economy with a significant reduction in private investment, an increase in the unemployment rate, and sharp increases in the provincial government's budget deficits. The downturn has sparked renewed calls for active government policies to promote economic diversification, and the provincial government has responded by repurposing the Alberta Economic Development Authority with the task of diversifying the economy, and announcing a number of tax measures to promote investment in the 2016 provincial budget.[2] However, there is a great deal of confusion about what constitutes economic diversification, and a lack of understanding of how economic volatility has changed with the evolution of the Alberta economy. Have economic fluctuations increased in recent years? Does the Alberta economy experience larger booms and busts than other provincial economies?

Even more fundamental questions need to be considered. Is Alberta's reliance on the oil and gas industry an example of market failure? In other words, does the private sector invest too much in volatile industries? If so, what is the source of the market failure, and what policies and programs should the government adopt to address this problem?

This paper addresses these issues concerning economic diversification. We begin by considering whether there is a market failure that leads to excessive economic specialization that contributes to economic insecurity. We argue that asymmetric information — often referred to as adverse selection and moral hazard — is the most likely source of market failure because asymmetric information can affect the ability of insurance and other financial markets to reduce the risks that workers face. This means policies to diversify the economy should focus on dealing with the fundamental problem of income insecurity, rather than trying to artificially change the structure of the economy. Some policy implications that flow from this are taken up in the concluding section of the paper.

The main section of the paper analyzes output and labour-income volatility in Alberta, with comparisons to Ontario, British Columbia and Quebec — provinces that are considered to have more diverse and more stable economies than Alberta's.

Our analysis indicates that per capita output was more volatile in Alberta than in Ontario and Quebec, but more stable than in British Columbia, during the 1997-2015 period. The construction, oil and gas extraction, and manufacturing sectors display the largest output volatility in Alberta, directly contributing to the volatility of total output in Alberta. They also indirectly increase volatility because output fluctuations in most other sectors of the Alberta economy also move in the same direction as in these sectors. As a consequence, output fluctuation in the construction, oil and gas extraction, and manufacturing sectors were major contributors to Alberta's overall high output volatility during the 1997-2015 period.

Based on the volatility of the resource sector, many have leaped to the conclusion that Alberta needs to adopt active industrial policies to diversify the economy. For example, the Resource Diversification Council of Alberta (2016) has stated that it will "work with government and other stakeholders in advancing energy diversification and further development of the petrochemical and hydrocarbon processing industries" for the purpose of "expanding and diversifying Alberta's resource manufacturing industries." However, our analysis in later sections of this paper indicates that such actions would not reduce economic output volatility in Alberta.

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[1]   See International Monetary Fund (2016).

[2]   See Henton (2015). However, there is a great deal of skepticism about the ability of governments to adopt policies that will diversify the economy, and past attempts have largely been costly failures. See, for example, Morton and McDonald (2015).

In fact, our analysis indicates that there has been a reduction in the concentration of output in the resource sector of Alberta, and the Alberta economy has become more output diversified over the last 20 years. As a result of the changes in the sectors' shares of output, the variance of output per capita in Alberta has fallen by 21 per cent. In other words, Alberta's output has become more diversified, and the volatility of total output has declined. Our analysis also indicates that changes in the industrial structures have reduced total output volatility in Ontario and Quebec, but increased it in British Columbia.

Although expanding Alberta's manufacturing sector has been proposed as a way of diversifying its economy, the sector had the third most volatile output in the 1997-2015 period. Output in the oil and gas extraction sector in Alberta had positive covariance with outputs in all subsectors of manufacturing, except fabricated metal manufacturing. The largest covariance was recorded with chemical manufacturing, followed by machinery manufacturing and wood product manufacturing. This positive covariance of the oil and gas extraction sector with the subsectors of manufacturing indicates that the manufacturing sector in Alberta experiences booms and busts at the same time as the oil and gas extraction sector as well as the construction sector. This means expanding Alberta's manufacturing activity in its current form will actually increase output volatility, rather than reduce it.

While Alberta's output has become more output diversified, the sectoral concentration of wage and salary income has increased, and labour-income diversification has declined since 1997. Labour-income volatility in Alberta was much higher than in the other three provinces in the 1997-2014 period, and the increase in the shares of labour income from the construction, oil and gas extraction, and manufacturing sectors has increased overall wage and salary volatility by almost 40 per cent.

Government should be looking to adopt policies that directly address the problem of labour-income volatility, rather than trying to change Alberta's industrial mix by subsidizing industries that may only contribute to the volatility of the economy. In the final section of the paper, we highlight three policy reforms that could be adopted to improve workers' income security in Alberta: enhancements to the Employment Insurance program, expanding limits on contributions to the tax-free savings accounts, and the adoption of counter-cyclical fiscal policies by the Alberta government.

2. INDUSTRIAL SPECIALIZATION AND ECONOMIC VOLATILITY

The concern that resource-rich economies are too dependent on volatile boom-and-bust industries goes to the core question of economics: Under what conditions does the invisible hand of the market produce an optimal allocation of land, labour, and capital? In *The Wealth of Nations*, published in 1776, Adam Smith argued that competitive markets are better at allocating resources to their most valuable uses than active government interventions, such as levying tariffs on imported goods to protect domestic industries from foreign competition or banning the export of raw materials to promote further processing in value-added industries — the mercantilist policies of the 17th and 18th centuries that some still advocate today. In 1817, in *On the Principles of Political Economy and Taxation,* David Ricardo argued that a country should specialize in the production and export of goods for which it has a comparative advantage — i.e., goods for which the opportunity cost of production is low — and import the goods for which it has a "comparative disadvantage." With free trade and competitive markets, a country can generate more income and achieve higher levels of consumption for its residents by specializing in goods that it can produce relatively cheaply and importing the goods that are relatively costly to produce. The prices of goods on international markets, and the profit or loss from producing them, provide the correct signals and incentives for the private sector to make the right decisions about which goods a region should specialize in.

Over the last 200 years, economists have developed a deeper understanding of how markets function and, in some cases, malfunction. They have identified three circumstances under which the invisible hand of the market fails to generate an efficient allocation of resources:

- The existence of public goods and externalities that produce spillovers of benefits or costs that are not reflected in market prices.
- Monopoly power that allows suppliers to set prices above the marginal costs of production.
- Unequal or asymmetric information between the buyers and sellers of a product's quality or its expected cost of production.

If there is a market failure, it is important to identify its source because this will determine what kind of government interventions should be adopted to diversify the economy.

In the face of economic volatility, various market mechanisms help to reduce individuals' exposures to major income losses. For example, investors can reduce the fluctuations in investment returns by holding a diversified portfolio of assets across industries and countries. Entrepreneurs can reduce their risks by selling shares to other investors, or using debt to finance investments. Workers also face the risk of major income losses from fluctuations in the demand for labour, leading to spells of unemployment and reductions in real wages. However, workers' ability to diversify their incomes is limited because they generally have to work for one, or only a few, employers at any one time, and they cannot sell shares in their expected future wage incomes.

Insurance markets exist to reduce individuals' risk of wealth losses from accidents, such as fire or storms. However, the private insurance industry's ability to offer comprehensive insurance against fluctuations in labour income is limited by the fact that workers and their employers have better information about the probability of a spell of unemployment, or a loss of wage income, than the insurance firm does. Workers with high probabilities of making an insurance claim will want to buy coverage, driving up average expected claims and premiums. Employees with a low risk of being laid off will not want coverage at the market premium that covers average costs of insurance against unemployment. This means if private unemployment insurance is offered, it will be very expensive, and will only cover a small segment of the workforce. This is the so-called problem of adverse selection, and the principal reason why unemployment insurance coverage in most countries is provided by the public sector, not the private insurance industry. In addition, employers can affect the probability of a layoff and employees can affect the duration of a spell of unemployment through the intensity of job search. Insurance coverage reduces the incentives of employers and workers to reduce the frequency of layoffs and income losses from unemployment spells. This is the so-called problem of moral hazard. For this reason, even the public sector should only provide limited unemployment insurance coverage so that workers and employers have some incentives to reduce the size and frequency of unemployment insurance claims.

The inability of the public or private insurance to provide comprehensive coverage against the risk of labour-income fluctuation raises concerns about whether there are gains from specialization and free trade if this exposes the economy to greater economic fluctuations. For example, David Newberry and Joseph Stiglitz (1984) developed a highly stylized theoretical model in which opening up an economy to free trade makes everyone worse off than they were with no trade, if the private sector does not provide insurance against the fluctuations in income that arise from participating in world markets.

Openness to trade, and concentration of production in the industrial sectors where an economy has a comparative advantage, does not necessarily increase economic volatility. A closed economy, such as North Korea's, may be a diversified economy, but it can still suffer major economic fluctuations because of natural disasters such as droughts, floods, and earthquakes. Without recourse to foreign markets for supplies of essential products, or loans to finance reinvestment and consumption, these purely domestic economic shocks can produce major hardships. On the other

hand, economies that specialize in the production of goods and services based on comparative advantage are exposed to fluctuations in international demands and supplies of commodities. Whether openness to trade, and the resulting concentration of production based on comparative advantage, results in more or less economic volatility is an empirical question. To this point, economic studies have reached conflicting conclusions about whether trade increases or decreases economic volatility.[3] It is still an open question whether or not there is even a trade-off between faster economic growth, openness to trade and specialization, and more economic volatility.

3. ECONOMIC VOLATILITY IN ALBERTA

The public's concerns about Alberta's boom-and-bust economy and the perceived lack of industrial diversification are not new. For example, one of the goals of the Alberta Heritage Savings Trust Fund, when it was established in 1976, was to "strengthen and diversify" the Alberta economy. Volatility in the Alberta economy has been the subject of other economic studies, some of which are briefly reviewed here.

Mansell and Percy (1990) studied the variability of gross domestic product, personal income, per capita personal income, and employment in Alberta over the 1961-1985 period. They found that, among all Canadian provinces, Alberta ranked first in terms of personal income volatility, while ranking second in terms of GDP volatility and per capita personal income volatility. Compared to Ontario, Alberta's volatility was not only higher, but the macroeconomic variables were also much more responsive to shocks in the economy. They suggested that specialization in the energy sector was one of the reasons for the economic pain in Alberta during the downturn in oil and gas prices in the mid-1980s. They also found that earnings in non-energy sectors were negatively affected during busts, although the impact on employment was not statistically significant. Gilchrist and St. Louis (1991) also concluded that energy-related specialization in Western Canada resulted in significant volatility in employment and real earnings in the region as a result of booms and busts.

Governments' tax policies and expenditure programs, such as the personal income tax and employment insurance, can help reduce the degree of income volatility.[4] Mansell and Percy (1990, 76) found that Alberta's tax policies during the 1961-1985 period were counter-cyclical, which helped to reduce fluctuations in real per capita income. This was not the case with other provinces, all of which had pro-cyclical fiscal policies during the same period. Ronald Kneebone (2008) studied the role of stabilization policies in Canada's boom-and-bust business cycles, and determined that interprovincial movements of goods, labour, and capital played an important role in minimizing the impact of volatility. He also determined that, in comparison to the federal budget, provincial budgets were much weaker in their stabilizing influence on the economy.

Dahlby, Macaspac and McMillan (2013) compared the volatility of population, employment, per capita gross domestic product, per capita personal income, and per capita consumption in Alberta and Ontario for the 1961-2008 period. They found that the oil and gas extraction sector and the manufacturing sector had the largest impact on the volatility of Alberta's aggregate output. In Ontario, economic volatility during the period was primarily due to output fluctuations in the province's manufacturing and finance sectors. They found that volatility in real income per worker in Alberta was twice as high as in Ontario.

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[3] Caselli et al., (2015) provide a brief review of the empirical literature on trade and volatility.

[4] See Kneebone and McKenzie (1997).

3.1 Output Volatility

We begin by measuring the degree to which production in Alberta is concentrated in a few key sectors, and how output concentration has changed over time. For comparative purposes, we also describe the trends in the concentration of production in Ontario, Quebec, and British Columbia.

Table 1 shows the changes in the real output shares of 22 sectors of the Alberta economy between 1997 and 2015. In 1997, the oil and gas sector accounted for 35.81 per cent of total Albertan economic output. By 2009, that share was 24.95, a decline of 10.86 percentage points. Although the share grew slightly in 2015, the sector's share of total provincial output declined by almost 10 percentage points between 1997 and 2015. The other sector that saw a major decline in its output share was manufacturing, which declined from 7.67 per cent in 1997 to 5.89 in 2015. The construction sector recorded the largest increase in its output share between 1997 and 2015 — increasing by 3.28 percentage points. Other sectors that grew their shares of provincial output in that period were finance and real estate (3.10 percentage points), professional services (1.46 percentage points), and retail (1.34 percentage points).

In Ontario, between 1997 and 2015, manufacturing had the largest decline in its output share, falling by 6.5 percentage points. While the output shares of 10 other sectors also declined, the declines were all less than one percentage point. Growing output shares of finance and real estate, wholesale, and professional services were the counterpoint to the relative decline in manufacturing output. In Quebec, the output share of the manufacturing sector declined by 4.46 percentage points, followed by a one percentage point decline in the educational services sector's share, while the output shares of finance and real estate, professional services, and construction sectors increased. In British Columbia, the health care and social assistance sector had the largest decline of 1.51 percentage points, followed by manufacturing (1.32 percentage points), while finance and real estate, oil and gas, and professional services sectors had the largest increases in output shares.

We use the Herfindahl index to measure the trend in the concentration of output.[5] This index is equal to zero if all sectors have an equal share of output, and it is equal to one if all output is concentrated in one sector. Table 1 shows that the Herfindahl index for Alberta declined from 0.122 in 1997 to 0.068 in 2009, indicating a significant decline in industrial concentration of output over this period, followed by a slight increase to 0.074 in 2015. For those same years, the Herfindahl indices for Ontario were 0.066, 0.058 and 0.062 respectively. Similarly, the indices for Quebec were 0.048, 0.038, and 0.038 respectively. For British Columbia, the indices were 0.043, 0.050, and 0.055 respectively. These indices indicate that the Alberta economy became more output diversified in the 1997-2015 period, especially between 1997 and 2009. For Ontario and Quebec, in the same period, there was movement towards further diversification, while British Columbia's output became somewhat more concentrated, i.e., less diversified, in that period.

We measure the degree of economic volatility using the Regional Economic Instability (REI) index, a commonly used measure of relative deviations of selected economic variables from their long-term trends.[6] The REI index is based on the fluctuations in outputs around the trend value, allowing us to compare economic volatility across regions and sectors. A higher REI index indicates greater volatility. Our focus is on short- to medium-term business cycle volatility. Neither seasonal variations in output nor long-term trends in output are captured by our measure of volatility.

To illustrate, we measure the volatility of the oil and gas extraction sector by the average deviation in output per capita from its long-term trend over the 1997-2015 period.[7] Figure 1 indicates that output per capita in the oil and gas sector was on a downward trend during the period. For example, output per capita deviated 4.7 per cent from the long-term trend output in 2009. On the other hand,

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[5] See Appendix 1 for the equation that defines the Herfindahl index.

[6] See Appendix 1 for the equations that define the REI index.

[7] Long-term trend output per capita was estimated using a quadratic time trend.

Figure 2 indicates that output per capita in the construction sector was on an upward trend during the period, except for a severe dip in 2009 due to the financial crisis, when output per capita fell 21.1 per cent below trend output, and another severe dip in 2015, when it fell 11.9 per cent below trend output.

TABLE 1   SECTORAL OUTPUT SHARES IN ALBERTA: 1997, 2009 AND 2015

	1997	2009	2015	Change from 1997 to 2009	Change from 2009 to 2015	Change from 1997 to 2015
CON (construction)	6.68	8.52	9.96	1.84	1.44	3.28
FIN (finance and insurance, and real estate and rental and leasing)	10.92	13.82	14.02	2.90	0.20	3.10
PRO (professional, scientific, technical and management services)	4.18	6.32	5.63	2.15	-0.69	1.46
RET (retail trade)	2.80	4.31	4.14	1.51	-0.17	1.34
HC (health care and social assistance)	4.00	4.94	4.89	0.94	-0.05	0.89
WHL (wholesale trade)	3.92	4.14	4.70	0.22	0.56	0.79
ADM (administrative, waste management and remediation services)	1.55	2.22	2.30	0.67	0.08	0.75
TRA (transportation and warehousing)	3.66	4.06	4.15	0.40	0.09	0.49
OTH (other services except public administration)	1.37	1.88	1.83	0.51	-0.05	0.46
INF (information and cultural industries)	1.83	2.62	2.21	0.79	-0.40	0.38
GOV (public administration)	3.77	4.32	3.98	0.54	-0.33	0.21
EDU (educational services)	3.16	3.63	3.32	0.47	-0.31	0.16
FOR (forestry and logging, fishing, hunting and trapping)	0.12	0.12	0.15	0.00	0.03	0.03
SAA (support activities for agriculture and forestry)	0.09	0.11	0.11	0.02	-0.01	0.01
ACC (accommodation and food services)	1.99	2.05	1.87	0.06	-0.19	-0.12
ART (arts, entertainment and recreation)	0.57	0.54	0.45	-0.04	-0.09	-0.12
CAP (crop and animal production)	1.16	1.01	0.98	-0.15	-0.04	-0.18
MIN (mining and quarrying, except oil and gas)	0.42	0.27	0.21	-0.14	-0.07	-0.21
SAM (support activities for mining and oil and gas extraction)	2.37	2.33	1.97	-0.04	-0.36	-0.40
UTL (utilities)	1.95	1.56	1.42	-0.39	-0.14	-0.53
MAN (manufacturing)	7.67	6.29	5.89	-1.38	-0.41	-1.78
OAG (oil and gas extraction)	35.81	24.95	25.82	-10.86	0.87	-9.99
Herfindahl Index	0.122	0.068	0.074	-0.054	0.006	-0.048

Source: CANSIM 379-0030 and authors' calculations.

FIGURE 1   PER CAPITA OUTPUT DEVIATIONS FROM THE TREND IN THE OIL AND GAS (OAG) EXTRACTION SECTOR IN ALBERTA, 1997-2015
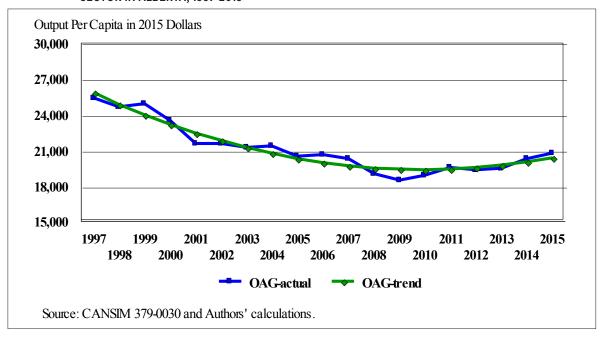

Source: CANSIM 379-0030 and Authors' calculations.

FIGURE 2   PER CAPITA OUTPUT DEVIATION FROM THE TREND IN THE CONSTRUCTION (CON) SECTOR IN ALBERTA, 1997-2015

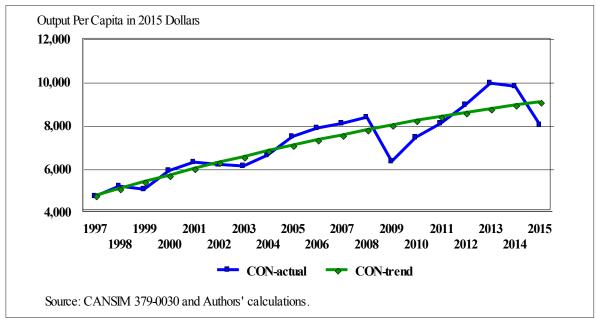Source: CANSIM 379-0030 and Authors' calculations.

Table 2 shows the sector-specific REI indices for Alberta based on data for the 1997-2015 period. Support activities for oil and gas extraction and mining had the largest REI index, followed by forestry, crop and animal production, mining, and construction. Educational services, finance and insurance and real estate, health care and social services, public administration, and information and cultural industries were the sectors with the lowest REI indices.

TABLE 2   REGIONAL ECONOMIC INSTABILITY (REI) RANKING OF SECTORS' OUTPUT VOLATILITY IN ALBERTA, 1997-2015

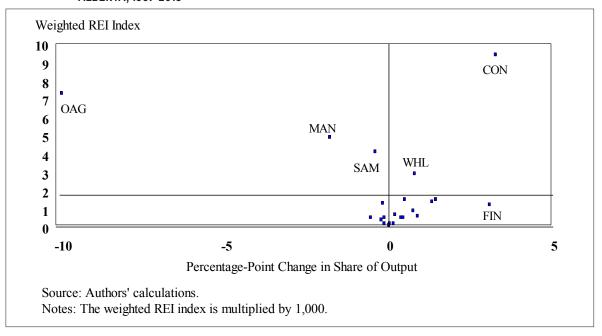| Rank	Sector	REI	Rank	Sector	REI
1	SAM	0.1532	12	TRA	0.0372
2	FOR	0.1452	13	OTH	0.0291
3	CAP	0.1269	14	UTL	0.0290
4	MIN	0.1166	15	PRO	0.0270
5	CON	0.1020	16	OAG	0.0264
6	MAN	0.0692	17	ACC	0.0246
7	WHL	0.0670	18	INF	0.0205
8	SAA	0.0654	19	GOV	0.0176
9	ART	0.0489	20	HC	0.0142
10	ADM	0.0441	21	FIN	0.0099
11	RET	0.0387	22	EDU	0.0065

Source: Authors' calculations using data from CANSIM 379-0030 and 051-0001.

However, the sectors with the largest REI indices do not necessarily have the largest impacts on the volatility of total provincial output because these indices do not take into account the size of the sectors. For example, despite having the highest REI value, support activities for the oil and gas extraction and mining sector in Alberta contributed only 2.68 per cent to the total provincial output during the period. In comparison, the construction sector had the fifth highest REI index in that period, but accounted for 9.96 per cent of total output in 2015. Therefore, volatility in the construction sector has a larger impact on Alberta's total output than the supporting activities for the oil and gas extraction and mining sector.

Table A1 in the data appendix shows the REI indices weighted by the sectors' average share of output in 1997-2015 for Alberta, Ontario, Quebec and British Columbia. For Alberta, these data indicate that the construction sector's fluctuations had the largest impact on total output volatility during the 1997-2015 period, followed by the oil and gas extraction sector, and the manufacturing sector. These three sectors, which also had the highest output weighted volatility indices, accounted for 43.4 per cent of Alberta's provincial output during the 1997-2015 period. These data also show that manufacturing was the most volatile sector in Ontario and British Columbia, and the second most volatile in Quebec. In contrast with Alberta, the construction sectors in the other three provinces were not as volatile, in absolute or relative terms, as in Alberta, because of the capital intensity of the oil and gas sector. Fluctuation in world prices of oil and gas results in large shifts in investment in the oil and gas extraction sector, which are reflected in the output of the construction sector.

For a small open economy such as Alberta, economic volatility can increase either because the international economic environment — which determines the value of exports and imports — becomes more volatile, or because the economy becomes more reliant on more volatile industries. As we saw in the previous section, there was a reduction in the oil and gas extraction industry's share of total output in Alberta during the 1997-2015 period, and, based on the Herfindahl index, the Alberta economy became more output diversified. Figure 3 plots the weighted volatility of output of the 22 sectors versus their changes in output shares over the 1997-2015 period. Three sectors with declining output shares, oil and gas extraction (OAG), manufacturing (MAN), and support activities for mining and oil and gas extraction (SAM), exhibited above-average output volatility. Furthermore, 12 sectors, including finance (FIN), with below-average output volatility, increased their shares of total output. These changes in output shares would tend to reduce total output volatility. On the other hand, the output shares of two sectors with above-average volatility, construction (CON) and wholesale services (WHL), also increased during this period, which would tend to increase output volatility.

FIGURE 3   CHANGES IN THE SECTORAL SHARES OF OUTPUT VERSUS VOLATILITY OF OUTPUT IN ALBERTA, 1997-2015

Source: Authors' calculations.
Notes: The weighted REI index is multiplied by 1,000.

While Figure 3 provides some intuition about how changes in the industrial structure could be affecting the variability of total output in the province, it does not show one important sectoral characteristic that will affect the degree to which the expansion or contraction of a sector affects overall volatility of the economy. That characteristic is the degree to which the fluctuations in the output of a sector are positively or negatively correlated with the fluctuations in the output of other sectors of the economy. A positive covariance means a sector tends to expand or contract at the same time as other sectors, which contributes to the volatility of the economy's total output. On the other hand, a negative covariance means a sector tends to expand when other sectors are contracting, or contract when other sectors are expanding, and this will tend to reduce the volatility of the economy's total output.

The variance-covariance matrix of output per capita for the 1997-2015 period[8] shows that the construction sector in Alberta had positive covariance with 19 other sectors and negative covariance with only two sectors: public administration, and arts, entertainment, and recreation. Similarly, the oil and gas extraction sector had positive covariance with 16 other sectors. The positive covariance of the oil and gas and construction sectors with most other sectors of the economy may be the reason for Alberta's high output volatility during the 1997-2015 period.

We use the contribution of changes in industrial mix to volatility (CIMV) index to measure how changes in the output shares of the 22 industrial sectors since 1997 have affected the variability of aggregate output.[9] The CIMV index represents the percentage change in the variance of total output due to changes in the economy's industrial structure. It reflects both the way changes in the sectors' shares of output directly affect the volatility of total output, and the change in the volatility of total output because fluctuations in the sectors' outputs are positively or negatively correlated with output fluctuations in other sectors of the economy.

Computation of the CIMV index for Alberta indicates that the changes in the industrial structure between 1997 and 2009 reduced the province's output volatility by 29.8 per cent. However, changes

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[8]   The data and calculations are available from the authors upon request.

[9]   See Appendix 1 and Dahlby, Macaspac and McMillan (2013) for a derivation and description of the CIMV index. Contact the authors for the calculation of the variance and covariance matrices of output and income in Alberta and Ontario.

in the industrial mix in the years following 2009 — mainly due to the construction sector's increased share of output — reversed this trend and contributed to an increase in the variance of total output since. Overall, the change in the industrial mix in Alberta between 1997 and 2015 reduced output volatility by 21 per cent.

For both Quebec and Ontario, changes in the industrial mix between 1997 and 2015 produced very large reductions in output volatility, 42.5 per cent and 34.5 per cent respectively, during the period. However, declines in the manufacturing sector's share of total provincial output contributed to a reduction in overall output volatility in the provinces, but that does not mean the decline in manufacturing was a good thing for the residents of those provinces. In contrast with the other provinces, changes in British Columbia's industrial mix led to a steady, and significant, 13.4 per cent increase in output volatility during the same period.

Dahlby, Macaspac and McMillan (2013b) also calculated the effects of changes in the industrial mix in Alberta on aggregate output variability using the CIMV index based on data from 1984 to 2003. Although Statistics Canada no longer publishes the data set they used, it is interesting to compare their result with our results based on more recent data that we use in our study. In Figure 4, we plot the CIMV for the 1984-2003 period from the Dahlby, Macaspac and McMillan (DMM) study and the CIMV index based on the more recent revised data for the 1997-2015 period, labelled DK.

FIGURE 4   CUMULATIVE CHANGES IN THE VARIANCE OF PER CAPITA OUTPUT IN ALBERTA DUE TO CHANGES IN THE INDUSTRIAL MIX, 1984-2015

Source: Authors' calculations.

The two CIMV series do not coincide over the period in which they overlap, 1997 to 2003, because they measure the cumulative change in the variance of output from different base years: 1984 in the case of the DMM CIMV index, and 1997 for the DK CIMV index. However, the slopes of the two lines are similar over this period, and the DMM CIMV recorded a 16.1 percentage point reduction in volatility between 1997 and 2003, while our version of the index indicates an 18.5 percentage point reduction. Since the results for the overlapping period are broadly similar, we can conclude that the reduction in volatility of output due to changes in the industrial mix that Dahlby, Macaspac and McMillan found in the 1997-2003 period continued to 2009, when, as we have noted earlier in this paper, volatility increased mainly due to the construction sector's growth.

As previously noted, the CIMV index can be decomposed into a variance effect and a covariance effect. The variance effect shows how a one percentage point expansion in a sector's share of

output directly increases the variance of total output because of its own volatility. In other words, the variance effect is related to the sector's REI index, and it shows how a change in the sector's share of output directly affects the volatility of total output. The covariance effect measures change in the volatility of total output because that sector's output is, on average, positively or negatively correlated with output fluctuations in other sectors of the economy. The variance effect is always positive, while the covariance effect could be positive or negative. A negative value for the covariance effect means an expansion of the sector tends to reduce the volatility of total output because the sector's output fluctuations are negatively correlated with fluctuations in other sectors. The sum of variance and covariance effects shows the total impact of a one percentage point increase in the output share of the sector.
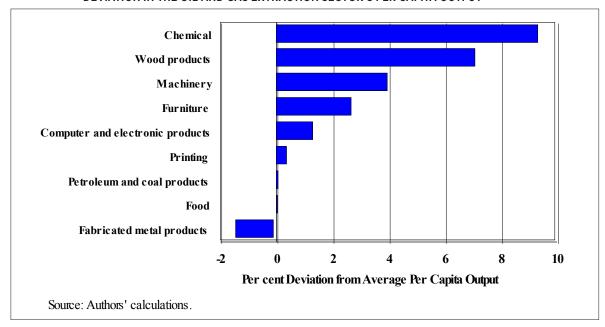
Table A2 in the data appendix shows the variance, covariance, and total effects for Alberta for each of the 22 sectors' outputs. Our calculation indicates that a one percentage point increase in the output share of the oil and gas extraction sector directly increases the volatility of total output in the economy by 3.53 per cent, as shown by the variance effect, because the sector is relatively large and has a relatively large REI index. Its covariance effect increases total output volatility by 0.72 per cent because output fluctuations in the oil and gas extraction sector are positively correlated on average with output fluctuations in most other sectors. Therefore, the overall effect of a one percentage point increase in the output share of the oil and gas sector is to increase aggregate output volatility in Alberta by 4.25 per cent. Of course, a one percentage point reduction in the output share of the oil and gas extraction sector would reduce total output volatility by 4.25 per cent, as well.

This decomposition of the CIMV index helps to quantify the impact of reduction in the oil and gas sector's share of output on the volatility of total output. Of course, changes in the output share of other sectors also contributed (or offset) the effect of the reduction in the output share of oil and gas extraction sector. These results indicate that a one percentage point increase in the output share of the construction sector would increase total output volatility in Alberta by 4.53 per cent, even higher than the effect of a one percentage point increase in the oil and gas extraction sector.

Note also that a one percentage point increase in the output share of the manufacturing sector in Alberta increases total output volatility by 0.43 per cent through the variance effect, and by 2.31 per cent through the covariance effect. This large covariance effect means that the manufacturing sector in Alberta tends to experience booms and busts at the same time as most of the rest of the provincial economy. Therefore, an expansion of manufacturing activity, of the type that currently exists in the province, would increase total output volatility in Alberta, not reduce it.

Figure 5 indicates the degree to which fluctuations in the output of the oil and gas sector are associated with fluctuations in the outputs of subsectors of manufacturing in Alberta. The figure shows the percentage deviations from average per capita output in each subsector associated with one standard deviation in the oil and gas extraction sector's per capita output. These data indicate that when oil and gas output increases one standard deviation from the average output, i.e., by $492 per capita, the chemical manufacturing sector's per capita output tends to increase by $56, i.e., a 9.45 per cent increase from average output. This means expanding the chemical processing industry in Alberta, through incentives to diversify the economy, will not reduce output volatility because the chemical manufacturing industry experiences booms and busts at the same time as the oil and gas extraction sector. Expanding this sector will tend to increase output volatility, rather than reduce it. Furthermore, as Trevor Tombe (2015, 3) has argued, government policies to support "certain projects or sectors … often come at the expense of all others," which, in turn, would result in the incentives becoming "value subtracting" instead of value adding. Note also that the other manufacturing subsectors, with the exception of fabricated metal products, display positive covariance with the output of the oil and gas extraction sector, and these are especially large for wood products manufacturing, and machinery manufacturing.

FIGURE 5   PERCENTAGE DEVIATIONS FROM AVERAGE PER CAPITA OUTPUT ASSOCIATED WITH ONE STANDARD DEVIATION IN THE OIL AND GAS EXTRACTION SECTOR'S PER CAPITA OUTPUT

Source: Authors' calculations.

3.2 Labour-Income Volatility

While fluctuations in aggregate output are commonly the focus of attention, it is the volatility of labour income that should be the primary concern of policy-makers. We begin by showing that labour income in Alberta has become more concentrated in the more volatile sectors of the economy, and then show that these changes in sectoral shares of labour income have increased aggregate labour-income volatility in Alberta over the 1997 to 2014 period.

The changes of sectoral share of labour compensation in Alberta from 1997 to 2014 are shown in Table A3 in the data appendix. During this period, the construction sector's share increased from 9.3 per cent in 1997 to 16.1 per cent in 2014, and the oil and gas extraction sector's share went from 4.4 per cent in 1997 to 9.1 per cent in 2014. In the meantime, the manufacturing sector saw the largest decline in its share of labour income from 10 per cent in 1997 to 6.4 per cent in 2014. The Herfindahl index of the sectoral concentration of labour income increased from 0.021 in 1997 to 0.033 in 2014. In other words, labour income in Alberta became less sector-diversified over this period, in marked contrast to the increased output diversification that we noted in the previous section.

Table 3 shows REI indices weighted by the sectors' average share of labour income in the 1997-2014 period. The construction sector in Alberta had the most volatile labour income in the period, followed by the oil and gas extraction sector, and the manufacturing sector. These three sectors were the most volatile sectors in terms of output as well as income volatility.

As shown in Figure 6, the two sectors that exhibit the highest labour-income volatility — oil and gas extraction and construction — were also the sectors that had the largest increase in their shares of total labour compensation. The sectors that had declines in their shares of labour compensation are concentrated in the lower left region of Figure 6, and generally displayed lower than average labour-income volatility. In other words, the growth sectors tended to have higher than average income volatility, and the sectors with declining shares of labour income were relatively more stable sources of labour income, manufacturing being the exception. As a result of these changes in the sectors' shares of labour income, the volatility of aggregate labour income in Alberta increased by almost 40 per cent between 1997 and 2014. While changes in the sectoral composition of output
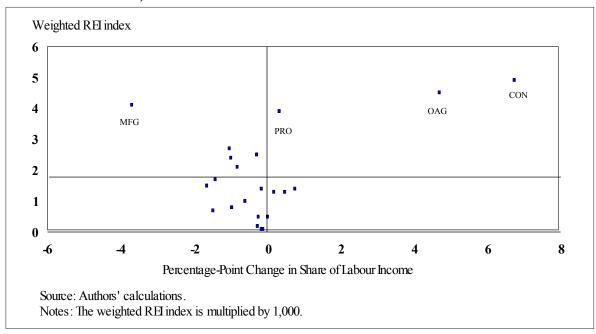
reduced aggregate output volatility, changes in the sectoral shares of labour income have increased aggregate labour-income volatility in Alberta.

TABLE 3   WEIGHTED REI RANKING OF SECTORS WITH HIGHEST INCOME VOLATILITY IN ALBERTA, 1997-2014

Rank	Sector	REI		Rank	Sector	REI
1	CON	0.0049		12	OTH	0.0014
2	OAG	0.0045		13	SAM	0.0013
3	MAN	0.0041		14	HC	0.0013
4	PRO	0.0039		15	ACC	0.0010
5	FIN	0.0027		16	INF	0.0008
6	RET	0.0025		17	CAP	0.0007
7	WHL	0.0024		18	ART	0.0005
8	TRA	0.0021		19	UTL	0.0005
9	EDU	0.0017		20	MIN	0.0002
10	GOV	0.0015		21	SAA	0.0001
11	ADM	0.0014		22	FOR	0.0001

Source: Authors' calculations using data from CANSIM 383-0031 and 326-0021.

FIGURE 6   CHANGES IN THE SECTORAL SHARES OF LABOUR INCOME VERSUS VOLATILITY OF LABOUR INCOME IN ALBERTA, 1997-2014

Source: Authors' calculations.
Notes: The weighted REI index is multiplied by 1,000.

4. POLICY IMPLICATIONS

Our analysis has shown that the Alberta economy has become more output diversified over the last two decades, and that the changes in the sectors' output shares have contributed to a 21 per cent reduction in the output volatility of the Alberta economy. We have also shown that while the Alberta economy has become more output diversified, labour income has become more concentrated in the two most volatile sectors: the oil and gas extraction sector and the construction sector. As a result, the volatility of total labour income increased by 40 per cent.

These trends mean that, instead of pursuing policies to increase output diversification through an expansion of the manufacturing sector, Alberta needs policies that deal with the issue of labour-income volatility.[10] First, we should recognize that some of the most important policy instruments that might help to improve the income security of Alberta workers are under the control of the federal government. The most important of these is the employment insurance (EI) program. Nationally, fewer than 40 per cent of the unemployed receive EI benefits. While we do not have these data for Alberta, historically the qualification periods have been longer, and weeks of coverage shorter, in Alberta than in other regions where average unemployment rates have been higher. This suggests that an even lower percentage of unemployed in Alberta could receive EI benefits than the national 40 per cent figure. Currently, Alberta's unemployment rate, 7.9 per cent, is above the Canadian average, but under the standard entitlement regulations the increase in the average Alberta unemployment rate since 2014 would have only reduced the minimum number of hours needed to qualify for benefits from 700 to 630, and increased the weeks of coverage from 14 to 17 weeks. In 2016, in recognition of this problem, the federal government extended EI coverage of workers in 15 regions, including Edmonton, Calgary, northern and southern Alberta, that were hard hit by the downturn in resource sectors. This amendment to the program indicates that the standard eligibility criteria, and weeks of coverage, based on regional unemployment rates should be re-examined and made more generous. Of course, this would imply that EI contribution rates for employers and employees would have to increase to pay for the increased level of coverage.

We also recommend that the maximum weekly benefit should be based on the regional or the provincial average weekly earnings. Currently, the general EI benefit is 55 per cent of a worker's weekly average insurable earnings, up to a maximum annual insurance earning of $51,300 or $543 per week, where the maximum annual earnings are based on the Canadian average weekly earnings. However, average weekly earnings in Alberta were 20 per cent above the national average weekly earnings over the 2012-2016 period. This means more Alberta workers earn more than the maximum insurance earnings than in other provinces, and these Alberta workers receive a lower effective replacement rate when they are unemployed and receive maximum EI benefits. To provide Alberta workers earning the average weekly earnings in the province with a replacement rate comparable to that received in other provinces, the maximum insurance earnings should be based on the regional or provincial average weekly earnings. Roughly speaking, that could mean the maximum weekly EI benefit in Alberta could be 20 per cent higher than the current rate. This would mean larger payouts to some unemployed workers in Alberta, and it might require a higher EI contribution rate in Alberta to pay for the enhanced replacement rate.

Higher EI contribution rates on low-wage workers, to pay for enhanced benefits for high-wage workers, would be considered a regressive measure. One alternative would be to make the enhanced coverage for high-wage workers voluntary. This supplementary coverage would be attractive to high-wage workers who are exposed to relatively high risks of income loss. Voluntary supplementary coverage, in combination with basic compulsory coverage, has been shown to be an efficient solution for insurance markets plagued by an adverse selection problem.[11] This supplementary coverage would be offered at an actuarially fair premium, and would be purchased by the employee. Administratively, it would be best if it were provided as a supplement to the existing EI program, but a provincial government could offer the supplementary EI coverage. Private sector re-insurance markets could be used to reduce the risk exposure of the provincial budget.

In summary, there are a number of EI reforms that could be adopted to improve the income security of Alberta workers, but the EI program and its financing are complex, and a great deal of research is needed to properly evaluate these reforms.

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[10]   See Mansell and Percy (1990, 134-136) for a wide-ranging discussion of policies to reduce economic volatility in Alberta.

[11]   See Dahlby (1981).

While enhanced insurance coverage is the best way to address employment income insecurity, measures to promote self-insurance — such as encouraging precautionary savings by workers to cope with periods of income losses — should also be considered. In particular, the federal and provincial governments should increase the limits on contributions to the tax-free savings account that would enhance workers' incentives to save when labour incomes are high.

Finally, the Alberta government could help stabilize incomes in the province by saving a very high proportion of non-renewable resource income during booms, so that there is a much larger stabilization fund to support public expenditures during downturns. Provincial governments have ratcheted up public spending when oil and gas prices are high, and non-renewable resource revenues are high, contributing to the demand for labour during the booms. When oil and gas prices decline, governments have incurred deficits for extended periods, but eventually a large fiscal adjustment is necessary when the economy still has not recovered. Rather than exacerbating Alberta's boom-and-bust cycle, the provincial government should adopt a counter-cyclical fiscal policy, which during boom times means restraining public spending, lowering public expectations concerning growth, and saving a substantial share of the non-renewable resource revenues.

In conclusion, governments should adopt policies that directly address the issue of labour-income volatility, rather than trying to change Alberta's industrial output mix by subsidizing industries that do not have a comparative advantage in Alberta, and that may only exacerbate the volatility of the economy.

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APPENDIX 1: THE REI, CIMV AND HERFINDAHL INDICES

The Regional Economic Instability (REI) Index

The REI index is defined by the following equation:[12]

$$REI = \left[\frac{\sum_{t=1}^{T}(e_t - \hat{e}_t)^2}{(T-3)\bar{e}^2} \right]^{1/2} \tag{1}$$

(where e_t represents the value of the economic variable of interest, such as output or income, in year t; $\bar{e}$ is the mean over the selected period; T is the total number of observation periods; and $\hat{e}_t$ is an estimate of the trend value of the variable, estimated using the following quadratic equation:

$$\hat{e}_t = \hat{\beta}_0 + \hat{\beta}_1(t) + \hat{\beta}_2(t^2) \tag{2}$$

In the REI equation, subtracting the trend value from the actual value isolates the random components from the original series. The resulting deviations are then squared and summed to calculate the variance. The variance is then divided by the square of the mean to account for the size of the region or sector. This standardization allows us to compare the REI from one region (Alberta) with that from another region (Ontario). These standardized deviations from the trend are divided by T-3 to adjust for the degrees of freedom lost in estimating the variable. The square root of this resulting term gives us the deviation-based measure of instability, i.e., the REI for that particular variable. The weighted sum of the REIs for the different industries in the economy provides a measure of the volatility of the entire economy.

The Changes in the Industrial Mix (CIMV) Index

The variance in the output of an economy is defined by the following equation:

$$V = \sum_{i=1} w_i^2 V[X_i] + \sum_{i=1} \sum_{j=1, j \neq i} w_i w_j Cov[X_i X_j] \tag{3}$$

where $V[X_i]$ is the variance of the output (or income) in sector i; $Cov[X_i, X_j]$ is the covariance of the output (or income) between sector i and j; w_i is the share of sector i in the total provincial output during the selected period; and N is the total number of industries in the region (N=22 in our study).

The variance and covariance are calculated as follows:

$$V[X_i] = \left[\frac{\sum_{t=1}^{T}(X_{it} - \hat{X}_{it})^2}{(T-3)} \right] \tag{4}$$

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[12]   See Mansell and Percy (1990).

$$Cov[X_i, X_j] = \left[\frac{\sum_{t=1}^{T}(X_{it} - \hat{X}_{it})(X_{jt} - \hat{X}_{jt})}{(T-3)} \right] \tag{5}$$

where X_{it} is the actual total output (or income) in industry i at time t; $\hat{X}_{it}$ is the quadratic estimate of the trend output in industry i at time t; and T is the total observed time period.

A change in this aggregate variance as a result of changes in the industrial mix can be approximated with this Taylor approximation:

$$\Delta V = \sum_{i=1}^{n} \frac{\partial V}{\partial w_i} \Delta w_i + \frac{1}{2} \sum_{i=1}^{n} \frac{\partial^2 V}{\partial w_i^2} (\Delta w_i)^2 \tag{6}$$

where

$$\frac{\partial V}{\partial w_i} = \sum_{j=1}^{n} 2w_j Cov[X_i, X_j] \tag{7}$$

$$\frac{\partial^2 V}{\partial w_i^2} = 2Var[X_i] \tag{8}$$

The CIMV index can then be expressed as:

$$CIMV = \frac{\Delta V}{V} 100 = \frac{1}{V} \left[\sum_{i=1}^{n} \sum_{j=1}^{n} 2w_j Cov[X_i, X_j] \Delta w_i + \sum_{i=1}^{n} Var[X_i] \Delta w_i^2 \right] 100 \tag{9}$$

The above equation indicates that the CIMV index has two components: a variance effect and a covariance effect. The variance effect and covariance effect are expressed as:

$$VE_i = \frac{(0.01 + 2w_i)Var[X_i]}{V} \tag{10}$$

$$CE_i = \frac{1}{V} \left[\sum_{j=1}^{n} 2w_j Cov[X_i, X_j] \right] \qquad j \neq i \tag{11}$$

The Herfindahl Index

The Herfindahl index is scaled, so that it varies between zero and one. The index is zero if all sectors have equal output (income) shares, i.e., complete diversification, and one if all output (income) is generated in one sector, i.e., complete concentration.

$$H = \frac{1}{N-1} \left[N \sum_{j=1}^{N} (s_j)^2 - 1 \right] \tag{12}$$

where N is the number of sectors, and s_j is the output (income) share of sector j.

DATA APPENDIX

TABLE A1   WEIGHTED REI RANKING OF SECTORS WITH HIGHEST OUTPUT VOLATILITY, 1997-2015

	Alberta		Ontario		Quebec		British Columbia	
Rank	Sector	REI	Sector	REI	Sector	REI	Sector	REI
1	CON	0.0094	MAN	0.0142	HC	0.0026	MAN	0.0028
2	OAG	0.0073	FIN	0.0035	MAN	0.0022	FIN	0.0025
3	MAN	0.0049	PRO	0.0031	GOV	0.0017	CON	0.0023
4	SAM	0.0041	WHL	0.0024	FIN	0.0016	PRO	0.0019
5	WHL	0.0029	GOV	0.0022	CON	0.0012	EDU	0.0018
6	PRO	0.0015	EDU	0.0019	RET	0.0011	TRA	0.0017
7	TRA	0.0015	CON	0.0018	TRA	0.0010	GOV	0.0017
8	RET	0.0014	MIN	0.0015	WHL	0.0010	HC	0.0017
9	CAP	0.0013	RET	0.0013	EDU	0.0009	RET	0.0016
10	FIN	0.0012	ADM	0.0011	PRO	0.0008	WHL	0.0014
11	ADM	0.0009	INF	0.0010	ADM	0.0008	INF	0.0012
12	GOV	0.0007	ACC	0.0010	UTL	0.0007	OTH	0.0011
13	HC	0.0006	TRA	0.0009	INF	0.0006	ACC	0.0010
14	OTH	0.0005	HC	0.0009	ACC	0.0006	ADM	0.0009
15	ACC	0.0005	UTL	0.0007	OTH	0.0004	UTL	0.0007
16	UTL	0.0005	OTH	0.0005	MIN	0.0003	FOR	0.0006
17	INF	0.0005	SAM	0.0004	CAP	0.0003	MIN	0.0006
18	MIN	0.0004	CAP	0.0003	ART	0.0002	CAP	0.0005
19	ART	0.0002	ART	0.0003	FOR	0.0002	ART	0.0004
20	EDU	0.0002	FOR	0.0002	SAA	0.0001	SAA	0.0003
21	FOR	0.0002	OAG	0.0000	SAM	0.0001	SAM	0.0002
22	SAA	0.0001	SAA	0.0000	OAG	0.0000	OAG	0.0001

Source: Authors' calculations using data from CANSIM 379-0030 and 051-0001.

TABLE A2   PERCENTAGE CHANGE IN THE VARIANCE OF TOTAL OUTPUT DUE TO A ONE PERCENTAGE POINT INCREASE IN THE SECTOR OUTPUT IN ALBERTA

	Variance Effect	Covariance Effect	Total Effect
CON	2.110	2.424	4.534
OAG	3.527	0.720	4.247
MAN	0.434	2.308	2.742
WHL	0.098	1.576	1.674
SAM	0.126	1.464	1.590
TRA	0.024	0.803	0.826
FIN	0.049	0.390	0.439
ADM	0.005	0.422	0.427
PRO	0.033	0.355	0.388
CAP	0.007	0.309	0.315
RET	0.022	0.278	0.300
UTL	0.001	0.210	0.211
INF	0.002	0.193	0.195
OTH	0.001	0.188	0.190
ACC	0.001	0.169	0.170
FOR	0.000	0.068	0.068
EDU	0.000	0.050	0.051
SAA	0.000	0.019	0.019
MIN	0.000	0.018	0.019
ART	0.000	0.009	0.009
HC	0.005	-0.068	-0.063
GOV	0.005	-0.315	-0.310

Source: Authors' calculations.

TABLE A3   SECTORAL SHARES OF LABOUR COMPENSATION IN ALBERTA, 1997, 2009 AND 2014

	1997	2009	2014	Change from 1997 to 2009	Change from 2009 to 2014	Change from 1997 to 2014
CON	9.28	12.86	16.06	3.58	3.20	6.78
OAG	4.36	7.82	9.09	3.46	1.27	4.73
ADM	2.52	3.17	3.30	0.65	0.14	0.78
HC	7.34	8.50	7.87	1.16	-0.64	0.52
PRO	7.75	8.20	8.11	0.45	-0.09	0.36
SAM	4.20	4.16	4.41	-0.04	0.25	0.21
UTL	1.23	1.42	1.27	0.19	-0.14	0.05
SAA	0.22	0.17	0.13	-0.05	-0.04	-0.09
OTH	3.04	3.00	2.91	-0.04	-0.09	-0.13
FOR	0.28	0.14	0.15	-0.14	0.01	-0.13
ART	0.90	0.90	0.69	-0.01	-0.21	-0.21
MIN	0.49	0.30	0.25	-0.19	-0.05	-0.24
RET	5.90	6.07	5.65	0.17	-0.42	-0.25
ACC	3.47	2.98	2.90	-0.49	-0.08	-0.57
TRA	5.46	4.42	4.68	-1.05	0.26	-0.79
INF	2.24	1.66	1.31	-0.58	-0.35	-0.93
WHL	6.49	5.47	5.54	-1.02	0.07	-0.95
FIN	9.03	7.82	8.01	-1.20	0.19	-1.01
EDU	6.60	6.14	5.21	-0.46	-0.94	-1.39
CAP	2.17	0.95	0.71	-1.21	-0.25	-1.46
GOV	7.00	6.23	5.38	-0.77	-0.85	-1.63
MAN	10.03	7.61	6.37	-2.42	-1.24	-3.67
Herfindahl Index	0.021	0.026	0.033	0.004	0.007	0.011

Source: CANSIM 383-0031 and authors' calculations.

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Bev Dahlby, Distinguished Fellow at the University of Calgary's School of Public Policy, attended St. Peter's College, the University of Saskatchewan, Queen's University and the London School of Economics. He is also the Research Director as well as the Scientific Director of the Fiscal & Economic Policy research division at The School. Dr. Dahlby has published extensively on tax policy and fiscal federalism.

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