

# Economic Commentary



## What is economic diversification and what does it mean for Alberta?

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**GLOBAL AND LOCAL  
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### *Main takeaways*

- *For more than four decades, economic diversification has been viewed as essential to ensure Alberta's long-term prosperity, especially given the boom-bust cycles of its main sector; oil and gas.*
- *However, apart from a general consensus that a more diversified economy is preferable, there is little mention of the province's current context, what shape diversification should take, and how to attain this goal.*
- *Alberta's diversification level relative to other provinces and US states is analyzed using three angles: employment, production and income.*
- *The province is the most diverse in terms of employment and the least diverse in terms of production. Its diversification level based on income is very volatile, going from the most diverse to one of the least depending on oil price.*
- *Compared to Texas, North Dakota and Oklahoma, the main US states producers of oil, Alberta is more diversified in terms of employment but less in terms of production and income.*
- *Lack of diversification is not necessarily a problem on its own. Volatility in economic outcomes, with frequent boom-bust, is the issue. Diversification is a way to reduce this volatility.*
- *Alberta is the second most volatile province in terms of economic outcome, based on employment, production and income. In all three cases, the natural resource sector, which includes oil and gas, makes an outsized contribution to the overall volatility compared to its share of the economy.*
- *The divergence between employment and production diversification is the result of the very high level of productivity or output per employee in the resource sector.*

- *This observation has important consequences for diversification. It means that, unless the industry gaining prominence has a level of productivity equal to the resource sector, any diversification could come at the expense of a lower GDP per capita, all else equal.*
- *Nevertheless, it is important to stress that with this cost comes an important benefit, a much less volatile economy, which is the objective of diversification.*
- *There are two ways to diversify an economy: 1) promote the development of other industries that are not correlated with the main industry, 2) reduce the volatility of the dominant industry by diversifying the dominant industry.*
- *The first avenue is what most have in mind when considering diversification and the idea behind the support for the agri-business, chemical industry, plastic manufacturing, tech sector, and financial sector.*
- *The second avenue includes promoting the use of Alberta's bitumen in for non-energy purposes (e.g. industrial usage) and the development of renewable energy, alternatives to fossil fuels, and carbon reduction technology that can be exported.*
- *While diversification is almost sure to come at a cost, the benefit from lower economic volatility and a more sustainable long term prosperity in the province will likely outweigh the cost.*

Economic diversification, a central component of Alberta's economic discourse for over four decades, is viewed as essential for the province's economy to ensure its long-term prosperity. Despite this, the interest in the topic fluctuates and generally follows the health of Alberta's main industry, the oil and gas sector.

The recent downturn in the oil and gas sector due to a collapse in world demand and the associated drop in oil prices have again revived the need for a more diversified economy. However, apart from a general consensus that more diversification is better, there is little mention of the current context in the province and what shape diversification should take.

This report presents the state of Alberta's economy compared to its Canadian counterparts as well as to US states, specifically those that produce oil. It is important to note that the fight against climate change and the necessary energy transition poses an existential threat on the oil and gas sector and will de facto force the province to diversify, willingly or unwillingly. However, while the energy transition can be viewed as a challenge, it also offers an amazing opportunity for Alberta to diversify its economy into high value-added sectors that will ensure its long-term prosperity.

### **What is diversification?**

Diversification can be summarized by the old saying of "not putting all one's eggs in the same basket." In other words, a diversified economy would feature a portfolio of unrelated industries to rely upon for growth, job creation

and wealth generation. In this type of economy, when one sector is under pressure for cyclical or structural reasons, other sectors of the economy remain unaffected, offsetting any drag.

Essentially, diversification prevents an over-reliance of the economy on a single, dominant industry. The primary risk with this type of economy is when a negative shock affects this industry, the whole economy is adversely affected. However, it is also important to note that the reverse is also true; when good times happen in the dominant industry, the rest of the economy also benefits. Therefore, diversification does not necessarily lead to a more positive outcome.

Diversification can be seen through two seemingly opposing views:

1. Standard economic theory suggests that an economy should specialize in an area where it has a comparative advantage, leading to efficiency gains and greater wealth and prosperity. In Alberta's case, having a natural endowment in oil and gas resources has led to a specialization in the sector, with the associated prosperity.
2. In the world of finance, diversification is key. The objective is to create an investment portfolio with the highest level of return given a level of risk or volatility. Here, economic concentration would unlikely be the result, unless under specific conditions.

Although these two views of diversification may appear contradictory – whereas the former emphasizes that specialization is positive, the latter states that diversification is of greater importance – they are compatible with one another. The main difference is the lack of inclusion of volatility or that the performance of various industries could vary substantially from period to period.

If we were to assume that the financial assets composing a portfolio have the same volatility (and a covariance of 0, for simplification), the optimal portfolio would be to concentrate the investment in the highest yielding asset.

Similarly, suppose we add volatility to the performance of industries. In this case, it could make sense for an economy to have some diversification level or have policies in place to help smooth the cycles in the dominant industry. However, it is important to note that this diversification comes at the cost of sacrificing potential returns by reducing our exposure to the dominant sector to reduce overall volatility.

In reality, economies fall somewhere in the middle; economies specialize in areas where they have a comparative advantage but also have other sectors – such as health care, education, public administration, retail trade, etc. – that provide some degree of diversification.

## How diversified is the Alberta economy?

To measure the diversification of an economy, we will analyze the share of the local economy's main industrial subsector. However, as various angles may be considered when measuring how diversified an economy is<sup>1</sup>, this report will study diversification through three angles: 1) employment, 2) real GDP or production, and 3) nominal GDP or income.

Various calculations may be used to determine the level of industrial concentration. For example, we can measure economic diversification using the normalized Herfindahl index, a measure often used to analyze industrial concentration following the impact of mergers. The resulting number falls in between a value of 100 (a fully concentrated economy) and 0 (a perfectly diversified economy). The idea behind this measurement is to determine the probability that two people work in the same industry; if there is only one industry – an extremely concentrated economy – this probability is 100%, and, if the economy is perfectly diversified, this probability is 0%.

### *Employment diversification*

Using the share in total employment of all major sectors of the economy, as published by Statistics Canada Labour Force Survey (1976 to present), we can determine concentration in the labour market.

In 2019, Alberta's biggest employment sector was the retail and wholesale trade industry, employing about 14% of workers, followed by health care and social services (13%) and construction (10%). This is very similar for the country as a whole, with retail and wholesale trade at 15%, health care at 13% and manufacturing at 9%. In Alberta, the resource sector (mining, oil and gas) employs about 6% of all workers (2% in Canada).

In the rest of the country, the retail and wholesale sector employs the most workers in most provinces, except for Newfoundland, New Brunswick and Manitoba, where the health care sector is the main employer (see Table in Appendix for details).

Once we calculate the diversification index for all provinces, the most surprising finding is that Alberta's labour market was the most diversified amongst Canadian provinces in 2019, followed closely by Saskatchewan, while Newfoundland and Nova Scotia are the least diversified. Even more interestingly, Alberta has been the most diverse province in terms of employment every year since 1976.

Additional findings include:

- Every province has seen an improvement in its level of labour market diversification since the late 1970s. Saskatchewan has seen the most

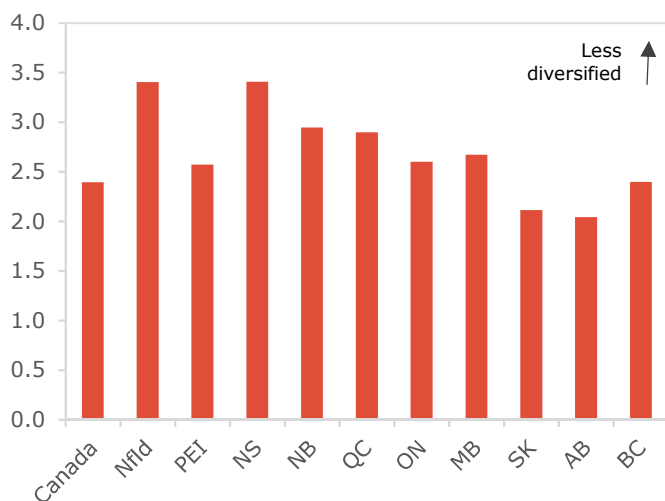
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<sup>1</sup> Our methodology is based on Mansell and Tombe, "If it matters, measure it: unpacking diversification in Canada", SPP Research Paper, University of Calgary School of Public Policy, November 2016.

significant diversification over the period, mainly due to a sharp decline in the share of workers in the agricultural sector.

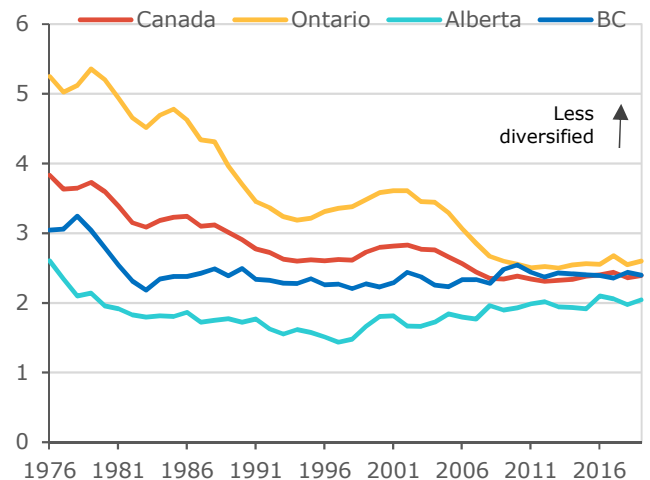
- While Alberta's labour market is more diverse now compared to the 1970s, its diversification level peaked in 1997 and has deteriorated slightly since. This reduction in diversification is not directly the result of the oil and gas extraction, since the share of the labour market employed by the resource sector is roughly unchanged over the period. Instead, the decrease in diversification is due to an increasing share of workers employed by the health care/social assistance and construction sectors. One could note that the increased importance of employment in the construction sector is likely indirectly linked to massive investment by the oil and gas industry over the past two decades.
- Quebec and Ontario have seen a big increase in diversification since the late 1970s due to a steady decline in employment in the dominant manufacturing sector over the period. The industry, which employed about 25% of workers in the late 1970s, currently employs approximately 10%. This decrease in the manufacturing sector has been offset by increases in the professional, scientific, and technical service sectors and healthcare and social assistance sectors. As a result of the reduction of the importance of the manufacturing sector, both provinces are at their most diversified levels since 1976.
- When compared to the US, the labour markets of Canadian provinces are more diverse than most US states. Even the most diversified US states, California, Colorado and Utah, are less diversified than most Canadian provinces. Alberta remains the most diversified labour market in North America.

**Fig 1. Diversification index – Employment (2019)**



Source: Statistics Canada, Alberta Central

**Fig 2. Diversification index – Employment**



Source: Statistics Canada, Alberta Central

### Production diversification

To estimate production diversification, the share of the main sectors of GDP by industry in real terms dating back to 1997 is used.

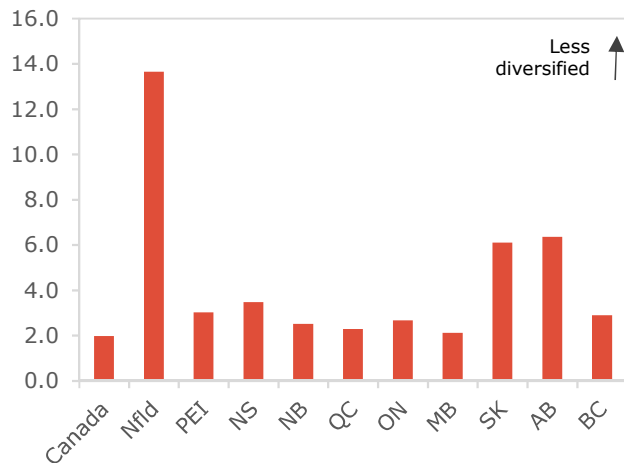
The main production sectors in Alberta are the resource sector (26%), real estate (10%), construction (8%) and manufacturing (8%). In the rest of the country, the real estate sector is the main sector of activity. The only exceptions are Newfoundland and Saskatchewan, where it is the resource sector, and Quebec, where it is the manufacturing sector (see Appendix for detail).

The diversification results are not surprising. Newfoundland, Alberta and Saskatchewan are the least diversified provinces. In all three cases, this is due to their high reliance on the resources sector, representing 36% of the economy in Newfoundland and 26% in Alberta and Saskatchewan.

The most diversified provinces are Manitoba, Quebec and New Brunswick. In all three cases, their respective biggest industry (real estate in Manitoba and New Brunswick, and manufacturing in Quebec) represent a maximum of 13% of the economy.

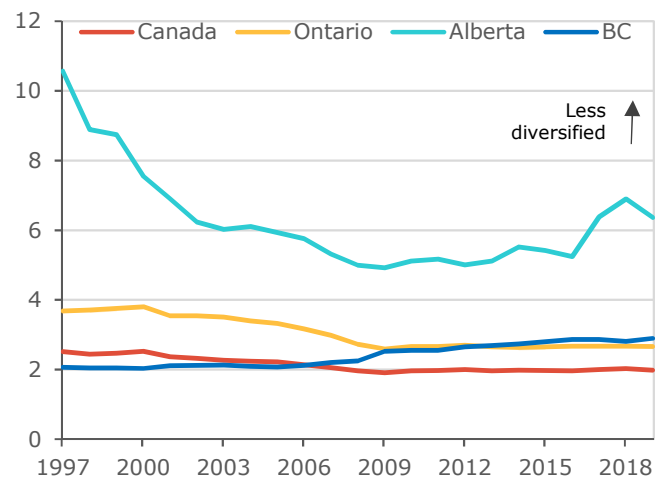
With the exception of Newfoundland, British Columbia and Nova Scotia, most Canadian provinces have improved their level of production diversification. Alberta and Saskatchewan have seen the most significant improvements in their diversification index since 1997. In both cases, this is the result of a reduction of the share of the resource sector in the economy, as many other industries gained importance.

**Fig 3. Diversification index – Production (2019)**



Source: Statistics Canada, Alberta Central

**Fig 4. Diversification index – Production**



Source: Statistics Canada, Alberta Central

Interestingly, Newfoundland transitioned from the most diverse province in 1997 to the least diversified by 2002. The development of the oil industry is the main culprit. The share of the resource sector in the economy increased from 9% in 1997 to 50% in 2007. Although the diversification score has improved since 2007, it remains the highest of all provinces.

The diversification score of Quebec and Ontario has improved significantly since 1997 due to the continued underperformance of the manufacturing sector over the period and gains in the finance and insurance and professional services sector.

Compared to US states, Newfoundland remains the least diversified region in North America. Alberta is more diverse than only five US states (Alaska, DC, Delaware, Indiana and Wyoming) and is about as diverse as New Mexico. Also, compared to other oil producing regions - specifically, Texas, North Dakota and Oklahoma -we find Alberta to be significantly less diverse than Texas and North Dakota and marginally less than Oklahoma. In Texas, the resource sector, the dominant sector by a thin margin, represents 15% of the economy, a bit more than half of the share in Alberta. The second biggest industry, manufacturing, represents 13% of the economy. In North Dakota, the share of the resource sector in the economy is 16%, again much lower than in Alberta. The second biggest sector in North Dakota is real estate (11%). In Oklahoma, the resource sector represents 23% of the economy, only marginally lower than in Alberta. The second biggest sector is public administration at 13%.

#### *Income diversification*

To estimate the level of diversification, we use the share of the main industries in nominal GDP. This provides the share of national income from the various industries. However, the latest available data is for 2017.

The main source of income are very similar to the main sector of production. As such, the resource sector is the main income generator in Alberta, Newfoundland and Saskatchewan. In the rest of the country, real estate is the main income source, except for Quebec, where it is the manufacturing sector. Interestingly, in 2017, the share of income coming from the real estate industry in BC is as important as the share of income from the resource sector in Alberta and Saskatchewan.

Using this information, we find that Newfoundland, Alberta and Nova Scotia are the most concentrated provinces in terms of their source of income, followed closely by Saskatchewan and PEI. At the other end of the spectrum, the most diversified provinces are Manitoba, Quebec and New Brunswick.

For Newfoundland, Alberta and Saskatchewan, the reliance on the resource sector remains the main reason for the lack of diversity. In the cases of Nova Scotia and PEI, it is the result of the real estate industry.

These results hide the high degree of volatility in the diversification score over the past two decades. As such, in 2014, Alberta was the second least

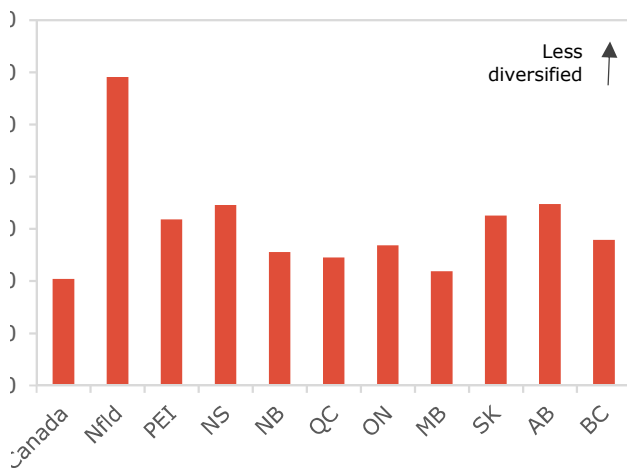
diversified province in terms of income, after Newfoundland, and became one of the most diversified by 2016. This volatility is because income in the resource sector depends on the terms-of-trade or price received for selling its production.

As such, when oil prices in Canadian dollars reached a high in 2008, the level of economic concentration was the highest in Alberta, Newfoundland and Saskatchewan. With oil prices declining by about 65% in Canadian dollar terms between 2014 and 2016 (72% in US dollar terms), the diversification index declined to its lowest in a decade. In fact, it reached a point where Alberta was amongst the most diverse provinces in 2016. With the drop in oil prices this year, the share of income derived from the resource sector is likely once again close to historic lows.

Quebec and Ontario have seen an improvement in their income diversification measures, once again due to a decline in the share of the manufacturing sector.

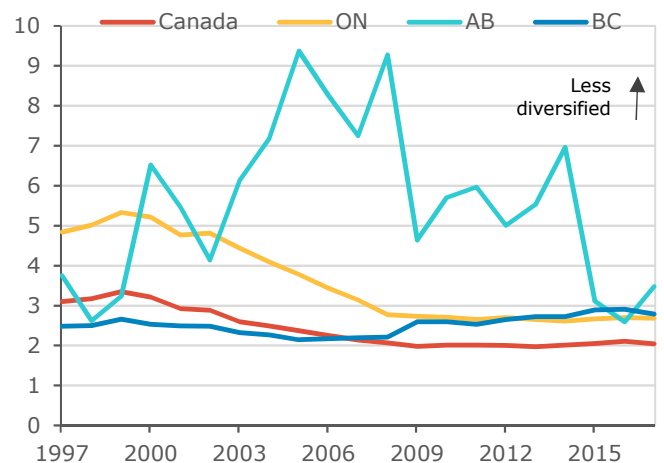
When compared to the US, it is interesting to note that Canadian provinces are, on average, more diversified than the US states. Moreover, in 2017, Alberta was more diverse in terms of income than 31 of the 50 US states. However, Alberta's income was more concentrated than in Texas and North Dakota, but only marginally less diverse than Oklahoma. Moreover, at the height of the latest oil boom in 2014, only 4 US states - Alaska, Delaware, DC and Indiana - were less diversified than Alberta; even the oil-producing US states were more diversified than Alberta.

**Fig 5. Diversification index – Income (2017)**



Source: Statistics Canada, Alberta Central

**Fig 6. Diversification index – Income**



Source: Statistics Canada, Alberta Central



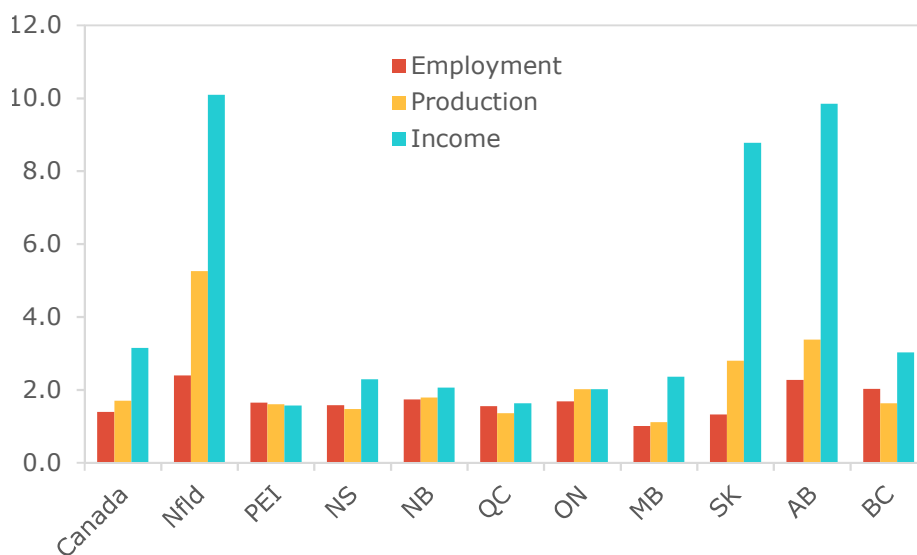
## Volatility matters

The industrial concentration of an industry provides a good measure of the amount diversification in an economy. However, a lack of diversification may not necessarily be a problem on its own. The issue comes mainly from when this dominant sector is volatile or, put differently, prone to boom-bust cycles, resulting in a highly volatile economic environment for the region. In other words, a heavy reliance on a sector would not typically be as concerning if its growth rate was stable over time.

With this in mind, we use the portfolio theory in finance to look at the contribution to economic volatility coming from the various industries. The benefit of using the portfolio volatility approach is that it also considers the correlation between sectors. For example, increased activity in the oil and gas sector will also increase activity in the pipeline industry, construction, engineering services and others. It will also take into account the industries that reduce volatility because they have a negligible or even negative correlation to other sectors (for example, health care, education, public administration).

By comparing the contribution to volatility and the sector's share in the economy, we can measure whether an industry is overly leading to more volatile economic outcomes. Focusing mainly on Alberta, we make the following observations regarding labour market volatility, production volatility and income volatility.

**Fig 7. Standard-deviations of yearly changes**



Source: Statistics Canada, Alberta Central

### Labour market volatility

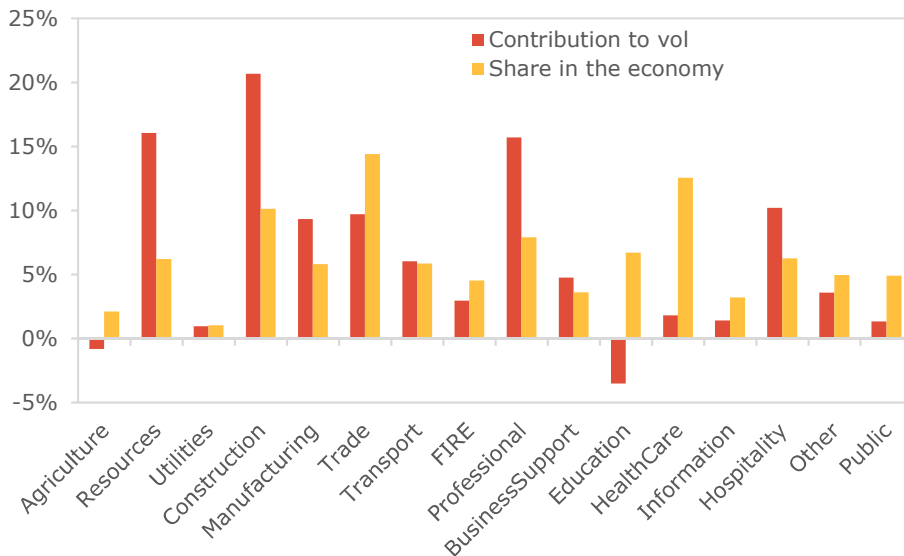
In regards to the labour market, we find that, while Alberta is the most diversified nationally, its labour market volatility is one of the highest, along with BC and Newfoundland. The least volatile are Manitoba and Saskatchewan. These findings are interesting as it suggests that, contrary to popular belief, diversification does not reduce volatility. This is because some sectors have a very high level of volatility.

The most volatile sectors of the labour market in Alberta are the utilities sector, followed by the resource sector, construction and agriculture. However, as mentioned previously, only looking at individual industries without accounting for the cross-correlation would underestimate an industry's contribution to overall volatility.

We find that the most significant contributors to labour market volatility are the construction, resources and professional, scientific and technical services sectors. Together, these three sectors account for about half of the labour market volatility but represent less than 25% of the province's jobs. The oil sector alone accounts for about 16% of the volatility but only represents 6% of total employment. The contribution of this sector to employment volatility is the highest of any province.

In comparison, nationally, the construction, manufacturing, trade and professional sectors are generally the main sources of employment volatility in most provinces.

**Fig 8. Contribution to volatility in employment - Alberta**



Source: Statistics Canada, Alberta Central

### Production volatility

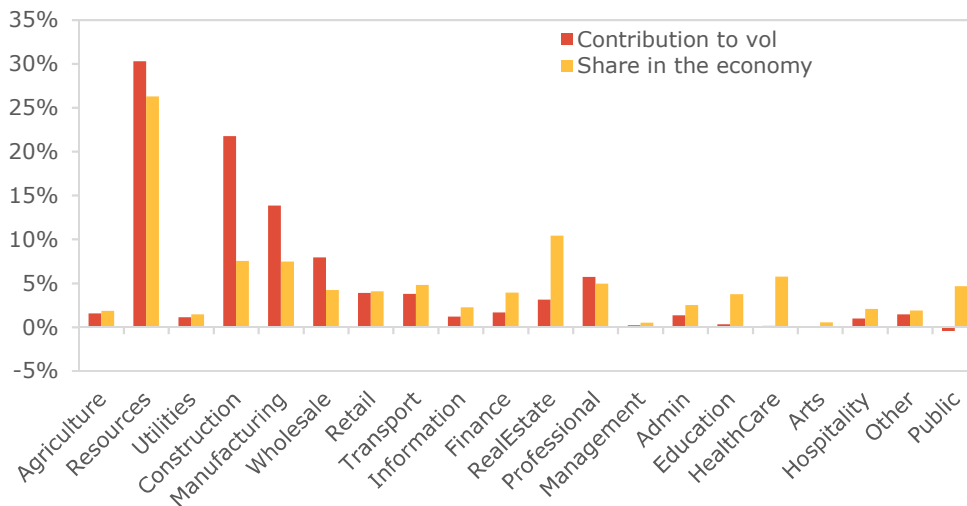
When it comes to production volatility, we find that greater diversification leads to lower volatility, as expected. The least diversified provinces by this measure - Newfoundland, Alberta and Saskatchewan - are also the most volatile. On the other end of the spectrum, the most diversified provinces, Manitoba and Quebec, are the least volatile.

We find that the agricultural, construction and management services sectors are the most volatile in terms of real growth in Alberta. Surprisingly, the resource sector only ranks as the 8th most volatile sector out of 20. However, the industry is responsible for about 30% of the total volatility in production. This is because of the sector's high share in real GDP at 25% and the high cross-correlation with other sectors, especially construction, manufacturing and wholesale trade.

The construction sector is also responsible for a greater share of the volatility than its share of the economy; 22% vs. 8%. This is the result of its strong correlation with many other sectors of the economy, especially manufacturing and wholesale trade. Similarly, the manufacturing sector also contributes a greater share to economic volatility than its weight in the economy.

On the extreme end, in Newfoundland, the resource sector is responsible for almost 100% of the volatility in real GDP.

**Fig 9. Contribution to volatility in production - Alberta**



Source: Statistics Canada, Alberta Central

## Income volatility

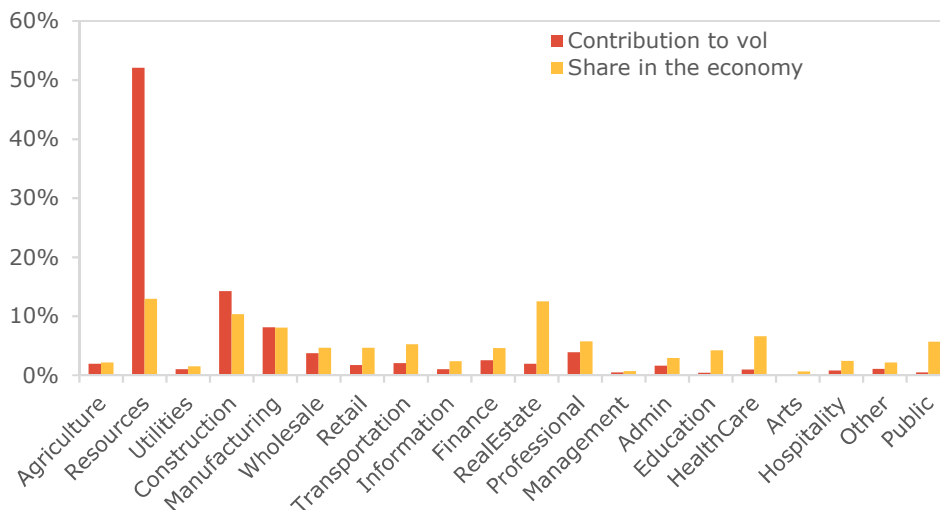
When it comes to income, the link between diversification and overall volatility depends on the year considered. This is because the main source of income volatility comes from changes in the terms-of-trade linked to variations in commodity prices, especially oil. These movements in commodity prices also influence the level of diversification, by increasing the share of the resource sector when commodity prices rise and reducing it when prices decrease. With the share of the resource sector in the economy increasing, its contribution to overall volatility also becomes more important, leading to greater overall volatility.

In Alberta's case, a decline in oil prices between 2014 and 2016 led to a decline in the share of the resource sector in nominal GDP and an increase in diversification between 2014 and 2016, as explained earlier.

As expected, Newfoundland, Saskatchewan and Alberta are the provinces with the most volatile incomes. On the other end of the spectrum, PEI, Nova Scotia and Quebec have the least volatile nominal GDPs.

Looking at the volatility of individual sectors in Alberta, we find that, unsurprisingly, the resource sector is the most volatile sector, with a standard deviation three times bigger than that of the whole economy. Agriculture is the second most volatile, followed by utilities, likely as a result of the volatile nature of commodity prices. However, agriculture and utilities represent a relatively small share of the nominal GDP, 2% and 1% respectively, and have little correlation to other sectors, meaning their contribution to overall volatility is low.

**Fig 10. Contribution to volatility in income - Alberta**



Source: Statistics Canada, Alberta Central

We find that the resource sector is responsible for about 62% of Alberta's income volatility, based on the share of the sector in the economy in 2017 (18% of nominal GDP). This is lower compared to the 1997-2016 period, when it contributed an average of approximately 71% to volatility.

The only other province where a single sector has such a big contribution to overall volatility is Newfoundland, where the resource sector is responsible for more than 90% of the volatility over the period. Saskatchewan is another province where the volatility in income comes from the resource sector (contribution of 40%) and from the agricultural sector (40%). Nationally, almost 40% of the volatility in national income can be linked to the resource sector, while the industry only represents 4% of the national economy.

As a comparison, in Ontario and Quebec, the manufacturing sector contributes for about 25%, the biggest sectoral contribution, to a much smaller overall volatility (about 5 times smaller than Alberta).

### ***Some observations on diversification***

Based on the above analysis of the level of diversification and volatility in employment, production and income, we make the following observations.

**Observation 1: Alberta tends to be less diversified than the oil producing states in the US.** Despite being a major industry for those two states, the oil industry is a smaller share of the economy, both in terms of production and income. In Texas, the manufacturing sector is more important while in North Dakota, it is real estate. This suggests that having a natural endowment in oil and gas does not necessarily lead to a highly specialized economy. More work into why Texas and North Dakota are more diversified would be warranted as it could provide some answers to better diversify Alberta's economy.

**Observations 2: Various methods to measure diversification provide very different conclusions,** with Alberta being the most diverse in terms of employment but the least in terms of production. Additionally, diversification by income is highly volatile and dependent on the price of oil.

The divergence in these measures exist because the resource sector has a very high productivity or output per employee. Each worker in the resource sector produced an equivalent of \$390,000 in national income 2017, the latest year of available data; this is three times as much as the average worker in the rest of the economy, at about \$120,000 per worker. On average, over the past 20 years, the resource sector has generated four times more income per worker than the rest of the economy. Looking at the real GDP, which removes the effect of the variation in oil prices, we find that the productivity of the resource sector was more than five times the rest of the economy in 2019 and 4.6 times over the past 20 years.

The very high productivity of the resource sector has important implications for the diversification of the economy. It means that replacing one worker in

the resource sector would necessitate creating at least three jobs in other sectors of the economy to keep national income unchanged, all else equal. It means that any diversification could come at a cost unless the new sector has a productivity level equivalent to the resource sector.

As a result, the likely outcome is that as Alberta's economy diversifies from the oil and gas industry, GDP per capita is likely to converge towards the national average. The pace of this convergence will depend on the productivity of the new industries. If productivity is high, Alberta will maintain a level of GDP per capita above the national average. However, if the new industries are low in productivity, it could potentially push the GDP per capita below the national average.

Nevertheless, it is important to stress that with this cost comes an important benefit, a much less volatile economy, which is the objective of diversification.

### ***How to diversify your economy?***

As shown previously, the need for diversification comes mainly from a desire to reduce volatility in economic outcomes. This can be done in two ways:

- 1) **Promote the development of other industries to increase their share of the economy.** This is usually what most have in mind when thinking about economic diversification and is similar to portfolio diversification. The aim is to develop industries that are uncorrelated to the dominant sector, thus reducing overall economic volatility.
- 2) **Reduce the dominant sector's volatility** by diversifying the dominant industry's activities, the customer base and markets, the products offering, etc. This is often overlooked as an avenue for economic diversification.

In Alberta's case, diversification, whichever route is chosen, means playing to the strength and comparative advantages of the province. However, as mentioned previously, diversification is likely to come at a cost. In addition to the cost of likely lower overall productivity, these costs may include support for new industries and new avenues in the dominant sector. However, these costs may be overshadowed by the benefits of a less volatile economy and more sustainable long-term prosperity.

#### *Diversification through new industries<sup>2</sup>*

The idea is to attract and develop industries, often already existing, that are either unrelated to the dominant industry or offer some complementarity or that are countercyclical to the dominant industry.

Considering Alberta's strength, a push in agri-business, chemical, petrochemicals and plastics, and tourism makes sense. These are sectors where Alberta has a comparative advantage. Alberta should also take advantage of its endowment in terms of a high quality of life, a business-

friendly environment, world-class infrastructures, and a young and educated population to attract other sectors.

Here are some examples of possible avenues:

- In the agri-business, Alberta's agricultural sector is a leader in crop and animal production and could leverage these sectors. As the world population continues to grow, demand for food will continue to remain high. Moreover, changing consumer behaviours also offer new markets for the sector. An example is the advent of vegan meat substitutes and other vegan products and the increasing demand for food products with lower carbon footprints. Similarly, with proper research and development, the province could also be a leader in lab-grown meat.
- The chemical, petrochemical and plastics sector plays on the synergy of the sector within the energy sector. Since oil and gas is an essential input in many petrochemicals and plastics, having a readily available supply of a key component is advantageous. Moreover, the sector has a positive sensitivity to oil and gas prices. In other words, lower oil and gas prices improve the profitability of the industry. As a result, it is likely to partly offset some of the traditional impacts of oil and gas prices fluctuation on the economy, reducing the overall economic volatility.
- A clear danger for the plastic manufacturing industry is the global push toward the reduction of plastic waste. The previous two sectors could also combine their efforts and knowledge to create the plastic of the future. Together, they could tackle plastic pollution by further developing biodegradable plastics and eliminating the use of damaging single-use plastics. Similarly, enhancing the scope and scale of plastic recycling capacity will be necessary to ensure plastic manufacturing's long-term viability.
- The tech industry has often been pushed as an avenue for diversification. Over the past two decades, there have been immense technological developments, going from the increased usage in mobile devices and the associated app environment to cloud computing, the big data revolution, and artificial intelligence progress. Alberta's young and educated population, in collaboration and coordination with leading teaching institutions, could create and nurture an environment to attract and support businesses.' creations in the sector.
- The financial sector also offers a path for increased diversification. As more and more investors are looking at investing in sustainable business models, there is a wall of money searching for investment opportunities in the field. Alberta has immense potential in attracting capital, foreign and Canadian, in search of investment in renewable energy and decarbonization. "Green financing" is one of the fastest-growing segments in finance, with the issuance of green bonds totaling about \$260bn so far in 2020 and increasing exponentially. Alberta is rightly placed to offer investment opportunities in the field through

renewable and decarbonization projects and have businesses acting as conduits to channel those investments in the province.

#### *Diversification in the dominant industry*

The idea is to diversify the dominant industry into unrelated sectors. In the case of the oil industry, this would be promoting the use of Alberta's oil for industrial usage. For example, bitumen extracted from the oil sands can be used to produce asphalt, needed for the construction and maintenance around the world.

If, the energy industry as a whole is considered in Alberta's case, this diversification of the energy sector could be met by the development of renewable energy, alternatives to fossil fuels and technology that can be exported.

Alberta has a strong capacity for solar, wind and geothermal power generation. Developing these sectors would reduce the reliance on the oil and gas sector to generate income, as electricity generation has a relatively high productivity level. As such, the utility sector in Quebec, which includes the electricity generation by Hydro-Quebec, has a high level of productivity, likely as a result of being an important export sector. While productivity remains slightly lower than in oil and gas, it has increased significantly over the past decade and remains well above other sectors of the economy.

The development of geothermal energy would have the added benefit of using Alberta's expertise in drilling for oil and gas. Moreover, while a lot of research and development is needed to make geothermal more efficient and widely useable, Alberta's expertise could be exported elsewhere. An added benefit of geothermal is that it allows workers in the field to transition into a sustainable sector with little need for retraining.

Similarly, green hydrogen development brings the promise of reducing carbon emissions from industries such as transportation and mining. Alberta has a comparative advantage in hydrogen production, especially blue hydrogen derived from natural gas with carbon capture. However, the sector's long-term sustainability will likely require the use of renewable electricity to produce green hydrogen.

However, these new energy sectors are unlikely to provide full diversification from the oil and gas sector. As electricity and hydrogen become more important in the energy mix, their demand and prices would be influenced by economic activity. This means that their prices are likely to decline when demand decreases due to a recession and increase when economic activity picks up, similar to the current price fluctuations of oil. However, the price of electricity, hydrogen and oil would be uncorrelated in the case of a supply shock, such as an increase in oil output by OPEC countries, for example.



## Conclusion

Economic diversification has been part of the economic discussion in Alberta for at least forty years. Despite this continued focus, it remains elusive. Diversification aims to limit one industry's impact on the broader economy, especially the volatility it induces. Our analysis of the situation also shows some interesting findings. Alberta's labour market is the most diversified in Canada, contrary to expectations. However, the province is amongst the least diversified in terms of production and income because of the high productivity in the resource sector. We also found that the resources sector is responsible for most of the economic volatility, even in the labour market.

There are two ways to diversify the economy. It can either be achieved by promoting and supporting new industries or through diversification of the main industry to reduce its intrinsic volatility. Alberta will need to play to its strength, using sectors where the province has a comparative advantage.

The very high productivity in the resource sector means that any diversification is likely to come at a cost. This is because many industries touted in the process are likely to have lower productivity. However, the benefit from lower economic volatility and more sustainable long term prosperity in the province will outweigh that cost.

## Appendix

**Fig 11. Share of employment (2019)**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	1.5	0.6	5.4	1.3	1.6	1.3	1.0	3.9	6.8	2.1	1.0
Resources	1.7	6.2	2.9	2.3	2.7	1.0	0.5	0.8	3.9	6.2	1.7
Utilities	0.7	1.2	0.4	0.8	1.0	0.6	0.7	1.0	1.1	1.0	0.5
Construction	7.7	8.5	8.2	7.4	6.9	6.1	7.3	7.7	8.1	10.1	9.2
Manufacturing	9.1	4.0	8.3	6.9	8.6	11.5	10.2	9.8	5.3	5.8	6.5
Trade	14.9	15.5	14.3	17.5	14.6	15.3	14.8	13.5	14.8	14.4	15.2
Transport	5.4	5.3	3.7	4.2	5.1	5.4	5.4	6.4	4.5	5.8	5.5
FIRE	6.3	3.1	3.8	4.6	4.7	5.6	7.9	5.2	5.2	4.5	6.2
Professional	8.2	4.3	4.4	6.0	4.8	8.0	9.2	4.5	4.8	7.9	8.7
Business Support	4.1	3.3	3.1	3.7	4.5	4.2	4.2	3.4	2.8	3.6	4.4
Education	7.2	7.1	6.9	8.0	7.5	7.0	7.3	7.9	7.7	6.7	7.0
HealthCare	13.1	17.5	14.2	15.8	17.0	14.0	12.2	15.9	13.9	12.5	12.2
Information	4.1	3.3	2.8	4.0	3.6	4.1	4.1	3.5	3.7	3.2	5.2
Hospitality	6.4	7.5	7.5	7.7	6.0	5.9	6.1	6.5	7.0	6.2	7.5
Other	4.3	4.5	4.2	3.6	4.0	4.2	4.0	4.3	4.9	4.9	4.6
Public	5.3	8.2	9.9	6.3	7.2	5.8	5.1	5.5	5.5	4.9	4.5

Source: Statistics Canada, Alberta Central

**Fig 12. Share of production - real GDP (2019)**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	2.1	0.8	6.5	2.4	3.4	1.9	1.2	5.1	8.8	1.9	2.2
Resources	7.5	37.9	0.1	1.4	1.0	2.3	0.9	3.0	25.7	26.3	4.3
Utilities	2.2	2.1	1.5	2.1	4.4	3.4	1.9	3.4	2.2	1.4	1.9
Construction	7.2	8.6	6.9	6.3	6.3	6.3	6.8	7.6	7.0	7.5	9.0
Manufacturing	10.2	2.8	10.2	7.3	9.5	13.4	12.0	9.7	6.1	7.5	6.9
Wholesale	5.1	2.1	2.1	3.3	3.3	5.4	6.4	4.8	4.7	4.2	3.8
Retail	5.2	4.9	6.9	6.9	6.5	6.0	5.1	5.5	3.9	4.1	5.8
Transportation	4.5	2.9	3.5	3.6	5.1	4.3	4.0	6.6	4.6	4.8	5.8
Information	3.2	2.3	3.0	3.7	2.8	3.2	3.9	2.8	1.6	2.2	3.5
Finance	6.7	2.9	5.2	5.5	5.4	6.0	9.4	5.4	3.2	3.9	5.7
Real Estate	12.7	9.0	13.1	16.5	13.0	11.3	13.0	13.0	9.5	10.4	18.1
Professional	6.0	2.7	2.9	4.3	3.3	6.4	7.2	3.3	2.0	4.9	6.4
Management	0.5	0.3	0.4	0.2	0.3	0.5	0.5	0.5	0.3	0.5	0.4
Admin	2.6	1.1	2.3	2.0	3.7	2.7	3.2	1.6	1.0	2.5	2.4
Education	5.3	5.1	7.1	6.7	6.2	5.9	5.7	5.8	4.4	3.7	5.1
Health Care	7.1	7.4	9.7	10.7	9.7	8.3	6.9	9.1	5.8	5.8	6.9
Arts	0.8	0.2	1.0	0.6	0.5	0.9	0.9	0.7	0.5	0.5	1.0
Hospitality	2.3	1.7	3.2	2.5	2.2	2.4	2.1	2.0	1.5	2.1	3.1
Other	1.9	1.6	2.0	2.1	1.9	2.1	1.8	1.8	1.4	1.9	2.1
Public	6.8	7.0	12.0	12.0	11.1	7.4	7.2	7.9	5.1	4.6	5.5

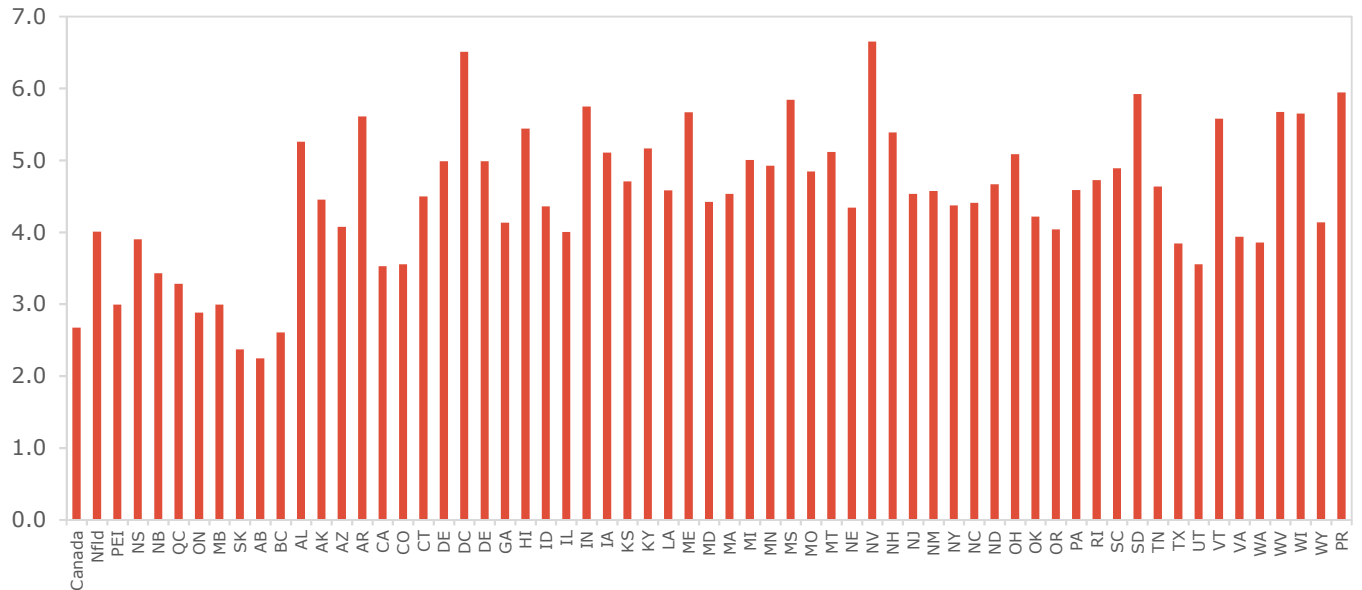
Source: Statistics Canada, Alberta Central

**Fig 13. Share of income – Nominal GDP (2019)**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	2.0	1.9	7.2	3.4	3.9	1.7	1.0	4.9	8.8	2.1	2.4
Resources	5.3	23.6	0.1	0.6	1.0	1.4	1.0	2.5	17.1	17.8	4.0
Utilities	2.2	1.9	1.5	2.1	3.1	3.4	1.8	3.3	2.9	1.4	2.1
Construction	7.6	12.3	6.4	6.3	6.9	6.7	6.9	7.4	8.7	9.5	8.0
Manufacturing	10.4	4.1	11.2	7.1	9.5	13.9	12.0	9.8	5.7	7.9	6.9
Wholesale	5.3	2.2	2.0	3.1	3.2	5.5	6.4	4.8	5.4	4.5	3.9
Retail	5.1	5.3	6.6	6.7	6.3	5.8	4.7	5.7	4.7	4.4	5.9
Transportation	4.6	3.2	3.6	3.5	5.3	4.5	4.1	6.0	4.8	5.1	6.0
Information	3.1	2.3	2.8	3.2	2.8	2.9	3.8	2.5	1.7	2.2	3.2
Finance	6.8	3.2	5.3	5.7	5.7	6.0	9.3	5.6	3.8	4.3	5.7
RealEstate	13.0	9.6	12.6	16.1	12.4	11.2	13.0	12.6	10.5	11.6	17.9
Professional	6.0	3.3	3.2	4.4	3.3	6.0	7.1	3.4	2.7	5.4	6.5
Management	0.5	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.3	0.5	0.4
Admin	2.8	1.4	2.0	2.1	3.8	2.9	3.3	1.9	1.3	2.6	2.6
Education	5.5	5.6	6.8	6.8	6.1	6.1	5.8	5.8	4.8	4.0	5.1
HealthCare	7.4	8.4	10.3	10.6	9.9	8.6	7.0	9.7	6.7	6.3	7.2
Arts	0.8	0.3	0.8	0.6	0.5	0.8	0.8	0.9	0.6	0.6	1.0
Hospitality	2.3	1.9	3.1	2.7	2.3	2.3	2.1	2.1	1.7	2.3	3.2
Other	2.1	1.7	2.1	2.0	1.9	2.2	2.0	1.9	1.6	2.1	2.3
Public	7.2	7.5	12.1	12.6	11.7	7.8	7.4	8.7	6.1	5.4	5.7

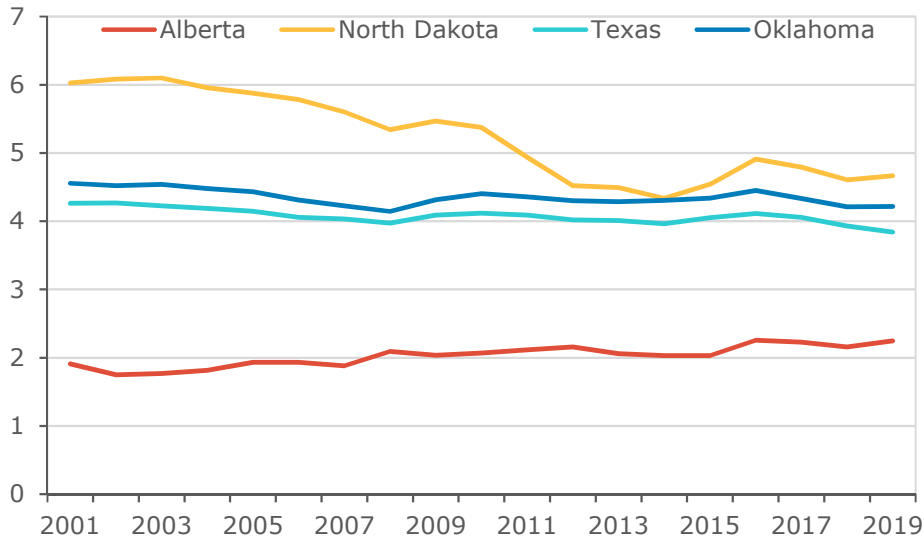
Source: Statistics Canada, Alberta Central

**Fig 14. Employment diversification index (Canada vs US, 2019)**



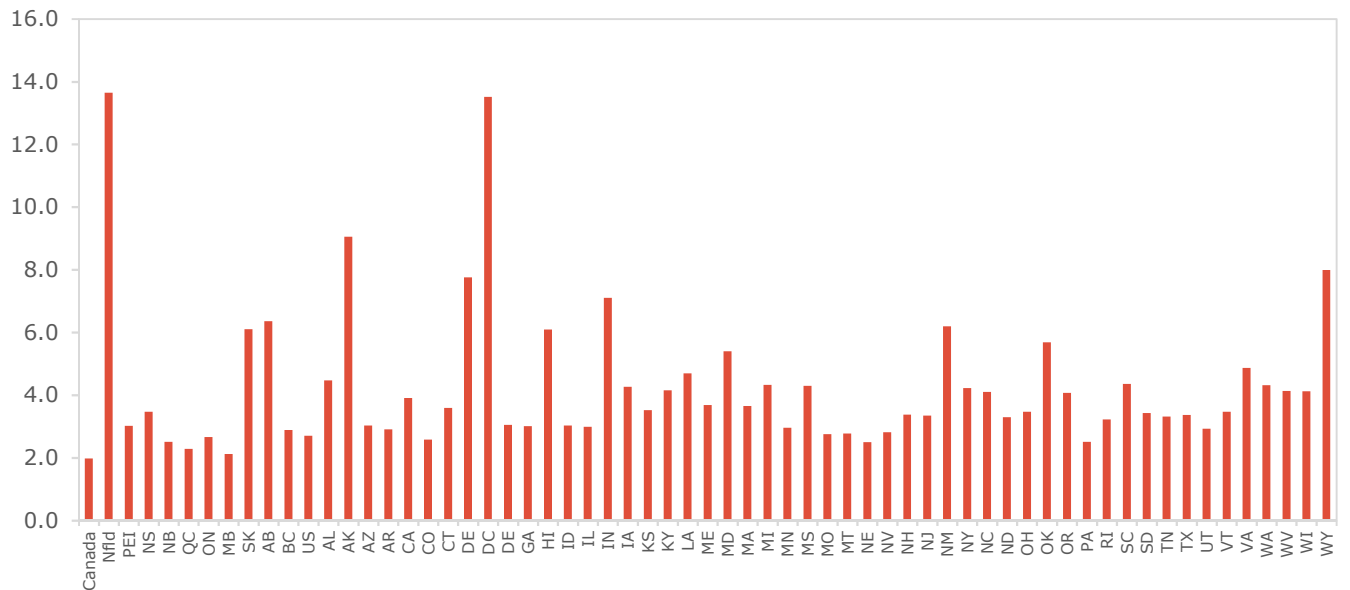
Source: Alberta Central

**Fig 15. Employment diversification index – Oil producers**



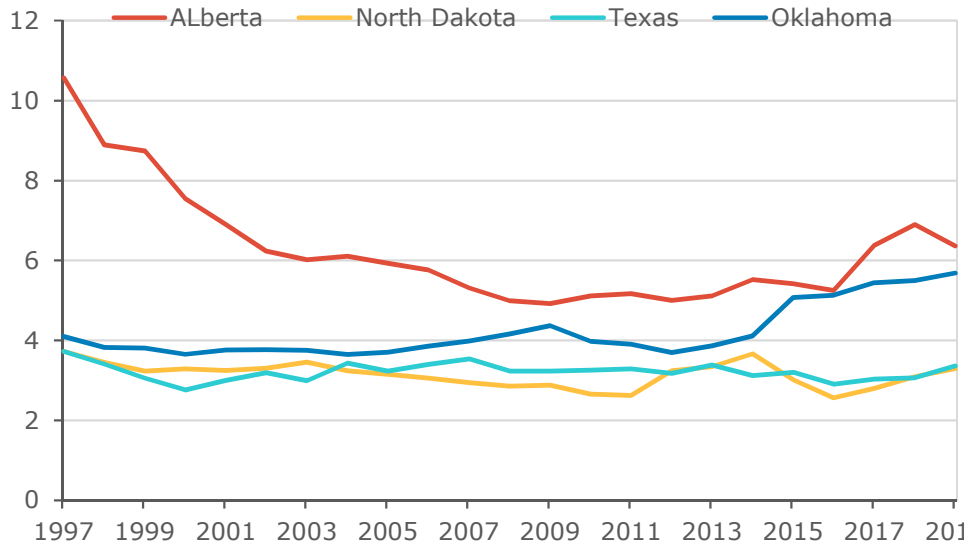
Source: Statistics Canada, Alberta Central

**Fig 16. Production diversification index (Canada vs US, 2019)**



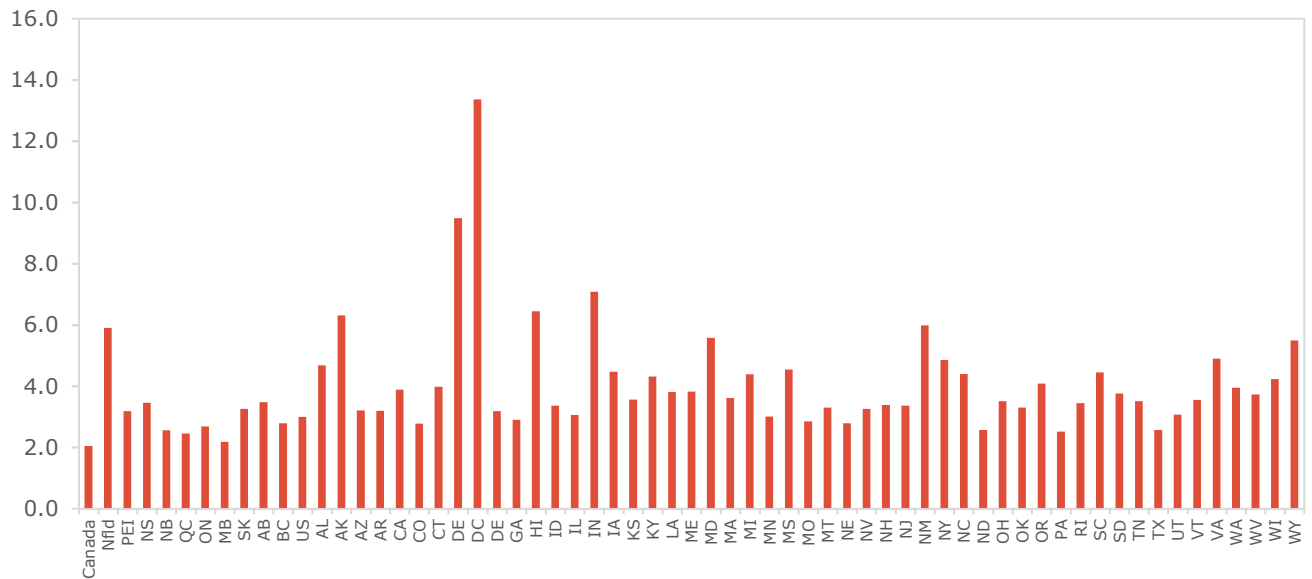
Source: Alberta Central

**Fig 17. Production diversification index – Oil producers**



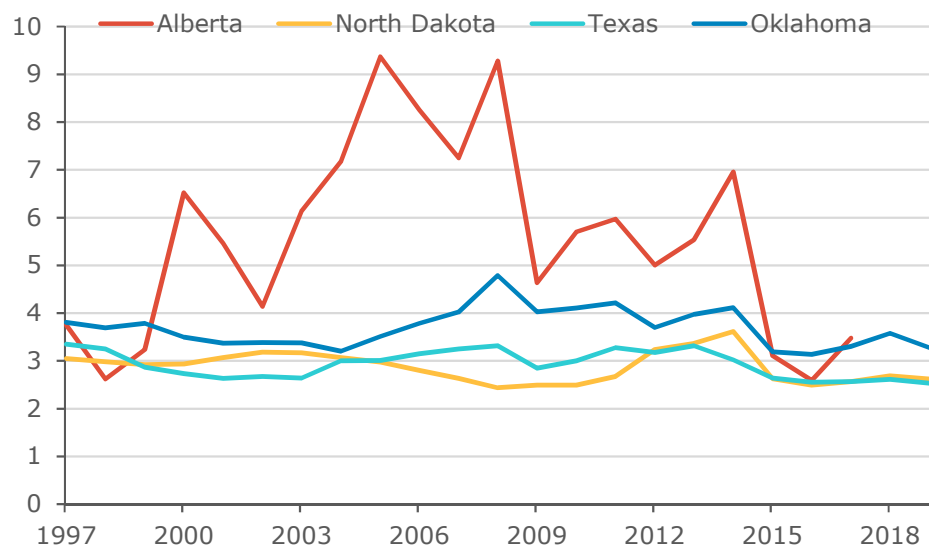
Source: Alberta Central

**Fig 18. Income diversification index (Canada vs US, 2017)**



Source: Alberta Central

**Fig 19. Income diversification index – Oil producers**



Source: Alberta Central

**Fig 20. Contribution to standard deviation - Employment**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	0.00	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.04	-0.02	-0.01
Resources	0.05	0.23	0.11	0.02	0.00	0.03	0.01	0.01	0.09	0.36	0.07
Utilities	0.01	0.01	0.02	0.00	0.00	0.00	0.02	-0.01	0.04	0.02	0.00
Construction	0.20	0.38	0.18	0.22	0.15	0.19	0.25	0.27	0.29	0.47	0.45
Manufacturing	0.25	0.16	0.25	0.15	0.22	0.25	0.33	0.18	0.01	0.21	0.15
Trade	0.18	0.17	0.08	0.33	0.23	0.26	0.18	0.03	0.29	0.22	0.27
Transport	0.09	0.03	0.03	0.04	-0.01	0.14	0.10	0.06	0.02	0.14	0.08
FIRE	0.06	0.16	0.03	0.05	0.06	0.03	0.10	0.06	0.10	0.07	0.11
Professional	0.21	0.21	0.19	0.16	0.23	0.14	0.26	0.07	0.01	0.36	0.34
Business Support	0.07	0.10	0.06	0.01	0.12	0.10	0.10	0.09	0.09	0.11	0.05
Education	0.01	0.08	0.01	0.00	0.05	0.05	0.02	0.02	0.09	-0.08	0.05
HealthCare	0.06	0.17	0.28	0.21	0.33	0.15	0.10	0.13	0.10	0.04	0.05
Information	0.05	0.00	0.05	0.06	0.03	0.05	0.07	0.01	-0.02	0.03	0.11
Hospitality	0.11	0.29	0.17	0.26	0.15	0.07	0.12	0.05	0.08	0.23	0.12
Other	0.04	0.15	0.04	0.02	0.07	0.07	0.02	0.05	0.06	0.08	0.09
Public	0.01	0.23	0.12	0.01	0.10	0.02	0.01	-0.02	0.03	0.03	0.06
Total	1.40	2.39	1.65	1.57	1.73	1.55	1.69	1.01	1.32	2.27	2.02

Source: Alberta Central

**Fig 21. Contribution to standard deviation - Production**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	0.03	0.02	0.23	0.05	0.07	0.02	0.01	0.43	1.06	0.05	0.04
Resources	0.22	9.02	0.01	0.13	0.04	0.02	0.04	0.12	1.22	0.97	0.08
Utilities	0.02	0.02	-0.04	0.06	0.01	0.04	-0.01	0.06	0.04	0.04	0.06
Construction	0.16	-0.35	0.24	0.31	0.36	0.04	0.16	0.08	0.11	0.70	0.32
Manufacturing	0.42	0.07	0.34	0.24	0.27	0.46	0.58	0.24	0.21	0.44	0.33
Wholesale	0.16	0.03	0.05	0.07	0.12	0.11	0.18	0.12	0.28	0.26	0.09
Retail	0.09	0.07	0.07	0.10	0.09	0.08	0.09	0.04	0.06	0.13	0.09
Transportation	0.07	-0.02	0.00	0.04	0.11	0.05	0.07	0.03	0.00	0.12	0.08
Information	0.07	0.07	0.07	0.06	0.07	0.06	0.14	0.01	-0.02	0.04	0.08
Finance	0.07	0.00	0.06	0.02	0.04	0.05	0.15	-0.02	0.01	0.05	0.11
Real Estate	0.04	-0.03	0.05	0.03	-0.01	0.01	0.11	0.00	0.05	0.10	0.06
Professional	0.15	0.05	0.08	0.00	0.11	0.16	0.25	0.01	0.06	0.18	0.12
Management	0.18	0.01	0.00	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.00
Admin	0.06	0.03	0.13	0.08	0.27	0.08	0.10	0.02	0.00	0.04	0.07
Education	0.00	0.01	0.04	0.02	0.02	0.01	-0.01	0.00	0.02	0.01	0.00
Health Care	0.00	0.04	-0.04	0.08	0.05	0.02	0.02	-0.01	0.00	0.00	0.00
Arts	0.00	0.00	0.03	0.00	0.00	0.01	0.01	0.01	-0.01	0.00	0.00
Hospitality	0.02	0.01	0.06	0.03	0.00	0.00	0.04	0.03	0.00	0.03	0.03
Other	0.02	0.02	0.02	0.04	0.01	0.03	0.03	0.01	0.02	0.05	0.02
Public	-0.03	-0.02	0.24	0.02	0.07	-0.01	-0.01	0.01	-0.02	-0.01	-0.03
Total	1.74	9.05	1.65	1.38	1.69	1.23	1.95	1.20	3.10	3.21	1.57

Source: Alberta Central

**Fig 22. Contribution to standard deviation - Income**

	Canada	Nfld	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Agriculture	0.1	0.0	0.6	0.1	0.0	0.0	0.0	0.5	3.3	0.1	0.0
Resources	1.3	9.5	0.0	0.1	0.2	0.1	0.1	0.5	3.0	3.7	0.7
Utilities	0.0	0.0	-0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.1	0.1
Construction	0.3	-0.7	0.2	0.2	0.4	0.1	0.1	0.3	0.5	1.0	0.5
Manufacturing	0.3	-0.1	0.1	0.3	0.4	0.4	0.5	0.4	0.6	0.6	0.5
Wholesale	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.1	0.6	0.3	0.1
Retail	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
Transportation	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
Information	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
Finance	0.2	0.1	0.1	0.1	0.0	0.2	0.3	0.1	0.1	0.2	0.2
RealEstate	0.0	-0.1	0.0	0.0	0.0	-0.1	0.1	0.0	0.1	0.1	0.0
Professional	0.2	0.1	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.3	0.2
Management	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Admin	0.1	0.0	0.1	0.1	0.3	0.1	0.1	0.0	0.0	0.1	0.1
Education	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HealthCare	0.0	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0
Arts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hospitality	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Public	0.0	0.1	-0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.8	9.4	1.5	1.6	2.0	1.6	2.0	2.5	8.6	7.2	2.9

Source: Alberta Central

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