Measuring Diversification in British Columbia

PREPARED BY BC STATS – APRIL 2018

BRITISH COLUMBIA | BCStats

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PUBLISH DATE

April 2018

Table of Contents

1. Executive Summary

The purpose of this report is to provide a quantitative measure of diversification in different aspects of the B.C. economy, in order to highlight potential areas of interest, as well as strength and risk in the economy for policy makers.

A common measure of diversification known as the Herfindahl-Hirschman Index (HHI) was used to provide an objective measure of diversification in the industrial composition of Gross Domestic Product (GDP), employment and exports for British Columbia and the rest of the provinces. The report uses the HHI range employed by Statistics Canada and the US Department of Justice and the US Federal Trade Commission to categorize results as diversified, moderately concentrated and highly concentrated.

All provincial economies were considered diversified in 2016 when using the industrial composition of Gross Domestic Product (GDP). Likewise, employment by industry is diversified across all provinces, as well as across British Columbia's development regions.

Exports on the other hand, tend to be more concentrated. Statistics Canada reports a provincial measure of export concentration by product. In 2016, British Columbia had highly diversified exports by product, ranking third among provinces.

Exports by destination are highly concentrated in all provinces. Nevertheless, in 2017, British Columbia had the second highest diversification by exports' destination among provinces, marginally behind Newfoundland and Labrador.

Important aspects of the economy were analyzed to measure economic diversification in British Columbia. The results place B.C. in a very favourable position among provinces, with diversified production (as measured by industrial GDP), employment by industry, and products exported. Even though British Columbia merchandise exports are highly concentrated by destination, among provinces and territories, B.C. is near the top in terms of market diversification.

2. Introduction

Measuring diversification is useful as it sheds light into possible areas of strength and risk in the economy. A more diversified economy (diversified in employment, exports, and industries) will be more resilient to external shocks and will provide more flexibility to adapt to structural changes.

The purpose of this report is to provide a quantitative measure of different aspects of the B.C. economy, in order to highlight potential areas of interest for policy makers. Additionally, the report provides information about other Canadian jurisdictions to compare the relative risks of the B.C. economy compared to the rest of Canada.

There are several ways in which diversification can be measured. Most indicators try to measure the level of concentration—the more concentrated a particular industry or economy, the less diversified it is. Concentration measures have been developed mainly in attempts to determine competitiveness in particular industries. The higher the concentration in an industry, the less competitive that industry becomes. Therefore, industry concentration is a key consideration in policy regarding firm-level mergers and other industrial policy decisions.

Concentration indicators developed for an industry can easily be used to measure concentration in the economy as a whole. Most measures of concentration are based on the use of shares of particular firms in different aspects of the market (sales, revenues, etc.). It is easy to substitute firm-level shares to measure concentration in different aspects of the economy.

Of the different concentration indicators, the most commonly used for determining industry concentration in merger analysis are those known as Concentration Ratios (simply using the market share of significant competitors on an industry) and the Herfindahl-Hirschman Index (HHI). Statistics Canada recently made available a report[1] using the HHI to measure export diversification for Canada as a whole, as well as for the provinces.

All provincial economies were in the diversified range of the diversification index in 2016 when considering the industrial composition of Gross Domestic product (GDP). Likewise,

[1] Statistics Canada (2017, December 11). Measuring Canadian Export Diversification. Latest Developments in the Canadian Economic Accounts (13-605-X), http://www.statcan.gc.ca/pub/13-605-x/2017001/article/54890-eng.htm

employment by industry is very diversified across all provinces, as well as across British Columbia's development regions.

Exports on the other hand, tend to be more concentrated. Statistics Canada reports a provincial measure of export concentration by product. In 2016, British Columbia had a concentration ratio indicating a high degree of diversification, one of only four provinces considered diversified using this measure. B.C. exports by destination are the second most diversified among provinces and territories, behind only Newfoundland and Labrador. However, although B.C. compared very well to the rest of Canada, the market for its exports is still highly concentrated, with British Columbia exporting the majority of its merchandise to the United States.

3. Methodology

Concentration ratios are the most widespread and simplest measures of diversification. They are calculated as the sum of the largest industry shares for a predetermined number of industries.

Concentration ratios are usually used to measure diversification within an industry, where the concentration ratio is the sum of the sales revenue of the largest firms divided by the total sales revenues for that industry. One of the most popular concentration ratios is that for the four largest firms, also known as four-firm ratio.

Concentration ratios have the disadvantage of not considering the relative dispersion or size of the rest of the firms; that is, they do not consider all information available and, as such, they are limited in scope. However, they are a simple, yet effective measure of concentration.

The Herfindahl-Hirschman Index (HHI) is the measured as the sum of the squared shares of each industry in the market. That is:

$$\mathrm{HHI} = \sum_{k=0}^{N} (s_k)^2$$

Where s_k is the decimal share of industry k as a proportion of the total (N). If the economy contained only one industry, the HHI would be equal to one ($1.0^2 = 1$). The smaller the shares of the industry the closer the HHI is to zero. [2]

In 2012/13, the Canadian Northern Development Agency (CanNor) created the Northern Diversification Index (NEDI). The purpose of the index is to measure the state of economic diversity of the northern territories that inform plans and priorities for the agency. The NEDI is a simple transformation of the HHI, that is, (1-HHI)*100.

Therefore, for the purposes of this report, the HHI will be used to measure the level of concentration of different aspects of the economy. A higher level of the HHI will indicate lower levels of diversification. Interpretation of the HHI will be done using the guidelines from Statistics Canada to determine diversification of exports. A market is considered diversified if the HHI is below 0.15, moderately concentrated if the HHI is between 0.15 and 0.25, and highly concentrated if the HHI is at or above 0.25. [3]

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[2] The HHI is therefore bound by 1.0 at the highest, which would imply perfect concentration in just one firm or industry. The lower bound is $(1/N)^2$, where N represents the number of relevant subcategories.

[3] Note that these parameters are also used by the US Department of Justice and the US Federal Trade Commission as guidelines for horizontal mergers.

Overall diversification of the economy as a whole is important. The industry level Gross Domestic Product (GDP) can be used to determine economic diversity at an aggregate level. The greater the dependence on a single or a small number of industries, the greater the impact of adverse economic shocks.

Another important aspect of diversification relates to the labour market. Employment indicators are key to consumer confidence and important drivers of household consumption, which accounts for over sixty percent of the economy. Therefore, we will also measure the diversification of overall employment by industry.

Note that the diversification of employment will be affected by the size, as well as the labour intensity of the particular industry. Therefore, the larger industries when measured by GDP may not be the same as those measured by employment. Employment data by industry is available at the development region level, so an index for each region will be calculated to analyze whether there are geographical differences in diversification; however, there are significant data gaps and the industry categories are slightly different, so results must be interpreted with caution.

Employment and GDP diversification were calculated using the first two digits of the North American Industry Classification System (NAICS) codes. Regional employment uses a slightly modified version of the two-digit NAICS codes. Note that a small rounding adjustment to the totals is needed in order to ensure that the sum of all subcategory shares is equal to exactly one hundred percent.

Merchandise exports are another vital part of the economy. B.C. has conducted a concerted effort to diversify its export market, with trade missions and support of federal trade agreements. Statistics Canada measures export diversification in three ways: product diversification, destination market diversification and geographic diversification (by province of origin). Due to the lack of data for B.C. regions, only the first two measures of diversification will be considered in this report. Disaggregated data for services exports are unavailable; therefore, only merchandise exports were analyzed.

To measure export diversification by product, the concentration ratios provided by Statistics Canada for the provinces and territories will be used. To measure destination diversification, all countries of destination for each individual province or territory are used in the calculation.

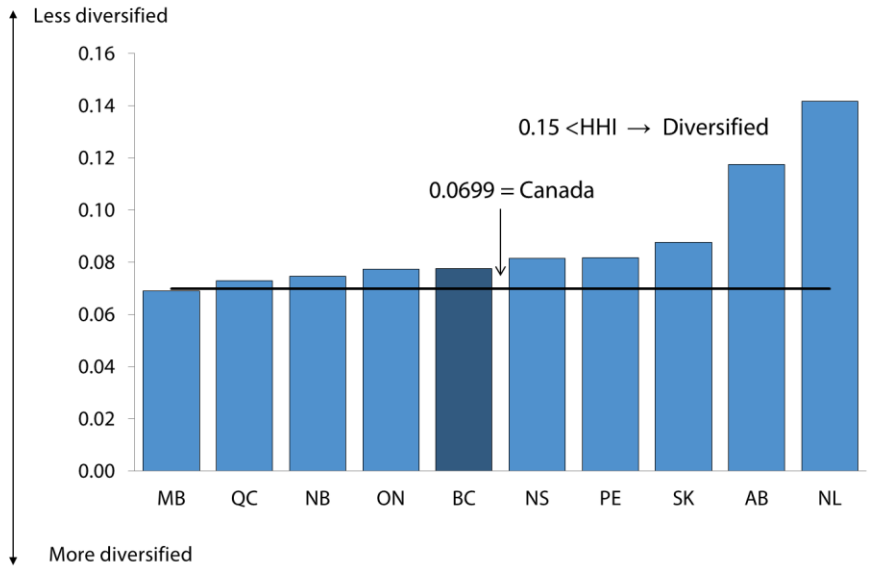
4. Production diversification

A good measure of overall diversification in the economy is the level of production in different industries. The diversification measure is calculated using Gross Domestic Product (GDP) by industry at basic prices. All provincial economies were in the diversified range of the diversification index in 2016, with the diversification index ranging from 0.0690 in Manitoba to 0.1418 in Newfoundland and Labrador. British Columbia was in the middle of the pack among provinces, reporting an HHI index of 0.0776, slightly above the Canadian average of 0.0699.

In 2016, Newfoundland and Labrador and Alberta were the least diversified provinces in Canada, with large mining, quarrying, and oil and gas extraction industries. Meanwhile Manitoba was the most diversified province in the country, with an index of 0.0690, the only province below the Canadian index.

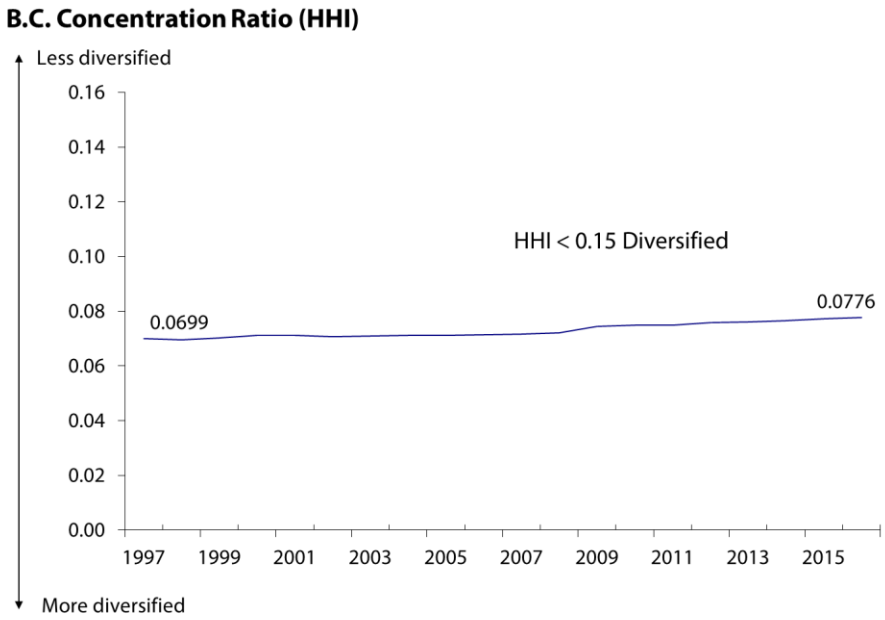
This chart also shows that by this measure, the Canadian economy as a whole is more diversified than any single province with the exception of Manitoba.

Concentration Ratio (HHI), 2016



Source: BC Stats calculations using data provided by Statistics Canada

The British Columbia economy has been diversified since 1997 (as far back as data are available); however, the diversification index has increased very marginally over time, going up from 0.0699 in 1997 to 0.0776 in 2016, indicating a slight increase in production concentration by industry over time.



Source: BC Stats calculations using data provided by Statistics Canada

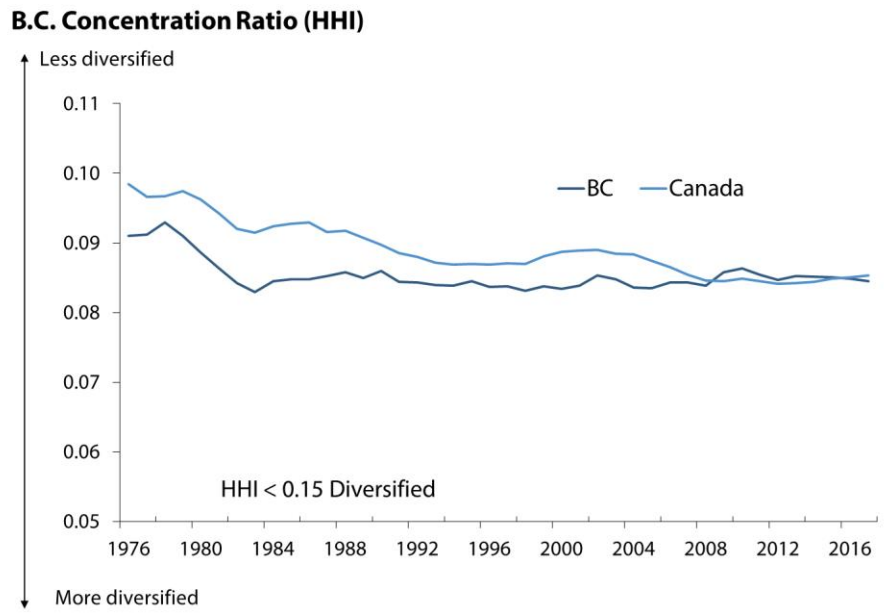
Note that diversification is not the only important aspect of the economy. In certain industries, economies of scale are needed to be competitive, which may reduce the level of overall diversification in the economy.

5. Employment diversification

Employment is very diversified across all provinces when considering the industry of employment. British Columbia had an index of 0.0845 in 2017. Diversification among provinces in 2017 ranged from a high of 0.0818 in Alberta to a low of 0.1003 in Newfoundland and Labrador.

This means that, in general, employment in B.C. and the rest of Canada is not heavily concentrated in any particular industry, which makes provinces more resilient to industry-specific shocks.

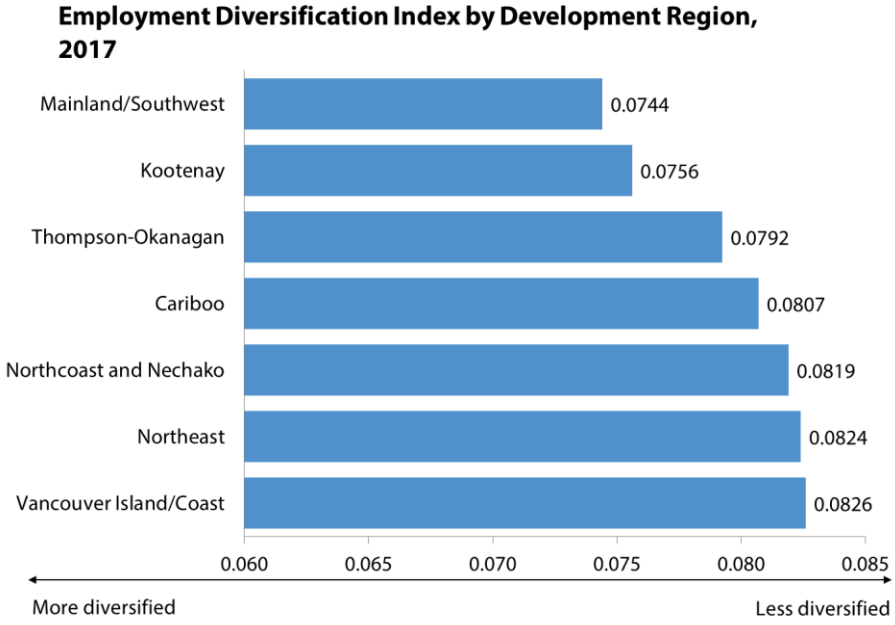
British Columbia employment has been marginally more diversified than the Canadian average, with the employment concentration index for B.C. fluctuating between 0.0830 and 0.0929 since 1976. On average, Canadian employment concentration is slightly higher, ranging from 0.0842 to 0.0984 in the same period. B.C. has had a slightly better measure of diversification than Canada as a whole every year since 1976, with the exception of the period between 2009 and 2015. It is important to note that the differences are too small to be significant.



Source: BC Stats calculations using data provided by Statistics Canada

The range of diversification across time and across provinces is very narrow, with all provinces presenting diversified labour markets. This pattern is observed across British Columbia's development regions as well.

All development regions present diversified labour markets, ranging from 0.0744 in Mainland/Southwest, to 0.0826 in Vancouver Island/Coast. Due to data gaps in employment by region, results must be interpreted with caution, especially in regions with lower employment levels (e.g., the two northern regions). Additionally, the industry categories used are slightly different than those used for the province as a whole.



Due to data gaps results must be interpreted with caution.
Source: BC Stats calculations using data provided by Statistics Canada

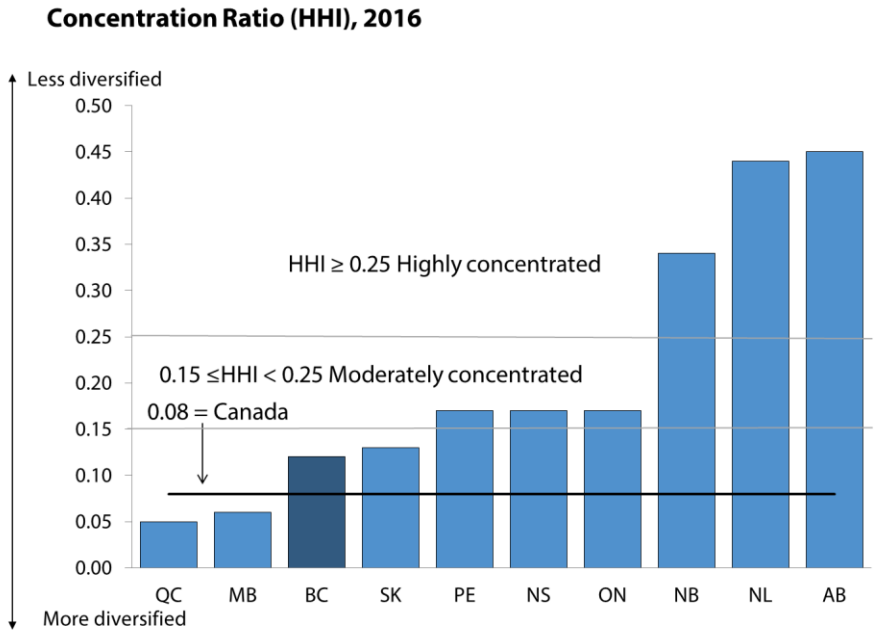
Note that a better diversification measure for the regions does not necessarily mean that certain towns or areas are not highly dependent on a few employers. That is, diversification measures are not to be confused with dependency measures. For example, in northern B.C. transportation and warehousing is an important support industry for natural resource extraction; therefore, impacts on one or two forestry mills or a mine may have important ramifications in employment levels in the transportation and warehousing industry in the surrounding area.

6. Merchandise exports diversification

6.1. Diversification by product

Statistics Canada reports a provincial measure of export concentration by product. In 2016, British Columbia had a concentration ratio of 0.12, indicating a high degree of diversification. British Columbia ranks as the third most diversified province behind Quebec (0.05) and Manitoba (0.06). Despite faring well compared to other provinces, and having a high degree of diversification, B.C. is still behind the Canadian index (0.08) and has been as far back as data are available (with the exception of 2014 where they were tied).

Export product diversification by province



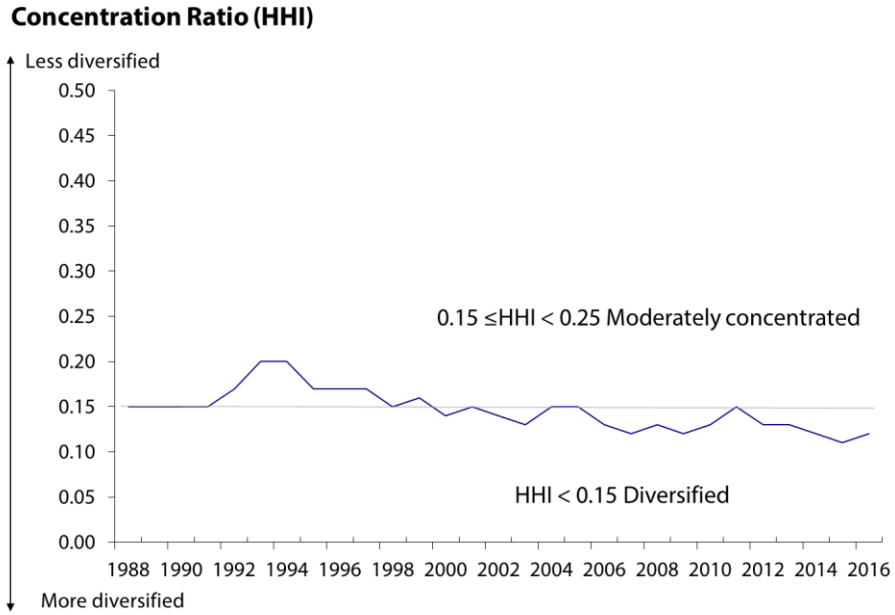
Source: Statistics Canada

Softwood lumber (15.2%), coal (15.1%), pulp (7.9%) and natural gas (6.4%) were the main B.C. exports in 2017. So although B.C. has a high degree of product diversification, it is still highly dependent on natural resource exports.

B.C. has diversified its exports over time. In 1988, the export concentration ratio was 0.15. Between 1988 and 1999, the concentration ratio remained at the moderately concentrated level, reaching a high of 0.20 in 1993 and 1994. It is likely that NAFTA had a positive effect on

export diversification by product in the province. Product diversification has improved gradually since 1995 and has remained at or below 0.15 since 2000. Diversification in Canada as a whole has remained somewhat stable over the last three decades, ranging from 0.08 to 0.12 since 1988.

B.C. Diversification of exports by product



Source: Statistics Canada

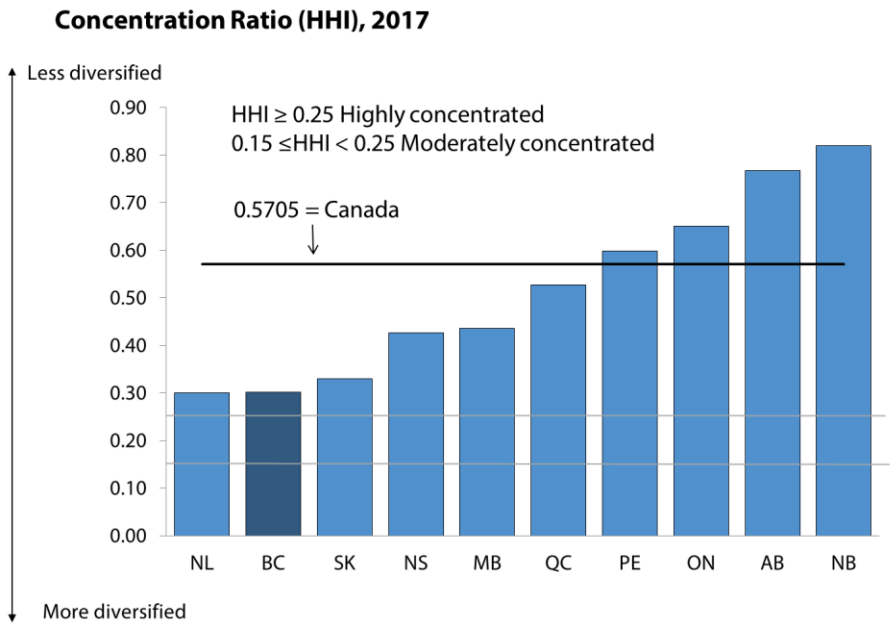
6.2. Diversification by destination

Another important aspect of export diversification is the number of markets that are reached by British Columbia exporters. Both federal and provincial governments have laboured for decades to open new markets and deepen existing ones with diverse programs, trade deals and trade missions. Most provinces' exports are highly concentrated in the United States' market, which is the main trade partner of every province and territory with the exception of Nunavut and the Northwest Territories, which export the majority of their goods to Switzerland and Belgium, respectively.

Newfoundland and Labrador has the most diversified export market among provinces, despite having high product concentration. In fact, among provinces, Newfoundland and Labrador has the second lowest share of exports going to its main trading partner, the United States (53.1%), behind only British Columbia.

B.C. exports by country are the second most diversified among provinces and territories, with an index of 0.3011 in 2017 (marginally higher than the 0.3003 observed in Newfoundland and Labrador). That is, although B.C. compared very well to the rest of Canada, exports are still highly concentrated. This should come as no surprise as exports to the United States comprise over half of all B.C. exports. Nevertheless, British Columbia has the smallest share of exports to a main trading partner among all provinces and territories, somewhat softening the direct effects on B.C. from shocks to the United States' economy.

Export destination diversification by province

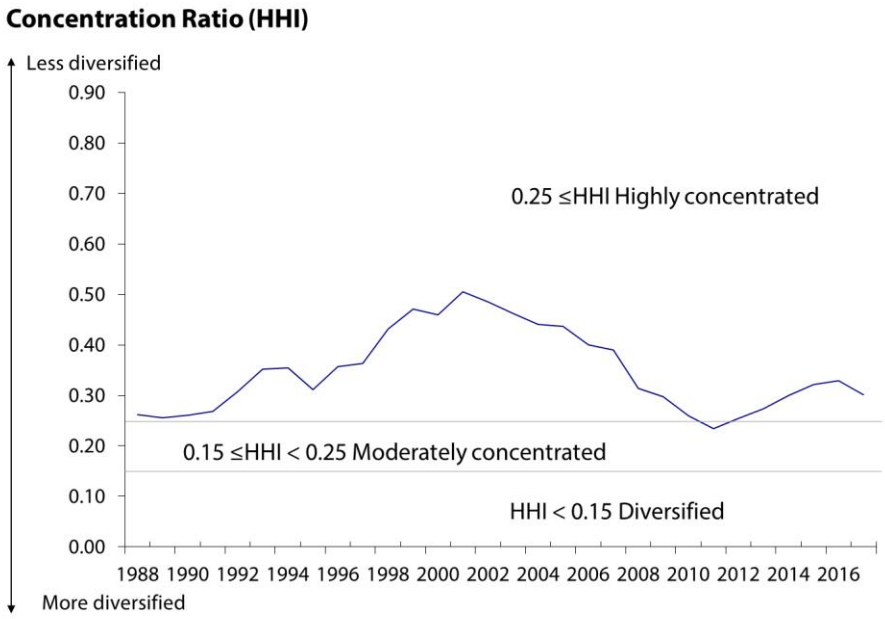


Source: BC Stats calculations using data provided by Statistics Canada

Mainland China has become a major trading partner for British Columbia, increasing its importance considerably in the last three decades, but particularly since 2002. In 2017, Mainland China was the second largest trading partner for British Columbia. Around 15.3% of B.C.'s merchandise exports went to Mainland China in 2017, a considerable increase from the 1.6% observed in 1988 and the 2.6% recorded in 2002. Japan is also a major market for B.C. but has lost some importance, with the share of B.C. exports falling from 27.1% in 1988 to 10.3% in 2017. Other major trading partners for B.C. are South Korea (6.6% of exports in 2017) and India (2.4% of exports in 2017).

B.C.'s export diversification by destination has eroded slightly in the last five years, from a high diversity of 0.2347 in 2011 to 0.3011 in 2017. Diversification also took a hit in the mid-1990s, likely the result of NAFTA coming into place, facilitating commerce with the United States and Mexico and shifting exporters' focus to those markets. Diversification fell to reach an index score of 0.5053 in 2001, then improved gradually during the 2000s.

B.C. Diversification of exports by destination



Source: BC Stats calculations using data provided by Statistics Canada

7. Conclusion

A more diversified economy is more resilient to external shocks and provides more flexibility to adapt to changes in the overall economic environment. Three interesting areas to measure diversification are overall production (GDP), employment and exports.

Using an objective measure of diversification, Canada and the provinces are extremely well diversified regarding overall production (GDP) and employment. British Columbia compares favourably to other provinces when measuring diversification.

Export diversification indexes have the most variability among provinces. Diversification of exports by product ranges from 0.05 (diversified) in Quebec to 0.45 in Alberta (highly concentrated).

Exports by destination are highly concentrated in all provinces, as the main trading partner is the United States. Despite the fact that exports to the United States comprise over half of all B.C. exports, British Columbia has the smallest share of exports to a main trading partner among all provinces and territories. B.C. compares very favourably to other provinces, having the second most diversified exports by destination among provinces.

Important aspects of the economy were analyzed to measure economic diversification in British Columbia. The results place B.C. in a very favourable position among provinces, with diversified production (as measured by industrial GDP), employment by industry, and products exported. Although merchandise exports are highly concentrated when measuring country of destination, B.C. has one of the most diversified markets for exports among provinces and territories.

8. References

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9. Appendix I. Detailed Tables

HERFINDAHL-HIRSCHMAN INDEX OF DIVERSIFICATION

GDP BY INDUSTRY BY PROVINCE

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CANADA	0.0725	0.0706	0.0695	0.0688	0.0694	0.0696	0.0698	0.0695	0.0697	0.0698	0.0699
NL	0.2090	0.2442	0.2176	0.1732	0.1788	0.1740	0.1375	0.1469	0.1354	0.1258	0.1418
PE	0.0788	0.0793	0.0801	0.0814	0.0814	0.0815	0.0815	0.0808	0.0812	0.0813	0.0817
NS	0.0747	0.0748	0.0751	0.0770	0.0775	0.0790	0.0807	0.0814	0.0803	0.0810	0.0816
NB	0.0699	0.0696	0.0693	0.0716	0.0722	0.0725	0.0731	0.0742	0.0740	0.0740	0.0746
QC	0.0792	0.0777	0.0765	0.0745	0.0742	0.0740	0.0740	0.0732	0.0735	0.0734	0.0729
ON	0.0820	0.0800	0.0773	0.0758	0.0765	0.0766	0.0770	0.0766	0.0765	0.0769	0.0773
MB	0.0680	0.0685	0.0681	0.0684	0.0688	0.0692	0.0692	0.0684	0.0689	0.0687	0.0690
SK	0.1050	0.1008	0.0948	0.0824	0.0902	0.0903	0.0867	0.0864	0.0900	0.0896	0.0876
AB	0.1233	0.1190	0.1138	0.1141	0.1165	0.1170	0.1145	0.1157	0.1216	0.1195	0.1175
BC	**0.0714**	**0.0716**	**0.0722**	**0.0744**	**0.0749**	**0.0749**	**0.0758**	**0.0761**	**0.0766**	**0.0772**	**0.0776**

Source: BC Stats calculations using data provided by Statistics Canada

EMPLOYMENT BY INDUSTRY BY PROVINCE

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CANADA	0.0854	0.0845	0.0845	0.0849	0.0845	0.0842	0.0843	0.0844	0.0848	0.0850	0.0853
NL	0.0912	0.0902	0.0930	0.0963	0.0952	0.0921	0.0929	0.0932	0.0956	0.0997	0.1003
PE	0.0853	0.0847	0.0854	0.0850	0.0842	0.0841	0.0874	0.0867	0.0864	0.0854	0.0872
NS	0.0911	0.0893	0.0895	0.0901	0.0908	0.0899	0.0905	0.0906	0.0910	0.0930	0.0932
NB	0.0862	0.0868	0.0862	0.0879	0.0879	0.0887	0.0895	0.0884	0.0881	0.0896	0.0921
QC	0.0925	0.0914	0.0908	0.0912	0.0906	0.0900	0.0911	0.0914	0.0923	0.0913	0.0902
ON	0.0893	0.0875	0.0868	0.0864	0.0860	0.0862	0.0859	0.0863	0.0865	0.0865	0.0876
MB	0.0865	0.0860	0.0846	0.0870	0.0889	0.0880	0.0876	0.0897	0.0896	0.0884	0.0880
SK	0.0841	0.0831	0.0828	0.0827	0.0822	0.0822	0.0834	0.0825	0.0830	0.0843	0.0847
AB	0.0791	0.0809	0.0803	0.0806	0.0811	0.0815	0.0807	0.0806	0.0804	0.0822	0.0818
BC	**0.0843**	**0.0839**	**0.0858**	**0.0864**	**0.0854**	**0.0847**	**0.0853**	**0.0851**	**0.0851**	**0.0849**	**0.0845**

Note: excludes unclassified industries.
Source: BC Stats calculations using data provided by Statistics Canada

EMPLOYMENT BY INDUSTRY BY DEVELOPMENT REGION

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MAINLAND/SOUTHWEST	0.0731	0.0721	0.0739	0.0741	0.0742	0.0735	0.0742	0.0742	0.0743	0.0744	0.0744
KOOTENAY	0.0792	0.0801	0.0906	0.0814	0.0777	0.0812	0.0833	0.0816	0.0849	0.0750	0.0756
THOMPSON/OKANAGAN	0.0800	0.0817	0.0801	0.0781	0.0823	0.0802	0.0805	0.0822	0.0780	0.0791	0.0792
CARIBOO	0.0904	0.0826	0.0795	0.0792	0.0799	0.0825	0.0813	0.0765	0.0786	0.0784	0.0807
NORTH COAST AND NECHAKO	0.0935	0.0893	0.0901	0.0886	0.0850	0.0839	0.0795	0.0856	0.0860	0.0846	0.0819
NORTHEAST	0.0825	0.0962	0.0956	0.0915	0.0744	0.0792	0.0783	0.0835	0.0833	0.0778	0.0824
VANCOUVER ISLAND/COAST	0.0815	0.0822	0.0800	0.0866	0.0838	0.0846	0.0829	0.0837	0.0852	0.0820	0.0826

Due to data gaps, results using regional data must be used with caution.
Source: BC Stats calculations using data provided by Statistics Canada

EXPORTS BY PRODUCT BY PROVINCE

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CANADA	0.090	0.090	0.120	0.090	0.100	0.110	0.110	0.110	0.120	0.080	0.080
NL	0.560	0.570	0.590	0.490	0.490	0.500	0.490	0.500	0.590	0.500	0.440
PE	0.160	0.200	0.190	0.200	0.190	0.170	0.160	0.170	0.160	0.140	0.170
NS	0.120	0.130	0.140	0.120	0.120	0.130	0.150	0.140	0.140	0.160	0.170
NB	0.370	0.410	0.490	0.450	0.490	0.530	0.530	0.520	0.460	0.380	0.340
QC	0.060	0.060	0.060	0.060	0.050	0.050	0.050	0.050	0.060	0.060	0.050
ON	0.180	0.160	0.120	0.110	0.140	0.130	0.150	0.150	0.150	0.150	0.170
MB	0.050	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.050	0.060
SK	0.220	0.200	0.220	0.180	0.200	0.200	0.210	0.210	0.210	0.150	0.130
AB	0.500	0.490	0.540	0.490	0.520	0.530	0.530	0.560	0.590	0.480	0.450
BC	**0.130**	**0.120**	**0.130**	**0.120**	**0.130**	**0.150**	**0.130**	**0.130**	**0.120**	**0.110**	**0.120**

Source: Statistics Canada

EXPORTS BY DESTINATION BY PROVINCE

	2017
CANADA	0.5705
NL	0.3003
PE	0.5983
NS	0.4261
NB	0.8195
QC	0.5274
ON	0.6504
MB	0.4353
SK	0.3294
AB	0.7675
BC	**0.3011**

Source: BC Stats calculations using data provided by Statistics Canada

BC Stats is the provincial government's leader in statistical and economic research, information and analysis essential for evidence-based decision-making. BC Stats, the central statistics agency of government, is excited to be taking a lead role in the strategic understanding of data sources and analysis across government. The goal is to increase overall business intelligence—information decision makers can use. As part of this goal, BC Stats is also developing an organizational performance measurement program. For more information, please contact Elizabeth Vickery.

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