

Catalogue no. 36-28-0001  
ISSN 2563-8955

## Economic and Social Reports

# Estimates of the economic activity in and around flooded areas in British Columbia



by Robby Bemrose and Ryan Macdonald

Release date: January 18, 2022



Statistics  
Canada Statistique  
Canada

Canada

---

## How to obtain more information

For information about this product or the wide range of services and data available from Statistics Canada, visit our website, [www.statcan.gc.ca](http://www.statcan.gc.ca).

You can also contact us by

Email at [infostats@statcan.gc.ca](mailto:infostats@statcan.gc.ca)

**Telephone**, from Monday to Friday, 8:30 a.m. to 4:30 p.m., at the following numbers:

- Statistical Information Service 1-800-263-1136
- National telecommunications device for the hearing impaired 1-800-363-7629
- Fax line 1-514-283-9350

### Depository Services Program

- Inquiries line 1-800-635-7943
- Fax line 1-800-565-7757

## Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, Statistics Canada has developed standards of service that its employees observe. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1-800-263-1136. The service standards are also published on [www.statcan.gc.ca](http://www.statcan.gc.ca) under "Contact us" > "[Standards of service to the public](#)."

## Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

Published by authority of the Minister responsible for Statistics Canada

© Her Majesty the Queen in Right of Canada as represented by the Minister of Industry, 2022

All rights reserved. Use of this publication is governed by the Statistics Canada [Open Licence Agreement](#).

An [HTML version](#) is also available.

*Cette publication est aussi disponible en français.*

---

# ***Estimates of the economic activity in and around flooded areas in British Columbia***

by *Robby Bemrose and Ryan Macdonald*

DOI: <https://doi.org/10.25318/36280001202101200003-eng>

## **Abstract**

This article reports experimental estimates for the economic activity in and around flooded areas of British Columbia. The paper uses a firm level dataset to geographically determine firm locations that are likely to have been affected by flooding due to heavy rains during November 13<sup>th</sup> to November 15<sup>th</sup> 2021. The estimates focus on economic activity in the Fraser River Valley (particularly in Sumas Prairie), in Merritt and in Princeton. Across these three areas, the firm locations most likely to have been directly affected by flooding accounted for 0.9% of British Columbia’s gross domestic product (GDP) in 2018. Additionally, the flooding in the Sumas Prairie affected areas that constitute an important share of animal herds and avian flocks in B.C.

## **Authors**

Robby Bemrose and Ryan Macdonald are with the Economic Analysis Division, Analytical Studies and Modelling Branch, at Statistics Canada.

## Introduction

This article discusses the amount of economic activity in and around recently flooded areas in British Columbia. It focusses on activity most likely to be directly affected by flooding around Abbotsford-Chilliwack and in Merritt and Princeton. Around Abbotsford-Chilliwack, the major effects occurred in the Sumas Prairie where farms and livestock were inundated by flood waters, while in the towns of Merritt and Princeton flooding led to the near total cessation of economic activity and the destruction of physical capital.

To provide an indication of the size of the economic activity in these economies, experimental estimates of the value of output (GDP) for firm locations (operating units) in these areas are used. Across these three areas, the firm locations most likely to have been directly affected by flooding accounted for 0.9% of BC's GDP in 2018. While accounting for a small share of the BC economy, on a regional basis the impacted areas account for 15.0% of the economy of Fraser River Valley, 4.6% of the economy of Thompson-Nicola and 6.2% of the economy of Okanagan-Similkameen. Additionally, the flooding in the Sumas Prairie affected areas that constitute an important share of animal herds and avian flocks in British Columbia.

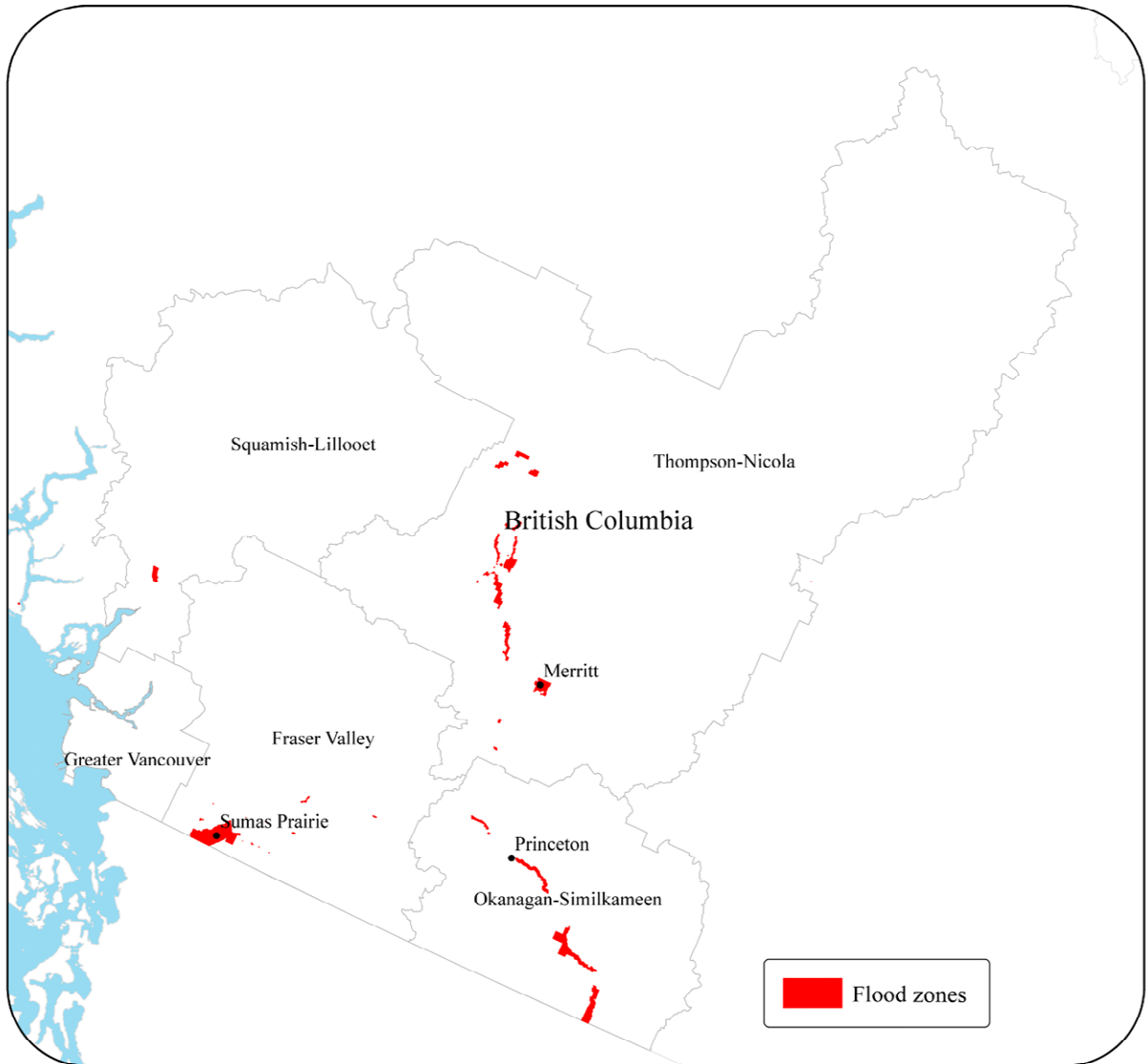
## The rain event and affected regions

Between November 13<sup>th</sup> and 15<sup>th</sup>, a major rain event occurred in British Columbia. Rainfall totals were between 150mm and 200mm (6-8 inches) for wide swaths of the south-western part of the province with Squamish, Chilliwack, Agassiz, Coquihalla Summit and Hope recording more than 200mm of precipitation during the storm (Accuweather 2021). The metropolitan Vancouver area, which includes Canada's largest port, received more than 125mm of precipitation (CBC 2021a). As a result of this heavy rainfall and resulting flooding, there was widespread interruption of economic activity, including disruptions to major transportation routes.

The 5 regions of BC that were the most affected by the rain event are Metro Vancouver, Fraser River Valley, Squamish/Lillooet, Thompson-Nicola and Okanagan-Similkameen. Fraser River Valley, Thompson-Nicola and Okanagan-Similkameen were the regions where the largest extent of the flooding occurred in British Columbia (Map 1), and these regions contain the cities and towns that were subject to the most extensive flood warnings and evacuation orders.

This article provides estimates of economic activity in and around these flooded areas. It reports on the GDP of firms and employment in and around these flooded areas. These estimates do not represent the total impact that the floods will have on the BC economy. For example, washed out transport infrastructure will have an impact on economic activity beyond the flooded areas.

### Map 1 Extent of major flooding across southwestern British Columbia



**Notes:** The data for this map were drawn from the following sources:  
Statistics Canada, 2016. Census - Boundary files:  
Government of BC, 2021. Business Innovation and Emergency Response, Provincial Evacuation Orders and Alerts data, Accessed November 18, 2021.  
**Source:** Statistics Canada, authors' calculations.

## Economic activity in flooded areas

Heavy rainfall led to extensive flooding in the area around Abbotsford-Chilliwack in Fraser Valley, evacuation orders for Merritt in Thompson-Nicola and flooding of the town of Princeton in Okanagan-Similkameem. In total, economic activity in these areas accounted for approximately 0.9% of BC's GDP in 2018 (Table 1). The activity was produced by 7,452 business locations and is associated with 7,940 jobs based on the 2016 Census<sup>1</sup>.

**Table 1**

**Share of gross domestic product and employment and business location counts in areas directly impacted by flooding, 2018**

	% of gross domestic product (GDP), 2018	% of regional GDP 2018	2016 Census employment	Business locations, 2018
Fraser Valley	4.2	100.0	139,125	46,348
Abbotsford and Chilliwack flooded areas	0.7	15.5	3,810 <sup>‡</sup>	5,599
Thompson-Nicola	2.2	100.0	61,955	19,443
Merritt	0.1	4.6	2,960	1,198
Okanagan-Similkameen	1.0	100.0	35,085	15,202
Princeton	0.1	6.2	1,170	655

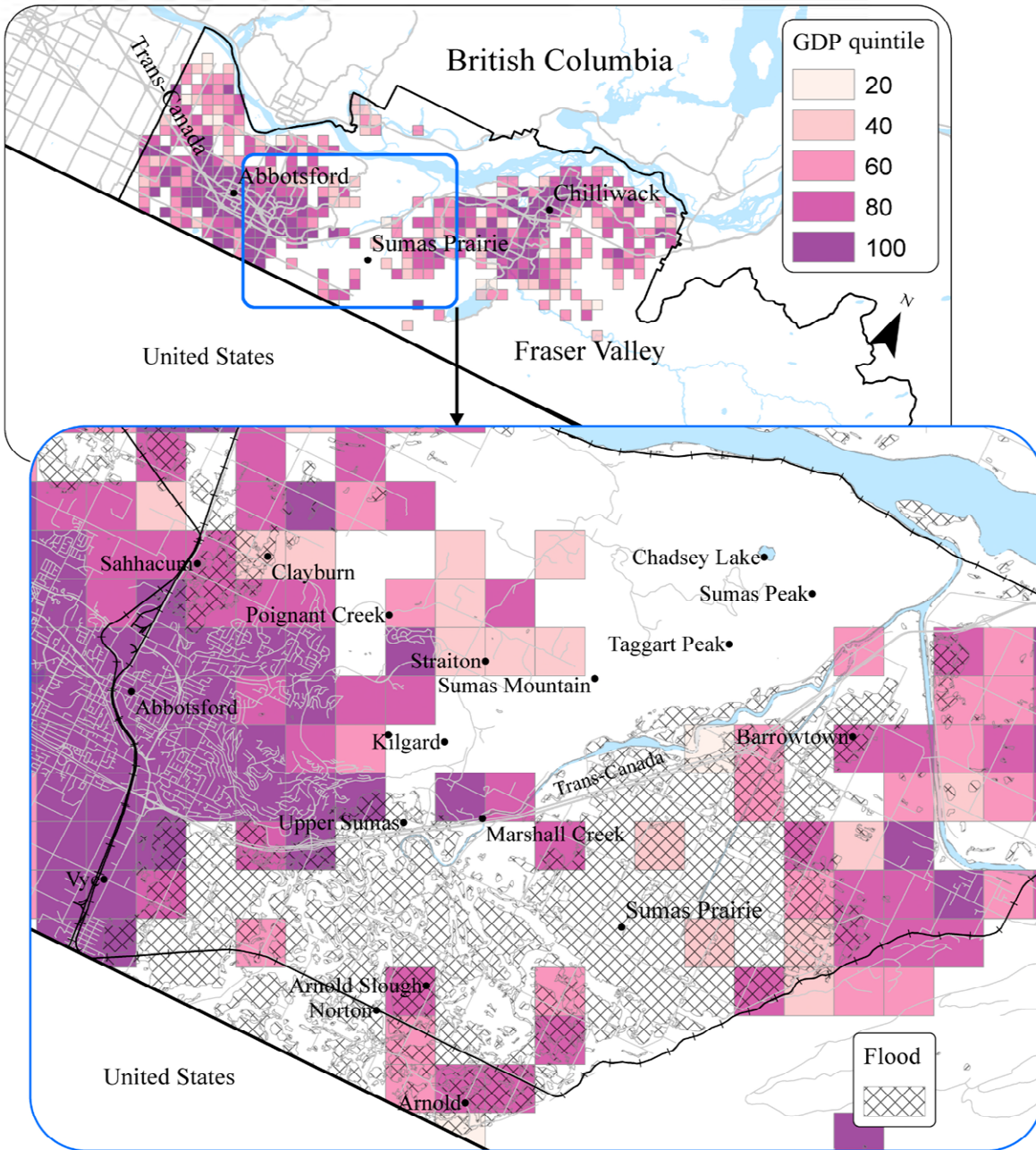
<sup>‡</sup> Fraser Valley census subdivision, excluding Abbotsford city and Chilliwack city census subdivisions.

Source: Statistics Canada, authors' calculations.

The area around Abbotsford-Chilliwack had extensive flooding that occurred primarily on farmland, and which largely avoided locations that produce higher levels of GDP. This can be seen when the production values for the area around Abbotsford-Chilliwack are plotted using 1 square kilometer grid squares. To do so, the value of GDP for each firm location is summed within the grid square where it occurs. The grid squares are then ranked by quintile across the region. The grid squares are shaded based on which quintile a grid falls into, and the grid squares with the largest amount of GDP (those in the top quintile) are shaded the darkest colour. Across the Abbotsford-Chilliwack region, the darkest squares tend not to coincide with flooded areas, and they do not appear in the Sumas Prairie (Map 2). Flooded locations, particularly in the Sumas Prairie, tend to be in the bottom quintile (the lightest shading) or do not have a reportable value. This would occur, for example, when the grid square is comprised of farmers' fields.<sup>2</sup> The fact that flooding around Abbotsford-Chilliwack tended to occur in locations that are used less intensively for GDP creation helps explain why, despite the extensive flooding and damage to farms, the amount of economic activity affected is only 0.7% of British Columbia's 2018 GDP.

1. Employment is not available at the location level based on direct measurement for the dataset used to estimate firm level GDP. Consequently, employment estimates based on overlapping census geographies from 2016 are used to provide an indication of how much employment could have been directly affected.
2. For some firms, production values and reporting locations do not perfectly coincide. This can occur, for example, with farms where production occurs on fields but farm production is assigned to a single point on the map.

**Map 2**  
**Geographic extent of flooding relative to gross domestic product creation in the Fraser Valley around Abbotsford and Chilliwack**



**Notes:** GDP: gross domestic product. The data for this map were drawn from the following sources:  
 Statistics Canada, 2016. Road Network file.  
 Statistics Canada, 2016. Census - Boundary files.  
 Statistics Canada, 2011. Lakes and Rivers file.  
 Natural Resources Canada, Floods in Canada, reference dates November 16, 2021 to November 20, 2021.  
 Natural Resources Canada, Canadian Geographical Names.  
 Natural Resources Canada, 2014. Transport Networks in Canada - CanVec Series - Transport Features.  
**Source:** Statistics Canada, authors' calculations.

Although the amount of GDP around Abbotsford-Chilliwack that is likely directly affected by flooding is limited for the overall B.C. economy, it still represents an important part of the regional economy, and an important shock for B.C.'s agriculture industry. Estimates suggest that flooding directly affected 15.0% of the economy of the Fraser Valley, and much of the flooding affected agricultural areas. The Abbotsford-Chilliwack area is an important location for livestock in B.C. It generates a nearly a fourth of farm revenue and accounts for a fifth of farm capital (Table 2). Dairy cattle, poultry and pig production for B.C. is centered in this region, which represents an important food source for the province, and provides inputs for food manufacturing industries.

**Table 2**  
**Agricultural output for the region around Abbotsford and Chilliwack<sup>‡</sup>**

	Number of farms	Cattle on dairy farms	All other cattle	Poultry production (kg)	Number of pigs	Agricultural employees	Total farm revenues ('000\$)	Total farm capital ('000\$)
Number	2,234	78,130	10,861	147,269,884	69,689	8,628	1,569,814	7,879,811
Percentage of B.C. total	12.75	51.39	2.14	61.90	78.42	25.11	38.46	21.00

<sup>‡</sup> Combined values for CCS number 5909036, Fraser Valley E; CCS number 5909052, Abbotsford; and CCS number 5909062, Fraser Valley G.

**Notes:** CCS: Consolidated Census Subdivision.

**Source:** Statistics Canada, Census of Agriculture.

Outside of Fraser Valley, Merritt and Princeton experienced significant flooding. Merritt was subject to an evacuation order, while half of Princeton was reported to be flooded after dikes were breached (CBC 2021b, 2021c). In total, 4.6% of the economy of Thompson-Nicola and 6.2% of the economy of Okanagan-Similkameem appear to have been directly affected by the disruptions in these towns. This represents 0.2% of British Columbia's economy in 2018.

## Measuring the economic activity in the flooded regions

While experimental measures of economic activity can be compiled, it is not straightforward to do so, and the estimates come with a degree of uncertainty. To determine the size of the economic activity that was potentially affected by the rain event, it is necessary to determine which businesses were affected, and what value of production this represents. Here, an estimate is provided for firm locations that are in and within 500 meters flooded areas. These are assumed to be the firm locations most likely to be directly affected by flood waters. Locations that are indirectly affected, such as the Port of Vancouver or trucking companies in the lower mainland that may have had to delay shipments due to road closures in the Fraser Valley are not included. It is not clear to what extent firms and farms outside of flooded areas have ceased or scaled back operations. As a result, the estimate here pertains only to those locations where there is the greatest likelihood of direct disruption.

To determine the value of production that is potentially disrupted, the starting point are the firm level data used to measure GDP by firm size<sup>3</sup>. These data directly measure GDP for small firm locations and estimate production values of the locations of larger, multi-location firms. As the data used to create the file is only available with a lag, the most recent year available is 2018 and values from that year are reported here.

To determine the value of economic activity that may have been impacted, the firm-level information is combined with geographic coordinates from Statistics Canada's Business Register to geographically

3. For an example of how the firm level GDP values have been used, please see Innovation, Science and Economic Development Canada 2021. For a description of how the different data sources are combined to measure firm level GDP, please see Leung, Rispoli and Chan 2012. For an example of how these files have previously been used to measure metropolitan GDP, please see Brown and Rispoli, 2014.



identify firm locations. Information on the extent of flooding from satellite images is then used to determine which business locations were within 500 meters of flooded areas and, therefore, how much GDP may have been directly affected.

This approach provides a method to estimate the percentage of GDP and number of business locations that are potentially affected by flooding. However, a note of caution is warranted. The firm-level GDP estimates were not constructed for the purpose of making fine level geographic comparisons. They have a number of features which may produce errors for fine geographies.<sup>4</sup> The estimates should, therefore, be viewed as indicative of the size of the disruption rather than as an exact accounting of its effects.

## Conclusion

The experimental estimates demonstrate the utility of geo-locating production activities. In the case of the BC floods, the flooding appears to have directly affected areas that accounted for around 0.9% of BC's GDP in 2018, and this effect appears to be concentrated in a select number of places. The flooding around Abbotsford-Chilliwack accounted for about 0.7 percentage points of GDP, while flooding in and around the towns of Merritt and Princeton each accounted for 0.1 percentage points of GDP. While these estimates do not present the entire impact of the flooding, they are a basis from which the impacts can begin to be calculated.

---

4. The data used to estimate GDP at the firm level is based on linkages between tax filings by businesses and the firm structures as they are represented on Statistics Canada's Business Register. For small, simple firm structures the place of work and the tax filing address are the same. For the majority of these firms, the location and production can be geo-located with a high degree of confidence. For a minority of small businesses, for example independent construction businesses, the location of work will not correspond with the tax filing address.

For large firms, the location of production activities and the address of a tax filing location do not necessarily correspond, particularly if the head office is where taxes are filed from. For these firms, allocation models based on employment or location counts are used to estimate the amount of activity by location. This produces errors for fine geographies as the file is unable to directly measure the value of production at a particular latitude/longitude. This effect is largest for firms involved in natural resource extraction and those that use networks. For example, mining companies will file tax forms from head offices rather than remote mine locations and electricity providers will tend to report from within major cities rather than at hydro dams, power generation plants or along transmission systems. These errors will tend to place more GDP into major cities and less in rural areas.

For the flooded areas examined here, errors related to natural resource extraction and utilities are unlikely to be substantial as the locations where businesses were disrupted tended did not have major resource extraction occurring within them, nor did they include major power generation sites. Nevertheless, there remain errors from the large firm allocation models. Efforts have been made to minimize the potential influence of these errors by examining individual records and making adjustments on a case-by-case basis, but a possibility remains that some small area values may be affected. Estimates should therefore be viewed as generally applicable, but not as direct measurement.

## References

- Accuweather 2021. Available at: <https://www.accuweather.com/en/severe-weather/death-toll-climbs-following-catastrophic-flooding-in-british-columbia/1049096>. Accessed November 25, 2021.
- Brown, M. and R. Rispoli. 2014. *Metropolitan Gross Domestic Product: Experimental Estimates, 2001 to 2009*. Economic Insights paper series. Statistics Canada Catalogue no. 11-626-X. No. 042.
- CBC 2021a. *These graphics show just how much record-breaking rain hit southern B.C. recently*. Available at: <https://www.cbc.ca/news/canada/british-columbia/bc-record-rainfall-graphics-1.6254271>. Accessed November 25, 2021.
- 2021b. *City of Merritt releases return-home plan for flooded-out residents*. Available at: <https://www.cbc.ca/news/canada/british-columbia/merritt-residents-returning-1.6258088>. Accessed November 26, 2021.
- 2021c. *Town of Princeton swamped after floodwaters breach dike*. Available at: <https://www.cbc.ca/news/canada/british-columbia/princeton-flooding-2021-1.6249710>. Accessed November 26, 2021.
- Innovation, Science and Economic Development Canada. 2021. *Key small business statistics - 2020*. Available at: [https://www.ic.gc.ca/eic/site/061.nsf/eng/h\\_03126.html](https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03126.html). Accessed November 26, 2021.
- Leung, D., Rispoli, L. and R. Chan. 2012. *Small, Medium-sized, and Large Businesses in the Canadian Economy: Measuring Their Contribution to Gross Domestic Product from 2001 to 2008*. Economic Analysis Research Paper Series. Statistics Canada Catalogue no. 11F0027M — No. 082.