Income and Expenditure Accounts Technical Series

Purchasing Power Parities between the United States and Canada: concepts and methods

by Nazrul Kazi and Conrad Barber-Dueck

Release date: April 26, 2019

Statistics Canada   Statistique Canada

Canadä

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 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.

Table of contents

Purchasing Power Parities between the United States and Canada: concepts and methods

by **Nazrul Kazi and Conrad Barber-Dueck**

Introduction

The aim of this article is twofold: first, to discuss concepts and methods of estimating Canada-U.S. purchasing power parity (PPP); and second, to present key estimates.

The estimates incorporate the 2017 benchmark prices from the Eurostat-Organisation for Economic Co-operation and Development (OECD) PPP Programme and corresponding national income data from the Canadian System of National Accounts. U.S. national income data were obtained from the Bureau of Economic Analysis (BEA) and the U.S. Census Bureau.

What are purchasing power parities?

In its simplest form, PPP is a ratio of the prices of a good or service paid in two countries in their own currencies.[1] For example, if the price of a chair is US$30 in the United States, and the same chair is sold for CAN$40 in Canada, the PPP is 30 ÷ 40 or US$0.75 per Canadian dollar.

If the exchange rate of a Canadian dollar is US$0.75, the prices of chairs in the two countries are expected to follow the same price ratio or PPP. The economy-wide PPP, however, incorporates prices of both traded and non-traded products. Consequently, the exchange rate and PPP often diverge substantially, because the former is mainly influenced by the prices of traded products.[2]

---

1. The concept of PPP was popularized by *The Economist* magazine in 1986 when it published the Big Mac Currencies. Using the current exchange rates, the Big Mac index converted the price of a McDonald's "Big Mac" hamburger in US$ in 41 countries and estimated the extent of over-and under valuation of currency. The Big Mac-PPP, however, grossly underrepresents national economies, which produce hundreds of different products. Nonetheless, its popularity suggests a need for comprehensive income comparison indicators.
2. In addition to trade requirements, currencies' demand and supply are influenced by factors such as currency speculation, interest rates, and capital flows between countries. As well, a sudden change these factors from a non-trading partner could substantially impact the exchange rate between two trading nations through the cross-exchange rate.

Chart 1
Purchasing power parities: United States compared with Canada

US$/CAN$
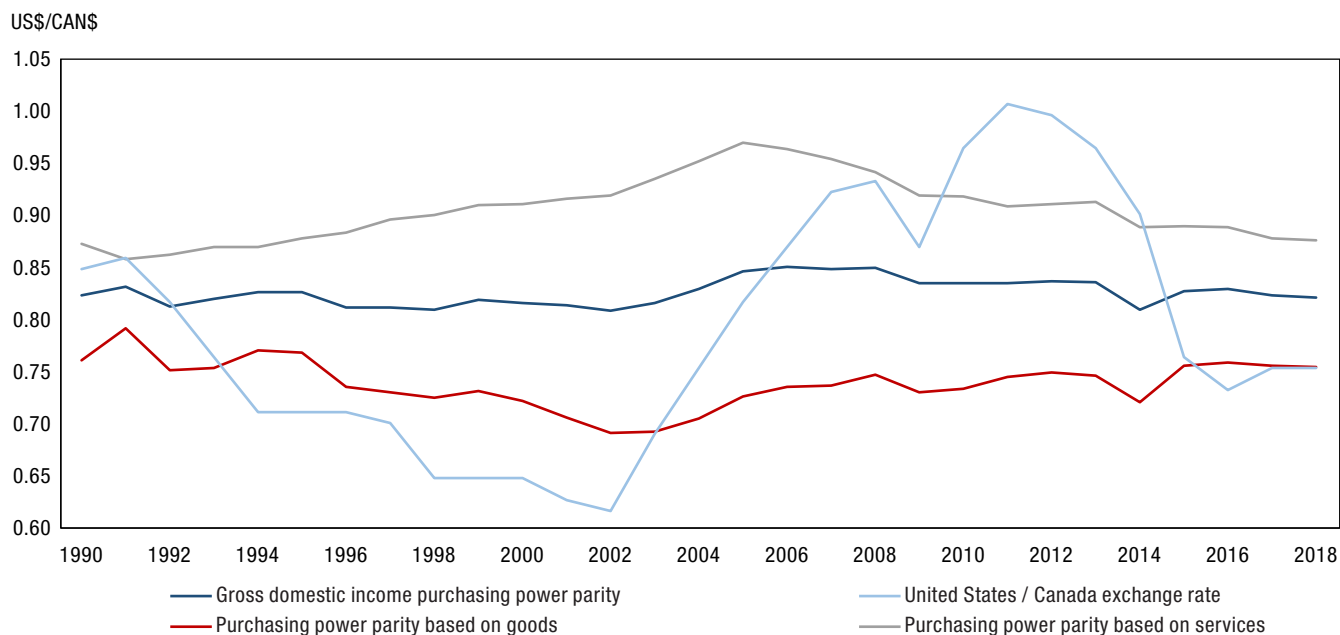
Source: Statistics Canada, Tables 36-10-0367-02 and 33-10-0163-01.

The exchange rate, which is determined by the demand for and supply of a currency compared with another currency, tends to be volatile. PPP, on the other hand, is relatively stable, as it captures the relative prices of all products included in the gross domestic product (GDP).

In 1998, for example, in the aftermath of the East Asian financial crisis, the Canadian dollar depreciated sharply (US$0.67), but PPP was largely flat (US$0.82). In 2011, the Canadian dollar appreciated to US$1.01, whereas the PPP hovered around US$0.84. From 1990 to 2018, the averages of the exchange rate and PPP were US$0.81 and US$0.84, respectively (Chart 1). In sum, the Canada-U.S. exchange rate and PPP diverge markedly in the short-term, but the longer-term averages are quite similar.

The PPP of goods follows the exchange rate more closely than does the PPP of major services, such as, health care and education. From 1990 to 2018, the average PPP of goods was US$0.76, indicating that goods were relatively more expensive in Canada. Specifically, the quantity of goods that US$76 in the United States could buy would cost CAN$100 in Canada, not CAN$94, which was the exchange-rate-converted price.

In Canada, the PPP of services has been higher than that of goods. From 1990 to 2018, the average PPP of services was US$0.91, well above the average exchange rate. Health care and higher education have been relatively cheaper in Canada than in the United States (Temple, 2011).

Why purchasing power parities?

The market exchange rate, not PPP, is used for comparing international trade, capital flows, and the value of foreign debt. However, for comparing incomes, PPP-adjusted per capita GDP is superior to that of exchange-rate-adjusted GDP, because the former takes into account all components of GDP. Consequently, PPP-adjusted income is used by international institutions, including the United Nations, the World Bank, and the OECD.

The United Nations Development Program uses PPP-adjusted per capita income in conjunction with indicators such as life expectancy and the literacy rate to calculate a human development index and rank countries. The United Nations also uses PPPs for assessing its Millennium Development goals.

The World Bank[3] notes that "PPPs are most appropriate for comparing levels of welfare, which is why they are used in measuring global poverty." Using PPP results, the WB created an international poverty threshold, widely known as "dollar-a-day." Purchasing power measures are also employed at the national level. Canada-U.S. PPP data are used to study the productivity gap between the two countries as well as for comparing Canada-U.S. per capita GDP (Baldwin and Macdonald, 2009).

Data sources

Each year, the OECD estimates multilateral PPPs. Statistics Canada participates by providing data, and as well, obtains a large number of U.S. price quotes from the Eurostat-OECD PPP Programme.[4]

The OECD has established a list of commodity specifications for which countries are asked to provide price information. Many of the specifications are generic, as exact matches of products across all countries may not exist. For government goods and services, which are not sold at market prices, an input-cost approach is used to establish prices. In this case, salary levels for 46 types of public sector occupations are used.

Statistics Canada organizes Canadian and U.S. gross domestic product (GDP) under 179 basic headings established by the OECD.[5] For each basic heading, price quotes are obtained from the OECD's multilateral PPP program.[6] Around 2,000 price quotes from each country are compiled and grouped under the 179 basic headings—5 to 15 pairs for each heading—to align with the corresponding GDP estimates or weights. U.S. GDP data are from the website of the BEA. The U.S. Census Bureau is the source of the population data required for estimating per capita consumption.

Conclusion

PPPs are influenced by factors such as geographical distance, cultural and structural differences, labour legislation, and unionization. Except for health care and higher education, structural differences between Canada and the United States are relatively small. Therefore, the long-term (from 1990 to 2018) averages of PPP and the exchange rate are similar: US$0.81 and US$0.84, respectively. However, in the short-term, the two indicators differ markedly.

For comparisons of income between nations, PPP-adjusted per capita GDP is superior to exchange-rate-converted per capita GDP. In 2018, PPP adjusted per-capita national income in Canada was US$49,900, which is 8.1% higher than the exchange-rate-converted per capita national income (US$46,200). In 2018, the per-capita national income was US$62,600 in the U.S.

The market exchange rate is a single measure and gets updated instantly. In contrast, PPPs are point estimates that are usually calculated once a year. The quality of PPP estimates depend on the reliability of the expenditure weights and the price data. PPP can be disaggregated to compare various components of national income (consumer spending or investment spending between nations), implying that the PPP can be tailored to fulfill specific needs, and that with additional data availability and further analysis, it can be improved.

Appendix

Methodology

PPPs are spatial price indexes, similar to temporal price indexes such as the consumer price indexes (CPI). The CPI, estimated using a base period, is widely employed for comparing prices between periods. Likewise, PPP is constructed with a base country/region and serves to compare incomes among nations.

---

3. In 2014, the World Bank's International Comparison Program used PPP-adjusted income to rank 199 countries. Canada ranked 23rd for GDP per capita and 11th for actual individual consumption per capita. The latter reflects material well-being at the household level.
4. The Eurostat-OECD PPP Programme collects and compiles price quotes of member countries every three years, the benchmark year—the latest being 2017. Statistics Canada regularly submits data—except for a few items including narcotics and prostitution—to the OECD, including price quotes and GDP.
5. Statistics Canada uses real GDI instead of real GDP as weights, because the former better reflects purchasing power. Real GDI deflates exports and imports, using the price index based on final domestic expenditure rather than their own prices. Consequently, the two measures differ, although in nominal terms, both measures are equal.
6. Statistics Canada compiles additional price quotes from various websites, such Walmart.ca and Walmart.com.

A wide variety of index number formulas with sound microeconomic-underpinning can be applied to track prices and volumes of goods and services (Allen, 1975; Statistics Canada, 2016). These formulas, essentially weighted averages, differ primarily in the weights assigned to calculate them.

Using the price (P) and corresponding real GDI of each item in Canada and the United States, PPP can be calculated using the Laspeyres (PL), Paasche (PP), and Fisher (PF) formulas.[7]

Equation 1

$$P_L = \frac{\sum_{i=1}^{n} P_u^i Q_c^i}{\sum_{i=1}^{n} P_c^i Q_c^i} = \frac{\sum_{i=1}^{n} \left[\frac{P_u^i}{P_c^i}\right] P_c^i Q_c^i}{\sum_{i=1}^{n} P_c^i Q_c^i}$$

Equation 2

$$P_P = \frac{\sum_{i=1}^{n} P_u^i Q_u^i}{\sum_{i=1}^{n} P_c^i Q_u^i} = \frac{\sum_{i=1}^{n} P_u^i Q_u^i}{\sum_{i=1}^{n} \left[\frac{P_c^i}{P_u^i}\right] P_u^i Q_u^i}$$

Equation 3

$$P_F = \sqrt{P_L P_P}$$

Where,

P_u^i = price of product "*i*" in the United States, the partner country,

P_c^i = price of product "*i*" in Canada, the base country,

Q_c^i = quantity of product "*i*" in Canada,

Q_u^i = quantity of product "*i*" in the United States.

Real GDI,[8] like GDP, is the unduplicated value of goods and services produced by a country or region in a given period. In the case of real GDP, exports and imports are deflated by their own price indices, whereas real GDI calculation requires deflating the trade components by the price of final domestic expenditure (Baldwin and Macdonald, 2009).[9]

Equations 1 to 3 show that for the Laspeyres index the weights comes from the base country's GDI, whereas the Paasche index applies the partner country's GDI as weights. The Fisher index is the geometric mean of these two indices.

---

7.   Like the CPI, PPPs are estimated using Laspeyres, Paasche, and Fisher formulas. For details see Statisitcs Canada, catalogue no. 13-606-G, Chapter 7.
8.   The term "real GDI" is used to express expenditure of the two countries using the same price ratios in a given period of time. In time series, however, the term "real" implies expressing expenditure of one period in terms of another period for a given country.
9.   GDI captures gains and losses arising from terms of trade—the ratio of export prices to import prices. If the price of exported items such as crude oil and gasoline rises, and the price of imported items such as automobiles and aircraft declines or remain s stable, the same volume of oil exports can import more automobiles. Hence, using GDI as weights better reflects purchasing power.

Assuming the value (purchasing power) of the base country's currency to be 1, or 100, the PPP of the partner country's currency is determined. Text box 1 shows the steps in calculating PPP for a simple economy with two products: bread and medical services.

Text box 1
Example of Purchasing Power Parity calculation: using hypothetical data and assuming an economy with only two products.

C1	C2	C3	C4	C5	C6
Basic headings	P_u/P_c †	GDI of Canada	GDI of United States	$P_u/P_c \times GDI_{CA}$	$P_c/P_u \times GDI_{US}$
Bread	0.74	100	500	74	676
Medical services	0.87	700	8,000	609	9,195
Total value: sum of bread and medical services		800	8,500	683	9,871

The total value in C5 represents the numerator, and that in C3 is the denominator of the Laspeyres index (Equation 1). That is, based on the Laspeyres formula, PPP of CAN$ = 683 ÷ 800 = US$0.854.

For the Paasche index, the numerator and denominator are shown by the total value in C4 and C6, respectively (Equation 2). Hence, based on the Paasche formula, PPP of a CAN$ = 8,500 ÷ 9,871 = US$0.861. According to the Fisher formula, PPP of a CAN$ = $(0.85 \times 0.86)^{1/2}$ = US$0.857.

† The price ratio of each basic heading, bread for instance, represents the geometric mean of price ratios of all types of breads for which data are available in both countries. Each type should be homogenous in terms of quantity and quality.

The price ratios and weights are organized under 179 basic headings (classification provided by the OECD). Detailed price data are compiled every third year (1990, 1993, ..., 2014, 2017), known as the benchmark year. Time series are produced by linking benchmark years. Prices and price structures are allowed to change between benchmark years. Inter-benchmark year (2015, for instance) prices are estimated using the growth rate of GDP implicit prices and supplemented by internet prices.

PPP can be estimated for sub-groups such as, food, health, education and gross fixed capital formation. A weighted aggregation of the indices is produced, and the estimates are disseminated under various headings through tables 36-10-0365-01 and 36-10-0367-01.

References

Allen, R. G. D. 1975, *Index Numbers in Theory and Practice*, Aldine Publishing Company, Chicago.

"Big Mac Currencies", *The Economist*, September issue, 1986.

Baldwin, J.R., R. Macdonald. 2009. "PPPs: Purchasing Power or Producing Power Parities?" Statistics Canada Catalogue no. 11F0027M — no. 058.

Eurostat-OECD *Methodological Manual on Purchasing Power Parities*, 2012 edition. Luxembourg: Publications Office of the European Union.

Statistics Canada. 2016. "User Guide: Canadian System of Macroeconomic Accounts" Chapter 7 Price and volume measures. Statistics Canada Catalogue no. 13-606-G.

Temple, J. 2011. "Purchasing Power Parities and Real Expenditures, United States and Canada, 2002 to 2009." Statistics Canada Catalogue no. 13-604-M — no. 064. Ottawa: Statistics Canada.

World Bank. 2014. "Purchasing Power Parities: Statistics to Describe the World". Washington, D.C., World Bank. International Comparison Program document.