Online Data Appendix

# Are Government Spending Multipliers State Dependent? Evidence from U.S. and Canadian Historical Data

*By* MICHAEL T. OWYANG, VALERIE A. RAMEY AND SARAH ZUBAIRY

September 5, 2013

**United States Data Appendix**

**GDP and GDP deflator:**

**1947 – 2011:** Quarterly data on chain-weighted real GDP, nominal GDP, and GDP deflator from BEA NIPA (downloaded from FRED, December 20, 2012 revision.)

**1889 – 1946:** Annual data from 1929 – 1946 from BEA NIPA (downloaded from FRED, December 20, 2012 version). For 1889 – 1928, series Ca9 and Ca13 from Table Ca9-19 in *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition,* edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright. New York: Cambridge University Press, 2006. http://dx.doi.org/10.1017/ISBN-9780511132971.Ca1-2610.1017/ISBN-9780511132971.

**1939 – 1946:** We used seasonally adjusted quarterly nominal data on GNP from *National Income, 1954 Edition, A Supplement to the Survey of Current Business* and seasonally unadjusted CPI (all items, all urban consumers) from FRED.

**1889 – 1938:** Quarterly data on real GNP and GNP deflator.
*Source*: Nathan Balke and Robert J. Gordon, "The Estimation of Prewar Gross National Product: Methodology and New Evidence," *Journal of Political Economy*, 97, February 1989. Data available at: http://www.nber.org/data/abc/

*Data adjustment:* For 1939-1946, we used a simplified version of the procedure used by Valerie Ramey, "Identifying Government Spending Shocks: It's All in the Timing", *Quarterly Journal of Economics,* February 2011. We used the quarterly nominal GNP series published in 1954 to interpolate the most recent NIPA annual nominal GDP series and the quarterly averages of the CPI to interpolate the NIPA annual GDP price deflator using the proportional Denton method. We took the ratio to construct real GDP to use as a second round interpolator. We spliced this real GDP series to the Balke-Gordon real GNP series from 1889 – 1938 and used the combined series to interpolate the annual real GDP series using the proportional Denton method. This method insures that all quarterly real GDP series average to the annual series. We used the Balke-Gordon deflator to interpolate the annual deflator series from 1889 – 1938 and combined it with the CPI-interpolated series from 1939-1946. Finally, we linked the earlier series to the modern quarterly NIPA series from 1947 to the present.

**Government Spending:**

**1947 – 2011:** Quarterly data on nominal "Government Consumption Expenditures and Gross Investment," BEA Table 1.1.5, line 21, December 20, 2012 version.

**1889 – 1946:** NIPA annual data from 1929 – 1946 (BEA Table 1.1.5, line 21) is spliced to annual data from 1889-1928, *Source:* John Kendrick, *Productivity Trends in the United States*, 1961, Table A-II.

**1939 - 1946**: Quarterly data on nominal government spending *National Income, 1954 Edition, A Supplement to the Survey of Current Business* is used to interpolate the modern annual NIPA values.

**1889 - 1938**: Monthly data on federal budget expenditures. *Source:* NBER MacroHistory Database http://www.nber.org/databases/macrohistory/contents/chapter15.html

m15005a U.S. Federal Budget Expenditures, Total 01/1879-09/1915
m15005b U.S. Federal Budget Expenditures, Total 11/1914-06/1933
m15005c U.S. Federal Budget Expenditures, Total 01/1932-12/1938

*Data adjustment:* The monthly series are spliced together (using a 12-month average at the overlap year) and seasonally adjusted in Eviews using X-12. This series includes not just government expenditures but also transfer payments, and so the monthly interpolator series is distorted by large transfer payments in different quarters. Thus, rather than using the series directly, we use it as a monthly interpolator for the annual series which excludes transfers. Following Gordon and Krenn (2010), to find these quarters, we calculated the monthly log change in the interpolator, and whenever a monthly change of +40 percent or more was followed by a monthly change of approximately the same amount with a negative sign (and also symmetrically negative followed by positive), we replaced that particular observation by the average of the preceding and succeeding months. These instances occurred for the following months: 1904:5, 1922:11, 1931:2, 1931:12, 1932:7, 1934:01, 1936:06, and 1937:06. In addition, the first quarter of 1917 was adjusted. The jump in spending was so dramatic in 1917q2 that the interpolated series showed a decline in spending in 1917q1 even though the underlying expenditure series showed an increase of 16 percent in that quarter relative to the previous one. Thus, we replaced the value of 1917q1 with a value 16 percent higher than the previous quarter. Note that our use of the proportional Denton method creates a bumpier series than an alternative that uses the additive Denton method. However, the additive Denton method leads to series that behave very strangely around large buildups and builddowns of government spending, so we did not use it for the U.S. On the other hand, the alternative series gave very similar results for the multiplier.

**Population:**

**1890-2011:**
Annual population data, based on July of each year, were taken from *Historical Statistics of the United States Millennial Edition Online*, Carter et al (2006). We used total population, including armed forces overseas for all periods where available (during WWI and 1930 and after); otherwise we used the resident population. For 1952 through the present we used the monthly series available on the Federal Reserve Bank of St. Louis FRED database, "POP."

*Data adjustment:* For 1890 through 1951, we linearly interpolated the annual data to obtain monthly series so that the annual value was assigned to July. We then took the averages of monthly values to obtain quarterly series. We did the same to convert the monthly FRED data from 1952 to the present.

**Tax Revenues:**

**1947-2012:** Quarterly data on nominal "Federal Government Current receipts," BEA Table 3.2, line 1, December 20, 2012 version.

**1879-1946:**
Monthly data on federal budget receipts. *Source:* NBER MacroHistory Database
http://www.nber.org/databases/macrohistory/contents/chapter15.html

m15004a U.S. Federal Budget Receipts, Total 01/1879-06/1933
m15004b U.S. Federal Budget Receipts, Total 07/1930-06/1940
m15004c U.S. Federal Budget Receipts, Total 07/1939-12/1962

Annual data on federal receipts. *Source:* Historical Statistics - fiscal year basis (e.g. fiscal year 1890 starts July 1, 1889)

*Data adjustment:* The monthly series are spliced together and seasonally adjusted in Eviews using X-12. The annual series is interpolated using the monthly data with the Denton proportional method.

**Unemployment rate:**

**1948-2011:** Monthly civilian unemployment rate**.** Source: Federal Reserve Bank of St. Louis FRED database, UNRATE http://research.stlouisfed.org/fred2/series/UNRATE

*Data adjustment:* Quarterly series is constructed as the average of the three months.

**1890-1947:**
Annual civilian unemployment rate.
*Source:* David R. Weir, "A Century of U.S. Unemployment, 1890-1990: Revised Estimates and Evidence for Stabilization." In *Research in Economic History*, edited by Roger L. Ransom, pp. 301–346. JAI Press, 1992. We adjusted the Weir series from 1933-1943 to include emergency workers.

1890-1929:
NBER-based monthly recession indicators. Source: Federal Reserve Bank of St. Louis FRED database, USREC http://research.stlouisfed.org/fred2/series/USREC.

1930-1946:
Monthly civilian unemployment rate (including emergency workers).
*Source:* NBER MacroHistory Database
http://www.nber.org/databases/macrohistory/contents/chapter08.html

m08292a U.S. Unemployment Rate, Seasonally Adjusted 04/1929-06/1942
m08292a U.S. Unemployment Rate, Seasonally Adjusted 01/1940, 03/1940-12/1946

1947:
Monthly civilian unemployment rate (including emergency workers, seasonally adjusted)
Source: Geoffrey Moore*, Business Cycle Indicators,* Volume II, NBER p. 122

*Data adjustment:* Monthly NBER recession data are used to interpolate annual data using the Denton interpolation from 1890-1929. For 1930-1947 onwards we use the monthly unemployment rate series to interpolate annual data using the Denton proportional interpolation.

**Interest rate:**

**1934-2011:**
Monthly 3 month Treasury bill. Source: Federal Reserve Bank of St. Louis FRED database, TB3MS http://research.stlouisfed.org/fred2/series/TB3MS.

**1920-1933**
Monthly 3 month Treasury bill
*Source:* NBER MacroHistory Database
http://www.nber.org/databases/macrohistory/contents/chapter13.html

m13029a U.S. Yields On Short-Term United States Securties, Three-Six Month Treasury Notes and Certificates, Three Month Treasury 01/1920-03/1934
m13029b U.S. Yields On Short-Term United States Securities, Three-Six Month Treasury Notes and Certificates, Three Month Treasury 01/1931-11/1969

*Data adjustment:* Quarterly series is constructed as the average of the three months.

**Canada Data Appendix**

**GDP:**

**1961-2011:** Quarterly data available in National Accounts. *Source:* Statistics Canada, Real GDP: v1992067.

**1919-1960:**
Monthly Industrial production index data, (Index, 1961=100). *Source:* Statistics Canada Archives, v462.

**1915-1918:**
Monthly seasonally adjusted production index. Source: F. Gardiner Perry, "A New Index of the Physical Volume of Canadian Business," *Journal of the American Statistical Association*, Vol. 24, No. 166 (Jun., 1929), pp. 127-143.

Annual data on real GNP. *Source:* Historical Canadian Macroeconomic dataset, compiled by Marvin McInnis at Queen's University. The major source for data for the early years is Malcolm C. Urquhart, *Gross National Product, Canada 1870-1926: The Derivation of the Estimates*. McGill-Queen's University Press, 1993.

*Data adjustment*: From 1912-1914, the annual data were linearly interpolated to quarterly. Monthly industrial production data from 1919-1960 were seasonally adjusted in Eviews using X-12 and then spliced to the earlier data from 1915-1918. Monthly data were converted to quarterly and then used to interpolate the annual data using the proportional Denton procedure, through 1961. The pre-1960 data were multiplied by the ratio of the National Accounts data in 1961 to the historical data in 1961.

**GDP deflator:**

**1961-2011:** Quarterly data available in National Accounts. *Source:* Statistics Canada, Real GDP: v1992067, nominal GDP: v498086, GDP deflator =nominal GDP/real GDP

**1914-1960:**
Monthly CPI, 2009 basket (2002=100). *Source:* Statistics Canada, v41690973.

Annual data on GNP deflator. *Source:* Historical Canadian Macroeconomic dataset.

*Data adjustment*: From 1912-1913, the annual data were linearly interpolated to quarterly. For 1914- 1960, we converted the monthly CPI data to quarterly and used it interpolate the annual data using the proportional Denton procedure, through 1961. The pre-1960 data were multiplied by the ratio of the National Accounts data in 1961 to the historical data in 1961.

**Population:**

**1946-2011**: Quarterly data on total population, Canada, provinces and territories, quarterly. *Source:* Statistics Canada, v1.

**1919-1945:**
Annual data for population. *Source:* Historical Canadian Macroeconomic dataset.
*Data adjustment*: Linearly interpolated.

**Government spending:**

**1961-2011:** Quarterly data available in National Accounts. *Source:* Statistics Canada, Nominal government current expenditures on goods and services, v498092

**1912-1960:**
Monthly government spending series, detailed categories. *Source: Canada Gazette* and *Monthly Review of Business Statistics.* We constructed a series which splices together the following:
01/1912- 12/1919: Expenditure on Account of Consolidated Fund + Capital Account
02/1920- 12/1923: Ordinary + Special + Capital Account
01/1924- 02/1932: Ordinary + Special + Capital Account
04/1932- 02/1946: Ordinary + Special + Capital Account
04/1946- 12/1949: Ordinary + Special + Capital Account + Demobilization and Reconversion Expenditure
02/1950- 08/1987: Total expenditures

Annual data on government expenditures on goods and services. *Source:* Historical Canadian Macroeconomic dataset.

*Data adjustment*: There were a number of missing values, often recurring in March or April. We imputed values based on the seasonality of proximate years with available data. We then seasonally adjusted in Eviews using X-12, separately for 1912:1 – 1938:12, 1939:1 – 1946:12, 1947:1 – 1960:12. Since the series includes transfers and interest on public debt, the series is smoothed before using it for interpolation. If there is an increase of 20% followed by a decrease of greater than 10%, and vice versa for a decrease, the value is substituted with the average of the preceding and following values. For 1912 - 1960, we converted the monthly data to quarterly and used it interpolate the annual data using the proportional Denton procedure, through 1961. The pre-1960 data were multiplied by the ratio of the National Accounts data in 1961 to the historical data in 1961.

**Tax Revenues:**

**1961-2011:** Quarterly data available in National Accounts. *Source:* Statistics Canada, Nominal total tax revenues, v498316

**1912-1960:**
Monthly series on tax revenues and total revenues. *Source: Canada Gazette* and *Monthly Review of Business Statistics.*

1912:1 – 1923:12: Total Revenue: As listed (does not seem to include the loan account). Tax Revenues: Total – Post Office.

1924:1 – 1949:12: Total Revenue: Customs + Excise + Post Office + Public Works + Miscellaneous + Excise Taxes + Inland Revenue + Business Profits Tax + Income Tax + Other War Tax Revenue.
Tax Revenues: Total – Post Office.

1950:1 – 1950:12: Total Revenue: Total Budgetary Revenue
Tax Revenues: Total Budgetary Revenue – Postal Revenue – Return on Investments – Miscellaneous Non-tax Revenue – Special Receipts.

Annual data on Canadian federal government total budgetary revenue. *Source:* Statistics Canada Archives, Table H1-18. http://www.statcan.gc.ca/pub/11-516-x/sectionh/4057752-eng.htm

*Data adjustment*: There were a number of missing values, often recurring in March or April. We imputed values based on the seasonality of proximate years with available data. We then seasonally adjusted in Eviews using X-12, separately for 1912:1 – 1938:12, 1939:1 – 1946:12, 1947:1 – 1960:12. We converted the monthly data to quarterly and used it interpolate the annual data using the proportional Denton procedure, through 1961. The pre-1960 data were multiplied by the ratio of the National Accounts data in 1961 to the historical data in 1961.

**Unemployment rate:**

**1976-2011:** Monthly data on unemployment rate: both sexes, 15 years and over. *Source:* Statistics Canada, Labor Force Survey estimates (LFS), v2062815

**1954-1975**: Monthly data on unemployment rate: both sexes, 15 years and over. *Source:* Data provided by contact at Statistics Canada. This is based on additional work done by Statistics Canada to create a monthly series from 1954-1975. The adjusted data were created using the relationship between the old and new questionnaires in 1975. In the creation of the historical series, the assumption was made that the 1975 relationship holds for all years from 1954 to 1974. While 1966 onwards estimates apply to both sexes, 15 years and over, pre-1966 estimates are based on 14 years and over.

*Data adjustment:* Quarterly series is constructed as the average of the three months.

**1912-1953:**

1926-2011, Monthly Business Cycle turning points. *Source:* Philip Cross and Philippe Bergevin, "Turning Points: Business Cycles in Canada since 1926." Commentary no. 366, C.D. Howe Institute.

1919-1925, Monthly Business Cycle turning points. *Source:* Edward Chambers, "Canadian Business Cycles since 1919, A Progress Report." *Canadian Journal of Economics and Political Science*, 24(2), 1958.

1912-1919 Monthly Business Cycle turning points. *Source:* Keith Hay, "Early Twentieth Century Business Cycles in Canada." *Canadian Journal of Economics and Political Science*, 32(3), 1966

1946-1953: Annual data on unemployment rate: both sexes, 14 years and over. *Source:* Data provided by contact at Statistics Canada.

1916-1945: Annual data on unemployment rate. *Source:* Walter Galenson and Arnold Zellner, "International Comparison of Unemployment Rates." NBER Chapters, in: *The Measurement and Behavior of Unemployment,* pages 439-584, National Bureau of Economic Research, 1957.

1912-1916: Annual data on unemployment rate is constructed using narrative accounts based on the following:

- Bryce M. Stewart, "Unemployment and Organization of Labour Market", *Annals of the American Academy of Political and Social Science*, 107, 1923.
- W.A. Berridge, "Report on Employment and Income of Labor in Canada", 1910-1931. *World Social Economic Congress*, 1931.
- The Canadian Forum/Trade and Industry/1921-01 (http://wikilivres.ca/wiki/The_Canadian_Forum/Trade_and_Industry/1921-01)

*Data adjustment:* Quarterly data obtained from average of the interpolation of the annual unemployment rate on the monthly business cycle turning points, using additive Denton procedure, through 1954.

**Interest rate:**

**1935-2011**: Bank rate, v122530. *Source:* Bank of Canada website, http://www.bankofcanada.ca/rates/interest-rates/selected-historical-interest-rates

**1919-1934**: Ordinary rate. *Source:* Ronald Shearer and Carolyn Clark, "Canada and the Interwar Gold Standard, 1920-35: Monetary Policy without a Central Bank," NBER Chapters, in: *A Retrospective on the Classical Gold Standard*, 1821-1931, pages 277-310, National Bureau of Economic Research, 1984.

*Data adjustment:* Quarterly series is constructed as the average of the three months.