

# Are Government Spending Multipliers State Dependent? Evidence from Canadian Historical Data

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Preliminary version: 17 December 2015

## **Abstract**

This paper investigates whether government spending multipliers differ according to the amount of slack in the economy. We shed light on this question by analyzing new quarterly historical data covering multiple large wars and deep recessions in Canada. We find evidence of higher multipliers during periods of slack. This is driven by GDP rising faster than government purchases in the high unemployment state.

We thank Robert Barro and Gordon Liao for use of their Canadian newspaper excerpts from WWI through the Korean War and Michelle Alexopoulos for providing us with some of the historical Canadian data. We are also grateful to Yuriy Gorodnichenko, Òscar Jordà and Garey Ramey for very helpful suggestions and to Michelle Ramey for research assistance.

# 1 Introduction

Does the government spending multiplier depend on the state of the economy? The policy debates during the Great Recession have led to an elevated interest in this question, in light of increased reliance on fiscal policy to stimulate the economy. Researchers and policymakers alike have argued that multipliers could be higher during times when unemployment rates are high or when interest rates are at the zero lower bound.

A growing strand of empirical literature has been exploring whether estimates of government spending multipliers vary depending on circumstances. Auerbach and Gorodnichenko (2012) was one of the first papers to explore the possibility that multipliers are different during recessions. They focus of post-World War II data for the U.S. and find significantly larger multipliers in recessions than in expansions. Other papers including Bachmann and Sims (2012), Baum et al. (2012), Fazzari et al. (2015) and Caggiano et al. (2015), also provide some evidence of state-dependent multipliers albeit statistically insignificant in some cases. In contrast, Ramey and Zubairy (2014) rely on a new quarterly data set for the U.S. extending back to 1889, and find no evidence of state-dependence in multipliers based on slack in the economy, measured by the unemployment rate. Another contribution of that paper is to show the importance of the methodology employed to study the question of state-dependent multipliers.

This paper contributes to this empirical literature by investigating whether government spending multipliers differ based on the amount of slack in the economy for Canada. In particular, we extend the initial steps in our shorter paper (Owyang, Ramey and Zubairy (2013)), where we exploit the fact that the entire 20th Century contains potentially richer information than the post-WWII data that has been the focus of most of the recent research. We found evidence of larger multipliers in slack state for Canada. In this paper, we follow up by first refining this quarterly Canadian data set, extending the data back to 1912 to include World War I into the analysis, and finally dig deeper into the evidence of state-dependence of multipliers. Notably, the full sample period from 1912-2011 include episodes of huge variations in government spending, wide fluctuations in unemployment, and a variety of tax responses.

Canada provides an interesting case study because its entry into the two World Wars preceded U.S. In particular, as pointed out in Barro and Redlick (2011), Canada provides a promising case to study the interaction of slack in the economy and spending multiplier, since the earlier entry into World War II means that the sharp increase in defence

spending came at a time of much higher unemployment rate than in the U.S. In addition, Canadian data helps provide evidence for the size of multipliers in a small open economy. Typically, given the short data sample available for most small open economies, the commonly used approach is to study them in the context of a panel. For example, Auerbach and Gorodnichenko (2013) exploit the cross-sectional dimension, and consider a panel of OECD countries, including Canada, with semi-annual data starting in 1980s and find evidence of larger multipliers during recessions. Also, Ilzetzki et al. (2013) use a quarterly dataset from 44 countries and document using pooled data for similar countries that fiscal multipliers in open economies are smaller than in closed economies.

In this paper we employ the Jordà's (2005) local projection method to estimate multipliers for the historical Canadian data set. We find that the government purchase multipliers for Canada over the full sample are around 0.5. Additionally, the state dependent results suggest that multipliers are significantly higher during high unemployment states, exceeding 1, and less than 0.5 in the low unemployment state. The higher multiplier during the slack state is driven by the relatively flat response of government spending to a news shock in the first few quarters, before picking up, while GDP rises much faster than government spending. We conduct an array of robustness checks and find the state-dependence results preserved in response to changing the unemployment rate threshold values, the threshold variable and identification schemes. We also consider the behavior of taxes and monetary variables, which partly help explain differences across the two states.

The paper proceeds as follows. We begin by discussing the data construction in Section 2. In Section 3 we introduce the econometric methodology, and Section 4 describes the indicator of the key states of the economy. In Section 5, we then present estimates of a model in which multipliers are allowed to vary according to the amount of slack in the economy. We first present baseline results using our new data and methodology, followed by various robustness checks. We also explore possible explanations for our results, such as the behavior of taxes and monetary variables, and potential spillover effects from U.S. The final section concludes.

## **2 Data Description**

A key contribution of the paper is the construction of a new data set that spans historical periods that involve potentially informative movements of the key variables, and spans over a century. In particular, we construct quarterly data from 1912 through 2011 for Canada.

We choose to estimate our model using quarterly data rather than annual data because agents often react quickly to news about government spending and the state of the economy can change abruptly. The series include real GDP, the GDP deflator, government purchases, tax revenue, deficit, population, the unemployment rate, interest rates, and defense news.

The separate data appendix contains full details, but we highlight some of the features of the data here. We use available quarterly series for the later sample, typically 1961 on for Canada. For the earlier periods, we use various higher frequency series to interpolate existing annual series, similar to the procedure used by Gordon and Krenn (2010). In most cases, we use the proportional Denton procedure which results in series that average up to the annual series. We interpolate annual Canadian GNP data compiled by McInnis (2001) using monthly industrial production. For fiscal data, we use monthly series on nominal federal revenues and outlays to interpolate annual series on nominal purchases, outlays and revenues.

The method used for interpolating unemployment is somewhat different. For pre-1954, we combine modern sources with historical sources in order to construct the annual rate and use business cycle dates to interpolate it.

Figure 1 shows the logarithm of real per capita government spending and GDP for the entire sample period. It is clear from the graph that both series are quite noisy in the first half of the sample. This is primarily due to the behavior of the interpolator series, particularly for government spending and taxes which are very noisy and we suspect the many large jumps we observe are due to vagaries of government budget accounting rather than actual jumps in spending or taxes. For this reason, our government spending series should be used to identify shocks using standard Choleski decompositions (such as the method of Blanchard and Perotti (2002)) with caution. Fortunately, the measurement errors are less of an issue for us because we identify the shocks using narrative methods.<sup>1</sup>

Since it is important to identify a spending shock that is not only exogenous to the state of the economy but is also unanticipated, we use narrative methods of Ramey (2011) to construct a defense news series for Canada. This news series focuses on changes in government spending that are linked to political and military events, since these changes are most likely to be independent of the state of the economy. Moreover, changes in defense spending are anticipated long before they actually show up in the national accounts. For a

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1. Because our shock is constructed independently from news sources and we regress both government spending and GDP on the shock and use the ratio of coefficients, our method is much less sensitive to measurement error in any of the series. See the appendix of Ramey (2011) and footnote 14 of Mertens and Ravn (2013) for a discussion.

benchmark neoclassical model, the key effect of government spending is through the wealth effect. Thus, the news series is constructed as changes in the expected present discounted value of government spending. The particular form of the variable used as the shock is this nominal value divided by one-quarter lag of nominal GDP.

### 3 Econometric Methodology

We follow the same methodology as Ramey and Zubairy (2014) and apply the local projection technique proposed in Jordà (2005) to estimate state-dependent models and calculate impulse responses. The Jordà method simply requires estimation of a series of regressions for each horizon  $h$  for each variable. The linear model looks as follows:

$$(1) \quad z_{t+h} = \alpha_h + \psi_h(L)y_{t-1} + \beta_h shock_t + \varepsilon_{t+h}, \text{ for } h = 0, 1, 2, \dots$$

$z$  is the variable of interest (discussed below),  $y$  is a vector of control variables,  $\psi_h(L)$  is a polynomial in the lag operator, and  $shock$  is the identified shock. The coefficient  $\beta_h$  gives the response of  $z$  at time  $t + h$  to the shock at time  $t$ . Thus, one constructs the impulse responses as a sequence of the  $\beta_h$ 's estimated in a series of separate regressions for each horizon. Our vector of control variables,  $y$ , contains logs of real per capita GDP, government spending and tax revenues. In addition,  $y$  includes lags of the news variable to control for any serial correlation in the news variable.  $\psi(L)$  is a polynomial of order 2.<sup>2</sup>

This method is easily adapted to estimating a state-dependent model. For the model that allows state-dependence, we estimate a set of regressions for each horizon  $h$  as follows:

$$(2) \quad z_{t+h} = I_{t-1} [\alpha_{A,h} + \psi_{A,h}(L)y_{t-1} + \beta_{A,h} shock_t] + (1 - I_{t-1}) [\alpha_{B,h} + \psi_{B,h}(L)y_{t-1} + \beta_{B,h} shock_t] + \varepsilon_{t+h}.$$

$I$  is a dummy variable that indicates the state of the economy before the shock hits. We allow all of the coefficients of the model (other than deterministic trends) to vary according to the state of the economy. As discussed in Section 2, the shock is identified as the news variable scaled by lagged nominal GDP. The only complication associated with the Jordà

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2. Note here in departure from Owyang et al. (2013), we additionally use log of tax revenues as a control variable.

method is the serial correlation in the error terms induced by the successive leading of the dependent variable. Thus, we use the Newey-West correction for our standard errors (Newey and West (1987)).

The Jordà method stands in contrast to the standard method of estimating the parameters of the VAR for horizon 0 and then using them to iterate forward to construct the impulse response functions. In addition, we do not have to make assumptions regarding how the economy transitions from state-to-state, as well as the feedback of the shocks to the state. In fact, the Jordà estimates incorporate both the natural transitions and endogenous transitions from state to state that occur on average in the data.<sup>3</sup> In addition, this method has the advantage that it does not constrain the shape of the impulse response function, so it is less sensitive to misspecification of the SVAR. Also, it does not require that all variables enter all equations, so one can use a more parsimonious specification.

Another advantage of the Jordà method is that the left-hand-side variables do not have to be in the same form as the right-hand-side variables. In order to avoid the bias in multipliers constructed from elasticities, pointed out in Ramey and Zubairy (2014), we follow Hall (2009) and Barro and Redlick (2011) and convert GDP and government spending changes to the same units *before* the estimation. In particular, our  $z$  variables on the left-hand-side of Equation 2 are defined as  $(Y_{t+h} - Y_{t-1})/Y_{t-1}$  and  $(G_{t+h} - G_{t-1})/Y_{t-1}$ .

The Jordà method does not uniformly dominate the standard SVAR method for calculating impulse responses, though. First, because it does not impose any restrictions that link the impulse responses at  $h$  and  $h + 1$ , the estimates are often erratic because of the loss of efficiency. Second, it sometimes displays oscillations at longer horizons. Since we are interested in the shorter-run responses, the long-run estimates are not a concern for us.

## 4 Defining Slack States

The key variation in the state of the economy that we consider is based on the amount of slack in the economy. The traditional Keynesian idea of government spending multipliers, on which so much of modern intuition is based, assumes an economy with substantial under-utilization of resources so that output is demand-determined rather than supply-determined. There are various potential measures of slack, such as output gaps, the unemployment rate, or capacity utilization. Based on data availability and the fact that it is generally accepted as a key measure of under-utilized resources, we use the unemploy-

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3. See Ramey and Zubairy (2014) for a more detailed explanation.

ment rate as our indicator of slack. We define an economy to be in a slack state when the unemployment rate is above some threshold.

Note that our use of the unemployment rate to define the state is different from using recessions or Auerbach and Gorodnichenko's (2012) moving average of GDP growth. The latter two measures, which are highly correlated, indicate periods in which the economy is moving from its peak to its trough. A typical recession encompasses periods in which unemployment is *rising* from its low point to its high point, and hence is not an indicator of a state of slack. We know of no theory that suggests that multipliers should differ according to the *change* in unemployment rates. In both Canada and the U.S., only half of the quarters that are official recessions are also periods of high unemployment.

In order to find the threshold to define high and low unemployment state, we conduct a grid search to see what threshold maximizes the likelihood of our baseline non-linear model, given by Equation (2).<sup>4</sup> This led us to a threshold of unemployment of 8.2%.<sup>5</sup> In our full sample, recessions are 23% of the sample, and a threshold of 8.2 percent unemployment rate results in 30% of sample in a high unemployment regime. In Section 5.2, we conduct various robustness checks to this choice of threshold.

Figure 2 show the unemployment rate and the military spending news shocks for Canada. The grey shaded time periods are classified as high unemployment periods and the white time periods are low unemployment periods. Notice that the news at the start of World Wars I and II occurs during the slack state.

Since our method for estimation can be interpreted as an instrumental variables regression, it is important to gauge the relevance of the news variable as an instrument. Figure 3 shows the first stage F-statistics.<sup>6</sup> The figure shows these for the full historical sample and the post-WWII sample, and splits each of these according to whether the unemployment rate is above 8.2 percent. According to Staiger and Stock (1997), a first-stage F-statistic below 10 can indicate that the instrument may have low relevance.<sup>7</sup> In all cases, the F-statistics are very low at short horizons. This is to be expected since the entire point of

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4. We compare the log likelihood for the Jorda specification at horizon  $h = 0$  with 2 lags of news, log GDP, log government spending, log taxes for the output equation, for threshold of unemployment between 6% and 9%.

5. For the US, Ramey and Zubairy (2014) use 6.5% as baseline threshold, but Canada has a higher natural unemployment rate

6. The F-statistics are based on the exclusion of current news (scaled by the previous quarter's nominal GDP) in the regression of the government spending variable at horizon  $h$  on current news, and two lags each of news, log GDP, log government spending and log tax revenues and a quartic trend.

7. Olea and Pflueger (2013) show, however, that the thresholds can be higher when the errors are serially correlated.

Ramey (2011) is that the news about government spending occurs at least several quarters before the government spending actually rises. For the linear model, the F-statistic is high for many horizons for all the samples considered. In contrast, the F-statistic is above 10 for the high unemployment state for most horizons in the full historical sample, but is always very low for the post-WWII period. The results for the low unemployment rate state look similar to the linear case, although the F-statistics are lower in the full historical sample. These results suggest that the post-WWII sample is not sufficiently rich to be able to distinguish multipliers across states using the military news instrument.

## **5 Multipliers During Times of Slack**

### **5.1 Baseline Results for Slack States**

We now present the main results of our analysis using the full historical sample and the local projections method. We first consider results from the linear model, which assumes that multipliers are invariant to the state of the economy. The top panel of Figure 4 shows that both government spending and output rise in a sustained manner, though the estimated government spending responses are rather erratic. As the first column of Table 1 shows, the implied multipliers are below unity in the linear model, close to 0.5 and usually statistically different from unity. The fiscal multipliers for Canada are also consistently smaller than the ones for U.S. found for the similar sample period by Ramey and Zubairy (2014).

The bottom panel of Figure 4 shows the results from the state dependent model. The responses of government spending and GDP are hump-shaped and peak around 6-7 quarters in response to a news shock in the low unemployment state. On the other hand, both government spending and GDP climb significantly in the high unemployment state gradually. More importantly, while government spending has a rather flat response for the first two years, before rising up significantly, GDP rises much faster in those initial quarters. Table 1 shows that the implied multipliers are greater during periods of slack. Using the multipliers based on the integral through two years, the value is 1.50 when the initial shock hits during the high unemployment state in contrast to only 0.34 when it hits in the low unemployment state. Thus, the estimates suggest that multipliers are substantially greater in the high unemployment state in Canada. The exact values depend on the horizon. Figure 5 shows the cumulative multipliers across the two states at various horizons between 5



and 20 quarters.<sup>8</sup> While the multipliers in high unemployment state can exceed 1, the low unemployment multiplier are closer to zero. Another thing to note is the multiplier in the high employment state are much larger at shorter horizons. This can be explained by the slower response of government spending than GDP to a news shock in that state.

To summarize we find over our full sample that the multipliers for Canada tend to be close to 0.5. Considering state dependence, there is evidence suggesting higher multiplier during periods of high unemployment in the economy.

## 5.2 Robustness Checks

In this section we address the robustness of our findings to the choice of our specific threshold, identification scheme and sample period.

In our baseline case, we used a threshold of 8.2% for unemployment rate to define high and low unemployment states. We first consider whether our results are sensitive to the choice of this threshold value. Figure 6 shows the difference between the high and low unemployment cumulative multipliers at different horizons for different threshold values from 6.5% to 9%. Similar to our baseline case, the high unemployment multiplier is significantly larger than the low unemployment multiplier at short horizons and the difference shrinks at longer horizons, though remaining positive. Note, the difference between the state dependent multiplier always exceeds 0.5.

We next consider a time-varying threshold, where we consider deviations from trend for Hodrick-Prescott filtered unemployment rate with a very high smoothing parameter of  $\lambda = 1,000,000$ . This definition of threshold results in about 40 percent of the observations being above the threshold for Canada. As shown in Figure 7, this threshold also suggests prolonged periods of slack both in the late 1890s and during the 1930s. There is substantial evidence that the "natural rate" of unemployment displayed an inverted U-shape in Canada in the post-WWII period, and this time-varying threshold also helps account for this. Using this time-varying threshold, we find results in line with our baseline findings (see the top panel of Table 2) and the multiplier is higher in the high unemployment state compared to the low unemployment state.

Instead of unemployment rate as the state variable, we also conduct a robustness of our

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8. We exclude the first few quarters in the figure since the multiplier in the high unemployment state oscillates a great deal during these quarters. It is negative for the first two quarters since government spending falls on impact in the high unemployment state before rising and then resulting in a very highly positive multiplier.

results by defining the state based on official recession dates. This is to help compare our findings with previous literature that considers state-dependence based on recessions and expansions. The bottom panel of Table 2 shows that multipliers are much larger when the news shock hits the economy during recessions than in expansions.

Next, we consider a threshold based on the moving average of output growth, instead of the unemployment rate. We construct a smooth transition threshold similarly to Auerbach and Gorodnichenko (2012), where we replace the dummy variable  $I_{t-1}$  in equation (2) with the function  $F(z_t)$ , where  $z$  is the 7-quarter moving average of output growth.<sup>9</sup> Figure 8 shows the function  $F(z)$  for Canada, for our full sample along with official recessions as grey bars. Results in the bottom part of Table 2 show that when we use this weighting function for recessionary regimes in our specification to construct state-dependent multipliers, our baseline results are preserved and the multipliers are much larger in recessions, both compared to the baseline case and also expansions.

The commonly used approach for spending shocks is to employ Blanchard and Perotti (2002) identification scheme which is based on the assumption that within quarter government spending does not contemporaneously respond to macroeconomic variables.<sup>10</sup> Table 2 shows that when we identify the government spending shock using Blanchard and Perotti (2002) identification scheme for our full sample, we find smaller multipliers both in the linear and state-dependent case. In this case too the multipliers are larger in the high unemployment state than the low unemployment state. However, note that multipliers under the Blanchard and Perotti (2002) identification scheme are below unity even in the slack state.

Most of the pre-existing literature employ a shorter data sample that spans the post World War II period, when computing multipliers. As a robustness check we limit our sample to this period, 1947-2011, and employ the Jorda local projection method on this data set. In this shorter sub-sample, about 25 percent of the observations are above our baseline threshold for unemployment rate, signifying state of slack.<sup>11</sup> In the post World War II sub-sample, the multiplier is larger than 1 at the 2 year horizon in the linear case, in contrast to the full sample where it was close to 0.5. Across the two states, the multiplier under low unemployment is similar to the linear case but large and negative under high

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9. Note  $F(z) = \frac{\exp(-\gamma z)}{1 + \exp(-\gamma z_{t-1})}$ , and the choice of  $\gamma = 3$  ensures that  $F(z)$  is greater than 0.8 close to 20 percent of the time, which lines up with the total duration of recession for Canada in the full sample considered.

10. Note, as mentioned earlier, this type of shock is much more sensitive to potential measurement errors given our historical construction of quarterly government spending and GDP series and is subject to the critique that it is likely to have been anticipated.

11. When conducting this sub-sample analysis we change our baseline specification to use a quadratic trend.

unemployment. This is because, counterintuitively, GDP falls in response to a news shock in this state. Note, however, as shown in Figure 3, in the high unemployment state in this post World-War II sample, the F-statistics for the instrumental relevance of the news variable in the slack state is very low, thus the state-dependent responses are estimated very imprecisely.

### 5.3 Considering Method of Financing

Our analysis so far has ignored the responses of taxes. Romer and Romer's (2010) estimates of tax effects indicate very significant negative multipliers on taxes, on the order of -2 to -3. Thus, it is important for us to consider how tax policy differs across the two states in order to understand our multiplier results.

We estimate our basic model with tax rates and deficits. Tax rates are computed as the ratio of federal receipts to nominal GDP, and represent average tax rates rather than marginal tax rates. We substitute tax rates for the real tax revenues in our baseline specification so that we can distinguish increases in revenues caused by rising output versus rising rates. The deficit is the real total deficit. We include two lags of these two new variables along with GDP and government spending as controls in all of the regressions. The multipliers in this case are shown in Table 3. The multipliers are similar to the baseline results for the linear case, but they are slightly lower across the high unemployment state, though we again find much high multiplier during the slack state.

Figure 9 shows the results for the response of variables to a news shock in the linear case. The responses of government spending and GDP are almost identical to the baseline case. The bottom panels show that both average tax rates and the deficit increase. Next, we consider the state-dependent responses to see if the financing of government spending differ across states and could help explain larger multipliers during the high unemployment state.

Figure 10 shows the state-dependent results. While the responses are rather erratic, it is apparent that just like spending and GDP, tax rates and deficits also rise more during periods of slack. In order to determine relative share of spending financed by deficits, we study the ratio of the cumulative deficit to cumulative government spending at each point in time along the path. We find that overall, more of government spending is financed with deficits when a shock hits during a slack state.<sup>12</sup> In addition, tax rates rise with a delay

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12. This is true with the exception of the first two quarters. This can be explained by the fact that initially

during the slack state relative to non-slack state. Thus, the method of financing partly helps explain why multipliers are higher during the slack state.

## 5.4 Accounting for Spillover from U.S.

We identify news shocks based on military buildup events. While these shocks are exogenous relative to the Canadian economy, one concern is that many of these shocks hit U.S. at around the same time, and thus we could potentially be capturing some spillover effects from the U.S. economy. Figure 11 shows the logarithm of per capita government purchases (deflated by the GDP deflator) for Canada in the top panel, and for the U.S. in the bottom panel for comparison. These include all federal, state (province), and local purchases; they exclude transfer payments. Note that the large events include WWI, WWII and the Korean War, where the entry of Canada in the World Wars is earlier than the U.S. in both cases. Particularly in the post-WWII period, it is difficult to see the military buildups in Canada's total government purchases series. Our separate analysis of defense purchases (not shown here) shows that with the exception of the Vietnam War, Canada's military build-ups and draw-downs are qualitatively similar to those of the U.S. While the percent change in defense spending in Canada during the post-WWII buildups was as large as in the U.S., military spending as a percent of GDP has been less than half as much in Canada as in the U.S.

In order to account for spillover effects from the U.S., we estimate our model by including current and one lag of logarithm of real per capita U.S. GDP to the baseline specification. Table 3 reports the multiplier in this case for both the linear and non-linear model. The multiplier in the linear case is similar to the baseline model, around 0.5. The difference between the high and low unemployment state multiplier is now even larger than in the baseline case, since the multiplier in the slack state is now larger and 1.6 at the 2 year horizon and 1.1 at the 4 year horizon. Thus, even after accounting for the U.S. economy, our baseline results are preserved.

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government spending and deficits rise slowly in response to a news shock and in the initial quarter, deficits fall very slightly before rising. For quarters eight to ten, the ratio of the cumulative deficit to cumulative government spending is very close across the two states.

## 5.5 Considering Monetary Variables

Theoretical models suggest that government spending multipliers can be much larger when the interest rates are at the zero lower bound. See, for example, Eggertsson (2011) and Christiano et al. (2011), who show it in context of a New-Keynesian model. The relationship between government spending multipliers and the degree of monetary accommodation, even outside zero lower bound has been explored by many others, including Davig and Leeper (2011) and Zubairy (2014). The intuition is that a deficit-financed increase in government spending leads expectations of inflation to rise. When nominal interest rates are held constant, or if monetary policy is accommodative, this increase in expected inflation drives the real interest rate down, spurring the economy. Thus, the stance of monetary policy is an important consideration for the size of a spending multiplier.

We consider the response of nominal and real interest rate and inflation to a news shock, in order to understand whether they play a role in driving our multiplier results. We estimate our model with 2 lags of nominal interest rate and (annualized) inflation in our baseline model. Since the date on nominal interest rate starts in 1919, we conduct our analysis for both the linear and state-dependent case for the shorter dataset, which notably excludes World War I. The last panel of Table 3 shows that the inclusion of the additional variables on the right hand side and shortening the data set does not result in very different multipliers from the baseline. The linear multiplier is around 0.5, and the multiplier in the high unemployment state is higher than the multiplier for the full sample and of multipliers in the low unemployment state.

Figure 12 shows the responses of the nominal and real interest rate and inflation for the linear model. The responses of all variables are essentially insignificant at all horizons, and rather noisy for inflation. Figure 13 shows the state dependent responses. While the response of nominal interest rate is not particularly different across the two states, inflation has a larger response during the high unemployment state than state with low unemployment. This results in a higher real interest rate response in the low unemployment state, and thus helps to explain the lower relative multiplier in that state.

## 6 Conclusion

In this paper, we have explored the idea that government spending multipliers vary depending on the state of the economy. In order to maximize the amount of variation in the

data, we constructed new historical quarterly data spanning close to 100 years for Canada. We considered the amount of slack as an indicator of the state of the economy. Using a more robust method for estimating state-dependent impulse responses and better ways of calculating multipliers from them, we provided numerous estimates of multipliers across different specifications.

Our results can be summarized as follows. The fiscal multiplier for Canada for the full sample is rather modest and around 0.5. We, however, find substantial differences in multipliers depending on the unemployment rate. Multipliers are around or above 1 during periods of high unemployment but less than 0.5 during periods of low unemployment. Both the response of deficits and taxes in financing spending and the response of real interest rate help explain this difference in multipliers across the two states.

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## 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 McNinnis 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

### **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](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.

**Table 1. Estimated multipliers: Considering slack state**

	Linear Model	High Unemployment	Low Unemployment	P-value for difference in multipliers across states
2 year integral	0.50 (0.230)	1.50 (0.378)	0.34 (0.170)	0.012
4 year integral	0.51 (0.188)	1.02 (0.127)	0.23 (0.098)	0.000

Note: The values in brackets under the multipliers give the standard errors.

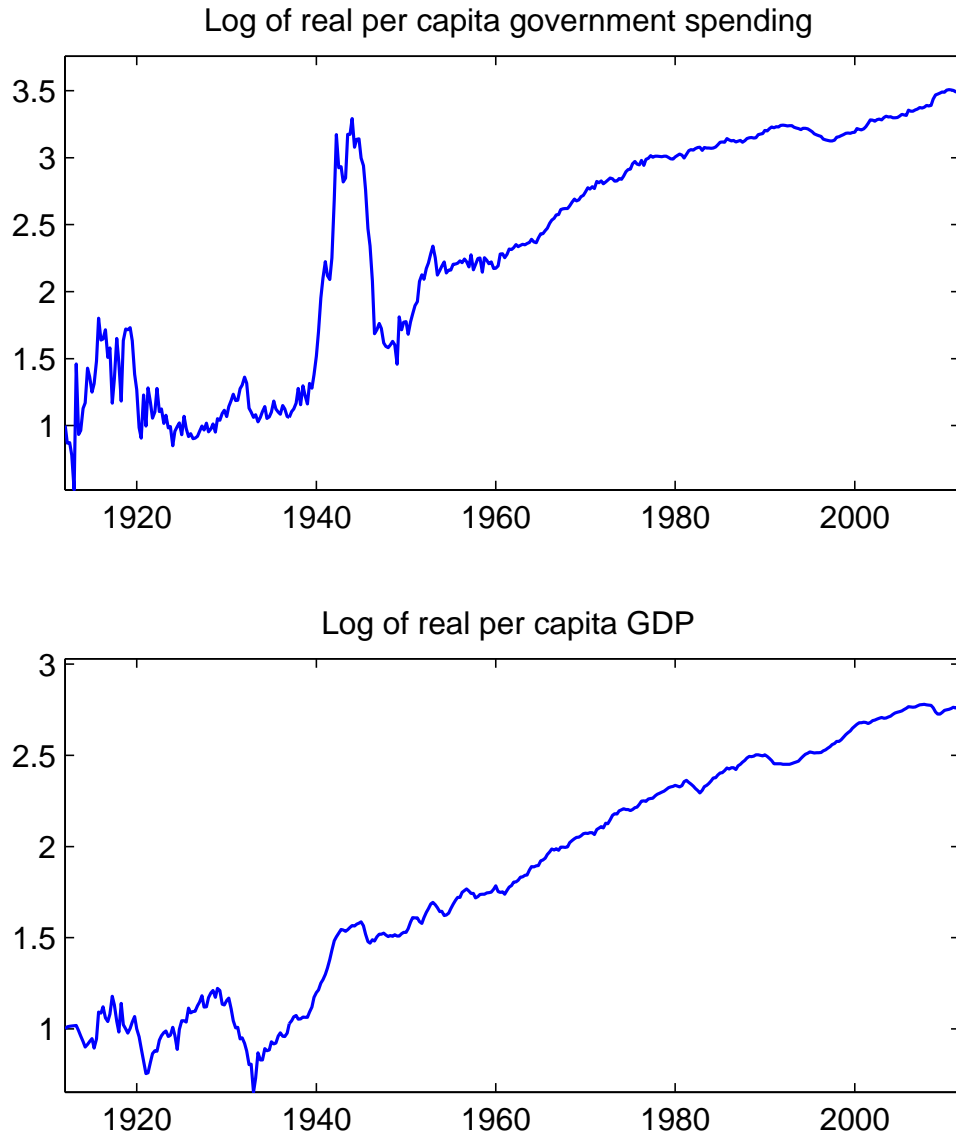
**Table 2. Robustness Checks**

	Linear Model	High Unemployment	Low Unemployment
<b>HP filtered time-varying threshold (with <math>\lambda = 10^6</math>)</b>			
2 year integral	0.50	1.39	0.19
4 year integral	0.51	1.00	0.12
<b>Blanchard-Perotti identification</b>			
2 year integral	0.31	0.76	0.30
4 year integral	0.35	0.68	0.28
<b>Subsample: 1947-2011</b>			
2 year integral	1.35	-4.20	1.27
4 year integral	0.76	-2.25	0.67
	Linear	Recession	Expansion
<b>Business Cycle Dates</b>			
2 year integral	0.50	1.91	0.42
4 year integral	0.51	1.40	0.51
<b>7 qtr. moving avg. output growth, <math>F(z)</math></b>			
2 year integral	0.50	4.04	0.48
4 year integral	0.51	1.11	0.29

**Table 3. Further Robustness Checks of Multipliers**

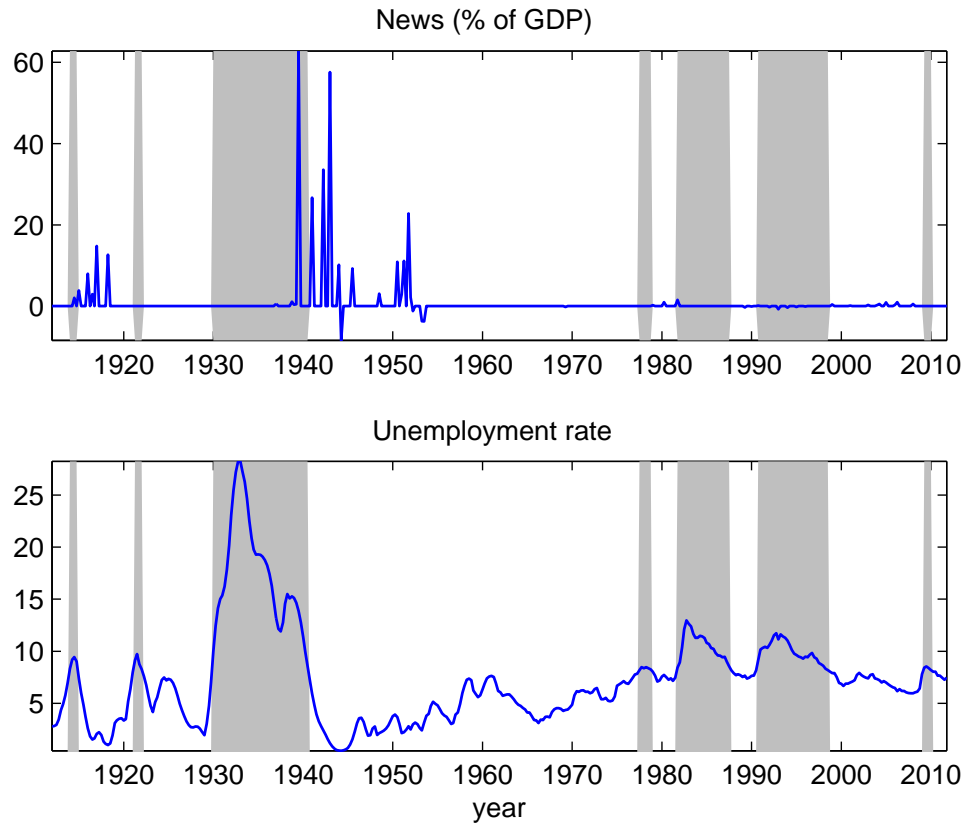
	Linear Model	High Unemployment	Low Unemployment
<b>Considering Method of Financing</b>			
2 year integral	0.55	1.36	0.38
4 year integral	0.52	0.94	0.24
<b>Accounting for U.S. spillover</b>			
2 year integral	0.50	1.60	0.33
4 year integral	0.51	1.08	0.22
<b>Considering Monetary Variables (1919-2011)</b>			
2 year integral	0.50	1.88	0.32
4 year integral	0.57	1.14	0.27

**Figure 1. Government Spending and GDP**



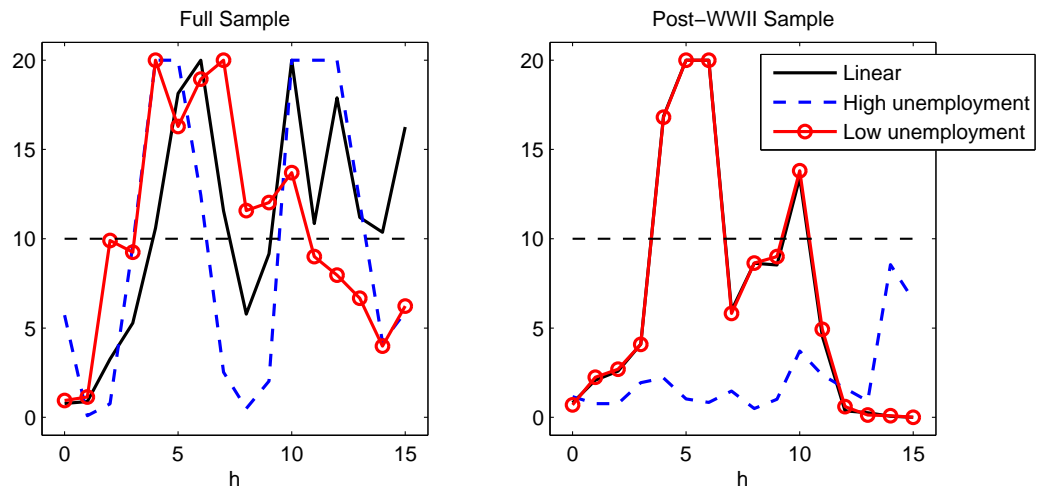


**Figure 2. Military spending news and unemployment rate for Canada**



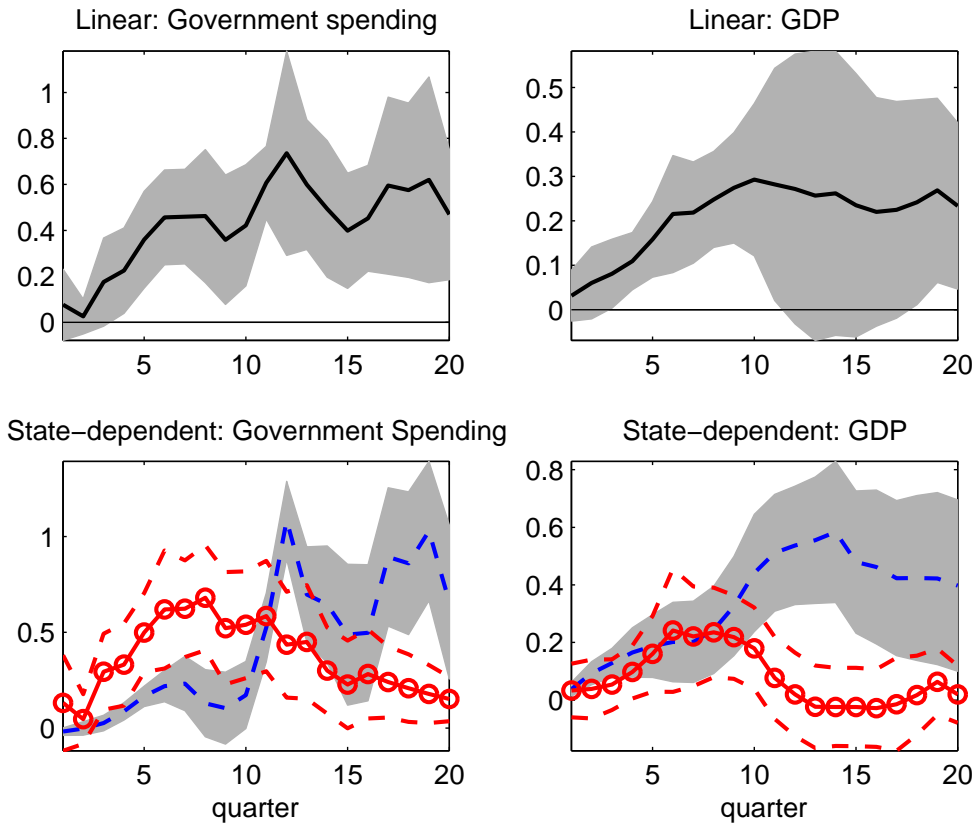
Note: Shaded areas indicate periods when the unemployment rate is above the threshold of 8.2%.

**Figure 3. Tests of Instrument Relevance Across States of Slack**



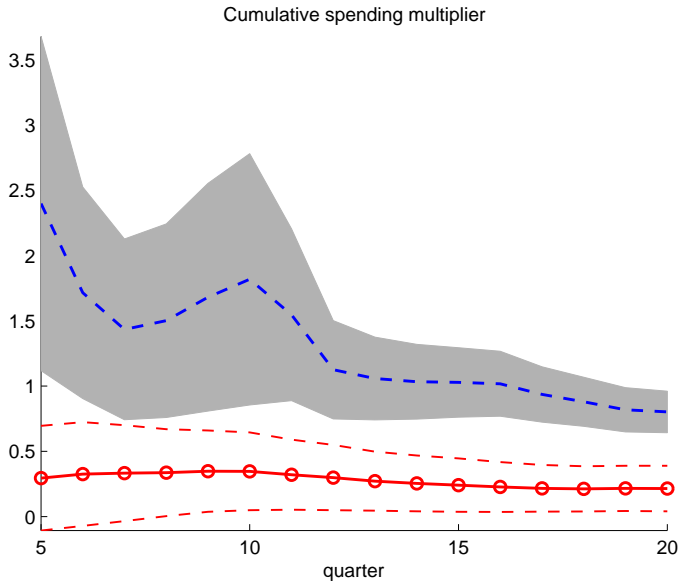
Note: "Slack" is when the unemployment rate exceeds 8.2 percent. The lines show the F-statistic on the news variable for each horizon in the case of the linear model (solid black lines), high unemployment state (blue dashed lines) and the low unemployment state (lines with red circles). Statistics are capped at 20. The full sample is 1912:1-2011:4, and the post-WWII sample spans 1947:3 - 2011:4.

**Figure 4. Government spending and GDP responses to a news shock**



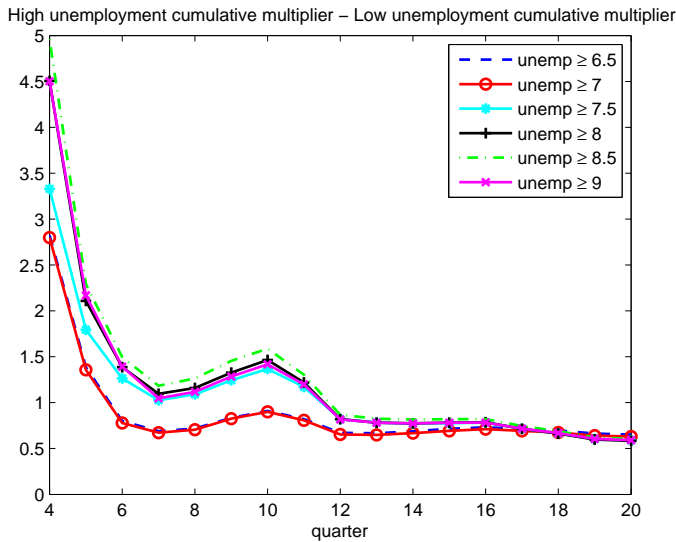
Note: Canada response of government spending and GDP to a news shock equal to 1% of GDP. The top panel shows the responses in the linear model. The bottom panel shows the state-dependent responses where the blue dashed lines are responses in the high unemployment state and the lines with red circles are responses in the low unemployment state. 95% confidence intervals are shown in all cases.

**Figure 5. Cumulative multipliers across slack states**



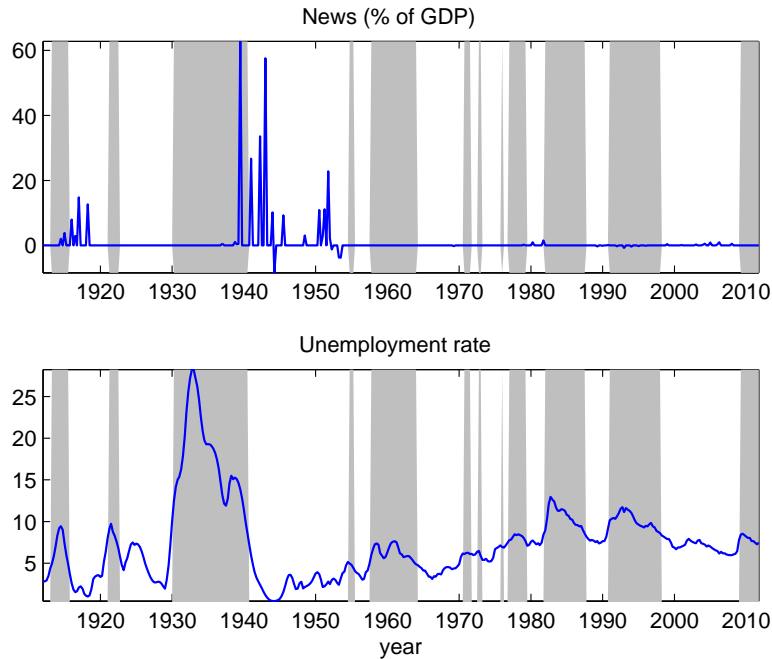
Note: Cumulative spending multipliers across different horizons starting at 5 quarters. The figure shows the state-dependent multipliers where the blue dashed lines are multipliers in the high unemployment state and the lines with red circles are multipliers in the low unemployment state. 95% confidence intervals are shown in both cases.

**Figure 6. Robustness check: Difference between state-dependent multipliers for different thresholds**



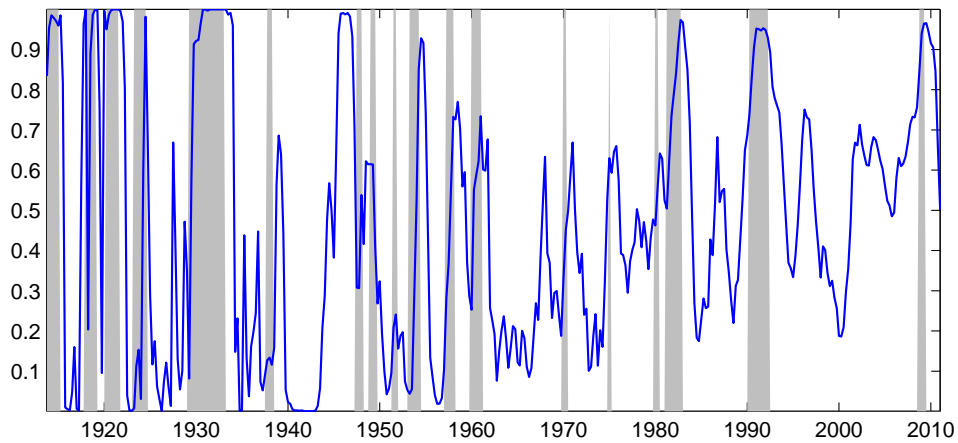
Note: Difference between the cumulative spending multipliers in the high unemployment state and low unemployment state, across different horizons, for different threshold values for the unemployment rate.

**Figure 7. Robustness check: New threshold of unemployment rate based on time-varying trend**



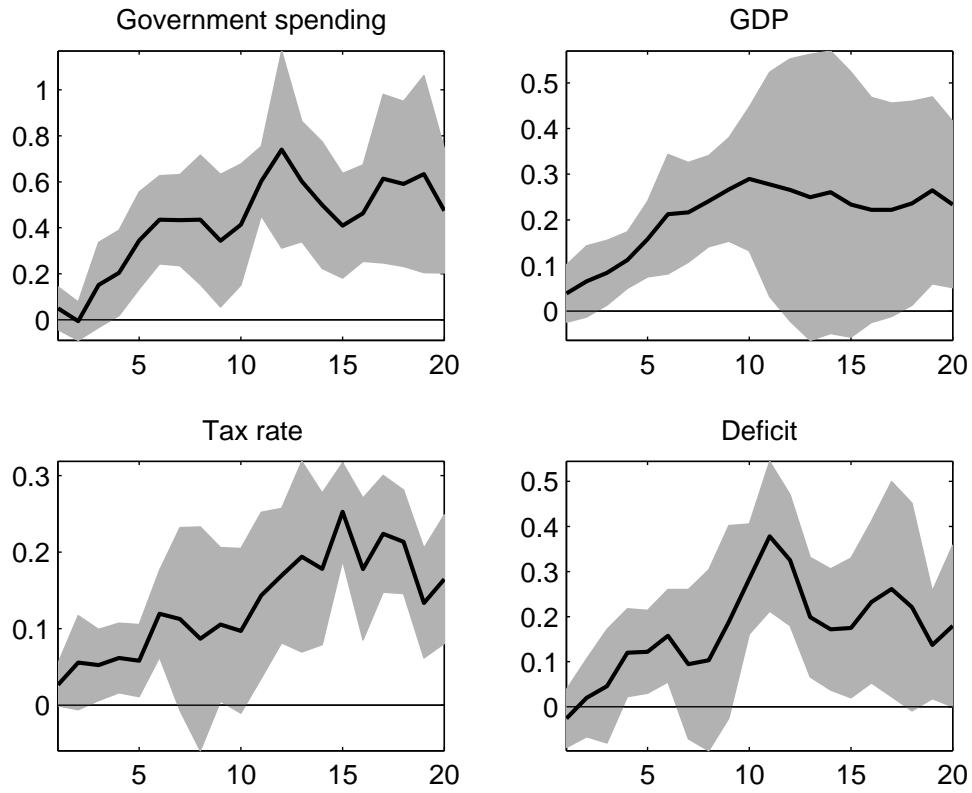
Note: Shaded areas indicate periods when the unemployment rate is above the time-varying trend based on HP filter with  $\lambda = 10^6$ .

**Figure 8. Robustness check: New smooth transition threshold based on moving average of output growth**



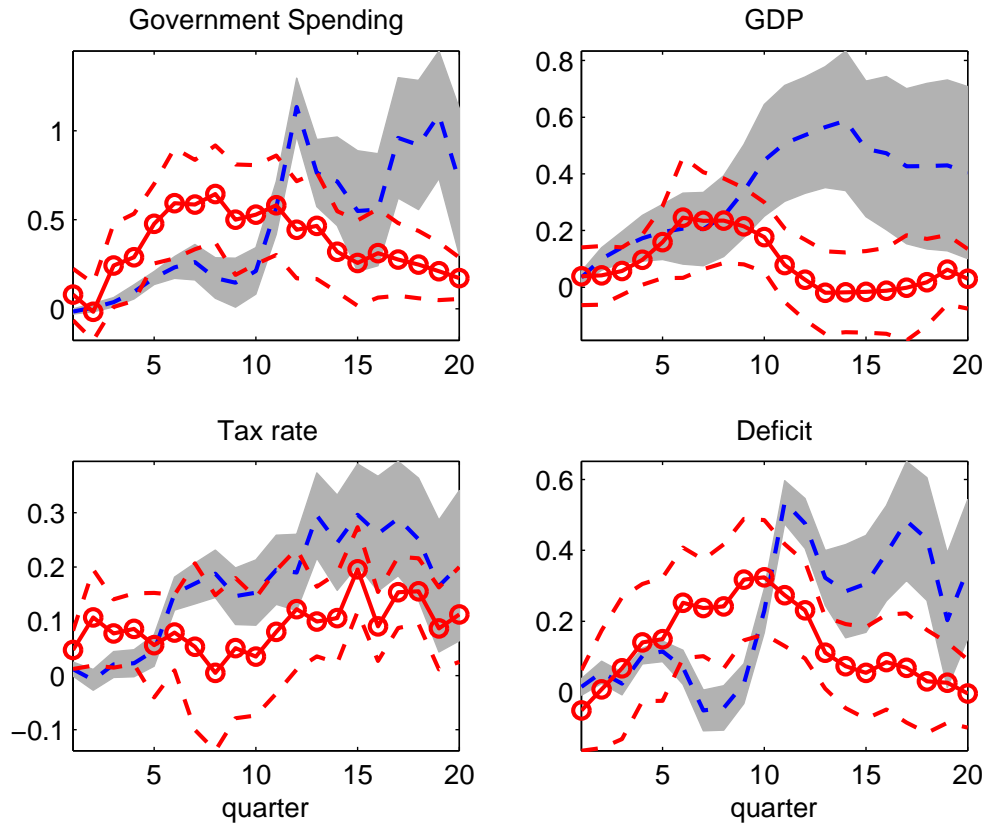
Note: The figures shows the weight on a recession regime,  $F(z)$  and the shaded areas indicate official recessions.

**Figure 9. Responses of taxes and deficits**



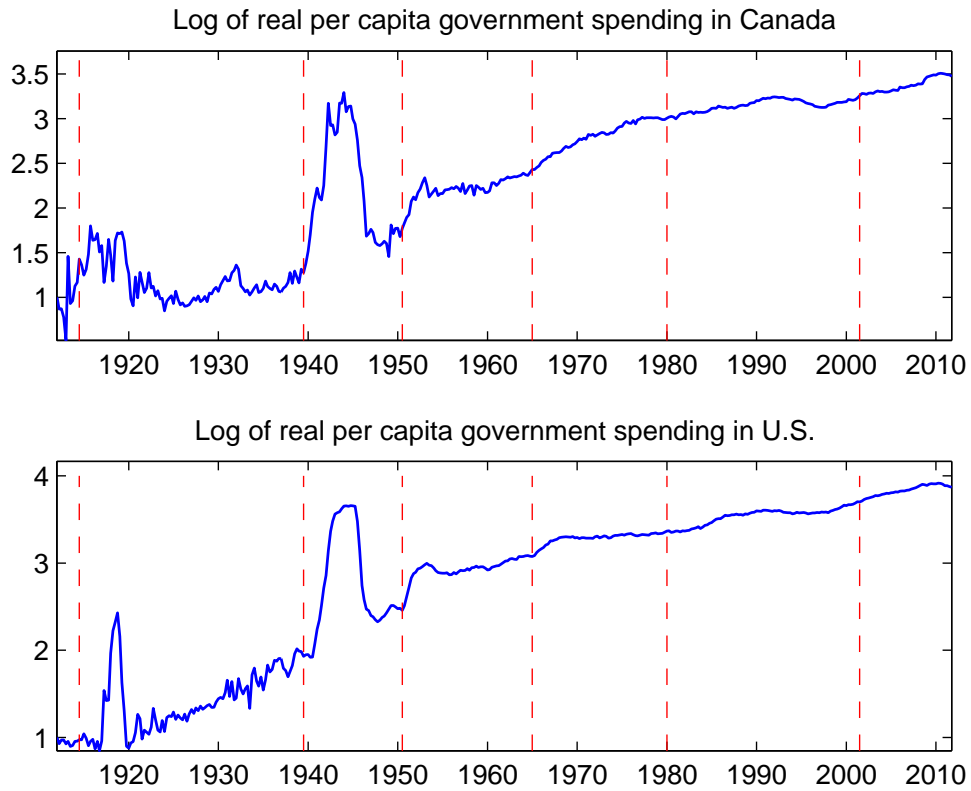
Note: These are responses for taxes and deficits in the linear model. The shaded areas indicate 95% confidence bands.

**Figure 10. State-dependent responses of taxes and deficits**



Note: These are state-dependent responses for taxes and deficits, where the blue dashed lines are responses in the high unemployment state and the lines with red circles are responses in the low unemployment state. 95% confidence intervals are also shown.

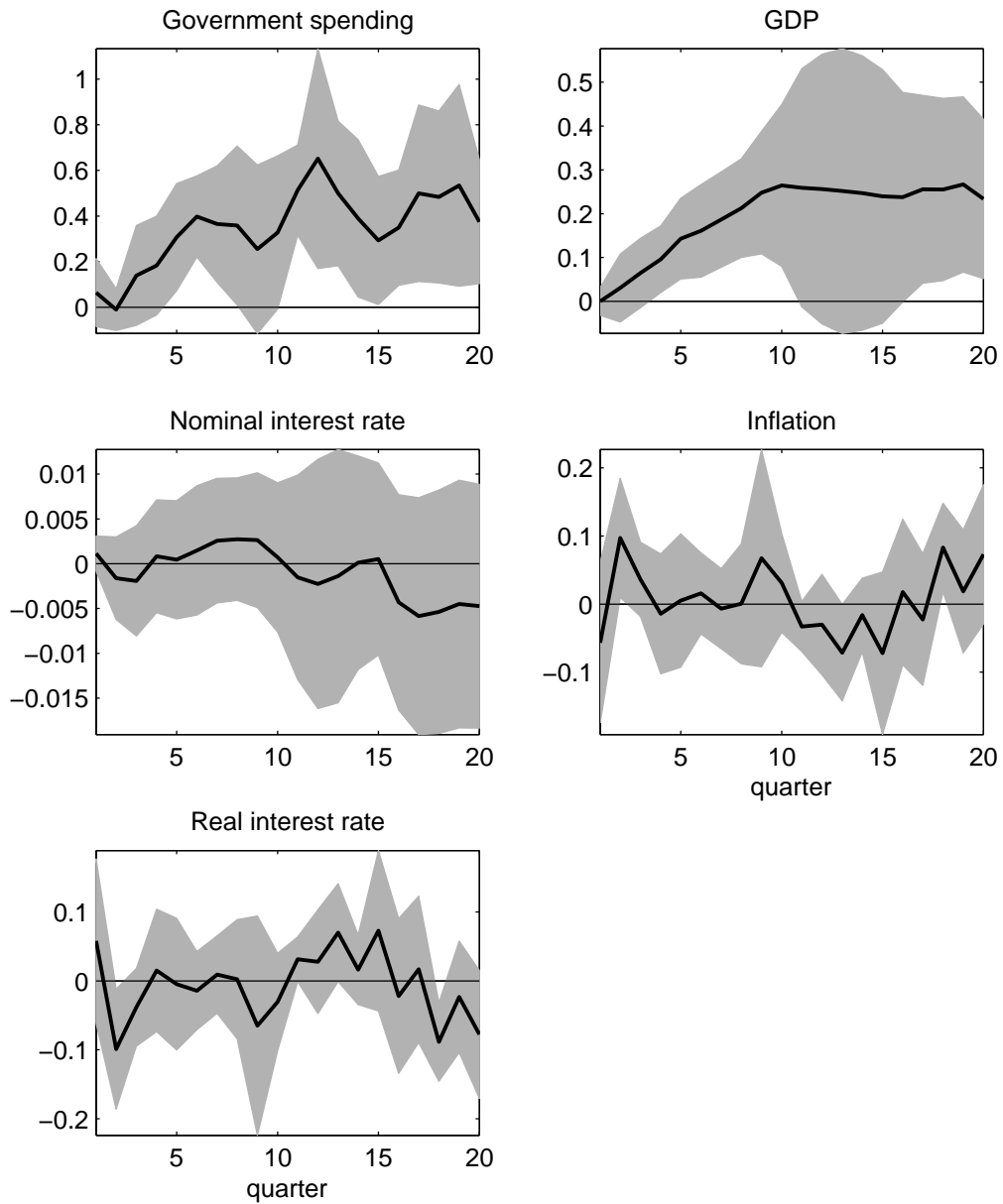
**Figure 11. Government Spending for Canada and U.S.**



Note: The vertical lines indicate major military events: 1898q1(The Spanish-American War starts with the sinking of the USS Maine), 1914q3 (WWI starts), 1939q3 (WWII starts), 1950q3 (Korean War starts), 1965q1 (Vietnam War starts), 1980q1 (Buildup in response to Soviet invasion of Afghanistan), 2001q3 (9/11).

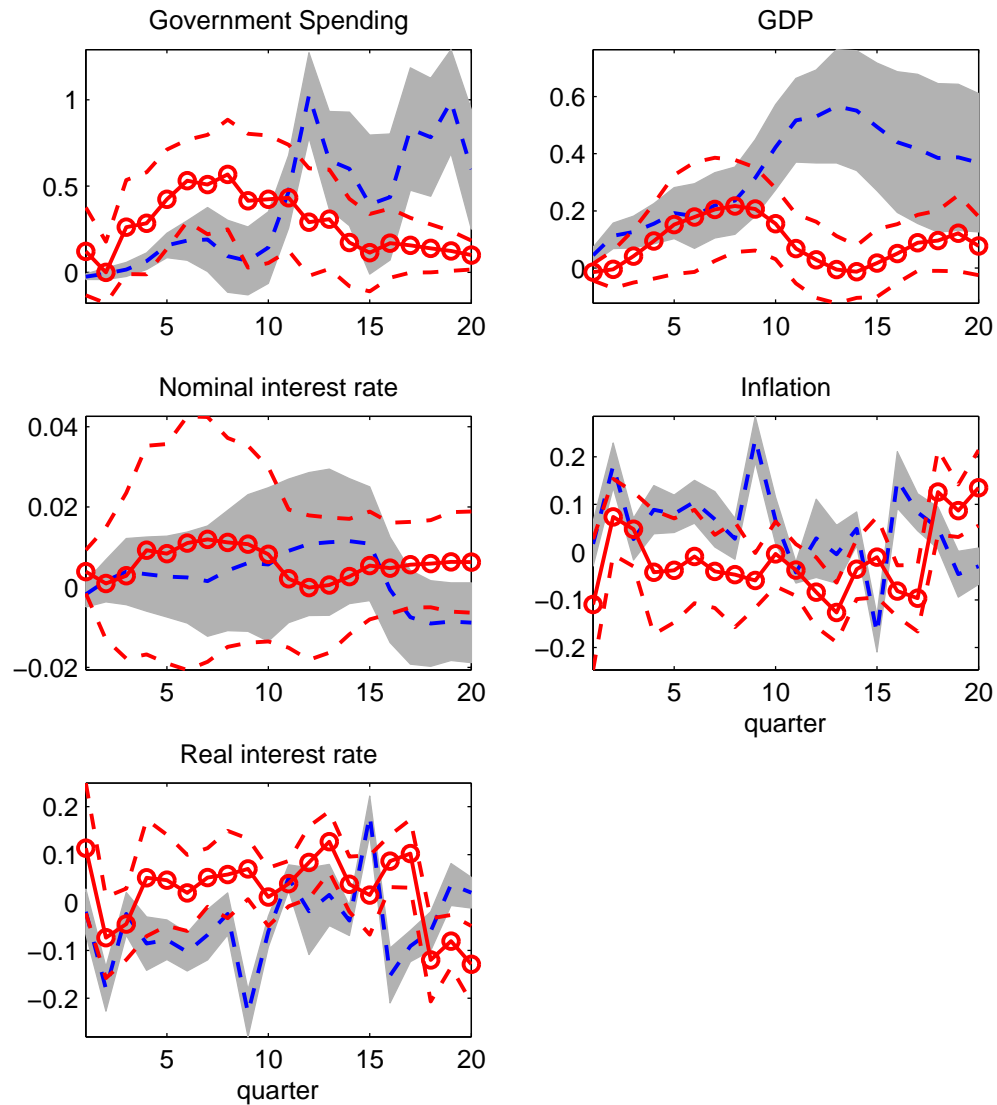


**Figure 12. Responses of inflation and interest rate for Canada**



Note: These are responses for inflation, nominal and real interest rates in the linear model, for data spanning 1919-2011. The shaded areas indicate 95% confidence bands.

**Figure 13. State-dependent responses of inflation and interest rate for Canada**



Note: These are state-dependent responses for inflation, nominal and real interest rates, for data spanning 1919-2011, where the blue dashed lines are responses in the high unemployment state and the lines with red circles are responses in the low unemployment state. 95% confidence intervals are also shown.