International spillovers from U.S. fiscal policy shocks

Nicar, Stephen

Franklin Marshall College

August 2014

International Spillovers from U.S. Fiscal Policy Shocks

Stephen Nicar *

This version:
September 2014

Abstract

I estimate the effect of U.S. government spending and tax shocks on Canada, Japan, and the U.K. for the period 1974 through 2007. Spending and tax shocks are identified using sign restrictions on the impulse responses from a vector autoregression (VAR). I find that while spillover effects of expansionary fiscal shocks are not uniform in direction or magnitude across countries, for Canada and Japan they result in economically significant GDP increases over some portion of the response horizon. For all three countries, government spending shocks generally have larger effects than net tax shocks. Altogether, the results support the idea that some countries may benefit significantly from expansionary U.S. fiscal policy.

Keywords: Fiscal policy, International Transmission, Spillovers, VAR models, Sign Restriction

JEL Classification Numbers: C32, E61, F42

*Department of Economics, Franklin & Marshall College, Lancaster, PA. Email: snicar@fandm.edu.
This paper is a revised version of a chapter from my Ph.D. thesis for the University of Colorado at Boulder. I would like to thank Martin Boileau, Robert McNown, Devrim Demirel, Charles de Bartolomé for helpful comments and suggestions.

1 Introduction

In response to the global recession that began in late 2007, policy makers called for coordinated fiscal responses, expressing a fear that spillover effects would dilute the effectiveness of policies pursued in isolation, and, implicitly, that some countries would free ride off of the difficult political decisions of others.[1] Were these policy makers' beliefs consistent with theoretical predictions and empirical evidence? To date there is little empirical evidence on the magnitude of fiscal policy spillovers, particularly for the United States. To the existing evidence I contribute estimates of the spillover effects of U.S. fiscal policy shocks on Canada, Japan and the U.K. from 1974 to 2007.

I find that while spillover effects of expansionary fiscal shocks are not uniform in direction or magnitude across the countries in my sample, for Canada and Japan they result in economically significant GDP increases over some portion of the response horizon. For all three countries, government spending shocks generally have larger effects than net tax shocks. Altogether, the results support the idea that some countries may benefit significantly from "free-riding" off of U.S. fiscal policy.

Several recent papers have looked at the effect of U.S. fiscal shocks on the U.S. real exchange rate, terms of trade and the trade balance, though in each case they estimate the effect relative to an aggregate of other countries rather than the effect on individual countries. Enders, Müller, and Scholl (2011), Monacelli and Perotti (2010), Kim and Roubini (2008) and Ravn, Schmitt-Grohé, and Uribe (2007) all find that increases in U.S. government spending or the primary budget deficit lead to real exchange rate depreciation. Enders, Müller, and Scholl (2011) and Corsetti and Müller (2006) also find that spending shocks decrease the terms of trade. Kim and Roubini (2008) and Corsetti and Müller (2006) find that increases in the primary deficit have a small but positive effect on the current account or trade balance, while Monacelli and Perotti (2010) find a negative effect on the trade balance. Boileau and Normandin (2008), in a multi-country study including the U.S., find that U.S. tax cuts increase the external deficit.

Arin and Koray (2009) and Canzoneri, Cumby, and Diba (2003) are the closest to what I do here. Arin and Koray (2009) estimate the effect of U.S. fiscal shocks on Canadian GDP, the bilateral real exchange rate, and Canadian and U.S. real short-term interest rates from 1961 to 2004. They find that U.S. government spending shocks have a negative effect on Canadian GDP, while net tax shocks do not have any significant effects. When their sample is restricted to 1973 through 2004 they find that Canadian GDP first increases in response to U.S. spending shocks, then becomes negative after 16 quarters. The latter finding is consistent with my results, discussed in detail below.

[1] See, e.g., the speech by Dominique Struass-Kahn, former managing director of the IMF, at Oesterreichische Nationalbank, Vienna, May 15, 2009, http://www.imf.org/external/np/speeches/2009/051509.htm, and the "Declaration of the Summit on Financial Markets and the World Economy" (G20 Washington Summit), November 15, 2008, http://www.g20.utoronto.ca/2008/2008declaration1115.html.

Canzoneri, Cumby, and Diba (2003) estimate the effect of U.S. fiscal shocks on GDP and the real effective exchange rate for the U.K., France and Italy from 1975 to 1999. They find that U.S. government spending increases lead to significant and persistent increases in foreign GDP, while an increase in net taxes has little to no effect. Spending increases in the U.S. also cause significant exchange rate depreciations in France and the U.K., with no significant effect for Italy, while net tax increases lead to significant appreciations in the U.K. and Italy, with no significant effect for France.

The introduction of the euro in 1999 and the resulting common monetary policy has motivated work on fiscal policy spillovers among euro-area countries. Beetsma, Giuliodori, and Klaassen (2006) and Giuliodori and Beetsma (2005) focus on international trade spillovers. Beetsma, Giuliodori, and Klaassen (2006), using a sample of 14 countries, find that domestic government spending increases and net tax decreases significantly increase imports from other euro area countries, with spending having the larger impact. Giuliodori and Beetsma (2005), likewise find that expansionary fiscal shocks in France, Germany and Italy lead to significant increases in imports from other euro area countries.

2 VAR Specification and Identification

I estimate the effects of fiscal shocks using a vector autoregression (VAR) on quarterly data from 1974:1 through 2007:4. The baseline specification for the VAR is of the form

$$x_t = \sum_{j=1}^{p} A_j x_{t-j} + u_t, \tag{1}$$

where x_t is the vector of endogenous variables, A_j is the coefficient matrix on lag j, u_t is the vector of reduced-form residuals and p is the lag length of the VAR. I start with a baseline specification that includes U.S. real government consumption and investment (g_t), U.S. real net taxes (t_t), U.S. real GDP (y_t), foreign real GDP (y_t^*), and the real bilateral trade balance (tb_t). Alternately, I include as a fifth variable the real bilateral exchange rate (q_t) and the ex-post real short term interest rate differential ($r_t - r_t^*$). U.S. net taxes are current tax and transfer receipts net of transfer, subsidy and interest payments. All variables except the interest rate differential are in natural logs and GDP, spending and net tax variables are per capita. The VAR is estimated in levels, with four lags, a constant and a linear time trend.

2.1 Identification

The residuals from an unrestricted VAR like (1) will, in general, be correlated across equations. As a result, the residuals from the equations for g and t cannot be interpreted as exogenous fiscal shocks – some method must be used to recover the uncorrelated structural shocks from the residuals. The relationship between the VAR residuals (u_t) and the desired structural shocks (ε_t) can be written as

$$u_t = B\,\varepsilon_t, \tag{2}$$

where $E[\varepsilon_t \varepsilon_t'] = I$. Two popular methods for recovering structural shocks require imposing specific restrictions on B.[2]

The first method, originally suggested by Sims (1980),[3] uses the Cholesky factorization of the estimated residual covariance matrix ($\widehat{\Sigma}_u$) for B.[4] This imposes a recursive ordering in which a shock to one variable has a contemporaneous effect on variables following it in the ordering, but no contemporaneous effect on those preceding it. One problem with this approach is technical: the impulse responses it generates may not be robust to alternate orderings of the variables. So the effect of changes in government spending or net taxes on GDP, for example, may change with the ordering of the variables. The larger the covariance between the residuals of the model the more sensitive the results will be to reordering. Another problem is conceptual: the contemporaneous effects it identifies may conflate discretionary policy responses with automatic changes in government spending or net taxes over the business cycle. For example, government transfers vary systematically over the business cycle by design and do not reflect discretionary policy changes. Since changes in the net taxes variable indirectly capture changes in transfers, the impulse responses to net tax shocks using a recursive identification reflect more than just responses to discretionary policy changes.

The second method, first used by Blanchard and Perotti (2002) in the fiscal policy context, seeks to deal with the conceptual problem of Cholesky identification by using external information to identify the contemporaneous response of government spending and net taxes to changes in output.[5] They use this information to derive restrictions on B that have the effect of isolating discretionary policy responses. For government spending they find no systematic response to changes in output at a quarterly frequency. In addition, they assume that policy makers take at least a quarter to make any discretionary changes in spending in response to changes in output. As a result, unanticipated government spending shocks are just the residuals from the spending equation in a VAR. This is equivalent to a recursive ordering with spending ordered before GDP. For net taxes, they use OECD estimates of the elasticity of taxes and transfers to changes in output to control for non-discretionary changes in net taxes. These estimates indicate a positive automatic response

[2] Another approach used in the fiscal policy literature does not identify fiscal policy shocks from measures of total government spending. Instead, measures of federal defense spending are used as instruments for government spending and included in a VAR. See Ramey (2011).

[3] Among the studies cited above, Arin and Koray (2009), Corsetti and Müller (2006) and Kim and Roubini (2008) use this method.

[4] The Cholesky factorization results in a lower triangular matrix P such that $PP' = \widehat{\Sigma}_u$. In this case, then, $B = P^{-1}$.

[5] Among the studies cited above, Canzoneri, Cumby, and Diba (2003) and Monacelli and Perotti (2010) use this identification method.

of net taxes to changes in GDP. Once the automatic response is controlled for, Blanchard and Perotti find a negative relationship between net taxes and GDP. A problem with this approach is that the results may be sensitive to the particular estimates used to control for the automatic responses. These estimates are obtained from regressions and therefore subject to estimation uncertainty which is not reflected in the resulting impulse responses.

2.2 Sign Restriction Methodology

In this paper I use the sign restriction approach of Mountford and Uhlig (2009) which I believe avoids the problems associated the identification methods above. The basic idea is to specify a minimal number of assumptions on what the impulse responses should look like, find a large number of candidate B matrices that produce impulse responses that satisfy the restrictions, and calculate point estimates and percentile bands from the resulting distribution of impulse responses. The advantage of this methodology over the recursive approach is that, like Blanchard and Perotti, I can specify the restrictions in a way that isolates discretionary policy shocks. In addition, the results are not dependent on the ordering of the variables. The advantage of this method over the Blanchard and Perotti approach is that it allows me to deal with the same problems they were addressing but in a more general way. Rather than specify a particular quantitative structural relationship *a priori* based on uncertain estimates of contemporaneous correlations, I generate many candidate structural relationships that share qualitative implications. This better accounts for the inherent uncertainty of the estimates.

2.2.1 Specifying the Restrictions

As mentioned above, the key to identifying discretionary policy shocks is controlling for the automatic response of spending and net taxes to changes in GDP. I accomplish this by following Mountford and Uhlig (2009) and first identifying a "business cycle shock" which captures these automatic responses and requiring government spending and net tax shocks to be orthogonal to the business cycle shock. To identify a business cycle shock I make one critical assumption: increases in net taxes do not cause increases in U.S. GDP; if output and tax revenue are both increasing it must be the result of an improvement in the business cycle. Specifically, I define a business cycle shock as a positive co-movement in the impulse responses of net taxes and U.S. GDP for quarters zero through four. In principal, the improvement in the business cycle could be the result of an increase in government spending. Accordingly, for a business cycle shock I also require that the increase in net taxes be greater than any change in government spending for quarters zero through four.[6]

A "government spending shock" is defined as increase in the impulse response of government spending for quarters zero through four that is also orthogonal to a business cycle

[6]The magnitude restrictions included for each of the shocks are intended to deal with what Fry and Pagan (2011) call the "multiple shocks problem." See below for additional detail.

Table 1: Identifying Sign Restrictions

	Business Cycle Shock	Gov't Spending Shock	Net Tax Shock
U.S. GDP (y_t)	$+$		
Gov't Spending (g_t)	$g_t < t_t$	$+$	$g_t < t_t$
Net Taxes (t_t)	$+$	$t_t < g_t$	$+$

Notes: This table shows the restrictions on the sign and relative magnitude of impulse responses for each identified shock. The restrictions are imposed for impact and the following four quarters.

shock. In certain draws that meet this restriction, it may also be the case that net taxes are decreasing over the same horizon. This is a fiscal change that is usually considered to have similar qualitative results as an increase in government spending. As a result, for government spending shocks I also require that the increase in government spending be greater in magnitude than any change in net taxes over the same horizon. I define "net tax shocks" analogously: an increase in the impulse response of net taxes for quarters zero through four that is orthogonal to a business cycle shock and which is greater than any change in government spending over the same horizon. Government spending and net tax shocks must also be mutually orthogonal. No restrictions are placed on the impulse responses of any of the other variables in the system. A summary of the identifying sign restrictions is provided in Table 1.

2.2.2 Generating Candidate Responses

First, it is useful to note that the Cholesky factorization mentioned above is only one of an arbitrarily large number of matrices for which $BB' = \widehat{\Sigma}_u$. As Fry and Pagan (2007) emphasize, each of these matrices represents a separate structural model, all of which are observationally equivalent in the sense that they produce residuals with the same covariance structure. To generate each set of impulse responses, I start with the Cholesky factorization (P) and multiply by an orthonormal matrix Q which has the property that $Q'Q = QQ' = I$. Accordingly, $PQQ'P' = \widehat{\Sigma}_u$. The sign restrictions I impose are restrictions on the responses of the first three variables in the VAR (government spending, g_t, net taxes, t_t, and U.S. GDP, y_t, respectively). So the matrix Q that I construct makes use of a Givens rotation in three dimensions. Specifically, for each set of candidate responses I draw $(\theta_1, \theta_2, \theta_3)$ from

$U[0,\pi]$ and calculate

$$Q_3 = \begin{bmatrix} \cos(\theta_1) & -\sin(\theta_1) & 0 \\ \sin(\theta_1) & \cos(\theta_1) & 0 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \cos(\theta_2) & 0 & -\sin(\theta_2) \\ 0 & 1 & 0 \\ \sin(\theta_2) & 0 & \cos(\theta_2) \end{bmatrix} \times \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\theta_3) & -\sin(\theta_3) \\ 0 & \sin(\theta_3) & \cos(\theta_3) \end{bmatrix},$$

where Q_3 is the upper left 3×3 section of Q. The rest of Q consists of ones on the diagonal and zeros everywhere else.

2.2.3 Potential Problems with the Methodology

Fry and Pagan (2007) and Fry and Pagan (2011) identify and discuss two potential problems when using the sign restriction methodology: the "multiple shocks problem" and the "multiple models problem." The multiple shocks problem arises when a set of responses could have been generated by more than one potential shock; not enough information is specified to discriminate between the potential shocks. An example of this in my case is a shock which produces an increase on impact and for the following four quarters in both net taxes and government spending. With only restrictions on the sign of the impulse responses this could be identified as either a government spending or net tax shock. As mentioned above, I impose additional restrictions on the magnitude of the responses to deal with this problem.

The multiple models problem arises from the fact that each set of impulse responses represents a different model of the relationship between the variables in the VAR. One way to present my results would be, for example, to provide the median response of foreign GDP to an identified net tax shock, calculating the median with reference to the range of responses of foreign GDP only. Then I could give the median response of the interest rate differential, calculating the median with reference to the range of responses of the interest rate differential only, and so on for the other variables. The problem with this approach is that if I do not consider the responses of all variables to a particular shock, there is no reason to expect that all of the median responses are coming from the same set of impulse responses. The result for each variable will likely be coming from a different model. To deal with this, Fry and Pagan (2007) suggest presenting the set of median responses that are "closest" to the median calculated across all candidate responses that meet the restrictions.

For this paper I generated candidate matrices Q until I had 1000 that each contained a business cycle, government spending and net tax shock identified using the restrictions discussed above. After I generated the corresponding impulse responses, I calculated the median and standard deviation of the responses to both the government spending and net tax shocks at each time horizon for each variable across all 1000 responses. I then calculated standardized deviations from the median by subtracting the median and dividing by the standard deviation. I calculated squared deviations for each variable in each candidate set of responses and then sum across the variables in that set of responses. This results in a single number that represents how close each set of responses is to the median across all

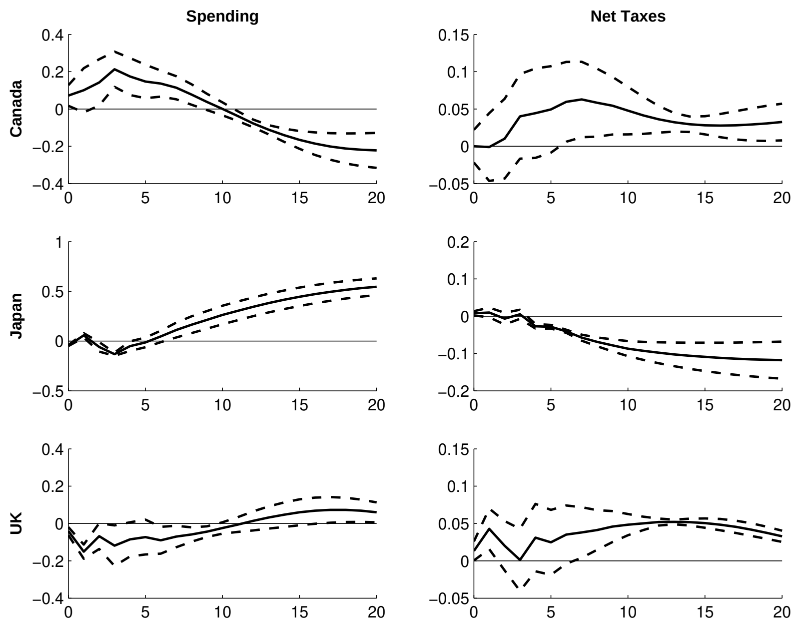

Figure 1: Effect of 1% increase in Spending and Net Taxes on Foreign GDP

variables and sets of responses. The set of responses with the lowest number is chosen as the median in the results I present.

3 Results

Graphs of the impulse responses to a positive government spending shock and a positive net tax shock are given in Figures 1 - 4. Tables 2 and 3 provide more detailed numerical results. Using the sign restrictions explained above, I generated 1000 sets of impulse responses. The point estimates are the median values across the identified responses. Two-standard-error bands were calculated from the standard error for each variable's response across all of the identified responses.

3.1 Foreign GDP

An increase in U.S. government spending initially has a positive effect on Canadian GDP, peaking at 0.21%, but the effect becomes negative after about 10 quarters. For Japan the effect alternates between negative and positive for the first 4 quarters, but is consistently positive thereafter, peaking at 0.55%. The effect on U.K. GDP is negative until around the tenth quarter, then becomes positive. The peak effect is a decrease of 0.15%. For all three countries, zero falls outside the two-standard-error bands over most

Table 2: Government Spending shock

	impact	4 qrts	8qrts	12 qrts	20 qrts	peak	
			Real GDP (%)				
Canada	0.07*	0.17*	0.08*	-0.08*	-0.22*	-0.22*	(20)
Japan	-0.04*	-0.05*	0.16*	0.34*	0.55*	0.55*	(20)
U.K.	-0.04*	-0.09	-0.06*	0.01	0.06*	-0.15*	(1)
			Trade Balance (%)				
Canada	0.27*	0.38*	0.59*	0.63*	0.54*	0.63*	(13)
Japan	-0.64*	-2.25*	-1.25*	-0.58*	0.19*	-2.41*	(3)
U.K.	-2.08*	-1.98*	-1.69*	-0.96*	0.69*	-2.55*	(3)
			Real Exchange Rate (%)				
Canada	0.18*	-0.40	-0.89*	-1.30*	-1.75*	-1.75*	(20)
Japan	-0.72*	-0.98*	-0.98*	-0.92*	-1.14*	-1.14*	(20)
U.K.	-0.11	1.06*	0.25*	-0.13	-0.68*	1.19*	(2)
			Interest Rate Differential (basis points)				
Canada	8.22*	-22.43*	-18.82*	-9.82*	-10.58*	-27.52*	(5)
Japan	6.83	-30.79*	-30.25*	-26.67*	-1.54	-31.21*	(5)
U.K.	4.10	-23.70*	-10.62*	-9.99*	-9.35*	-23.70*	(4)

Notes:
Response to a one-period, 1% increase in the level of real U.S. government spending per capita. An asterisk indicates that zero falls outside two-standard-error bands. The number in parentheses is the quarter in which the peak effect occurs.

Table 3: Net Tax shock

	impact	4 qrts	8qrts	12 qrts	20 qrts	peak	
			Real GDP (%)				
Canada	0.000	0.044	0.058*	0.036*	0.033*	0.063*	(7)
Japan	0.008*	-0.027*	-0.069*	-0.098*	-0.118*	-0.118*	(20)
U.K.	0.013*	0.031	0.041*	0.052*	0.033*	0.052*	(12)
			Trade Balance (%)				
Canada	0.026*	0.118*	0.032	-0.048	-0.117*	0.128*	(5)
Japan	-0.311*	0.069	-0.002	0.053	0.123*	-0.311*	(0)
U.K.	-0.006	-0.095	0.009	0.097*	0.233*	-0.248*	(1)
			Real Exchange Rate (%)				
Canada	-0.077*	-0.235*	-0.267*	-0.300*	-0.354*	-0.354*	(20)
Japan	0.134*	0.046	0.268*	0.360*	0.379*	0.379*	(20)
U.K.	-0.007	-0.150*	-0.057	-0.036	-0.095*	-0.163*	(3)
			Interest Rate Differential (basis points)				
Canada	5.011*	6.053*	4.936*	5.430*	4.150*	8.937*	(3)
Japan	-1.286	5.354*	4.754*	3.258*	-0.613*	6.703*	(3)
U.K.	2.640*	10.706*	9.396*	5.232*	3.945*	10.984*	(6)

Notes:
Response to a one-period, 1% increase in the level of real U.S. net taxes per capita. An asterisk indicates that zero falls outside two-standard-error bands. The number in parentheses is the quarter in which the peak effect occurs.

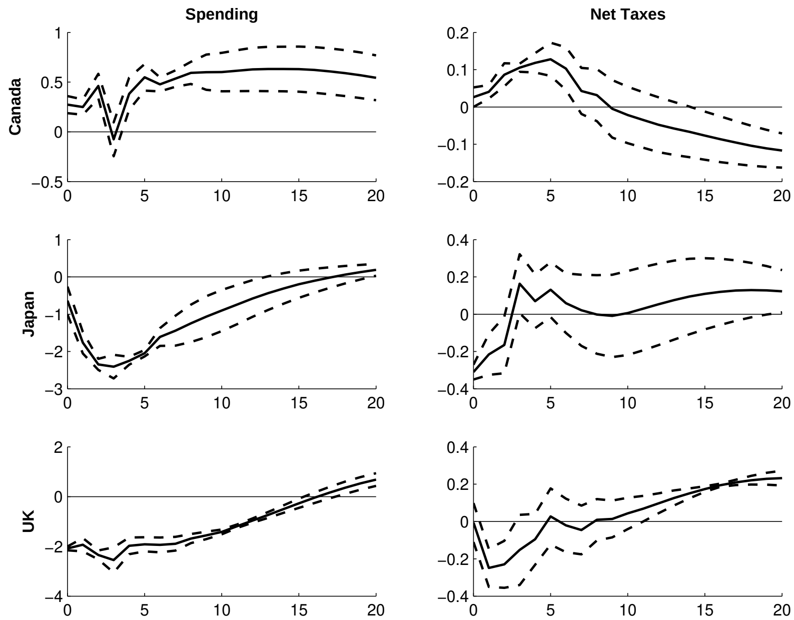

Figure 2: Effect of 1% increase in Spending and Net Taxes on Trade Balance

of the response horizon. A temporary increase in U.S. net taxes has a positive effect on Canadian and U.K. GDP, peaking at 0.063% and 0.052% respectively. There is initially a positive impact on Japan's GDP, but the effect becomes negative after 4 quarters, peaking at -0.118%.

3.2 Bilateral Trade Balance

With respect to Canada, the effect of a government spending shock improves the trade balance and the effect is persistent. An increase in spending leads to a decrease in the trade balance with Japan and the U.K., though the effect becomes positive near the end of the response horizon. The peak effects are improvements of 0.63% with respect to Canada and a deterioration of 2.41% and 2.55% with respect to Japan and the U.K. In all cases zero falls outside the two-standard-error bands over most of the response horizon.

With an increase in net taxes the trade balance with Canada initially improves but the effect becomes negative after nine quarters. The trade balance with Japan initially falls, with a positive effect occurring around three quarters after the shock. After basically no effect on impact for the U.K, the effect becomes negative for several quarters and then becomes positive again for the rest of the response horizon. The magnitude of the effects are smaller than for spending shocks; the peak effects are improvements of 0.13% for Canada, and a deterioration of 0.25% and 0.31% for Japan and the U.K.

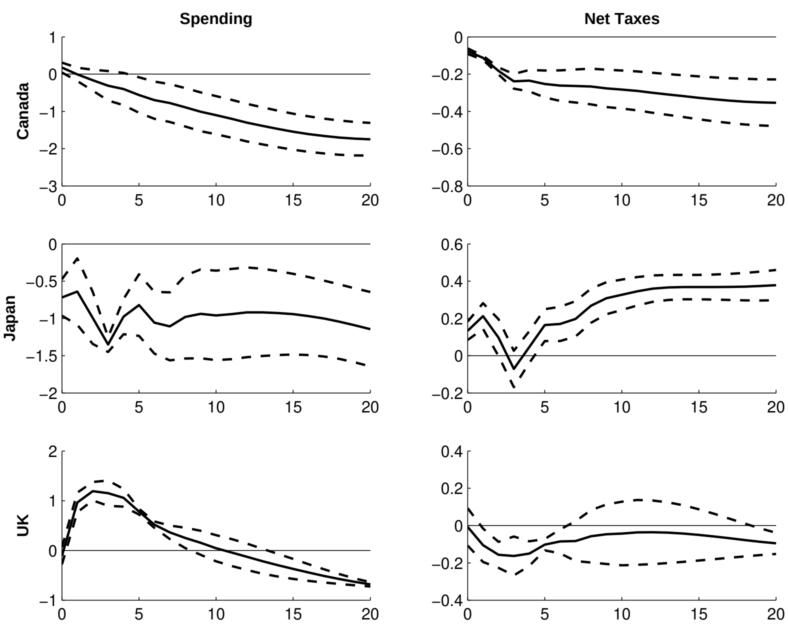

Figure 3: Effect of 1% increase in Spending and Net Taxes on Real Exchange Rate

3.3 Real Exchange Rate

A government spending shock leads to a persistent real exchange rate depreciation with respect to both Canada and Japan. For the U.K., a depreciation on impact quickly becomes an appreciation and then a depreciation again after ten quarters. The peak effect ranges from a 1.19% appreciation relative to the U.K. (eventually becoming an 0.68% depreciation) to a 1.14% depreciation relative to Japan to a 1.75% depreciation relative to Canada. A net tax increase results initially in a depreciation again with respect to Canada, but an appreciation with respect to Japan and a depreciation with respect to the U.K. Once again, the peak effects are significantly smaller than for government spending shocks: depreciations of 0.35% and 0.16% with respect to Canada and the U.K., and an appreciation of 0.38% with respect to Japan.

3.4 Interest Rate Differential

For all three countries, a positive spending shock leads to a decrease in the interest rate differential. This implies a decrease in the U.S. rate, a decrease in the foreign rate or both. Net tax shocks have the opposite result for all three countries. The peak effects for spending shocks are -28, -31 and -23 basis points for Canada, Japan and the U.K. respectively. For net tax shocks the peak effects are 9, 7 and 11 basis points for Canada, Japan and the U.K. If the effect of net tax decreases is symmetric to that of increases, then

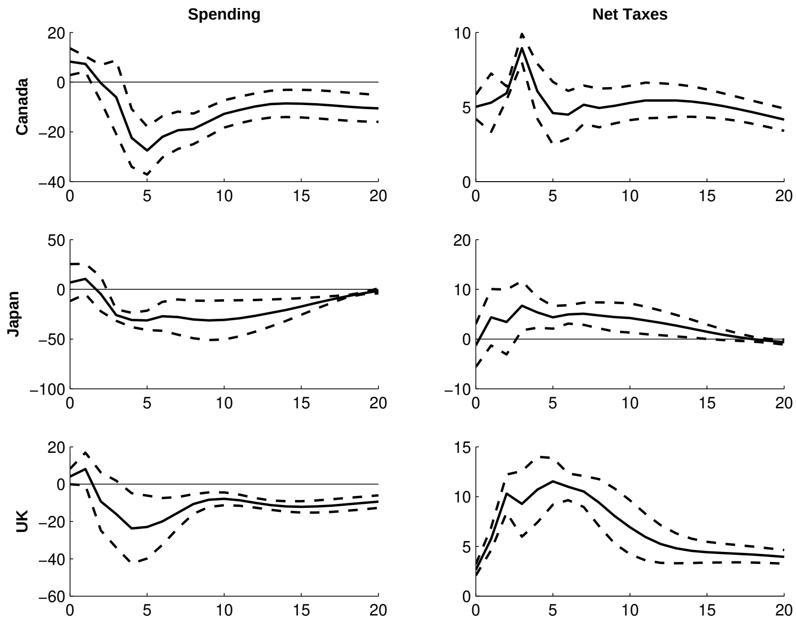

Figure 4: Effect of 1% increase in Spending and Net Taxes on Interest Rate Differential

this is the only variable for which the estimated direction of the effect is consistent across both types of "expansionary" shocks.

3.5 Sign Restriction vs. Other Identification Methods

In this section I consider the results generated from the sign restriction identification relative to those generated by recursive identification and the Blanchard and Perotti methodology. For the recursive identification the U.S. variables were ordered government spending, net taxes, then GDP. For the Blanchard and Perotti methodology I used the values reported in their paper to estimate a VAR using my data sample. Figure 5 shows the results for government spending shocks and Figure 6 shows the results for net tax shocks. Since there is no reason to think that the relative difference in identifications should vary by country, I only report results for the U.S. - Canada specifications.

From the figure it is clear that the government spending shocks identified from the sign restriction approach generate nearly identical responses to those identified by a recursive ordering with government spending ordered first. For the Blanchard and Perotti methodology, the shape of the responses is very similar, but the magnitudes on impact are smaller. For the foreign variables, this is the result of additional zero restrictions I had to impose to identify the model.[7] For all of the variables except the GDP variables, the Blanchard

[7] In Blanchard and Perotti (2002) they estimate a three-variable VAR consisting only of U.S. government

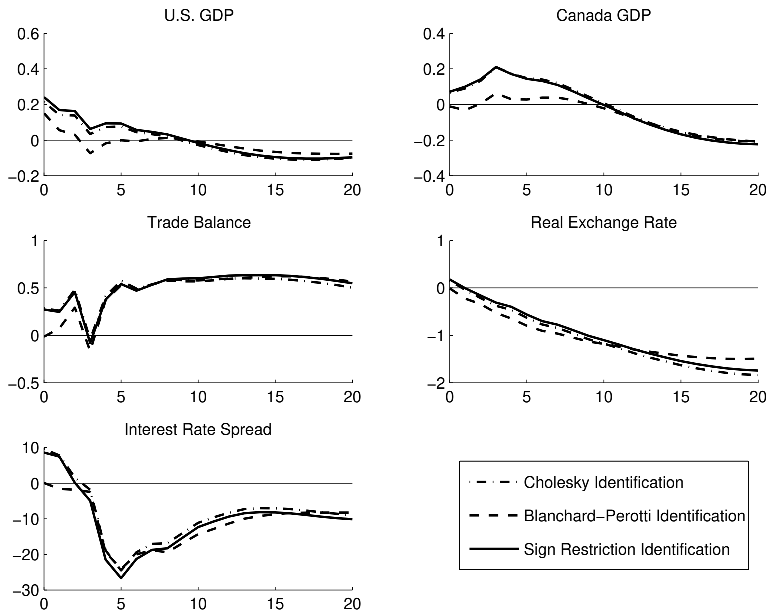

Figure 5: Effect of 1% increase in Spending.

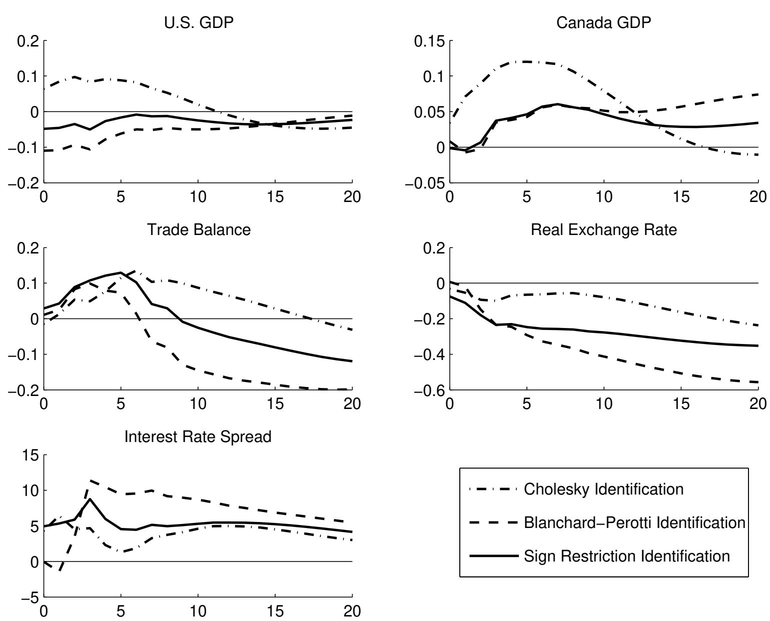

Figure 6: Effect of 1% increase in Net Taxes

and Perotti responses track the recursive and sign restriction responses very closely after the first few quarters. For U.S. and Canadian GDP, the magnitude of the response is lower than the recursive and sign restriction responses for about eight quarters. Overall the similarity of the recursive and sign restriction results supports Blanchard and Perotti's finding that there are no systematic changes in government spending in response to GDP at a quarterly frequency. As a result, it does not seem to matter which of the methods are used to estimate responses to government spending shocks.

A much clearer difference is evident with the responses of U.S. and Canadian GDP to net tax shocks. In the case of U.S. GDP, the response on impact to a positive net tax shock is negative for both the sign restriction and Blanchard and Perotti approaches while in the recursive specification it positive. This difference in responses supports the conclusion that a simple recursive specification does not adequately control for automatic co-movements in net taxes and GDP. With Canadian GDP, the three identification methods all show a positive effect but the recursive specification shows a larger effect on impact and much larger peak effect. This difference is likely driven by the difference in responses for U.S. GDP. For the trade balance, real exchange rate, and interest rate difference the qualitative results for each identification method are similar: an increase in the trade balance, depreciation of the exchange rate, and increase in the interest rate difference. The sign restriction approach generates responses whose magnitudes typically fall between the recursive and Blanchard and Perotti methods. Overall, the identification method makes a difference for identifying the effects on GDP, but not so much for the other variables.

3.6 Open Economy vs. Closed Economy Multiplier

In this section I compare the estimated multipliers on U.S. fiscal policy shocks in a closed-economy empirical model relative to an open-economy model. Basic economic intuition suggests that the multipliers on government spending and net tax shocks should be smaller in an open economy since any change in private demand that results from changes in fiscal policy will fall in part on imports rather than domestic production. Table 4 shows numerical results for the two specifications, while Figure 7 shows the impulse responses.[8]

The peak effect of a one-dollar increase in government spending is a \$1.23 increase in U.S. GDP in both specifications and occurs on impact. In the open-economy specification, however, the effect decreases more rapidly than in the closed-economy specification and becomes negative after ten quarters. After twenty quarters the effect is a decrease of \$0.50 in the open-economy specification, while in the closed-economy specification the effect is still positive at \$0.17. For an increase in net taxes, one again the peak effects are similar, with a one-dollar increase in net taxes leading to a peak decrease in U.S. GDP of \$0.46 in the closed-economy specification and a peak decrease of \$0.35 in the open-economy

spending, net taxes, and GDP.

[8] The open-economy specification includes Canadian GDP and the U.S.-Canada trade balance as the foreign variables.

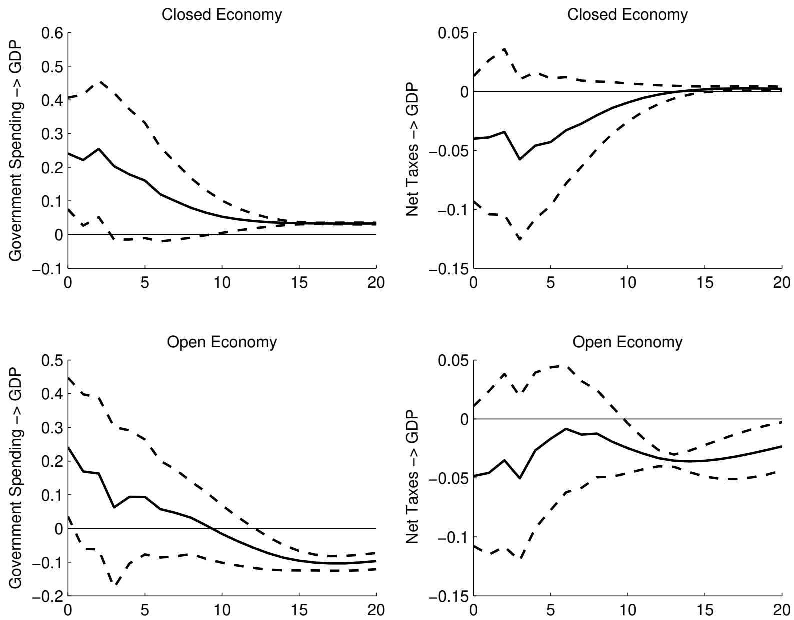

Figure 7: Response of U.S. GDP to a positive 1% shock to Spending and Net Taxes.

Table 4: Open vs. Closed Economy Multipliers

	impact	4 qrts	8qrts	12 qrts	20 qrts	peak	
				Open Economy			
Spending	1.23	0.48	0.16	-0.30	-0.50	1.23	(0)
Net Taxes	-0.35	-0.17	-0.08	-0.25	-0.19	-0.35	(0)
				Closed Economy			
Spending	1.23	0.91	0.40	0.21	0.17	1.23	(0)
Net Taxes	-0.32	-0.36	-0.16	-0.02	0.02	-0.46	(3)

Notes:
Response, in dollars, to a one-period, $1 increase in the level of real U.S. government spending or U.S. net taxes per capita. The number in parentheses is the quarter in which the peak effect occurs.

specification. In the closed-economy specification the effect gradually approaches zero, while in the open-economy specification the negative effect persists for the entire impulse response horizon.

4 Conclusion

The response to U.S. fiscal shocks is not uniform across countries or type of shock. In general the response to government spending shocks is much larger – often an order of magnitude – than the response to net tax shocks. Qualitatively, the effect of spending shocks are sometimes expansionary for the foreign country. For example, U.S. spending shocks lead to significant increases in GDP in both Canada and Japan over some part of the response horizon, though in Canada they eventually lead to decreases. Net tax increases are expansionary for Canada and the U.K. over most of the horizon, though they are contractionary for Japan after about 4 quarters. Spending increases lead to real exchange rate depreciations with respect to Canada and Japan, an appreciation with respect to the U.K., and improve the trade balance with Canada, but not with Japan and the U.K. Net tax increases cause exchange rate appreciations with respect to Japan but depreciations with respect to Canada and the U.K. For Canada and the U.K. net tax increases have the same effect on the trade balance as spending increases. But again, for both the real exchange rate and trade balance the magnitudes are much smaller than for spending shocks.

This paper relied on an identification method for fiscal shocks that has conceptual benefits over other common identification methods. As a practical matter, however, when government spending shocks are identified from total government spending and investment in a VAR each of the three identification methods discussed produces similar results. For net tax shocks the identification method matters, particularly for the short-term responses.

References

Arin, K., and F. Koray (2009): "Beggar thy Neighbor? The Transmission of Fiscal Shocks from the US to Canada," *Open Economies Review*, 20, 425–434.

Beetsma, R., M. Giuliodori, and F. Klaassen (2006): "Trade Spill-Overs of Fiscal Policy in the European Union: A Panel Analysis," *Economic Policy*, 21(48), 639–687.

Blanchard, O., and R. Perotti (2002): "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *The Quarterly Journal of Economics*, 117(4), 1329–1368.

Boileau, M., and M. Normandin (2008): "Do Tax Cuts Generate Twin Deficits? A Multi-Country Analysis," Mimeo.

Canzoneri, M. B., R. E. Cumby, and B. Diba (2003): "New Views on the Transatlantic Transmission of Fiscal Policy and Macroeconomic Policy Coordination," in *Monetary and Fiscal Policies in EMU: Interactions and Coordination*, ed. by M. Buti, pp. 283–311. Cambridge University Press, Cambridge.

Corsetti, G., and G. J. Müller (2006): "Twin Deficits: Squaring Theory, Evidence and Common Sense," *Economic Policy*, 21(48), 597–638.

Enders, Z., G. J. Müller, and A. Scholl (2011): "How do fiscal and technology shocks affect real exchange rates?: New evidence for the United States," *Journal of International Economics*, 83(1), 53 – 69.

Fry, R., and A. Pagan (2007): "Some Issues in Using Sign Restrictions for Identifying Structural VARs," Working Paper 14, National Centre for Econometric Research.

——— (2011): "Sign Restrictions in Structural Vector Autoregressions: A Critical Review," *Journal of Economic Literature*, 49(4), 938–60.

Giuliodori, M., and R. Beetsma (2005): "What are the Trade Spill-Overs from Fiscal Shocks in Europe? An Empirical Analysis," *De Economist*, 153(2), 167–197.

Kim, S., and N. Roubini (2008): "Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S.," *Journal of International Economics*, 74(2), 362 – 383.

Monacelli, T., and R. Perotti (2010): "Fiscal Policy, the Real Exchange Rate and Traded Goods," *The Economic Journal*, 120(544), 437–461.

Mountford, A., and H. Uhlig (2009): "What are the Effects of Fiscal Policy Shocks?," *Journal of Applied Econometrics*, 24(6), 960–992.

Ramey, V. A. (2011): "Identifying Government Spending Shocks: It's All in the Timing," *The Quarterly Journal of Economics*, 126(1), 1–50.

Ravn, M. O., S. Schmitt-Grohé, and M. Uribe (2007): "Explaining the Effects of Government Spending Shocks on Consumption and the Real Exchange Rate," Working Paper 13328, National Bureau of Economic Research.

Sims, C. A. (1980): "Macroeconomics and Reality," *Econometrica*, 48(1), 1–48.