The impacts of standard monetary and budgetary policies on liquidity and financial markets: International evidence from the credit freeze crisis

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Abstract

This paper evaluates the domestic and international impacts of lowering short-term interest rates and increasing budget spending on several indicators of liquidity, volatility, credit and economic activity. Data from the 2003-2011 period in the United States, the Euro zone and Canada were used to develop two SVAR models for assessing the national effectiveness and the international spillovers of monetary and budgetary policies during the credit freeze crisis. While monetary policies caused a temporary decrease in volatility and increase in liquidity in North American stock markets, the shocks were mainly domestic and ineffective at generating liquidity in the banking sector. In contrast, government spending shocks had a positive impact on credit and consumption, especially in Europe and Canada. Moreover, budgetary policies also had a positive international spillover effect on consumption and credit, especially for smaller economies such as Canada.

JEL classification: F42, G15, G18.

Keywords: Bayesian estimation, Credit freeze crisis, Budgetary policy, International transmission, Monetary policy, SVAR.

1. Introduction

The recent credit freeze crisis provoked a global economic recession. The financial literature documents several causes for the crisis, namely low interest rates (Brunnermeier, 2009, Taylor, 2009), the perverse effects of securitization (Mian and Sufi, 2008, Brunnermeier, 2009) and misallocation of investment created by asymmetries of information (Diamond and Rajan, 2009). The effects of the mortgage crisis in the United States were limited at first, but soon all financial markets and the real economy were infected. By 2008, the credit freeze crisis had spread internationally, causing a dramatic global decrease in stock markets and a fall in consumer and firm confidence (Blanchard, 2009). Monetary and budgetary expansionary policies were adopted in order to stabilize the economies (Almunia et al., 2010). Central banks decided to decrease their interest rate[3] and the government implemented a fiscal stimulus order[4] to limit the real

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[3] For example, on 8th October 2008 six central banks worldwide (including the FED, the EBC and the Bank of Canada) reduced their interest rates by 0.5% in an unexpected shift.

impacts of the financial crisis (Blanchard et al., 2010 and Woodford, 2011). The objective was threefold. First, governments supported the banking sector by buying illiquid assets, recapitalizing banks that could survive the crisis, and merging or closing banks that could not (Blanchard, 2009 and Diamond and Rajan, 2009). Second, restore confidence in financial markets by injecting liquidity into the banking sector and other distressed sectors (Spilimbergo et al., 2009). Finally, interventions were designed to stimulate consumption and growth (Woodford, 2011 and Coenen et al., 2012).

This paper investigates whether such standard monetary and budgetary policies have been effective in mending the financial meltdown caused by the credit freeze crisis, by looking at the impact of lowering interest rates and increasing government budget on key economic and financial indicators of liquidity, economic recovery and financial market stability. An autoregressive (SVAR) methodology that relies on Bayesian identification (Sims and Zha, 1998, 1999) is used to study and compare three countries/regions: the United States, the Euro zone and Canada during the 2003-2011 period. First, the performance of standard monetary and budgetary domestic policies is evaluated. Second, the cross-country spillover effects of these economic policies in each of the three countries on the others' economies of the sample are identified.

This paper makes two main contributions to the financial literature. First, the existing economic literature on SVAR models and on the impact of monetary and budgetary policies focuses mainly on macroeconomic variables. However, it is important to consider the efficiency of these policies to restore the "credit channel," especially in the first stage of the crisis - the illiquidity period (Blanchard et al., 2010). Consequently, this paper extends the existing empirical literature using the Structural Vector Autoregression model (SVAR) approach by considering the impact of standard economic policies on financial variables. We introduce measures of the banking sectors' liquidity as well as liquidity and volatility indicators for the financial markets. Banking and financial variables are still rarely incorporated into analyses, though doing so could help in evaluating a government's ability to stabilize the financial sector as well as the real economy. Our objective is to bridge this gap by introducing well-known financial indicators from the financial and asset pricing literature. This paper pays particular attention to international channels of transmission of liquidity in the banking sector and their modeling implications. Second, the impact of monetary and budgetary policies is not restricted to the domestic market. This paper examines whether a "remedy" consisting of standard monetary and budgetary policies can have an effect beyond its domestic market and "immunize" others as well. Another possible dynamic is a zero-sum game, where liquidity injected into one market prevents similar injections into other markets due to a worldwide shortage of funds. Thus, another aim of this paper is to assess whether a country's foreign policies have a positive, negative or neutral impact on the recovery of other countries, not only on their macroeconomic situation (Auerbach et al., 2012a, 2012b).

Our main results are as follows. First, lowering short-term interest rates proved ineffective in creating liquidity in the banking sector in all countries/regions considered. However, despite the low short-term interest rates during the study period, stock market volatility decreased and stock market liquidity increased when interest rates were lowered in North American stock markets. No such positive effect of monetary policy was found in Europe. Second, increasing government

[4] This fiscal stimulus was esteemed as 2% of the G-20 GDP during 2009 by the World Economic Outlook.

spending can have a positive effect on credit and consumption. While private consumption increased after budgetary shock in all countries/regions considered, the ratio of credit to GDP increased in Europe and Canada, but not in the United States. Finally, budgetary policies appear to have especially significant positive international spillovers in smaller countries such as Canada.

2. Literature review

In terms of monetary policies, the international evidence in the literature focuses on the macroeconomic effects of monetary policy often associated with variations in US interest rates. In particular, the analyses are concentrated on the effects of domestic and external monetary shocks on macroeconomic variables such as exchange rates, the CPI index and industrial production (Cushman and Zha, 1997, Kim and Roubini, 2000, Kim, 2001, Mongelli, 2002, Canova, 2005 and Mackowiak, 2007). Concerning the international spillover of monetary policies, the real impact of the U.S. interest rates shock in the more advanced economies is limited even if these countries generally respond with the same policy (Kim and Roubini, 2000 and Mackowiack, 2007).

The recent literature suggests that budgetary policies could be effective to ease the credit freeze crisis, even if increasing credit is primarily believed to be the job of monetary policy. Tax breaks can strengthen consumers' and companies' financial health, which would in turn increase their access to credit as well as their credit score (Spilimbergo et al., 2009). Moreover, Blanchard et al. (2010) argue that the crisis forced governments and central banks to extend their liquidity support to non-depository institutions by intervening directly (with repurchase) and indirectly (by acting as collateral) in a broader range of markets than their traditional role as a last-resort lender with banks. Eggertsson and Krugman (2012) show that expansionary fiscal policy should be effective because it needs only to be temporary given that the deleveraging shock is inherently transitory. The impact of the fiscal stimulus and the multiplier effect is typically assessed via several macroeconomic variables, including private consumption, industrial production, GDP and unemployment (Blanchard and Perotti, 2002 Asdrubali and Kim, 2008, Mountford and Uhlig, 2009, Almunia et al., 2010 and Auerback et al., 2012a, 2012b). With respect to the recent credit freeze crisis, the budgetary measures undertaken were different according to the countries that used spending increases and/or tax decreases. The evaluation of the direct real effects of the fiscal multipliers is the subject of considerable debate (Blanchard and Leight, 2013) and results depend on the type of fiscal measures implemented (Blanchard and Perotti, 2002, Almunia et al., 2010, Auerbach et al., 2012a, 2012b and Coenen et al., 2012). Moreover, the literature presents evidence of international spillovers for fiscal policies depending on the trading links distance and size of the economies. Positive spillovers are particularly important for the nearer and smaller commercial partners and the Euro area (Benassy-Quéré et al., 2012, Corsetti et al., 2010, Auerbach et al., 2012c and Hebous and Zimmerman, 2013).

While this literature recognizes the importance of the banking and financial sectors in the context of the credit freeze crisis, the empirical assessment of policies relies almost exclusively on macroeconomic variables. Though the effects of liquidity and volatility are extensively

reported in microstructure literature[5], empirical assessment of the relationship between financial liquidity, volatility, government policies and the real economy is still not well-developed. In general, a negative relationship between illiquidity and expected asset returns has been found (Amihud, 2002, Pastor and Stambaugh, 2003, Acharya and Pedersen, 2005 and Bekeart et al., 2007). In terms of government intervention, Alfonso and Martin (2012) document changes in the US yield curve shape following a budgetary shock. Tirole (2008) shows it is possible for governments to provide outside liquidity to the financial sector, but doing so may accentuate the perverse effects of information asymmetries. Given that the connections between governments, central bank policies and liquidity are still not fully understood, we argue that the flexibility of the SVAR model is advantageous because it allows for a multivariate system where these variables interact together.

3. The structural vector auto-regression (VAR) model

The reduced form representation of VAR (q), where q is the number of lags and e_t is a white noise, is:

$$Y_t = \sum_{i=1}^{q} A_i Y_{t-i} + e_t . \tag{1}$$

The variance-covariance matrix of the error vector has no restrictions, that is to say $E(e_t, e_t^T) = \Omega$ and $E(e_t) = 0$. Standard notation is used and L is the lag operator. Consequently, the VAR(q) model can be written as:

$$A(L)Y_t = e_t \tag{2}$$

To obtain the shock response functions and the error variance decompositions, the process is expressed in the infinite moving average form. The Wold Theorem specifies the moving average where e_t represents the vector of canonical innovations:

$$Y_t = \sum_{j=0}^{\infty} C_j e_{t-j} = C(L)e_t . \tag{3}$$

The structural moving average representation is:

$$Y_t = \sum_{j=0}^{\infty} \Theta_j \varepsilon_{t-j} = \Theta(L)\varepsilon_t \tag{4}$$

where ε_t is the vector of structural shocks and Θ_j their associated coefficients. With P, an invertible matrix n x n has to be estimated to identify the structural shocks:

$$e_t = P\varepsilon_t \tag{5}$$

[5] See for example, Kyle (1985), Easley and O'Hara (1987), Glosten and Harris (1988), Brennan and Subrahmanyam (1996) and Bernardo and Welch (2004).

Sims and Zha (1998) use priors and Bayesian inference to identify the *P* matrix. With this approach, economic theory can be incorporated into the priors (so that they are not flat). The method imposes no restrictions on the conditional mean of lagged variable coefficients. However, it does restrict beliefs about lagged variable coefficients to be Gaussian and uncorrelated across equations conditional on contemporaneous variable coefficients, though it allows them to be correlated in different ways in different equations. As a result, this method not only makes it possible to evaluate large systems (because it imposes cross-equation restrictions on priors) but also allows non flat priors based on economic theory. Moreover, Bayesian inference is not affected by the presence of a unit root (Sims, 1988, Sims and Uhlig, 1991). This feature of the Sims and Zha (1998) method and Bayesian inference in general means macroeconomic variables can be introduced in levels rather than first differences, which is more informative.

Impulse response functions and their standard errors associated with a one standard deviation shock in either monetary or budgetary policy were generated using the Bayesian Monte-Carlo integration method proposed by Sims and Zha (1999)[6]. Furthermore, the effects of domestic and foreign economic policies on domestic variables are compared. We first measure the influence on domestic financial and economic indicators of domestic policy using national interest rate shock and domestic budgetary policy shock. Then, the influence of foreign interest rate shocks and foreign budgetary policies on domestic indicators is investigated in a separate model. The analysis was performed successively with US, European and Canadian domestic variables. This separate identification strategy used to assess the impact of foreign variables on domestic ones follows a well-established procedure (Kim and Roubini, 2000, Canova, 2005, Beetsma et al., 2006, Mackowiak, 2007and Benassy-Quéré et al., 2012).

4. Data and restrictions

This section describes data and contemporaneous restrictions used to identify Eq. (4) for the monetary and budgetary models. In both models, contemporaneous restrictions on the *P* matrix are specified according to economic theory and the financial literature. Our sample comprises US, European and Canadian financial and macroeconomic data for an eight-year window starting in January 2003 and ending in December 2011. This study period was chosen to obtain an undiluted message about the credit freeze crisis (/illiquidity crisis), which may require a different set of fiscal and monetary measures than the sovereign debt crisis in Europe. All variables except interest rates are in logarithms. The United States, Europe and Canada were selected for study as they represent different economic situations in international markets. The United States is an obvious choice, providing an opportunity to further document the US monetary policy transmission mechanism found in Kim (2001) as well as the spillover effects of US budgetary policy. The Euro zone was selected for two reasons: its size in the world economy and its common monetary policy, which adds another dimension to the analysis. Finally, the economic literature stresses the importance of assuming a small open economy when studying the effects of US monetary policy (Cushman and Zha, 1997, Canova, 2005, and Mackowiak, 2007). Canada is introduced as a case where this assumption is plausible, with the effects of Canadian policies

[6] Kilian and Chang (2000) show that Bayesian Monte Carlo integration technique proposed by Sims and Zha (1999) avoids the bias of the bootstrap method and outperforms other procedures for short horizons.

on US and European markets assumed insignificant and not investigated. With the Canadian evidence, the impacts of domestic and foreign policies in leading countries and in small economies can be compared and contrasted.

3.1. Domestic and foreign impacts of monetary policies

3.1.1. Financial indicators related to monetary policy models

In the first model, the objective is to investigate the impact of monetary policies on liquidity, volatility and the term spread. Monthly observations are used for monetary policy. Aggregated data are used for the Euro zone given its common monetary policy and monetary authority.

Table 1 presents a detailed description of the variables used in the monetary model. The exogenous variable in Eq. (4) is the three-month interest rate (3MM). This is the standard tool in the literature to assess monetary policies[7] (see e.g. Sims and Zha, 1995, Kim and Roubini, 2000, Mackowiak, 2007). Selection of the risk-free rate as the monetary tool meant that nonstandard policies, such as quantitative easing (QE), could not be covered in this paper. Since only the United States officially resorted to QE measures during the study period, it would not be relevant to evaluate the impact of a QE shock in Canada or the Euro zone[8]. Moreover, Table 2 reports that the average risk-free rate for the study period was lower in the United States than in the Euro zone or Canada. Thus, an international study of the effectiveness of expansionary interest rate policies remains relevant.

The four endogenous variables are liquidity of the banking sector (LIQ), term spread (TS), market liquidity (LIQMKT) and realized volatility (VOL). The liquidity of the banking sector (LIQ) is measured as the spread between the bank prime lending rate and the risk-free rate. The prime rate is uniformly reported and available for all countries/regions studied here. This is a different spread than the ones used in the funding risk literature, which focuses on interbank market liquidity[9]. The crisis was characterized by a diminished access to credit by firms and consumers (Blanchard et al., 2010). Eisenschmidt and Tapking (2009) find evidence that banks did not stop lending to each other in the short term in August 2007. They document that EONIA volume increased slightly during the crisis and that the spread of repo rates did not increase during the turmoil. The focus of this paper is not the interbank market in itself, but rather in the ability of the banking sector to transfer liquidity from the interbank market to the financial markets and the real economy. The prime rate spread measures whether liquidity from the interbank sector was transferred to the real economy.

[7] As a robustness check for our choice of monetary policy indicator for the period considered, we performed the tests based on the seminal work by Sims (1986) and Sims and Zha (1999). The results, available upon request, show that the data related to monetary policy during the studied period behave similarly as previously observed in the literature, suggesting it is appropriate to look at interest rate shocks in terms of monetary shocks.

[8] ECB launched an extensive long-term refinancing operation (LTRO) to alleviate the effect of the debt crisis in Europe in December 2011. However, this period is not covered by our study. LTROs have been used as a refinancing tool throughout the history of the ECB, but the operation of December 2011 was unexpectedly massive and considered a QE by some analysts.

[9] Typically, spreads such as the difference between the three months Euribor rate and the three months EONIA swap rate are used to study interbank liquidity (see Haider et al. 2009).

The term spread (TS), defined as the spread between a long-term government bond (10 years) and a short-term risk free rate is motivated by the asset pricing financial literature. This literature suggests that the slope in the yield curve (i.e. the term spread) predicts stock and bond markets (Keim and Stambaugh, 1986, Fama and French, 1989, Cochrane and Piazzesi, 2005, Ludvigson and Ng, 2007 and 2009 and Maio and Santa-Clara, 2012). An increase in the term spread predicts an increase in economic activity, whereas a decrease in the term spread typically precedes a recession in the United States (see e.g Estrella and Hardouvelis, 1991 and Adrian and Estrella, 2008). Thus, our paper investigates whether a decrease in the short-term interest rate can induce the yield curve's slope (measured by the term spread) to increase. Moreover, Fama and French (1989) find that the term spread is related to the shorter-term business cycles. Given that we look at the short term effects of monetary interventions, the term spread factor is included as a short-term financial indicator that predicts economic and financial recovery.

Liquidity in financial markets (LIQMKT) is a monthly average of daily bid-ask spreads on a given country's market index expressed as a percentage[10]. Bid-ask spreads are widely used as liquidity indicators in the financial literature.[11] In general, a negative relationship between illiquidity and expected asset returns has been found in the financial literature (Amihud, 2002, Pastor and Stambaugh, 2003, Acharya and Pedersen, 2005 and Bekeart et al., 2007).

Last, realized stock market volatility (VOL) is included in the model in order to investigate the ability of monetary intervention to appease financial markets. Realized volatility is an ex-post nonparametric and unbiased volatility estimator (Andersen et al., 2003, 2005, Phillips and Yue, 2009)[12]. This variable indicates the confidence level of financial investors in financial markets (Spilimbergo et al., 2009).

Table 2 gives descriptive statistics for the variables described above. The Canadian banking sector appears to have been the most liquid of the three banking sectors studied, as the spread between lending and borrowing rate was smallest (1.832%) here. Realized market volatility was similar across the study countries/regions. Finally, the US market was the most liquid of our sample, as its bid-ask spread was the smallest. The European bid-ask spread and its associated standard deviation was the highest in our sample, possibly because the IShare used as a proxy for the index is less accurate than the index itself.

[10] As a robustness check, we also used Pastor and Stambaugh's (2003) liquidity risk factor instead of the S&P 500 bid-ask spread for the United States. Results were unchanged by this substitution. As the Pastor and Stambaugh liquidity factor is not available for Canada or the Euro zone, results reported herein were obtained using bid-ask spread.

[11] See e.g. Amihud and Mendelson, 1986, Eleswarapu and Reinganum, 1993, Brennan and Subrahmanyam, 1996, Acharya and Pedersen, 2005 and Amihud et al., 2005.

[12] As a robustness check, we also used the VIX index for the United States. Results were unchanged by this substitution. Again, results are reported using realised volatility given that it is available internationally.

3.1.2. Contemporaneous restrictions for monetary policy shocks

Eq. (4) is estimated using:

$$Y = \begin{pmatrix} 3MM \\ TS \\ LIQ \\ LIQMKT \\ VOL \end{pmatrix},$$

,the vector of endogenous variables, and

$$\varepsilon_t \begin{pmatrix} \varepsilon_{mm} \\ \varepsilon_{ts} \\ \varepsilon_{bliq} \\ \varepsilon_{mliq} \\ \varepsilon_{mvol} \end{pmatrix}$$

the vector of structural shocks. ε_{mm} represents the expansionary monetary policy shock. In order to compare the impact of domestic and foreign monetary policies on domestic variables, we proceed with two series of tests. First, the 3MM shock is the shock associated to the domestic interest rate of the country and corresponds to the national monetary policy. Second, the foreign interest rate is considered in a separate model in order to measure the domestic impact of foreign monetary policy. ε_{ts}, ε_{bliq}, ε_{mliq}, ε_{mvol} are, respectively, domestic term spread, banking sector liquidity, financial market liquidity and market volatility shocks.

The objective is to identify the n^2 elements of P, the matrix specifying the contemporaneous restrictions of the model. As the matrix Ω is symmetric, $n(n+1)/2$ orthogonality constraints are already admitted. Thus, an additional ten conditions must be imposed on the transition matrix to obtain a just-identified structural model.

In the first series of tests, when the 3MM shock is the shock associated to the domestic interest rate of the country, adjustments of national interest rate to domestic shocks in the other variables are postponed for a month (Sims and Zha, 1995, Kim and Roubini, 2000). In the second series of tests, the first variable is replaced by the foreign interest rate in order to measure the effect of foreign monetary policy on domestic variables. The foreign monetary policy variable is supposed to be exogenous in the short term (Kim and Roubini, 2000, Canova, 2005, and Mackowiak, 2007). Consequently, the restrictions imposed on the first line of the P matrix are the same as the domestic monetary policy case.

Concerning the other domestic variables, we assume that long-term interest rates are unlikely to adjust within a single month to unexpected changes in banking and market liquidity and market volatility. The asset pricing literature provide indirect justifications for the restriction in the adjustment of bond variables simultaneous to a shock in stock indicators, as Fama and French (1989) found that that bonds risk factors are more appropriate to explain bond return than

stock risk factors. Consequently, term spread will not react immediately to changes in liquidity and volatility[13]. We obviously did not impose identification restrictions on term spread adjustment to monetary policy change. Next, we follow the order of events and the chain of transmission of the recent credit freeze crisis by imposing identification restrictions on the remaining variables. It is generally understood that the crisis originated in the housing and banking sector and eventually contaminated financial markets (Blanchard, 2009). Thus, the identification strategy should reflect the impact the credit and bond sectors have on the stock markets by allowing the stock market to adjust contemporaneously with 3MM, TS and LIQ. Thus, the banking sector liquidity indicator is assumed exogenous to financial market indicators in the short term. Finally, we allow for contemporaneous response of market liquidity and volatility to interest-rate, term-spread and banking-liquidity shocks. As it is not obvious whether the impact of market volatility on market liquidity should be restricted or vice versa, both identification restrictions are implemented, with comparable results[14]. Thus, our specification of the restrictions takes the form of a Choleski matrix in the two series of tests, with the most exogenous variable (3MM) in the first row and the most endogenous variable (VOL) in the last row.

3.2. Domestic and foreign impacts of budgetary policies

3.2.1. Indicators related to budgetary policy models

Next, we estimated the capacity of domestic and foreign budgetary policy to facilitate access to credit in the private sector, decrease risk in the financial market and boost economic recovery. The variables are at a quarterly frequency, as no higher frequency was widely available internationally.

Table 3 summarizes the variables used in the budgetary model. The exogenous variable in Eq. (4) is government budget (BUDGET). This indicator, which corresponds to the Maastricht criteria, aggregates into a single datum different types of expenses surplus and/or taxes cut measures adopted by the US, European and Canadian governments during the period of analysis. BUDGET is used in the literature in related contexts to assess the effects of fiscal policies (Aghion and Marinescu, 2007) and their cross-border externalities (Dees et al., 2007, Hebous and Zimmermann, 2013).

The endogenous variables are household consumption (CONS), industrial production (IP), credit to the private sector (CREDIT) and realized volatility (VOL). The first two variables were introduced to measure the impact of fiscal stimuli on the real economy. The effects of fiscal policy on economic recovery are measured on the demand side by household consumption as a percentage of total GDP (CONS) (see e.g. Christiano et al., 2011 and Auerbach et al., 2012a,

[13] This question has not been studied in the literature, especially because this paper is the first to introduce liquidity and volatility indicators in SVAR models. Thus, we performed a robustness check with a different order for TS and LIQ. The models were estimated with the following order: 3MM, LIQ, TS, LIQMKT, VOL. Results were similar from the case reported here and are available upon request.

[14] Results are reported using the following order of variables:3MM, TS, LIQ, LIQMKT, VOL. Results obtained using the alternative order of restriction (3MM, TS, LIQ, VOL, LIQMKT) were almost identical and are available upon request.

2012b). On the supply side, the industrial production index (IP) was used to evaluate the recovery of production (see e.g. Kim and Roubini, 2000, Mackowiak, 2007, Almunia et al., 2010, Benassy-Quéré et al., 2012). The recent literature identifies a chain of transmission of budgetary policies to the credit sector. Spilimbergo et al. (2009) define the credit crunch as a lack of bank capital. Blanchard (2009) documents that the financial crisis affects the economy through credit rationing, i.e., the tightening of lending standards by banks. We follow this rationale by using credit to the private sector (volume of loans to the private sector), expressed as a percentage of GDP (CREDIT), as the banking liquidity indicator. The CREDIT variable represents the volume of loans to the private sector and is therefore a direct measure of the banking sector's ability or willingness to loosen credit standards following a budgetary shock. This indicator therefore measures the banking sector's ability to mobilize resources for the private sector after the government-assisted recapitalization of financial institutions through injection of funds, for exemple (see e.g. Diamond and Rajan, 2009 and Blanchard, 2009). Last, realized volatility (VOL) expressed as daily percentage variation in stock market index measured the impact of the stimulus plan on stock market risk and instability (Spilimbergo et al., 2009)[15].

Table 4 shows mean and standard deviations for the quarterly data for the United States and Canada and for weighted averages of European countries. Table 5 gives the same statistics for the eleven countries in the European panel. The United States had the highest average deficit-to-GDP ratio (-1.49%). Average deficit-to-GDP ratio of the Euro zone was -0.82%, driven, not surprisingly, by Greece, Ireland and Portugal. Canada maintained a budgetary equilibrium over the study period, enjoying a budget surplus until the third quarter of 2008. Household consumption was highest in the United States at 67.78%. Industrial production (IP) and credit to the private sector (CREDIT) were highest in Canada during the study period.

3.2.2. Contemporaneous restrictions for budgetary policy shocks

In the second model, Eq. (4) is estimated using:

$$Y = \begin{pmatrix} BUDGET \\ IP \\ CONS \\ CREDIT \\ VOL \end{pmatrix}$$

the vector of endogenous variables, and ,

$$\varepsilon_t \begin{pmatrix} \varepsilon_{budg} \\ \varepsilon_{IP} \\ \varepsilon_{CONS} \\ \varepsilon_{CR} \\ \varepsilon_{fivol} \end{pmatrix}$$

[15] Again, as a robustness check, this variable was replaced by the VIX index in the US. Impulse response functions and variance decompositions remained unchanged.

the vector of structural shocks. ε_{budg} is the expansionary budgetary policy shock . We also proceeded with two series of tests in order to compare the impact of domestic and foreign budgetary policies on domestic variables. First, the shock is associated to the domestic budgetary policy indicator. In a second series of tests, this variable is replaced by the foreign budgetary policy indicator. ε_{cons}, ε_{IP}, ε_{CR}, ε_{fivol} are, respectively, the consumption, industrial production and domestic credit generated by banking sector and financial volatility shocks.

Budgetary policies of Euro area countries are independent (Maastricht Treaty signed in 1992). Thus, our analysis is supplemented by a panel SVAR for budgetary measures in the Euro area. In the panel formulation of Eq. (4), the reduced-form representation of the vector auto-regression model VAR(q), e_{it} is the vector of errors and $e_{it} = b_i + b_t + b_{it}$, where b_i is the individual fixed effect, b_t the time fixed effect and b_{it} is the disturbance term whose variance-covariance matrix has no restrictions, that is to say, $E(b_{i,t}, b_{i,t}^T) = \Omega$ and $E(b_{i,t}) = 0$. The vector of canonical innovations b_{it} is supposed to be a linear combination of structural impulses d_{it} at the same time, and thus $b_{i,t} = Pd_{i,t}$ (Alesina et al., 2002, Ardagna et al., 2004, Beetsma et al., 2006, Kim and Lee, 2008, Kim and Yang, 2011). Again, short-run constraints are imposed on P. The structural shocks are assumed to be uncorrelated and have unitary variance:

$$E(\varepsilon_t, \varepsilon_t^T) = I_n \tag{6}$$

Ω is the variance-covariance matrix of the canonical innovations e_t, thus:

$$E(e_t, e_t^T) = PE(\varepsilon_t, \varepsilon_t^T)P^T = PP^T = \Omega \tag{7}$$

The objective is to identify the n^2 elements of the P matrix. The $n(n\text{-}1)/2$ constraints (10 short-term constraints in the model) are chosen based on the economic literature and the literature on the credit freeze crisis. The matrix of restriction is defined as:

$$P^{bud} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ P_{21} & 1 & 0 & P_{24} & 0 \\ P_{31} & 0 & 1 & P_{34} & 0 \\ P_{41} & 0 & P_{43} & 1 & 0 \\ P_{51} & P_{52} & P_{53} & P_{54} & 1 \end{pmatrix}$$

Given that one objective of this paper is to evaluate the impact of budgetary shock, the contemporaneous response of the four variables to budgetary shock is left unrestricted (the first column of P^{bud}).

In the first series of tests, when the domestic budgetary policy is considered, it is not possible for governments to implement discretionary budgetary measures to respond to the current economic and financial changes within a quarter. This is a commonly established assumption in the recent literature on multiplier effects (Blanchard and Perotti, 2002, Beetsma et al., 2006, Dunguey and Fry, 2009, Mountford and Uhligh, 2009 Almunia et al., 2010). This assumption also applies to the foreign budgetary policy in the short term (Beetsma et al., 2006,

Benassy-Quéré et al., 2012). Thus in both cases we set budgetary constraints such as $P_{12}=P_{13}=P_{14}=P_{15}=0$.

All coefficients pertaining to a shock in volatility were restricted to zero ($P_{25}=P_{35}=P_{45}=0$), given that market volatility is observed at a higher frequency than the other macro variables (Dunguey and Fry, 2009). Moreover, the real supply shock and a volatility shock do not affect the credit supply within a quarter (Mizen, 2008 and Blanchard, 2009), so responses from the banking sector were restricted accordingly ($P_{42}=P_{45}=0$). Last, the response of production to consumption shock was restricted ($P_{23}=0$) (Kim and Roubini, 2000) and inversely ($P_{32}=0$) (Peersman and Smets, 2001).[16] Industrial inventories piled up in the months leading up to the freeze[17], meaning firms had to get rid of their inventories before increasing production after consumption began to increase.

4. Results

This section reports results of the estimation of Eq. (4) based on impulse response functions[18] and variance decomposition associated with domestic and foreign monetary and budgetary policy shocks. SVAR models (monetary policies and budgetary policies) are estimated with one lag, as is optimal according to the Bayesian Schwartz criterion and appropriate given the limited period (and number of observations) of our study, particularly in the budgetary policies model.

4.1. The impact of monetary policy shocks

4.1.1. The impact of monetary policy shocks on US variables

Fig. 1 depicts impulse response functions for the United States for a shock in domestic and foreign interest rates. Table 6 gives related variance decompositions. First, the impulse functions show that lowering domestic interest rates lead to a short-term (three months) decrease in stock market volatility (VOL) and an increase in stock market liquidity (decrease in bid-ask spread) (LIQMKT). The variance decomposition for these two variables is consistent with a short-term impact of lowering interest rates and shows that about 11% of the variance on these variables is explained by interest rates. However, there is no significant impact on banking sector liquidity (LIQ). Furthermore, term spread (TS) increases for two years, which is an economic recovery predictor. The variance decomposition associated with the term spread (TS) shows that short-term interest rates have a positive but decreasing impact on term spread, starting with an explanatory power of 20% of the variation in term spread and decreasing to less than 10% after

[16] As the literature includes few cases of liquidity and financial variables used with SVAR models, we tested the robustness of our results using different restrictions on P^{bud}. In particular, we tried to relax the assumptions relating to the credit freeze chain of contagion and allow for contemporaneous adjustments of CREDIT and VOL. Results were very similar, as these coefficients are not always significant.

[17] Inventory data (Bloomberg) for the study countries/regions show inventories piled up in 2007 and 2008 and decreased throughout 2009 and 2010 in Europe and the US. Inventories in Canada were more or less constant throughout the study period.

[18] Following Sims and Zha (1999), error bands correspond to the 16% and 84% quartiles (68% confidence interval). Results are significant if the confidence interval does not include the 0 axis.

eight quarters. In general, US expansionary monetary policies have a positive short-term impact on stock markets but do not help to ease the credit freeze in the banking sector.

Second, we focus on the impact of foreign interest rate on US domestic variables. The bottom part of Fig. 1 shows the response of US variables to European interest-rate shock. As with the domestic shock, financial market liquidity (LIQMKT) and volatility (VOL) improve. However, banking sector liquidity (LIQ) and the term spread (TS) decline. These last results are excluded given that the variance decomposition suggests the European impact is small and marginal (less than 10%) and less than that of domestic shock. We conclude that our results do not suggest important contagion effects of European monetary policies in the United States.

4.1.2. The impact of monetary policy shocks on European variables

Fig. 2 shows impulse response functions for European variables following a drop in domestic and US interest rates. Table 7 shows associated variance decompositions. First, domestic interest-rate shock affects European variables. Term spread (TS) increases permanently. Market volatility (VOL) also temporarily rises. The domestic shock increases the liquidity spread in the banking sector (LIQ) and on the stock market index (LIQMKT), explaining much of the variance in domestic variables (ranging from 11% for liquidity in the banking sector to over 50% for term spread). Taken collectively, these results suggest that lowering interest rates in Europe is not an appropriate remedy for the credit freeze crisis, but it has a positive effect on the term spread and could therefore contribute to economic recovery.

Second, considering the external interest rate shock, lowering US short-term interest rates has the same impact on European domestic variables as a domestic shock. While the impulse response functions related to US monetary shocks are similar to those for a European interest rate shock, US monetary shock explains far less of the variation in European variables (less than 12% for all variables combined) than a European monetary shock, suggesting a low level of contagion of the European variables to US monetary policy.

4.1.3. The impact of monetary policy shocks on Canadian variables

Fig. 3 illustrates impulse response functions for the Canadian variables, and Table 8 presents the associated variance decompositions. First, a domestic expansionary monetary policy in Canada is temporarily beneficial for the domestic financial market, causing stock market liquidity (LIQMKT) to increase, market volatility (VOL) to decline for seven months and a temporary increase of the term spread (TS). While a domestic expansionary monetary policy is beneficial for the stock market and for the term spread (at least in the short term), banking sector liquidity (LIQ) does not improve as a result of the shock, as the liquidity spread increases temporarily. Domestic interest rate shock explains a large portion (20% to 50%) of the variation in Canadian variables.

Second, focusing on the external shocks, impulse response functions for Canadian variables following a US monetary shock show no significant effect and associated variance

decompositions are low. In contrast, a European interest-rate shock has a small impact. Fig. 3 shows a small but significant decrease in term spread six months after the shock, although the associated variance decomposition is not as great as the domestic shock. European shock increases the prime rate spread in the banking sector and decreases volatility (VOL) of the Canadian stock market after two months. The shock explains between 10% and 25% of the variance in the Canadian variables. Last, financial sector liquidity (LIQMKT) improves slightly after three months, but variance decomposition is less than with a domestic shock.

4.1.4. Discussion of monetary policy results

Four main conclusions can be drawn from these results. First, domestic as well as foreign interest-rate shocks were ineffective in creating banking liquidity in all studied countries/regions. The difference between the prime lending rate and the risk-free rate (i.e., the liquidity spread) never narrows when interest rates are lowered. In fact, in most cases it increases. This finding suggests that private banks do not follow the central banks' lead in lowering the prime lending rate when liquidity is scarce in a context of banking system distress (Almunia et al., 2010). Second, lowering domestic interest rates stabilizes North American financial markets by temporarily decreasing volatility, increasing liquidity and increasing the term spread temporarily. In North America (the United States and Canada), a decrease in short-term interest rates is perceived as good news by financial markets, even when interest rates are already low. No positive impacts were observed in Europe after an interest rate shock, a rather worrisome finding given that this is the main financial instrument of the European Union. This result is perhaps a foreshadow of the sovereign debt crisis and could suggest that although the ECB was taking measures to restore confidence, the deeper issue of debt sustainability was under further stress from the crisis. Third, we found no strong evidence of international transmission of US monetary policy to other advanced economies as found in Kim and Roubini (2000) and Mackowiak (2007). We found no evidence in financial indicators of such a transmission of US monetary policies during the credit freeze crisis, suggesting monetary policies do not always have the same impact internationally. The only transmission found was from a European shock to Canadian variables, but the effect was small and did not explain a large portion of the variation in Canadian variables compared to a domestic shock. Our data suggest our findings related to the U.S interest rate shock are probably related with the low level of interest rates in the United States before the crisis, which had perhaps reached the zero lower bound (Bernanke et al., 2004, Bernanke and Reinhart, 2004, Spilimbergo et al., 2009 and Blanchard et al., 2010). Finally, monetary policies have a positive impact on the term spread in the short term, in most of the cases considered. Given that the literature generally finds a positive relationship between term spread and stock and bonds returns (see Fama and French, 1989), this finding suggests that although the international effects of monetary policies is somewhat mitigated by their inabilities to increase liquidity in the banking sector, it is still a positive measure for stock market traded assets.

4.2. The impact of budgetary policy shocks

4.2.1. The impact of budgetary policy shocks on US variables

Fig. 4 shows impulse response functions related to budgetary shocks for US variables. Associated variance decompositions are presented in Table 9.

First, at a national level, private consumption (CONS) is positively affected by a budgetary policy shock in the United States. Also, domestic shock has a temporary negative impact on industrial production (IP) for two years and on financial markets (VOL) for one year. The impact on credit (CREDIT) is not significant immediately, but is negative after three quarters. Budgetary policy shock explains a large portion of the variance in US variables, especially after three quarters.

Second, concerning the external shock, the impact of European budgetary policies on US domestic variables is similar to the impact of a domestic budget stimulus. The response functions associated with a European budget stimulus suggest an increase in private consumption (CONS), a decrease in US credit (CREDIT) and a temporary decrease in industrial production (IP). The variance decomposition associated with the shocks on these variables ranges from 15% to 35%.

4.2.2. The impact of budgetary policy shocks on European variables

Fig. 5 shows impulse response functions for the European variables. Associated variance decompositions are shown in Table 10.

First, domestic budget shock impacts all European variables. Budget stimulus has a positive effect on private consumption (four quarters) (CONS) and on credit (seven quarters) (CREDIT). However, the European stimulus has a negative but diminishing impact on industrial production (IP) and market volatility (VOL). These findings suggest that the budgetary stimulus plan has some perverse effects but nonetheless succeeds in increasing credit and consumption. However, variance decompositions are low and mitigate this result.

Second, concerning the external shock, the effect on European variables of foreign budget stimulus is similar, increasing credit (CREDIT), decreasing industrial production (IP) and increasing stock market volatility (VOL). However, no significant change in consumption (CONS) is noted. Variance decompositions are similar for US shock and for domestic shock, but higher for credit for a US shock.

4.2.3. The impact of budgetary policy shocks on Canadian variables

Fig. 6 presents impulse response functions for Canadian variables. First, a Canadian budget shock causes stock market volatility (VOL) to decline in the first and third quarters. There is no significant impact on private consumption (CONS), Canadian industrial production (IP), or

credit (CREDIT). Moreover, the variance decompositions shown in Table 11 indicate that domestic budgetary shock explains a smaller portion of the variance in Canadian variables than do US and European budgetary shocks. Actually, focusing on the external shocks, a US budget increase has positive impacts on Canada, increasing credit (CREDIT) for more than two years and private consumption (CONS) for five quarters, though the impact on Canadian stock market volatility (VOL) is not significant. Last, industrial production (IP) diminishes for five quarters. US budget shock explains an important part of the variance in Canadian variables, a higher portion than domestic shock. For example, only 3% of the variations in Canadian credit are explained by domestic budgetary shock while the US shock explains more than 30% of the variations.

European shock also impacts Canadian consumption (CONS) positively for a year and credit (CREDIT) for three quarters, but there is no significant impact on industrial production (IP) and volatility (VOL). As Table 11 shows, European shock explains approximately 15% of the variance in Canadian variables—less than US shock but similar to if not more than domestic shock.

4.2.4. Discussion of budgetary policy results

Three main conclusions can be drawn from our findings on budgetary policy outlined above. First, budget shocks can facilitate access to credit and boost consumption. This finding provides posterior support for recommendations in the literature (Blanchard, 2009, Diamond and Rajan, 2009, Mountford and Uhlig, 2009 and Spilimbergo et al., 2009) advocating timely and large budgetary stimulus plans to restore the credit channel (Blanchard et al., 2010) and recover from the crisis. These budgetary policies are particularly important when the interest rate is at the zero lower bound (Christiano et al., 2011, Woodford, 2011 and Auerbach et al., 2012a, 2012b). Interestingly, budgetary packages have been effective in generating credit in Europe and Canada but not in the United States, where the agents were already heavily leveraged and had to undergo rapid deleveraging (Blanchard et al., 2010, Eggertsson and Krugman, 2012).

Second, foreign budgetary shocks have international spillovers. A foreign budget shock is often as beneficial as or more beneficial than a domestic budget stimulus plan to domestic key indicators (Corsetti et al., 2010, Auerbach et al., 2012c, Benassy-Quéré et al., 2012, Hebous and Zimmerman, 2013). This result provides further evidence to this literature on international spillovers of fiscal policies by documenting them at the credit and financial stability level. This is particularly true in the case of smaller economies such as Canada, where foreign shocks from bigger countries have more impact than domestic shocks, but it was also observed in Europe with respect to US budgetary policy. This can be explained by the distance and the weight of commercial links between these countries and the US (Benassy-Quéré et al., 2012). Surely, there is a size effect at play in the Canadian case, as the foreign shocks are larger in dollar terms than the domestic shocks. Positive transmission of shocks raises a potential free-riding problem: when the outcome of a foreign budgetary stimulus plan can be as beneficial as that of a domestic stimulus plan, it is tempting to pass on to other countries the budgetary burden of government interventions. This finding underscores the importance of synchronizing stimulus plans and provides further empirical evidence supporting Moshirian (2011), who argues that in the absence

of a globally integrated financial framework, regulations and interventions in reaction to global financial crises will not be effective. Third, our results show that budgetary incentives do not improve industrial production— further documentation of the robustness of the negative relationship between government spending and the supply side using industrial production as a measure of output rather than private spending. This puzzling finding is consistent with the inventory data before and during the crisis and with the result in Almunia et al., 2010, which also suggests that inventories piled up before and during the crisis such that when consumption picked up, the push was to get rid of inventories before increasing production. Similarly, Alesina et al. (2002) and Blanchard and Perotti (2002) found a negative relationship between spending and private investment. Moreover, this can be connected with the findings in Blanchard et al. (2010) who found that, in some instances, the fiscal measures came too late to stem the recession and to limit the negative impacts of the crisis on production.

5. Conclusion

This paper asks whether traditional interventions such as lowering short-term interest rates and increasing government spending can be effective tools for recovery from the credit freeze. The results of our investigations using SVAR methodology show that monetary policies are ineffective in creating liquidity in the banking sector, but that budgetary policies can increase the ratio of available credit to GDP. Monetary policies had a positive impact on stock markets in North America. Budgetary policies had positive impacts on the European and Canadian lending sectors, but not on the US one. Whereas monetary policies were found to have mostly domestic effects on financial markets, US and European budgetary policies had international spillover effects. In recent decades, much attention in academic literature has been devoted to financial market integration and its repercussions in domestic economies. The positive contagion of budgetary stimuli documented in this paper perhaps suggests the importance of developing political integration along with financial integration, as financial problems have become global issues.

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Figures

Figure. 1

Impulse response functions of US variables to monetary policy shocks

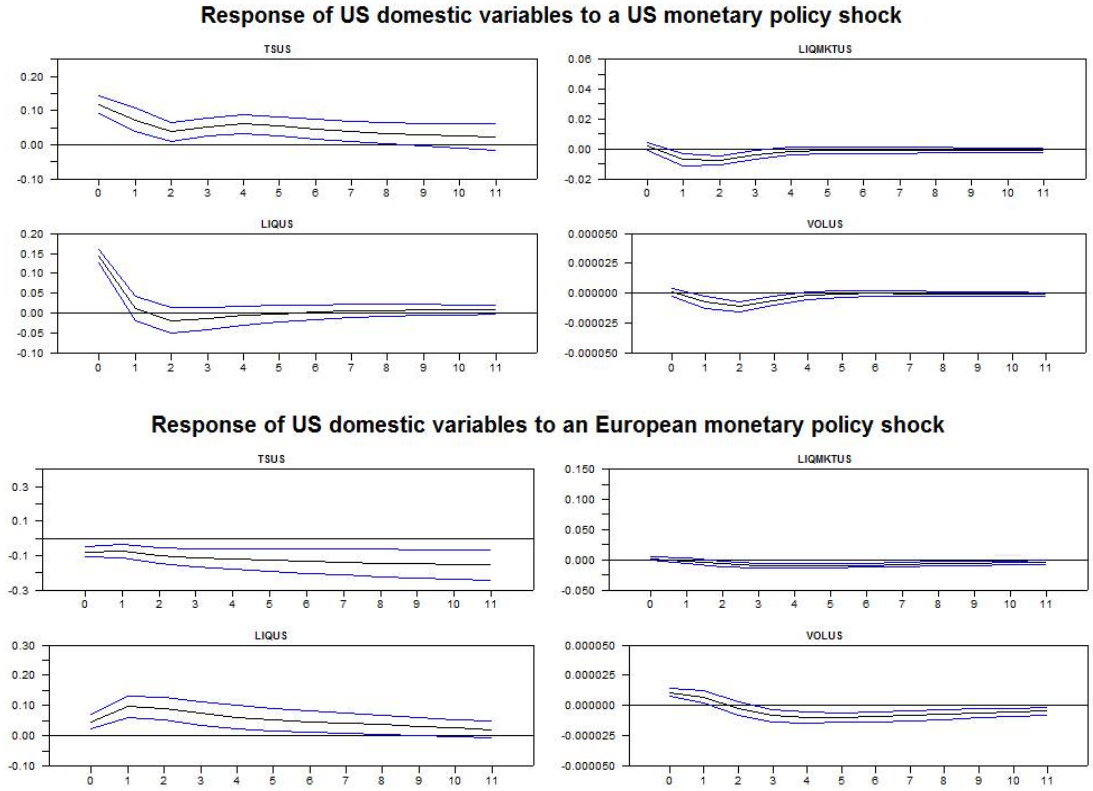

Fig. 1 Impulse response functions of US variables associated with monetary shocks. The exogenous variables are three-month risk-free rate (3MM) for the United States (top) and Europe (bottom). The dependent variables are US term spread (TSUS), liquidity in the US banking sector (LIQUS), US stock market liquidity (LIQMKTUS) and US stock market volatility (VOLUS).

Figure. 2

Impulse response functions of European variables to monetary policy shocks

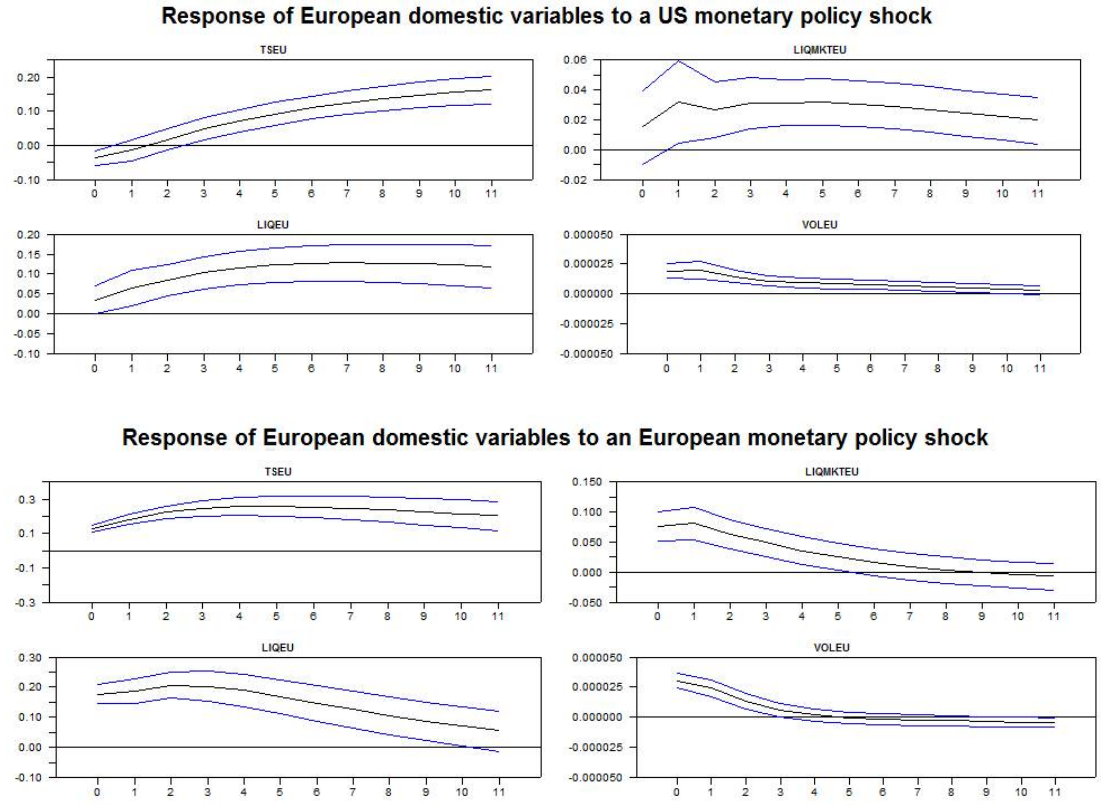

Fig. 2 Impulse response functions of European variables associated with monetary shocks. The exogenous variables are three-month risk-free rate (3MM) for the United States (top) and Europe (bottom). The dependent variables are European term spread (YCEU), liquidity in the European banking sector (LIQEU), European stock market liquidity (LIQMKTEU) and European stock market volatility (VOLEU).

Figure. 3

Impulse response functions of Canadian variables to monetary policy shocks

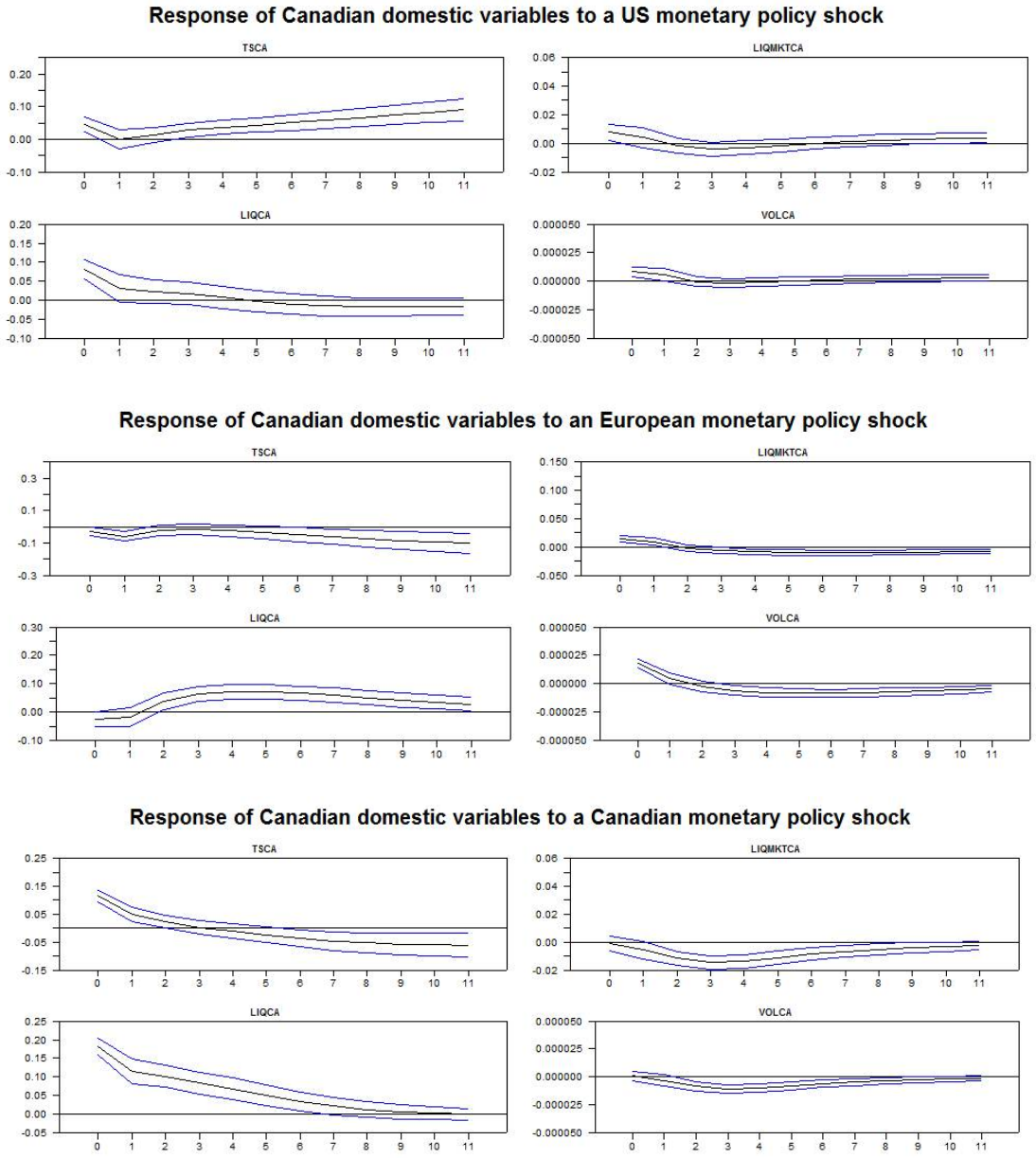

Fig. 3 Impulse response functions of Canadian variables associated with monetary shocks. The exogenous variables are three-month risk-free rate (3MM) for the United States (top), Europe (middle) and Canada (bottom). The dependent variables are Canadian term spread (TSCA), liquidity in the Canadian banking sector (LIQCA), Canadian stock market liquidity (LIQMKTCA) and Canadian stock market volatility (VOLCA).

Figure. 4

Impulse response functions of US variables to budgetary policy shocks

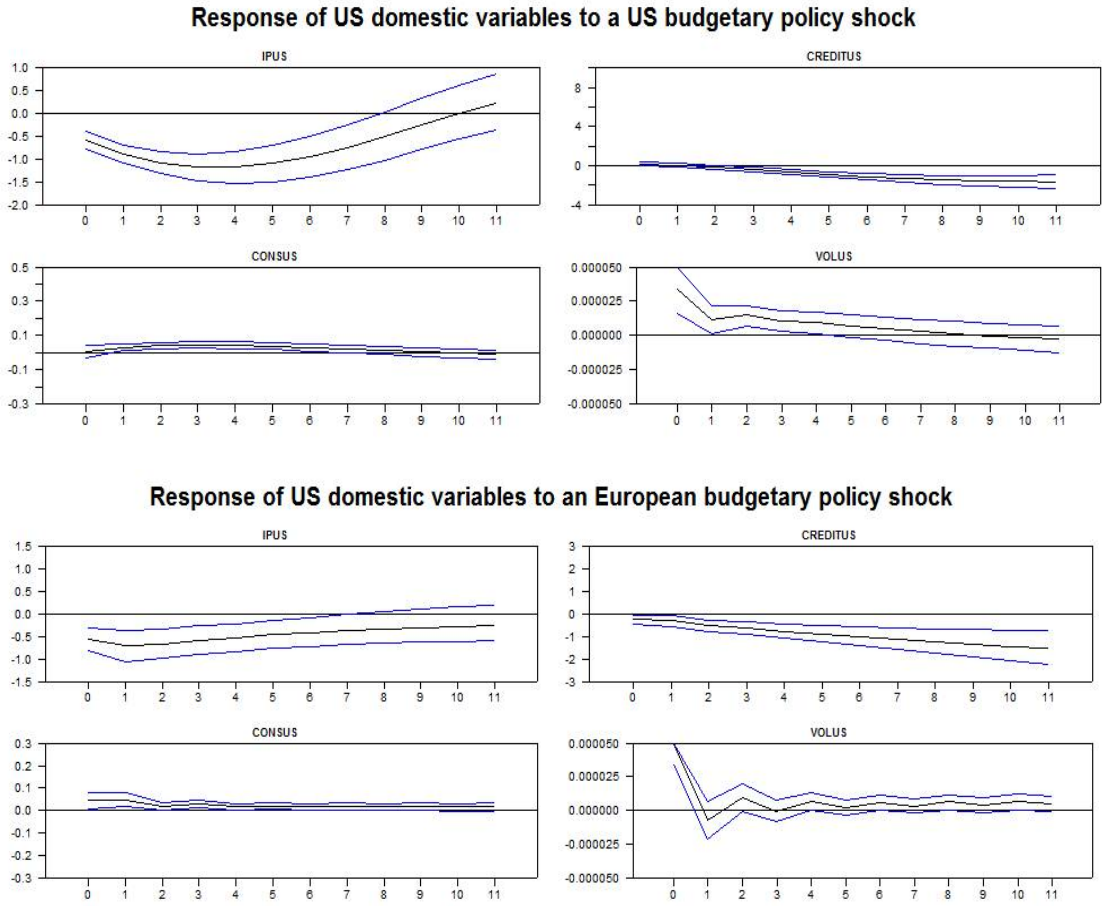

Fig. 4 Impulse response functions of US variables associated with budgetary shocks. The exogenous variables are government budget/GDP (BUDGET) for the United States (top) and Europe (bottom). The dependent variables are the US industrial production index (IP), US household consumption (CONSUS), US domestic credit/GDP (CREDITUS) and US stock market volatility (VOLUS).

Figure. 5

Impulse response functions of European variables to shocks in budgetary policy

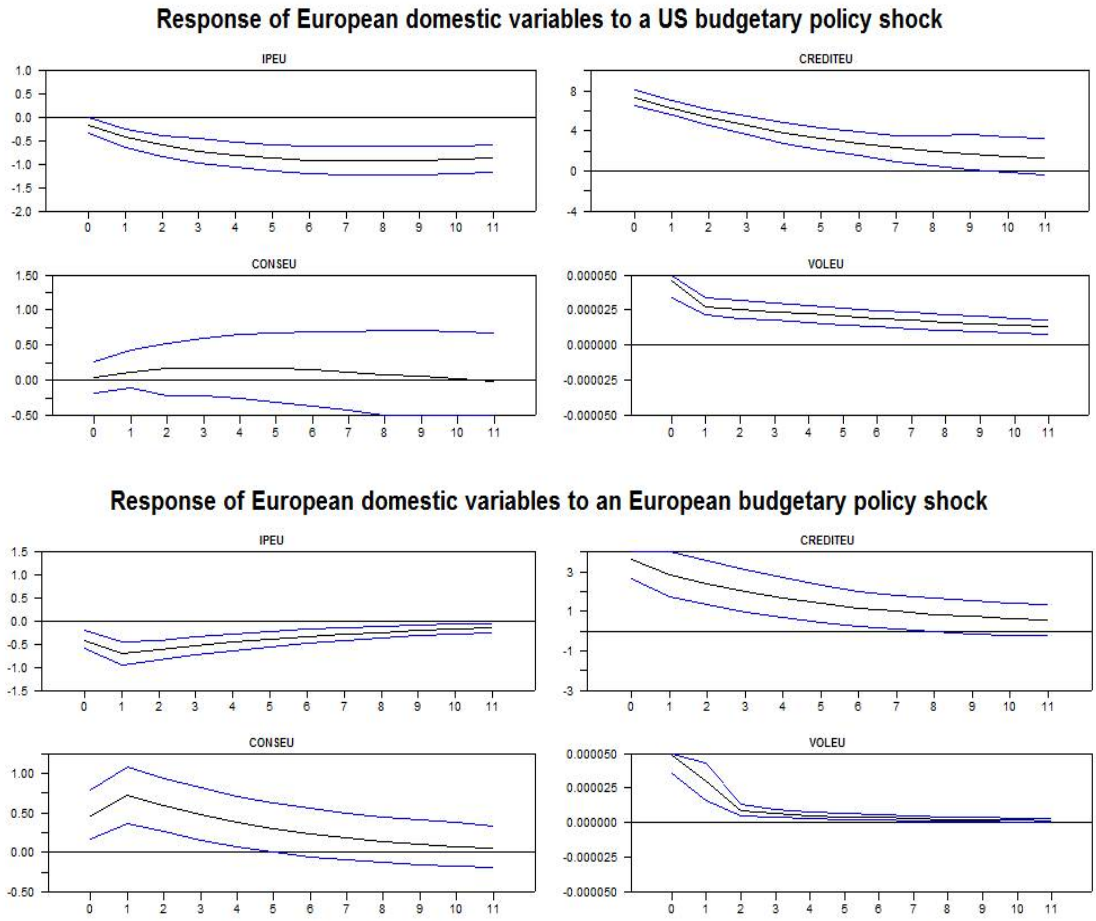

Fig. 5 Impulse response functions of European variables associated with budgetary shocks. The exogenous variables are government budget/GDP (BUDGET) for the United States (top) and Europe (bottom). The dependent variables are the European industrial production index (IPEU), European household consumption (CONSEU), European domestic credit/GDP (CREDITEU) and European stock market volatility (VOLEU).

Figure 6

Impulse response functions of Canadian variables to budgetary policy shocks

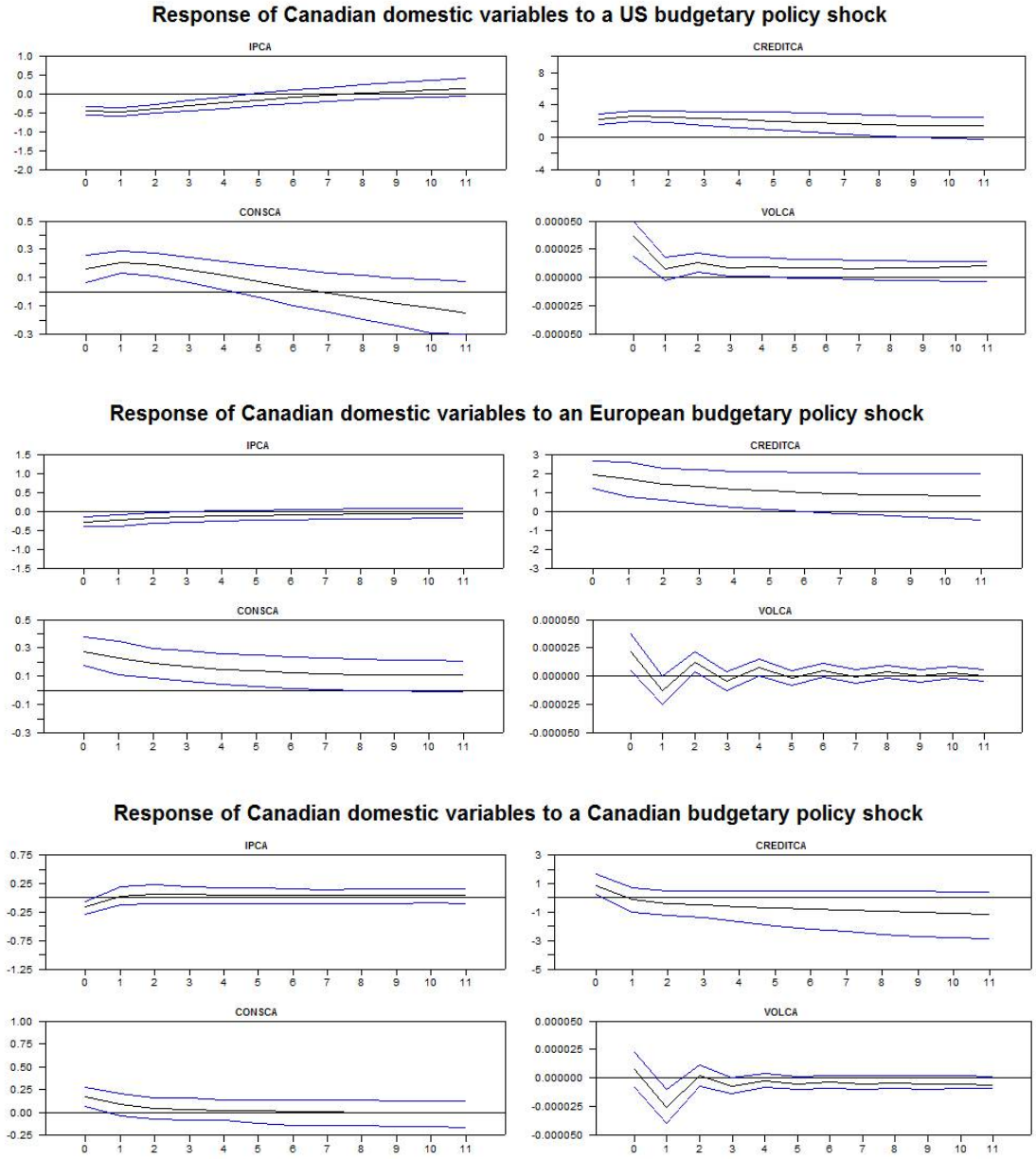

Fig. 6 Impulse response functions of Canadian variables associated with budgetary shocks. The exogenous variables are government budget/GDP (BUDGET) for the United States (top), Europe (middle) and Canada (bottom). The dependent variables are the Canadian industrial production index (IPCA), Canadian household consumption (CONSCA), Canadian domestic credit/GDP (CREDITCA) and Canadian stock market volatility (VOLCA).

Tables

Table1
Summary of the variables in the monetary policy models

Name	Variable	Definition	Source
3MM	Monetary policy	The three-month interest rate	(Bloomberg and IFS)
LIQ	Liquidity of the banking sector	Spread between the prime lending rate and the three-month risk-free rate (IFS)	IFS
TS	Term spread	Spread between the annual yield of ten-year bonds and the annualized three-month risk-free rate	(Bloomberg for the United States and Canada and from the IFS for the euro zone)
LIQMKT	Market liquidity	Monthly average of daily bid-ask spreads on a given country's market index expressed as a percentage.	Bloomberg
VOL	Realized volatility	Monthly realized volatility was measured as the standard error of daily returns for each month using daily Datastream price indices for each study country/region	Datastream

Table 2
Descriptive statistics for indicators related to monetary policy shock

	US	EURO	CAN
3MM	1.974	2.333	2.371
(% ann)	1.803	1.139	1.333
TS	1.978	1.683	1.590
(% ann)	1.335	1.041	1.030
LIQ	3.168	4.835	1.832
(% ann)	0.475	0.833	0.455
VOL	0.003	0.005	0.003
(% daily)	0.007	0.008	0.006
LIQMKT	0.091	0.331	0.213
(% daily)	0.054	0.340	0.081

Note: Table 2 reports averages and standard deviations (in parenthesis) for each variable used in model (4) to estimate adjustment to a one standard deviation shock in US, Canadian or euro zone monetary policy. 3MM is the three-month t-bill rate for the country/region expressed as an annual percentage. TS is the spread between long-term and short-term interest rates in the country/region expressed as an annual percentage. LIQ is liquidity in the private banking sector measured by the difference between lending and borrowing rates offered in the private banking sector expressed as an annual percentage. VOL is real volatility observed on the stock market measured as monthly average of real volatility expressed as a daily percentage. LIQMKT is the liquidity of the stock market measured as monthly average of bid-ask spread on the market index expressed as a daily percentage.

Table 3
Summary of the variables in the budgetary policy models

Name	Variable	Definition	source
BUDGET	Government budget	Government budget surplus or deficit expressed as a percentage of total GDP	IFS
CONS	Household consumption	Household consumption as a percentage of total GDP	IFS
IP	Industrial production	Industrial production index	IFS
CREDIT	Credit to the private sector	Volume of loans to the private sector, expressed as a percentage of GDP	IFS
VOL	Realized market volatility	Realized volatility computed using daily Datastream price indices for each study country/region	Datastream

Table 4
Quarterly regional descriptive statistics for indicators related to budgetary policy shock

	Country/region		
Variable	USA	Europe	Canada
IP index	98.67 (4.19)	100.31 (5.71)	101.90 (4.38)
CONS billions	67.78 (0.26)	54.32 (0.92)	56.43 (1.34)
CREDIT % GDP	177.29 (6.73)	155.16 (17.03)	245.43 (31.16)
BUDGET % PIB	-1.49 (0.87)	-0.82 (0.61)	-0.04 (0,40)
VOL (% daily)	0.00766 (0.01077)	0.00012 (0.00028)	0.0089 (0.0010)

Note: Table 4 reports averages and standard errors (in parenthesis) for the country/regional variables used to estimate adjustment to a one standard error shock in US, Canadian or euro zone budgetary policy. IP is the industrial production index. CONS is household consumption expressed as a percentage of total GDP. CREDIT is credit to private sector expressed as a percentage of total GDP. BUDGET is government budget surplus or deficit expressed as a percentage of total GDP. VOL is the quarterly average of realized volatility of the stock market index expressed as a daily percentage.

Table 5
Quarterly descriptive statistics for indicators related to budgetary policy shock (European panel)

	Country										
Variable	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
IP	104.73	105.10	103.40	97.44	102.98	96.00	102.76	97.94	101.12	99.69	96.12
index	8.88	9.21	8.42	5.02	8.17	6.54	5.70	8.03	3.72	5.86	8.67
CONS	54.27	52.24	52.30	57.12	57.75	73.76	49.04	59.32	19.39	65.43	57.56
% GDP	1.56	1.97	1.64	0.67	1.18	5.79	3.30	0.69	0.41	1.63	0.60
CREDIT	151.00	154.17	87.69	140.49	150.66	117.79	269.95	128.40	211.67	185.73	192.19
% GDP	11.39	6.77	13.71	17.21	4.43	18.43	63.47	21.46	24.75	32.23	41.19
BUDGET	-0.68	-0.57	0.54	-1.04	-0.61	-2.16	-1.52	-0.94	-0.45	-1.37	-0.62
% PIB	0.74	1.71	0.69	0.93	0.60	1.18	3.03	0.73	0.55	0.94	1.50
VOL	0.01498	0.00990	0.02600	0.00869	0.00980	0.01789	0.02100	0.00853	0.00865	0.00809	0.00972
(% daily)	0.03520	0.01772	0.04116	0.00140	0.01652	0.02922	0.04470	0.02288	0.01978	0.01630	0.01785

Table 5 reports averages and standard errors (in parenthesis) for national variables for the European panel used to estimate adjustment to a one standard deviation shock in budgetary policy of the United States or the euro zone. IP is the industrial production index. CONS is household consumption expressed as a percentage of total GDP. CREDIT is credit to private sector as a percentage of total GDP. BUDGET is government budget surplus or deficit expressed as a percentage of total GDP. VOL is the quarterly average of the realized volatility of the stock market index expressed as a daily percentage.

Table 6
Variance decomposition associated with monetary policy shocks on US domestic variables

	US interest rate shock				European interest rate shock			
Lag	TSUS	LIQUS	LIQMKTUS	VOLUS	TSUS	LIQUS	LIQMKTUS	VOLUS
1	19.6	56.7	0.4	0.1	8.0	3.8	0.7	13.3
2	18.4	18.6	8.0	7.1	5.2	8.5	1.0	7.2
3	17.3	12.9	10.9	12.4	5.6	7.5	1.0	5.6
4	16.1	10.9	10.0	11.8	7.4	6.4	2.6	5.7
5	15.5	9.7	9.1	11.1	8.2	5.7	4.2	6.6
6	14.4	8.8	8.5	10.5	8.0	5.2	5.4	7.4
7	12.7	8.3	8.0	10.1	7.5	4.9	6.0	7.9
8	11.0	7.9	7.5	9.7	7.0	4.8	6.3	8.2
9	9.7	7.6	7.1	9.3	6.4	4.7	6.3	8.2
10	8.4	7.3	6.7	9.0	5.9	4.6	6.2	8.1
11	7.4	7.0	6.5	8.7	5.4	4.6	6.1	8.0
12	6.5	6.8	6.2	8.4	5.1	4.5	6.0	7.9

Table 6 reports variance decomposition associated with estimation of model (4) under restrictions 3.1.2. Exogenous variables are three-month risk-free rate (3MM) for the United States (left) and Europe (right). Dependent variables are US term spread (TSUS), liquidity in the US banking sector (LIQUS), US stock market liquidity (LIQMKTUS) and US stock market volatility (VOLUS).

Table 7
Variance decomposition associated with monetary policy shocks on European domestic variables

	US interest rate shock				European interest rate shock			
Lag	TCEU	LIQEU	LIQMKTEU	VOLEU	TCEU	LIQEU	LIQMKTEU	VOLEU
1	3.6	1.2	0.5	11.8	39.4	30.2	11.5	28.1
2	2.1	1.2	2.9	17.9	46.3	29.9	13.8	28.5
3	1.5	2.0	2.6	21.4	52.0	28.8	13.5	27.2
4	1.9	2.6	3.1	23.1	54.0	26.9	13.1	26.1
5	3.3	3.5	3.5	24.3	53.8	24.2	12.6	25.0
6	5.9	4.5	3.9	24.8	52.1	21.4	12.1	24.0
7	9.3	5.5	4.2	25.0	49.4	18.7	11.7	23.1
8	13.4	6.6	4.4	24.9	46.0	16.2	11.5	22.4
9	18.0	7.8	4.5	24.7	42.4	14.1	11.4	21.7
10	22.7	9.0	4.5	24.5	38.6	12.3	11.5	21.4
11	27.4	10.2	4.5	24.3	34.8	10.8	11.6	21.2
12	31.8	11.4	4.4	24.1	31.2	9.8	11.8	21.4

Table 7 reports variance decomposition associated with estimation of model (4) under restrictions 3.1.2. Exogenous variables are three-month risk-free rate (3MM) for the United States (left) and Europe (right). Dependent variables are European term spread (TSEU), liquidity in the European banking sector (LIQEU), European stock market liquidity (LIQMKTEU) and European stock market volatility (VOLEU).

Table 8
Variance decomposition associated with monetary policy shocks on Canadian domestic variables

	US interest rate shock				European interest rate shock				Canadian interest rate shock			
Lag	TCCA	LIQCA	LIQMKTCA	VOLCA	TCCA	LIQCA	LIQMKTCA	VOLCA	TCCA	LIQCA	LIQMKTCA	VOLCA
1	4.2	10.5	2.5	4.9	1.7	1.2	9.3	24.5	31.9	55.0	0.0	0.2
2	3.6	7.7	3.7	7.0	3.1	6.4	9.2	16.1	20.5	36.7	4.2	0.8
3	4.2	6.6	4.6	8.6	2.8	5.5	8.6	14.9	17.8	35.3	11.9	8.0
4	5.7	5.9	4.9	9.3	3.4	5.1	9.2	15.4	15.6	36.3	20.7	16.6
5	7.7	5.4	5.1	9.7	3.7	4.7	9.3	15.6	13.3	37.6	23.6	20.1
6	9.7	5.0	5.2	10.0	3.8	4.6	9.2	15.6	11.5	38.5	24.7	21.5
7	11.3	4.7	5.3	10.2	3.7	4.7	9.0	15.5	10.8	39.3	25.8	22.7
8	12.1	4.5	5.4	10.2	3.7	4.9	8.9	15.4	11.0	40.0	26.7	24.0
9	12.3	4.4	5.5	10.1	3.5	5.1	8.9	15.5	11.6	40.6	27.6	24.8
10	11.9	4.3	5.6	10.0	3.3	5.4	8.9	15.6	12.5	40.7	28.1	25.4
11	11.2	4.2	5.6	9.9	3.1	5.7	9.0	15.7	13.6	40.4	28.5	25.8
12	10.3	4.1	5.7	9.8	3.0	6.0	9.2	15.9	14.6	39.6	28.8	26.0

Table 8 reports variance decomposition associated with estimation of model (4) under restrictions 3.1.2. Exogenous variables are three-month risk-free rate (3MM) for the United States (top), Europe (middle) and Canada (bottom). Dependent variables are Canadian term spread (TSCA), liquidity in the Canadian banking sector (LIQCA), Canadian stock market liquidity (LIQMKTCA) and Canadian stock market volatility (VOLCA)

Table 9
Variance decomposition associated with budgetary shocks on US domestic variables

	US budget shock				European budget shock			
Lag	IPUS	CONSUS	CREDITUS	VOLUS	IPUS	CONSUS	CREDITUS	VOLUS
1	27.1	0.1	2.8	14.5	18.9	4.9	3.6	29.3
2	42.5	2.1	1.9	20.7	30.6	8.9	4.8	32.8
3	52.3	8.2	1.3	25.3	31.6	8.9	10.2	31.3
4	58.0	15.8	2.5	28.3	32.1	10.0	13.8	32.0
5	60.6	22.9	8.5	30.0	31.9	10.4	18.0	31.8
6	61.2	28.5	20.2	30.5	31.5	11.2	21.8	31.9
7	60.4	32.1	35.3	30.4	30.9	11.8	25.4	31.8
8	58.7	34.0	49.3	30.0	30.2	12.5	28.6	31.6

Table 9 reports variance decomposition associated with estimation of model (4) under restrictions 3.2.2. Exogenous variables are government budget/GDP (BUDGET) for the United States (right) and Europe (left). Dependent variables are US industrial production (IPUS), US consumption (CONSUS), domestic credit (CREDITUS) and US market volatility (VOLUS).

Table 10
Variance decomposition associated with budgetary shocks
on European domestic variables

	US budget shock				European budget shock			
Lag	IPEU	CONSEU	CREDITEU	VOLEU	IPEU	CONSEU	CREDITEU	VOLEU
1	0.2	0.0	19.9	3.3	1.3	0.8	4.5	3.4
2	1.2	0.1	18.6	4.1	2.1	1.4	3.9	5.2
3	2.9	0.1	17.2	4.7	2.3	1.4	3.5	5.2
4	5.0	0.1	16.0	5.1	2.3	1.4	3.2	5.2
5	7.3	0.1	14.8	5.5	2.4	1.4	2.9	5.2
6	9.8	0.1	13.8	5.7	2.4	1.3	2.6	5.2
7	12.1	0.1	12.9	5.8	2.4	1.2	2.4	5.2
8	14.2	0.1	12.1	5.9	2.3	1.2	2.3	5.2

Table 10 reports variance decomposition associated with estimation of model (4) under restrictions 3.2.2. Exogenous variables are government budget/GDP (BUDGET) for the United States (right), Europe (middle) and Canada (left). Dependent variables are European industrial production (IPEU), European consumption (CONSEU), domestic credit (CREDITEU) and European market volatility (VOLEU).

Table 11
Variance decomposition associated with budgetary shocks on Canadian domestic variables

Lag	US budget shock				European budget shock				Canadian budget shock			
	IPCA	CONSCA	CREDITCA	VOLCA	IPCA	CONSCA	CREDITCA	VOLCA	IPCA	CONSCA	CREDITCA	VOLCA
1	51.3	10.9	32.6	17.5	16.9	25.4	22.4	6.9	6.7	8.1	3.6	0.6
2	51.3	14.1	35.9	19.1	8.1	17.4	9.6	12.0	4.3	14.1	4.4	11.7
3	52.3	16.0	38.5	19.3	5.7	14.4	5.9	10.6	3.4	11.9	3.9	14.3
4	53.6	16.6	40.2	19.3	5.2	12.3	5.4	12.0	3.7	12.3	2.9	15.5
5	52.8	16.1	41.0	19.2	6.1	11.0	6.3	11.8	3.6	11.8	2.6	15.6
6	50.9	15.1	41.0	19.1	7.2	10.3	7.9	12.5	3.7	11.7	2.4	15.7
7	48.3	13.8	40.4	19.0	8.3	10.2	9.3	12.7	3.8	11.5	2.3	15.7
8	45.8	12.6	39.4	19.0	9.3	10.6	10.6	13.1	3.9	11.4	2.3	15.7

Table 11 reports variance decomposition associated with estimation of model (4) under restrictions 3.2.2. Exogenous variables are government budget/GDP (BUDGET) for the United States (right), Europe (middle) and Canada (left). Dependent variables are Canadian industrial production (IPCA), Canadian consumption (CONSCA), domestic credit (CREDITCA) and Canadian market volatility (VOLCA).