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An Empirical Study of Credit Shock Transmission in a Small Open Economy

Nathan Bedock[*], *Dalibor Stevanović*[†]

Résumé / *Abstract*

In this paper we identify and measure the effects of credit shocks in a small open economy. To incorporate information from a large number of economic and financial indicators we use the structural factor-augmented VARMA model. In the theoretical framework of the financial accelerator, we approximate the external finance premium with credit spreads. We find that an adverse global credit shock generates a significant and persistent economic slowdown in Canada; the Canadian external finance premium rises immediately while interest rates and credit measures decline. Variance decomposition reveals that the credit shock has an important effect on real activity measures, including price and leading indicators, and credit spreads. On the other hand, an unexpected increase in the Canadian external finance premium shows no significant effect in Canada, suggesting that the effects of credit shocks in Canada are essentially caused by the unexpected changes in foreign credit market conditions. Given the identification procedure our structural factors have an economic interpretation.

Mots clés/*Keywords* : Credit shock, structural factor analysis, factor-augmented VARMA.

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Contents

1 Introduction

The current economic downturn suggests that there is information in the financial sector that has not been integrated into our understanding of macroeconomics. Studies by Stock and Watson (1989,2003), Estrella and Hadrouvelis (1991), Gertler and Lown (1999), Diebold *et al.* (2006), Mueller (2007), and Gilchrist, Yankov, and Zakrajsek (2009) have shown that there is predictive content in financial series. The results in Forni *et al.* (2003) show that financial variables are important when forecasting inflation rates but do not help in predicting industrial production, which is also confirmed in Espinoza *et al.* (2009). Moreover, the non-neoclassical monetary policy transmission mechanisms which are related to credit markets are theoretically and empirically under-documented. Here, we propose to empirically measure the impact of credit shocks in Canada within this theoretical framework.

Due to the complexity of credit markets, we doubt that their informational content can be synthesized in as few variables as a vector autoregressive (VAR) model allows us. In order to incorporate information from a large number of economic and financial indicators, we will use the structural factor analysis approach proposed by Bernanke *et al.* (2005), Marcellino and Kapetainous (2005), and Stock and Watson (2005), among others. In particular, we will use a factor-augmented VARMA (FAVARMA) model proposed by Dufour and Stevanovic (2010). This is a theoretically coherent model with an approach that combines two dimension reduction techniques: factor analysis and VARMA modeling. The identification of structural shocks is achieved by imposing a recursive structure on the impact matrix of the structural MA representation of observable variables.

Similar studies have been made for the US economy by Boivin, Giannoni, and Stevanovic (2009b) (BGS hereafter) and Gilchrist, Yankov, and Zakrajsek (2009). Both studies find that credit shocks have wide effects on the economy that are consistent with a significant economic slowdown. Pesaran et al. (2006) use the global VAR model to link the firm-specific changes in the credit portfolio to macroeconomic business cycles. Safei and Cameron (2003) and Atta-Mensah and Dib (2008) have studied the dynamics of the Canadian credit market, the former employing a structural VAR approach, the latter using a general equilibrium approach. The conclusions drawn by Safei and Cameron (2003) show a lack of robustness, suggesting that there is information missing in their structural VAR models. The present exercise tries to correct this problem by using a large data set. The results of Atta-Mensah and Dib (2008) are more coherent with the dynamic stochastic general equilibrium (DSGE) literature describing credit market models, except that they consider Canada as a closed economy. Our methodology will allow us to include more information about the global financial market and to simulate shocks from outside of Canada, which will be important in our following discussion.

Our results show that an unexpected increase in the external finance premium on global financial markets, approximated by the US credit spread, generates a significant and persistent economic slowdown in Canada. Canadian credit spreads rise immediately, while interest rates and credit measures decline. Contrary to existing work on the Canadian economy, we find that price indexes fall persistently[1]. Since we do not impose timing restrictions on forward-looking variables, these leading indicators respond negatively on impact, as expected. This gives a more realistic picture of the effect of credit shocks on the economy and provides information about the transmission mechanism of these shocks. According to R^2 results, the common component captures an important dimension of the business cycle movements. From the variance decomposition analysis, we observe that the credit shock has an important effect on several real activity measures including price indicators, leading indicators, and credit spreads.

Another piece of important empirical evidence concerns the identification of national financial shocks. Previous studies have treated Canada as a closed economy when identifying a credit shock and have found some real effects. Our results suggest that there is no significant effect of domestic shocks in Canada. Indeed, the effects of credit shocks in Canada are essentially caused by unexpected changes in foreign credit market conditions.

In robustness analysis, we compare our benchmark results after the US credit shock to two other factor representations with different identification schemes. The dynamic responses for many variables are quite similar and confirm our previous findings. Finally, a by-product of our identification approach is a rotation matrix that can be used to recover the structural factors. These rotation matrices still have the same informational content, but their interpretation, in terms of the correlation structure, can change. Indeed, we find that the rotated principal components do have an economic interpretation.

In the rest of the paper, we first present the theoretical framework in which credit shocks can occur. Then, we present our econometric framework in a data-rich environment and discuss the estimation and identification issues. The main results are presented in Section 5, followed by a conclusion. The Appendix contains some additional results, an explanation of the bootstrap procedure, and the data description.

[1]A FAVAR analysis includes more information than a VAR and less structure than a DSGE. Other FAVAR studies find a fall in price indexes where VAR and DSGE studies concerning the Canadian economy do not.

2 Theoretical framework

In this section we briefly discuss how the financial and economic sides are connected and through which channel(s) shocks on the credit market could affect economic activity.

Financial frictions are crucial when linking credit market conditions to economic activity. We see this from the fact that in a framework of incomplete information, the Modigliani-Miller theorem does not apply. This means that a firm's value is determined by its capital structure. After aggregation and if credit markets determine capital structure in the economy, we should observe informational frictions characterizing the firm's value. Frictions can arise from both supply and demand.

On the supply side, usually interpreted as the bank lending channel, Bernanke (1993) observes that banks and other financial intermediaries are able to fund projects which are complex to evaluate, using funds from investors that have only partial information about these projects. If banks resolve asymmetric information problems in the credit market, they can be considered credit creators and their health becomes an important macroeconomic parameter. However, because of the democratization of credit in the 1980s, informational frictions on the supply side seem to be less present. Dynan *et al.* (2006) provide empirical evidence that households' expenses are less sensitive to their income, encouraging us to look for other kinds of frictions.

On the demand side, which links to the balance sheet channel, Bernanke *et al.* (1999) (BGG hereafter) introduce the idea of a financial accelerator working through the interaction of two measures. The first is the external finance premium, defined as the difference between the external cost of capital and the internal opportunity cost of capital. The second is the net worth of potential borrowers, which is used to measure the collateral that firms are able to offer to obtain credit. The idea of the financial accelerator is that there is an inverse relationship between these two measures. If the net worth of a firm falls, the collateral value that it will be able to present to banks will also fall. Similarly, the firm's contribution to capital will also decline. In consequence, the bank will possess relatively more parts of the firm, creating an agency cost to solve the divergence between the two parts. This agency cost will raise the external finance premium, i.e. the firm's capital cost. Thus, the financial accelerator mechanism works as follows: a fall in net worth (due to a financial crisis, for example) raises the acquisition capital cost, pushing firms to invest a sub-optimal quantity of capital and creating a persistent effect from the original crisis.

Building on BGG, Gilchrist, Ortiz, and Zakrajsek (2009) aim to quantify the role of financial frictions in generating business cycle fluctuations. They augment a standard DSGE model with the financial accelerator mechanism which links the conditions in the credit market to the real economy through the external finance premium. Two financial shocks are introduced: a financial disturbance shock, which affects the external finance premium, and a net worth shock affecting the balance sheet of a firm. The first shock is presented as a credit supply shock, which Christiano *et al.* (2009) interpret as an increase in the agency costs due to a higher variance of idiosyncratic shocks affecting the firm's profitability. The second shock can be viewed as a credit demand shock. Its effect will depend on the degree of frictions in the financial market. After estimating the structural model, the authors find that both financial shocks cause an increase in the external finance premium, which, through the financial accelerator, implies a slowdown in economic activity. Finally, Bloom (2009) provides a framework to analyze the impact of uncertainty shocks. He finds that increased volatility generates short, but sharp, recessions and recoveries.

3 Econometric framework in data-rich environment

As information technology improves, the availability of economic and financial time series grows in terms of both time and cross-section size. However, a large amount of information can lead to the curse of dimensionality when standard time series tools are used. Since most of these series are highly correlated, at least within some categories, their co-variability pattern and informational content can be approximated by a smaller number of variables. A popular way to address this issue is to use factor analysis. The structural factor model approach will here be used to identify a structural shock and its effects on the economy.

Previous studies have used standard VAR techniques with recursive identification schemes to identify credit shocks. However, as Bernanke *et al.* (2005) pointed out, the small-scale VAR model presents three issues. First, due to the small amount of information in the model, relative to the information set potentially observed by agents, VAR suffers from an omitted variable problem, which can alter the impulse response analysis. The second problem in a small-scale VAR model is that the choice of a specific data series to represent a general economic concept is arbitrary. Moreover, measurement errors, aggregations, and revisions present additional problems when linking theoretical concepts to specific data series. Even if the previous problems do not occur, we can only produce impulse responses for the variables included in the VAR. Finally, Forni *et al.* (2009) argues that while non-fundamentalness is generic in a small-scale models, it cannot arise in a large dimensional dynamic factor models[2]. This is of primary importance, since the objective is to identify a relatively new structural shock in empirical macroeconomics.

[2]If the shocks in the VAR model are fundamental, then the dynamic effects implied by the moving average representation can have a meaningful interpretation, i.e. the structural shocks can be recovered from current and past values of observable series.

One way to address all of these issues is to take advantage of the information contained in large panel data sets using dynamic factor analysis and the factor-augmented VAR (FAVAR) model in particular. The importance of large data sets and factor analysis is well documented in both forecasting macroeconomic aggregates and structural analysis. Boivin *et al.* (2009a) have recently shown that incorporating information through a small number of factors corrects for several empirical puzzles when estimating the effect of monetary policy shocks in a small open economy. However, Dufour and Stevanovic (2010) argue that in general, multivariate series and their associated factors do not both follow a finite order VAR process. Hence, they propose a FAVARMA framework that combines two parsimonious methods to represent the dynamic interactions between a large number of time series: factor analysis and VARMA modeling.

3.1 Factor-augmented VARMA model

Using the notation from Dufour and Stevanovic (2010), the dynamic factor model (DFM) where factors have a finite order VARMA(p_f,q_f) representation can be written as

$$\begin{aligned} X_{it} &= \tilde{\lambda}_i(L)f_t + u_{it}, \quad i = 1, \dots, N, \quad t = 1, \dots, T && (1) \\ u_{it} &= \delta_i(L)u_{i,t-1} + \nu_{it} && (2) \\ f_t &= \Gamma(L)f_{t-1} + \Theta(L)\eta_t, && (3) \end{aligned}$$

where $\tilde{\lambda}_i(L)$ is a lag polynomial, $\delta_i(L)$ is a $p_{x,i}$-degree lag polynomial, $\Gamma(L) = [\Gamma_1 L + \ldots + \Gamma_{p_f} L^{p_f}]$, $\Theta(L) = [I - \Theta_1 L - \ldots - \Theta_{q_f} L^{q_f}]$, and ν_{it} is an N-dimensional white noise uncorrelated with q-dimensional white noise process η_t. The equation (1) relates observable variable X_{it} to q (latent) factors, f_t, and to its idiosyncratic component, u_{it}. The element $\tilde{\lambda}_i(L)f_t$ is called the common component. We also allow for some limited cross-section correlations among the idiosyncratic components[3].

Subtracting $\delta_i(L)u_{it-1}$ from both sides of (1) gives the DFM with serially uncorrelated idiosyncratic errors:

$$X_{it} = \lambda_i(L)f_t + \delta_i(L)X_{it-1} + \nu_{it}, \tag{4}$$

[3]So that there exists a small number of largest eigenvalues of the covariance matrix of common components that diverge when the number of series tends to infinity, while the remaining eigenvalues as well as the eigenvalues of the covariance matrix of specific components are bounded. See Bai and Ng (2008) for an overview of the modern factor analysis literature, and the distinction between exact and approximate factor models.

where $\lambda_i(L) = (1 - \delta_i(L)L)\tilde{\lambda}_i(L)$.

Then, we can rewrite the DFM in the following form:

$$X_t = \lambda(L)f_t + D(L)X_{t-1} + \nu_t \quad (5)$$

$$f_t = \Gamma(L)f_{t-1} + \Theta(L)\eta_t, \quad (6)$$

where

$$\lambda(L) = \begin{bmatrix} \lambda_1(L) \\ \vdots \\ \lambda_n(L) \end{bmatrix}, D(L) = \begin{bmatrix} \delta_1(L) & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \delta_n(L) \end{bmatrix}, \nu_t = \begin{bmatrix} \nu_{1t} \\ \vdots \\ \nu_{nt} \end{bmatrix}.$$

To obtain the static version of the previous factor model suppose that $\tilde{\lambda}(L)$ has finite degree p-1, and let $F_t = [f_t' \quad f_{t-1}' \dots f_{t-p+1}']'$. Let the dimension of F_t be K, where $q \leq K \leq qp$. Then,

$$X_t = \Lambda F_t + u_t \quad (7)$$

$$u_t = D(L)u_{t-1} + \nu_t \quad (8)$$

$$F_t = \Phi(L)F_{t-1} + G\Theta(L)\eta_t \quad (9)$$

where Λ is a $N \times K$ matrix whose i^{th} row consists of coefficients of $\tilde{\lambda}_i(L)$, $\Phi(L)$ contains coefficients of $\Gamma(L)$ and zeros, and G is a $K \times q$ matrix (consisting of 1's and 0's) that loads (structural) shocks η_t to static factors. Note that if $\Theta(L) = I$, we obtain the factor-augmented VAR (FAVAR) model.

Finally, since the VARMA models are not identified in general, we will impose the diagonal moving average representation that is presented in following definition.

Definition 1 (Diagonal MA equation form) *Suppose N-dimensional stochastic process X_t has the following VARMA representation:*

$$\Phi(L)X_t = \Theta(L)u_t$$

This VARMA representation is said to be in diagonal MA equation form if $\Theta(L) = \text{diag}[\theta_{ii}(L)] = I_N - \Theta_1 L - \cdots - \Theta_q L^q$ *where* $\theta_{ii}(L) = 1 - \theta_{ii,1}L - \cdots - \theta_{ii,q_i}L^{q_i}$, $\theta_{ii,q_i} \neq 0$, *and* $q = \max_{1 \leq i \leq N}(q_i)$.

From the point of view of practitioners, this form is very appealing since adding lags of u_{it} to the i^{th} equation is a natural extension of the VAR model. It also has the advantage of giving a simple structure to the MA polynomials, the part which complicates the estimation.

3.2 Estimation

We will work with the static version (7-9). Also, we assume the same number of dynamic and static factors, $G = I$, and no autocorrelations in the idiosyncratic component, $D(L) = 0$, which gives the following simplified model:

$$X_t = \Lambda F_t + \nu_t \tag{10}$$

$$F_t = \Phi(L)F_{t-1} + \Theta(L)\eta_t, \tag{11}$$

To estimate this model, we use the two-step Principal Component Analysis (PCA) estimation method (see Stock and Watson, 2002; and Bai and Ng, 2006; for theoretical results concerning the PCA estimator). In the first step, $\hat{F}_t$ are computed as K principal components of X_t. In the second step, we estimate the VARMA representation (11) using $\hat{F}_t$. The standard estimation methods for VARMA models are maximum likelihood and non-linear least squares. Unfortunately, these methods require non-linear optimization, which may not be feasible when the number of parameters is relatively large. In this paper, we will use the GLS method proposed in Dufour and Pelletier (2008).

Since the unobserved factors are estimated and then included as regressors in the FAVARMA model, the two-step approach suffers from the "generated regressors"problem. To get an accurate statistical inference on the impulse response functions that accounts for uncertainty associated with factors estimation, we use a bootstrap procedure suggested by Yamamoto (2009) and implemented in Dufour and Stevanovic (2010). The details of the bootstrap procedure are presented in the Appendix.

3.3 Identification of structural shocks

To identify the structural shocks, we adapt the contemporaneous timing restrictions procedure proposed in Stock and Watson (2005) to the FAVARMA framework. After inverting the VARMA process of factors in (11), assuming stationarity, and plugging it into (10), we obtain the MA representation of X_t:

$$\begin{aligned} X_t &= \Lambda[I - \Phi(L)L]^{-1}\Theta(L)\eta_t + u_t \\ &= B(L)\eta_t + u_t. \end{aligned} \tag{12}$$

We assume that the number of static factors, K, is equal to the number of dynamic factors and that residuals in (11) are linear combinations of structural shocks ε_t

$$\varepsilon_t = H\eta_t, \tag{13}$$

where H is a nonsingular square matrix and $\mathrm{E}[\varepsilon_t\varepsilon_t'] = I$. Replacing (13) in (12) gives the structural MA form of X_t:

$$\begin{aligned} X_t &= \Lambda[I - \Phi(L)L]^{-1}\Theta(L)H^{-1}\varepsilon_t + u_t \\ &= B^\star(L)\varepsilon_t + u_t. \end{aligned} \tag{14}$$

To achieve the identification of shocks in ε_t, the contemporaneous timing restrictions are imposed on the impact matrix in (14)

$$B_0^\star \equiv B^\star(0) = \begin{bmatrix} x & 0 & \cdots & 0 \\ x & x & \ddots & 0 \\ x & x & \ddots & 0 \\ x & x & \cdots & x \\ \vdots & \vdots & \vdots & \vdots \\ x & x & \cdots & x \end{bmatrix}.$$

Let $B_{0:K}^\star = B_{0:K}H^{-1}$ be a $K \times K$ lower triangular matrix, where $B_{0:K}$ contains the first K rows of B_0.

Then, H is obtained as

$$H = [\text{Chol}(B_{0:K}\Sigma_e B'_{0:K})]^{-1}\Lambda_K, \tag{15}$$

where Σ_η is the covariance matrix of η_t and Λ_K is a $K \times K$ matrix of the first K rows of Λ. To estimate H, we just plug in the estimates of $B_{0:K}$, Σ_e and Λ_K. Hence, the impulse responses to any shock in ε_t are obtained using (14). This identification procedure is similar to the standard recursive identification in VARMA models. To just identify the K structural shocks, we need to impose $K(K-1)/2$ restrictions. Imposing them in a recursive way makes estimation of the rotation matrix H easy. Also, it should be noted that the number of static factors must be equal to the number of series used in the recursive identification. Moreover, contrary to other identification strategies in the FAVAR literature, we do not need to impose any observed factor or rely on the interpretation of a particular latent factor.

Remark that we follow the strategy to impose the minimum number of restriction by choosing the impact response of only K variables. Since there are many series in X_t, another possibility is to over-identify the model by imposing zero restrictions on more than K series. In that case, $B^\star$ would be block lower triangular. While, if all these additional restrictions are satisfied, this would produce more efficient results, our approach is more robust, and we believe more appropriate in this type of structural analysis.

4 Data

The majority of our data comes from Dufour and Stevanovic (2010). It contains 332 monthly StatCan series that synthesize real and financial Canadian activity. Also included are variables describing a small open economy: exchange rates and global financial information. The time span is from January 1986 to November 2009.

Credit spreads measuring credit market conditions are also included as additional series. A credit spread is defined as the difference between the actuarial rate of a firm bond and the actuarial rate of a risk-free product (typically a treasury bond). We were built American credit spreads using Moody's bond index as described in BGS. Canadian credit spreads were built using a Canadian Dex bond index rated AA. Table 1 synthesizes information about the credit spread for Canada and the US. Because our results are very similar from one spread to another, we have selected a Canadian 10-Year A spread and an American 10-Year B spread. The two series are plotted in Figure 1.

5 Results

The goal of this paper is to measure the dynamic effects of credit shocks on economic activity in Canada. Since we are looking at a small open economy it is important to control for any global influence on financial markets when identifying the credit shock effects. In previous studies, authors have considered Canada to be a closed economy, but our empirical evidence suggests this could be misleading. Indeed, our results show that the effect of a credit shock is essentially driven by global financial conditions and by US credit markets in particular. Given the fact that the US represents around 80% of foreign trade in Canada, we approximate the world financial conditions with the US proxies. Hence, we use the US 10-year credit spread (USspread10y) in the recursive identification scheme. On the other hand, we take the Canadian 10-year credit spread (CANspread10y) as a proxy to identify the national credit shock. In all specifications the lag order tests suggest a VARMA(2,1) process for the extracted factors.

5.1 Global credit shock

To identify the global credit shock, we impose the following recursive scheme such that $B^{\star}_{0:K}$ is lower triangular:

$$[USspread10y, \quad CPI, \quad UR, \quad MS, \quad R, \quad FX],$$

where CPI is the Consumer Price Index: all items, UR is the Unemployment Rate, MS is the Money Base, R is the 3-month Treasury Bill and FX stands for the Can/US Exchange Rate. The credit shock is the first element in ε_t. This identification scheme implies that Canadian CPI, UR, MS, R and FX can respond immediately to a credit shock in the US. In other words, the contemporaneous response to a credit shock of all 349 variables is completely unrestricted.

The impulse responses for some variables of interest are presented in Figure 2. A one-standard deviation credit shock immediately raises the US credit spread by 0.4 basic points, while the effect on the Canadian spread is two times smaller. This unexpected increase in the global external finance premium generates a significant and persistent economic downturn. We see that economic activity indicators such as production, employment, hours, prices and wages decline significantly. Production measures in particular go down for more than a year. Employment is also negatively affected, especially in the construction sector[4]. All

[4]We have looked at all of the employment series responses and find that the magnitude responses vary across sectors. For

consumer price indexes show approximately the same pattern of a gradual and highly persistent slowdown, but most are non-significant. On the other hand, the industrial and commodities price indexes respond in a statistically significant way and stay below their steady-state value. This result is different from what Atta-Mensah and Dib (2008), and Safaei and Cameron (2003) report, where prices rise in response to a credit shock[5].

The effects on financial markets are even more striking. Treasury bills and government market bonds respond negatively and the effect is significant and persistent. Business and consumer credit measures decline. Leading indicators such as new orders, building permits and housing also start responding negatively on impact.

Our econometric framework allows the possibility of measuring the effects of structural shocks across different economic activity sectors, as well as across geographical regions. This is important in the case of Canada because of its huge territory and small overall population density. Thus, it is interesting to see how the credit shocks propagate across different regions. The results are presented in Figure 6 in the Appendix. It seems that in general, the Atlantic provinces demonstrate the most inconsistent behavior with respect to the rest of Canada.

The variance decomposition results are presented in Table 2. The second column reports the contribution of the credit shock to the variance of the forecast error at a 48-month horizon. According to these results, and contrary to the literature on monetary policy shocks identified in structural VAR framework, the global credit shock has an important effect on several variables: credit spreads, interest rates, industrial price indexes, credit measures, production and employment. This surprising evidence of the importance of credit shocks is also documented in BGS.

Finally, since we are using a factor model, the natural question is how well the extracted factors explain the variability in the observable series. Looking at the R^2 results in the third column in Table 2, we see that the common component explains a sizeable fraction of the variability in these variables[6]. This means that these factors do capture the important dimensions of business cycle movements.

sake of space, we will not report the impulse responses on all of the series in our data set but they are available on demand.

[5]It is worth noting that the impulse responses in Figure 2 present similar pattern to effects of credit shocks on the US economy reported in BGS and Gilchrist, Yankov and Zakrajsek (2009).

[6]Remember that only 6 factors were extracted from a data set containing 349 time series presenting different correlation patterns.

5.2 Canadian credit shock

In the previous section, we showed that a global credit shock has significant and meaningful effects on the Canadian economy. Now, we will see if a national credit shock, identified using a Canadian external finance premium measure, produces any effect. The recursive scheme is the following:

$$[USspread10y, \quad CPI, \quad UR, \quad MS, \quad R, \quad FX, \quad CANspread10y].$$

The credit shock is identified as the last element of ε_t. This identification is similar to what has been done in structural VAR and in FAVAR frameworks with the US data: activity and price measures do not respond immediately to a credit shock, nor to interest rates or money supply. We also add the exchange rate, considered exogenous to the credit shock[7]. Contrary to other studies, we control for the US credit markets by including the US credit spread, but the results do not change if we exclude it.

The impulse responses are presented in Figure 3. Overall, the national credit shock does not seem to produce any significant effect on the economy. In particular, the standard deviation of the credit shock in this identification scheme is more than 8 times smaller than in the case of the global credit shock.

The previous results suggest that all effects on the Canadian economy are caused by a global (or US) credit shock. Hence, modeling Canada as a closed economy when identifying and measuring the effects of credit shocks can be misleading in the sense that if any effects are found, these are not caused by a national but a global shock.

To understand better this phenomenon, we tried another recursive scheme:

$$[CANspread10y, \quad CPI, \quad UR, \quad MS, \quad R, \quad FX].$$

Here, the Canadian credit spread is taken to be exogenous to price, activity, money, interest rate and exchange rate measures. Our *a priori* idea is that the Canadian credit spread is Granger caused by the US spread so that this identification scheme would produce similar results to the first one.

In Figure 4 we present the results from these two identification schemes. Overall, they are very similar, except that when using the Canadian spread the effects are slightly more important for some variables. This suggests that the same shock can be identified using either Canadian or US external finance premium

[7] Other orderings were also tried and the results were very similar.

measures. Moreover, the structural factors from the two models are highly correlated (correlation coefficients are higher than 0.9 in absolute value).

Finally, we tested the Granger causality between the two credit spreads. The results are reported in Table 3. According to p-values, the hypothesis that the US credit spread does not cause the Canadian credit spread is strongly rejected and there is no evidence to reject the hypothesis that the Canadian credit spread does not Granger cause the US spread. Hence, these results confirm our intuition and suggest that the effects of credit shocks in Canada are essentially caused by unexpected changes in foreign credit market conditions.

5.3 Further robustness analysis

So far the results confirm our intuition, indicating that Canadian credit conditions are a quasi-deterministic component of American credit conditions (interpreted as global conditions). Thus, it seems that the Canadian credit market is not able to generate shocks. We know that Canadian firms are more liquid than American ones, but their capital structure should not change anything as long as the credit market has been defined here as exogenous to Canadian economy. Our best guess to explain these results seem to be in relation to the size of the Canadian economy and its opening on US economy.

But one could ask if we are confident that the insertion of an American credit spread in our database is enough to understand US dynamics? In other words, do we really identify a US credit shock or some global shock to which US economy responds. To answer this question we do two simple robustness analysis and check different identification schemes. The first consider a FAVARMA model with observed factors (US spread), and the second propose an extension of the FAVARMA model by allowing for exogenous variables in factors dynamic.

FAVARMA with observable factors The model can be written as follows:

$$X_t = \Lambda F_t + \nu_t \tag{16}$$

$$\begin{pmatrix} R_t \\ F_t \end{pmatrix} = \Phi(L) \begin{pmatrix} R_{t-1} \\ F_{t-1} \end{pmatrix} + \Theta(L)\eta_t, \tag{17}$$

where R_t contains M observed factors. In our example, R_t is the US 10-year B-spread. The model is estimated in the same way as the benchmark specification, with one additional step to impose R_t as observed factor. To do so, we follow the iterative principal approach as in Boivin, Giannoni and Stevanovic (2009):

1 Initialize $\hat{F}_t$ to be the K first principal components of X_t.

2 (i) Regress X_t on $\hat{F}_t$ and R_t, to obtain $\hat{\Lambda}_t^{F,j}$ and $\hat{\Lambda}_t^{R,j}$. (ii) Compute $\tilde{X}_t^j = X_t - \hat{\Lambda}_t^{R,0} R_t$ (iii) Update $\hat{F}_t$ as the first K principal components of $\tilde{X}_t$.

We use the causal ordering in (17) to identify the innovation associated to R_t. Hence, the US spread is exogenous to all Canadian factors. The impulse response of all elements in X_t are easily obtained after inverting (17) and premultiplying it by $\hat{\Lambda}$.

FAVARMA-X What if we observe the US credit shock such that it is exogenous to the Canadian economy? A natural thing to do would be to add it as an exogenous variable in the FAVARMA framework. The model becomes:

$$X_t = \Lambda F_t + \nu_t \tag{18}$$

$$F_t = \Phi(L) F_{t-1} + \beta W_t + \Theta(L) \eta_t, \tag{19}$$

where W_t is the exogenous variable. The estimation proceeds as in Dufour and Stevanovic (2010), with exception that W_t is added to the matrix of regressors during the second step.

Here, W_t contains the estimate of US credit shock from Boivin, Giannoni and Stevanovic (2010). Their data set ends on March 2009, so we also restrict our series to end on that period. The advantage of this framework is that the US credit shock has been identified within a US economy model, and then is not subject to the critique that we do not necessary identify the good shock.

The impulse response functions after a positive unexpected US credit shock from both models are compared in Figure 5. In both models a VARMA(2,1) has been suggested by the information criterion. We standardized all IRF to have the unit variance, since the impulse shock is not of the same size across models. Hence, the scale is irrelevant, but our interest is to compare the shape and qualitative features of the responses in Figure 5, to IRFs from our benchmark model in Figure 2. We remark that all these specifications and identifications scheme produce quite similar dynamic responses of many variables of interest. Hence, we believe that the identification procedure in our benchmark model measures the effects US credit shocks in Canada.

5.4 Interpretation of factors

As it was pointed out in BGS, the procedure to identify the structural shocks can produce interpretable factors[8]. Remember that structural shocks are linear combination of residuals, $\varepsilon_t = H\eta_t$. Using this hypothesis, we can rewrite the system (10)-(11) in its structural form

$$\begin{aligned} X_t &= \Lambda^\star F_t^\star + u_t \\ F_t^\star &= \Phi^\star(L) F_{t-1}^\star + \Theta^\star(L)\varepsilon_t, \end{aligned}$$

where $F_t^\star = HF_t$, $\Lambda^\star = \Lambda H^{-1}$, $\Phi^\star(L) = H\Phi(L)H^{-1}$, and $\Theta^\star(L) = H\Theta(L)H^{-1}$. Hence, given the estimates of F_t and H, we can obtain an estimate of the structural factors: $\hat{F}_t^\star = \hat{H}\hat{F}_t$. The last six columns in Table 2 contain the marginal contribution of each structural factor to the total R^2. We can see that the first structural factors mostly explain the two credit spreads. The second is very important for consumer price indexes and housing prices, while the third contributes by completely explaining the unemployment rate. Finally, the fourth factor is important for monetary measures (not reported in the table) and interest rates, while the last two factors do not seem to be interpretable.

6 Conclusion

In this paper we measured the impact of a credit shock in Canada in a data-rich environment. To incorporate information from a large number of economic and financial indicators, we used a factor-augmented VARMA (FAVARMA) model. The structural shocks were identified by imposing a recursive structure on the impact matrix of the structural MA representation of observable variables.

We found that an unexpected increase in the external finance premium on global financial markets, approximated by the US credit spread, generates a significant and persistent economic slowdown in Canada.

[8]Note however that factors are identified up to a rotation. Hence, any orthogonal rotation matrix will give the same common component even though the interpretation of each factor in terms of correlation can change.

Canadian credit spreads rise immediately, while interest rates and credit measures decline. According to R^2 results, the common component captures an important dimension of business cycle movements. From the variance decomposition analysis, we observed that the credit shock has an important effect on several economic and financial measures.

Another important result is related to the identification of national financial shocks. Previous studies have treated Canada as a closed economy when identifying a credit shock and have found some real effects. Our results suggested however that there is no significant effect of domestic shocks in Canada. Indeed, the effects of credit shocks in Canada are fundamentally caused by the unexpected changes in foreign credit market conditions.

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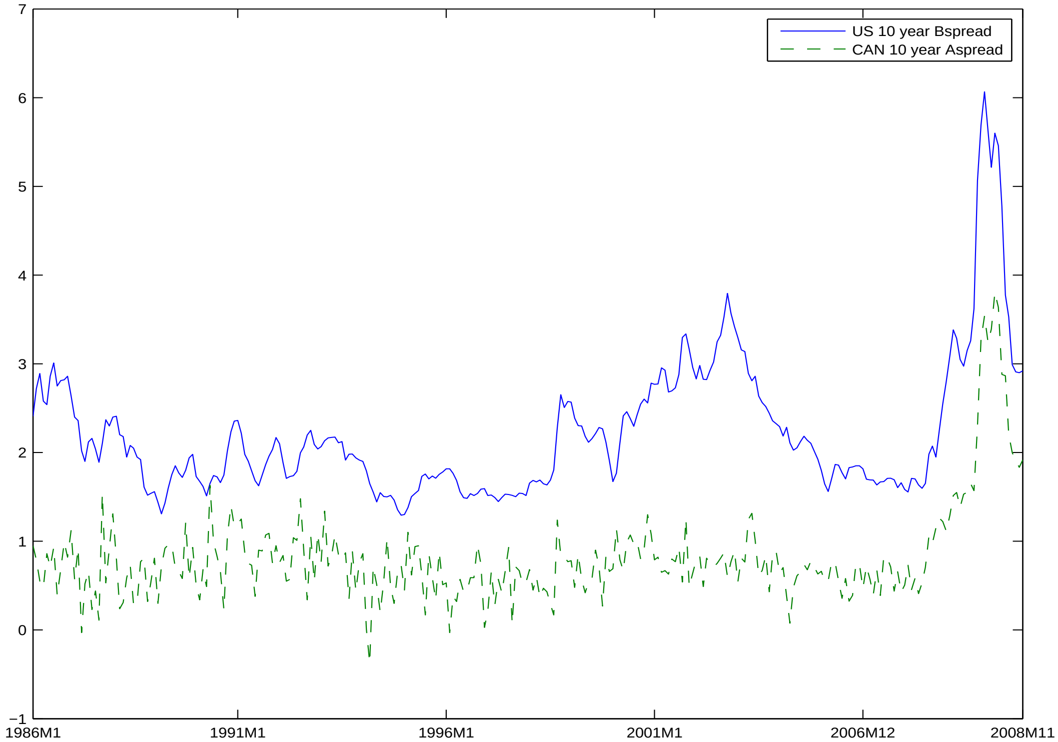

Figure 1: Credit spreads used in identification of structural shocks

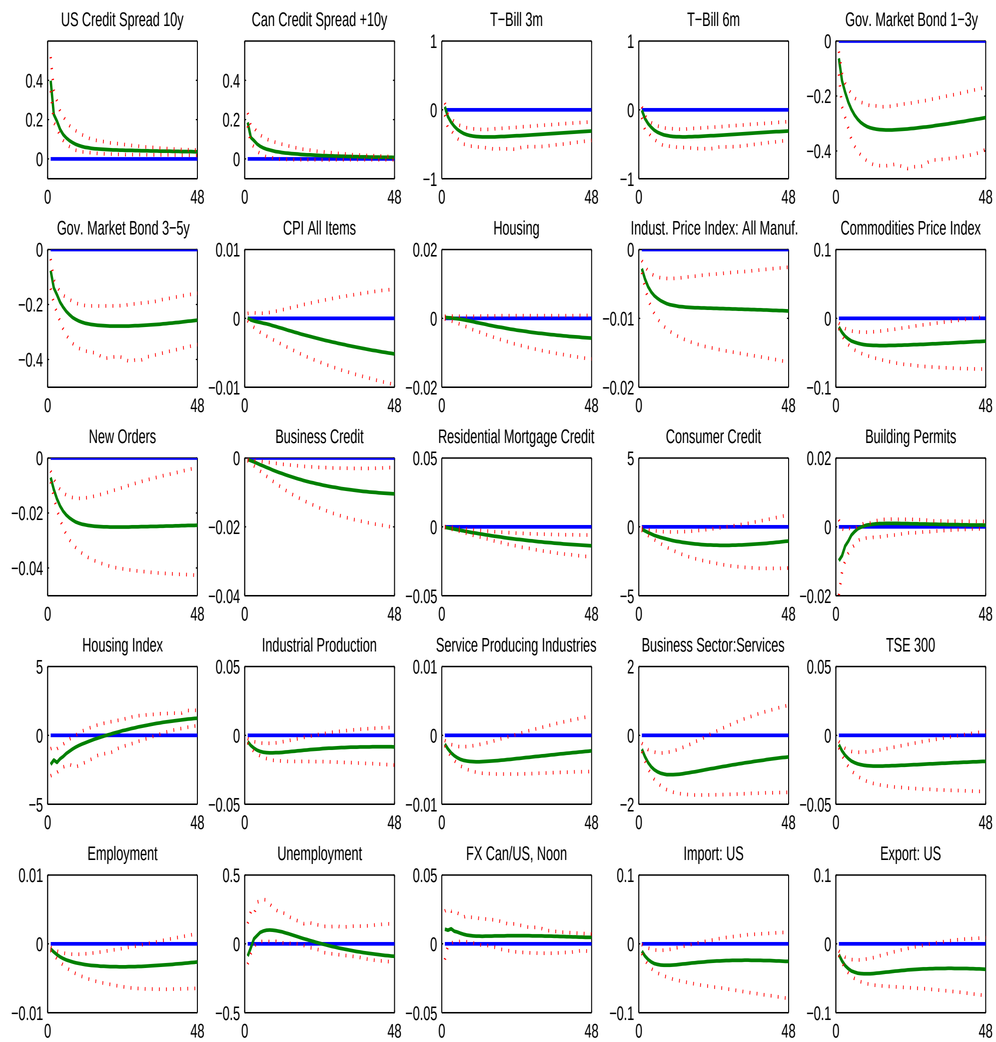

Figure 2: Impulse of some variables of interest to one standard deviation global credit shock

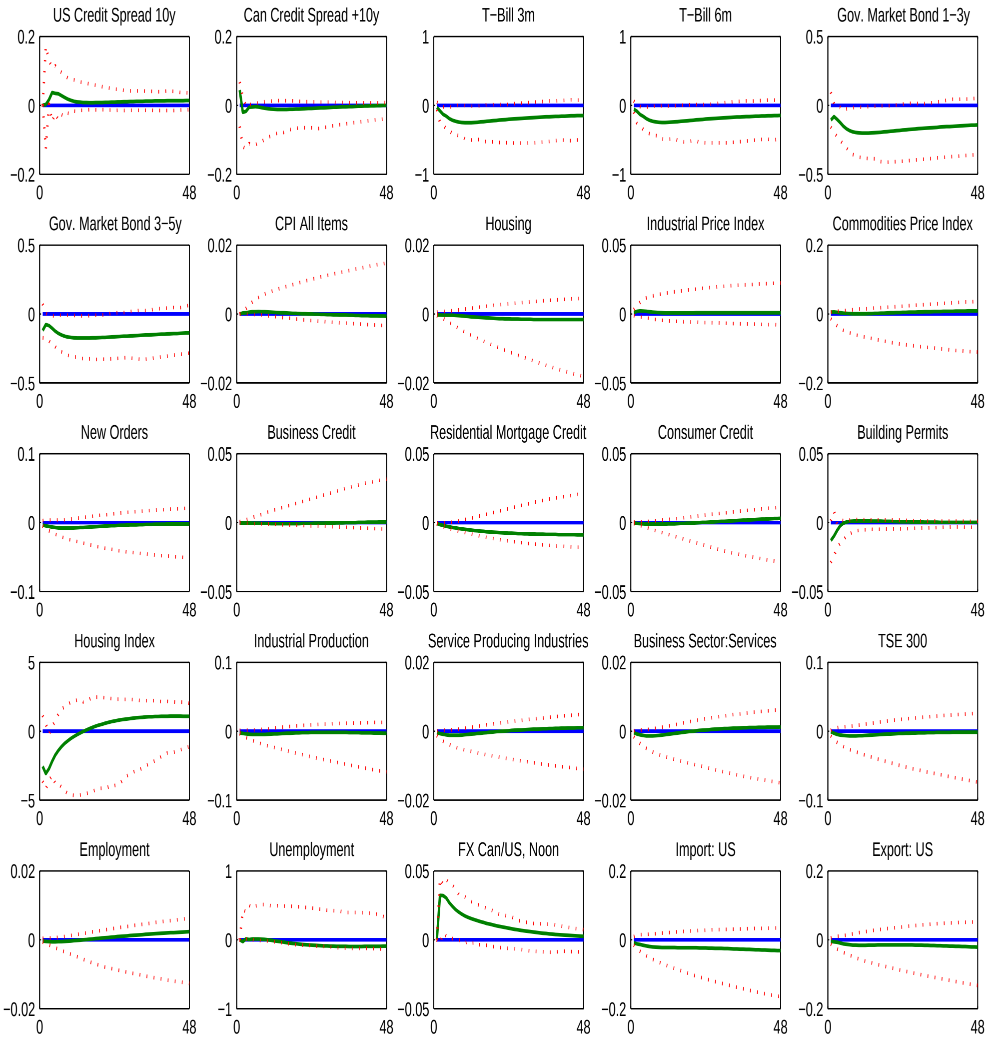

Figure 3: Impulse of some variables of interest to one standard deviation Canadian credit shock

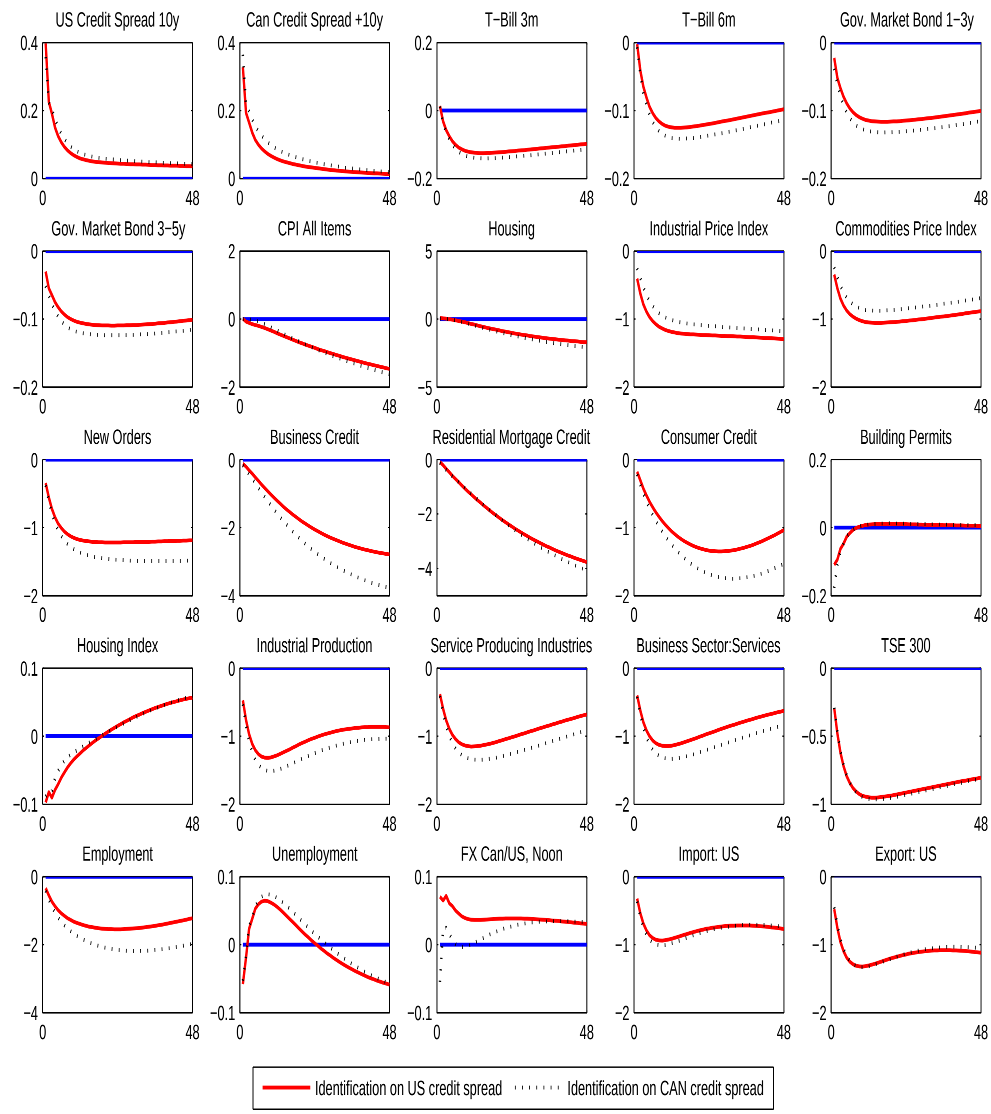

Figure 4: Comparison of impulse responses to a credit shock identified by US and Canadian credit spreads

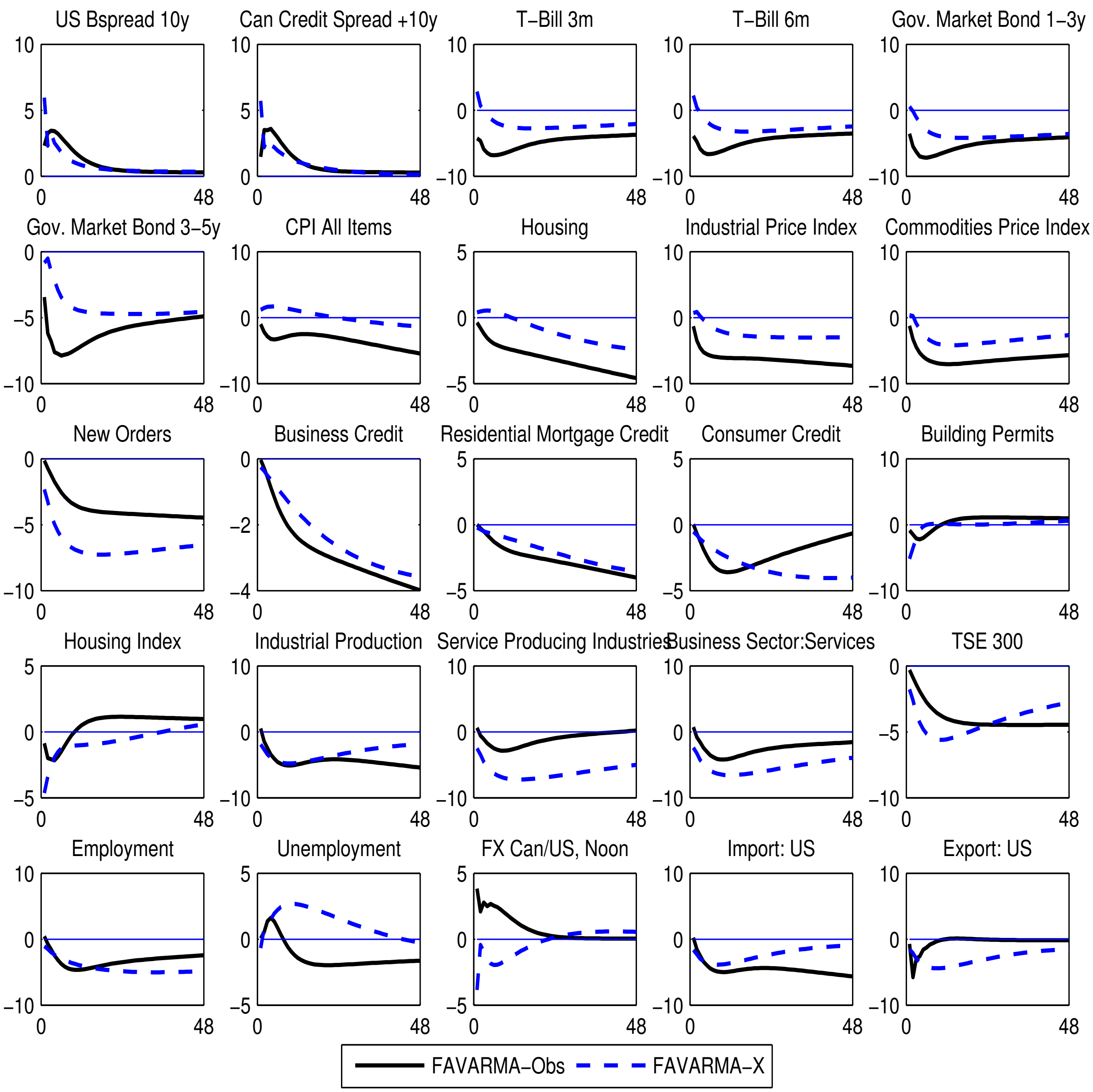

Figure 5: Comparison of IRFs obtained from FAVARMA-obs and FAVARMA-X models

Table 1: Credit spreads

Series label	**Description**
SCM2AST(RY)	Bond Yeld: DEX Capital Overall AA Short Term (% per Annum)
SCM2AMT(RY)	Bond Yeld: DEX Capital Overall AA Mid Term (% per Annum)
SCM2ALG(RY)	Bond Yeld: DEX Capital Overall AA Long Term (% per Annum)
v122531	Interest Rate: T-bills 3 Months (% per Annum)
v122499	Interest Rate:Gov. of Can.marketable Bond, 1-3 years (% per Annum)
v122501	Interest Rate:Gov. of Can. marketable Bond, over 10 years (% per Annum)
FYAAAC	Bond Yeld: Moodys AAA Corporate (% per Annum)
FYBAAC	Bond Yeld: Moodys BAA Corporate (% per Annum)
FYGT1.M	Rate: U.S. Treasury Const. Maturities, 1-Year (% Per Annum, NSA)
FYGT10.M	Rate: U.S. Treasury Const. Maturities, 10-Year (% Per Annum, NSA)
	Canadian credit spreads
3 Months A Spread	SCM2AST(RY) - v122531
1 Year A Spread	SCM2AMT(RY) - v122499
10 Year A Spread	SCM2ALT(RY) - v122501
	US credit spreads
10 Year B Spread	FYBAAC - FYGT10.M
10 Year A Spread	FYBAAC - FYGT10.M
1 Year B Spread	FYBAAC - FYGT1.M

Table 2: Explanatory power of global credit shock and common component

Variables	Variance decomposition	R^2	Marginal contribution to R2 F_t					
			F_1^*	F_2^*	F_3^*	F_4^*	F_5^*	F_6^*
US Credit Spread 10y	0.8813	0.4631	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CAN Credit Spread 10y	0.6293	0.5019	0.7730	0.0003	0.0430	0.0209	0.0518	0.1109
T-Bill 3m	0.3947	0.9603	0.3505	0.0281	0.0399	0.5797	0.0016	0.0001
T-Bill 6m	0.4076	0.9685	0.3739	0.0254	0.0396	0.5592	0.0015	0.0005
Gov. Market Bond 1-3y	0.4231	0.9779	0.4052	0.0206	0.0837	0.4841	0.0022	0.0041
Gov. Market Bond 3-5y	0.4088	0.9717	0.4093	0.0183	0.1279	0.4347	0.0026	0.0072
CPI: all items	0.0214	0.9121	0.0313	0.9687	0.0000	0.0000	0.0000	0.0000
Housing price index	0.0520	0.4149	0.0263	0.8049	0.0428	0.0826	0.0066	0.0367
Industrial price index	0.5029	0.4942	0.3727	0.1894	0.0127	0.1834	0.0008	0.2410
Commodity price index	0.5197	0.3525	0.2383	0.2580	0.0523	0.2489	0.0442	0.1583
New orders	0.7074	0.2874	0.5524	0.0012	0.0143	0.2315	0.0696	0.1310
Business credit	0.3425	0.4045	0.4472	0.0000	0.3007	0.0944	0.0302	0.1277
Residential mortgage credit	0.1982	0.6025	0.1181	0.0310	0.1648	0.3405	0.3373	0.0083
Consumer credit	0.4595	0.3332	0.0935	0.0025	0.7411	0.0382	0.0350	0.0896
Building permits	0.1688	0.1184	0.0469	0.0381	0.0053	0.2183	0.2942	0.3971
Housing index	0.1149	0.8045	0.0640	0.0009	0.6939	0.0211	0.2177	0.0024
Indust. Prod.: manufact.	0.5726	0.6352	0.3971	0.0002	0.0451	0.3325	0.0784	0.1467
Indust. Prod.: services	0.6779	0.3501	0.3738	0.1041	0.0278	0.3205	0.0686	0.1052
Business sector: services	0.6749	0.3793	0.3894	0.1336	0.0061	0.3317	0.0516	0.0876
TSE 300	0.6659	0.1972	0.3591	0.0773	0.0210	0.3141	0.2109	0.0176
Employment	0.5691	0.5161	0.3528	0.0081	0.2223	0.1725	0.0013	0.2430
Unemployment rate	0.0840	0.8403	0.0465	0.0049	0.9486	0.0000	0.0000	0.0000
FX Can/US	0.0201	0.7872	0.0092	0.0084	0.0091	0.1638	0.5601	0.2495
Imports: US	0.4857	0.3276	0.3150	0.0142	0.0704	0.2515	0.2310	0.1179
Exports: US	0.7741	0.4445	0.5063	0.0082	0.0284	0.3419	0.1125	0.0028

Table 3: Testing Granger causality between US and Canadian credit spreads

H_0	**F-stat**	**P-value**
US Spread does not Granger cause Can Spread	11.3519	0.0001
Can Spread does not Granger cause US Spread	1.0326	0.3574

Appendix A: Additional results

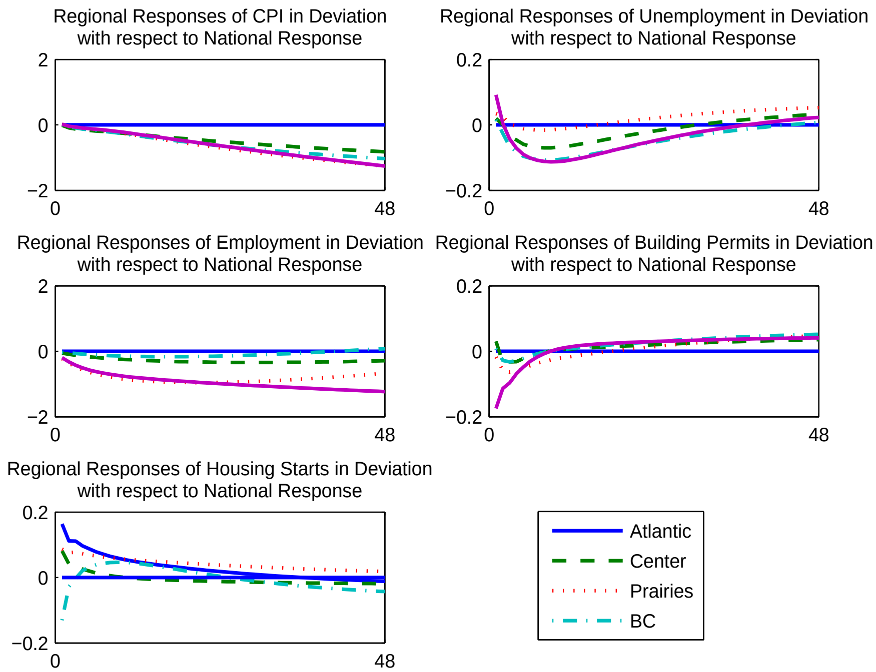

Figure 6: Regional impulse responses to a credit shock in deviation with respect to national response

- Atlantic provinces: Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick
- Center: Québec and Ontario
- Prairies: Manitoba, Saskatchewan and Alberta
- BC: British Columbia

Appendix B: Bootstrap procedure

The goal is to obtain confidence bands for impulse responses to structural shocks in representation (10-11) with assumption (13).

- **Step 1**
  Shuffle the time dimension of the residuals in (11) and resample static factors using estimates of the VARMA coefficients:
  $$\tilde{F}_t = \hat{\Phi}(L)\tilde{F}_{t-1} + \hat{\Theta}\tilde{\eta}_t$$
- **Step 2**
  Shuffle the time dimension of the residuals in (10), and resample the observable series using new factors obtained from the previous step and the estimated loadings:
  $$\tilde{X}_t = \hat{\Lambda}\tilde{F}_t + \tilde{u}_t$$
- **Step 3**
  Estimate the FAVARMA model on $\tilde{X}_t$, identify the structural shock and produce impulse responses.

As it was pointed out in Dufour and Stevanovic (2010), having a good approximation of the true factor process can be very important in order to get the right bootstrap procedure. If the finite VAR approximation is far away from the truth, and if the finite VARMA representation does much better, allowing for the MA part should provide a more reliable inference.

Appendix C: Data description

The transformation codes (labeled T-Code) are: 1 - no transformation; 2 - first difference; 4 - logarithm; 5 - first difference of logarithm.

Canadian Data

No.	StatCan no	Code	Series category
			Table 326-0020 Consumer Price Index Canada, Provinces
1	v41690973	5	All-items (2002=100)
2	v41690974	5	Food (2002=100)
3	v41690993	5	Dairy products (2002=100)
4	v41691046	5	Food purchased from restaurants (2002=100)
5	v41691051	5	Rented accommodation (2002=100)
6	v41691055	5	Owned accommodation (2002=100)
7	v41691065	5	Natural gas (2002=100)
8	v41691066	5	Fuel oil and other fuels (2002=100)
9	v41691108	5	Clothing and footwear (2002=100)
10	v41691129	5	Private transportation (2002=100)
11	v41691153	5	Health and personal care (2002=100)
12	v41691170	5	Recreation, education and reading (2002=100)
13	v41692942	5	All-items excluding eight of the most volatile components (Bank of Canada definition) (2002=100)
14	v41691232	5	All-items excluding food (2002=100)
15	v41691233	5	All-items excluding food and energy (2002=100)
16	v41691238	5	All-items excluding energy (2002=100)
17	v41691237	5	Food and energy (2002=100)
18	v41691239	5	Energy (2002=100)
19	v41691219	5	Housing (1986 definition) (2002=100)
20	v41691222	5	Goods (2002=100)
21	v41691223	5	Durable goods (2002=100)
22	v41691225	5	Non-durable goods (2002=100)
23	v41691229	5	Goods excluding food purchased from stores and energy (2002=100)
24	v41691230	5	Services (2002=100)
25	v41691231	5	Services excluding shelter services (2002=100)
26	v41691244	5	Newfoundland and Labrador; All-items (2002=100)
27	v41691369	5	Newfoundland and Labrador; All-items excluding food and energy (2002=100)
28	v41691363	5	Newfoundland and Labrador; Goods (2002=100)
29	v41691367	5	Newfoundland and Labrador; Services (2002=100)
30	v41691379	5	Prince Edward Island; All-items (2002=100)
31	v41691503	5	Prince Edward Island; All-items excluding food and energy (2002=100)
32	v41691497	5	Prince Edward Island; Goods (2002=100)
33	v41691501	5	Prince Edward Island; Services (2002=100)
34	v41691513	5	Nova Scotia; All-items (2002=100)
35	v41691638	5	Nova Scotia; All-items excluding food and energy (2002=100)
36	v41691632	5	Nova Scotia; Goods (2002=100)
37	v41691636	5	Nova Scotia; Services (2002=100)
38	v41691648	5	New Brunswick; All-items (2002=100)
39	v41691773	5	New Brunswick; All-items excluding food and energy (2002=100)
40	v41691767	5	New Brunswick; Goods (2002=100)
41	v41691771	5	New Brunswick; Services (2002=100)
42	v41691783	5	Quebec; All-items (2002=100)
43	v41691909	5	Quebec; All-items excluding food and energy (2002=100)
44	v41691903	5	Quebec; Goods (2002=100)
45	v41691907	5	Quebec; Services (2002=100)
46	v41691919	5	Ontario; All-items (2002=100)
47	v41692045	5	Ontario; All-items excluding food and energy (2002=100)
48	v41692039	5	Ontario; Goods (2002=100)
49	v41692043	5	Ontario; Services (2002=100)
50	v41692055	5	Manitoba; All-items (2002=100)
51	v41692181	5	Manitoba; All-items excluding food and energy (2002=100)
52	v41692175	5	Manitoba; Goods (2002=100)
53	v41692179	5	Manitoba; Services (2002=100)
54	v41692191	5	Saskatchewan; All-items (2002=100)
55	v41692317	5	Saskatchewan; All-items excluding food and energy (2002=100)
56	v41692311	5	Saskatchewan; Goods (2002=100)
57	v41692315	5	Saskatchewan; Services (2002=100)
58	v41692327	5	Alberta; All-items (2002=100)
59	v41692452	5	Alberta; All-items excluding food and energy (2002=100)
60	v41692446	5	Alberta; Goods (2002=100)
61	v41692450	5	Alberta; Services (2002=100)
62	v41692462	5	British Columbia; All-items (2002=100)
63	v41692588	5	British Columbia; All-items excluding food and energy (2002=100)
64	v41692582	5	British Columbia; Goods (2002=100)
65	v41692586	5	British Columbia; Services (2002=100)
			Table 026-0001 Building permits, residential values and number of units
66	v14098	1	Canada; Total dwellings (number of units) [D848383]
67	v41651	1	Canada; Total dwellings (dollars - thousands) [D845521]
68	v13824	1	Newfoundland and Labrador; Total dwellings (number of units) [D847651]
69	v41560	1	Newfoundland and Labrador; Total dwellings (dollars - thousands) [D845363]
70	v13859	1	Prince Edward Island; Total dwellings (number of units) [D847658]
71	v41595	1	Prince Edward Island; Total dwellings (dollars - thousands) [D845370]
72	v13866	1	Nova Scotia; Total dwellings (number of units) [D847665]
73	v41602	1	Nova Scotia; Total dwellings (dollars - thousands) [D845377]
74	v13873	1	New Brunswick; Total dwellings (number of units) [D847672]
75	v41609	1	New Brunswick; Total dwellings (dollars - thousands) [D845384]
76	v13880	1	Quebec; Total dwellings (number of units) [D847679]
77	v41616	1	Quebec; Total dwellings (dollars - thousands) [D845391]
78	v13887	1	Ontario; Total dwellings (number of units) [D847686]
79	v41623	1	Ontario; Total dwellings (dollars - thousands) [D845398]
80	v13894	1	Manitoba; Total dwellings (number of units) [D847693]
81	v41630	1	Manitoba; Total dwellings (dollars - thousands) [D845405]
82	v13901	1	Saskatchewan; Total dwellings (number of units) [D847700]
83	v41637	1	Saskatchewan; Total dwellings (dollars - thousands) [D845412]
84	v13908	1	Alberta; Total dwellings (number of units) [D847707]
85	v41644	1	Alberta; Total dwellings (dollars - thousands) [D845419]
86	v13831	1	British Columbia; Total dwellings (number of units) [D847714]
87	v41567	1	British Columbia; Total dwellings (dollars - thousands) [D845426]

Table 027-0002 CMHC, housing starts, under constr and completions, SA

88	v730040	**1**	Canada; Total units (units - thousands) [J9001]
89	v729972	**1**	Newfoundland and Labrador; Total units (units - thousands) [J7002]
90	v729973	**1**	Prince Edward Island; Total units (units - thousands) [J7003]
91	v729974	**1**	Nova Scotia; Total units (units - thousands) [J7004]
92	v729975	**1**	New Brunswick; Total units (units - thousands) [J7005]
93	v729976	**1**	Quebec; Total units (units - thousands) [J7006]
94	v729981	**1**	Ontario; Total units (units - thousands) [J7008]
95	v729987	**1**	Manitoba; Total units (units - thousands) [J7011]
96	v729988	**1**	Saskatchewan; Total units (units - thousands) [J7012]
97	v729989	**1**	Alberta; Total units (units - thousands) [J7013]
98	v729990	**1**	British Columbia; Total units (units - thousands) [J7014]

Table 377-0003 Business leading indicators for Canada

99	v7677	**1**	Average work week, manufacturing; Smoothed (hours) [D100042]
100	v7680	**1**	Housing index; Smoothed (index, 1992=100) [D100043]
101	v7681	**5**	United States composite leading index; Smoothed (index, 1992=100) [D100044]
102	v7682	**5**	Money supply; Smoothed (dollars, 1992 - millions) [D100045]
103	v7683	**5**	New orders, durable goods; Smoothed (dollars, 1992 - millions) [D100046]
104	v7684	**5**	Retail trade, furniture and appliances; Smoothed (dollars, 1992 - millions) [D100047]
105	v7686	**1**	Shipment to inventory ratio, finished products; Smoothed (ratio) [D100049]
106	v7678	**5**	Stock price index, TSE 300; Smoothed (index, 1975=1000) [D100050]
107	v7679	**5**	Business and personal services employment; Smoothed (persons - thousands) [D100051]
108	v7688	**5**	Composite index of 10 indicators; Smoothed (index, 1992=100) [D100053]

Table 379-0027 GDP at basic prices, by NAICS, Canada, SA, 2002 constant prices

109	v41881478	**5**	All industries [T001] (dollars - millions)
110	v41881480	**5**	Business sector, goods [T003] (dollars - millions)
111	v41881481	**5**	Business sector, services [T004] (dollars - millions)
112	v41881482	**5**	Non-business sector industries [T005] (dollars - millions)
113	v41881485	**5**	Goods-producing industries [T008] (dollars - millions)
114	v41881486	**5**	Service-producing industries [T009] (dollars - millions)
115	v41881487	**5**	Industrial production [T010] (dollars - millions)
116	v41881488	**5**	Non-durable manufacturing industries [T011] (dollars - millions)
117	v41881489	**5**	Durable manufacturing industries [T012] (dollars - millions)
118	v41881494	**5**	Agriculture, forestry, fishing and hunting [11] (dollars - millions)
119	v41881501	**5**	Mining and oil and gas extraction [21] (dollars - millions)
120	v41881524	**5**	Residential building construction [230A] (dollars - millions)
121	v41881525	**5**	Non-residential building construction [230B] (dollars - millions)
122	v41881527	**5**	Manufacturing [31-33] (dollars - millions)
123	v41881555	**5**	Wood product manufacturing [321] (dollars - millions)
124	v41881564	**5**	Paper manufacturing [322] (dollars - millions)
125	v41881602	**5**	Rubber product manufacturing [3262] (dollars - millions)
126	v41881606	**5**	Non-metallic mineral product manufacturing [327] (dollars - millions)
127	v41881637	**5**	Machinery manufacturing [333] (dollars - millions)
128	v41881654	**5**	Electrical equipment, appliance and component manufacturing [335] (dollars - millions)
129	v41881662	**5**	Transportation equipment manufacturing [336] (dollars - millions)
130	v41881663	**5**	Motor vehicle manufacturing [3361] (dollars - millions)
131	v41881674	**5**	Aerospace product and parts manufacturing [3364] (dollars - millions)
132	v41881675	**5**	Railroad rolling stock manufacturing [3365] (dollars - millions)
133	v41881688	**5**	Wholesale trade [41] (dollars - millions)
134	v41881689	**5**	Retail trade [44-45] (dollars - millions)
135	v41881690	**5**	Transportation and warehousing [48-49] (dollars - millions)
136	v41881699	**5**	Pipeline transportation [486] (dollars - millions)
137	v41881724	**5**	Finance, insurance, realestate, rental and leasing and management of companies and enterprises [5A] (dollars - millions)
138	v41881756	**5**	Educational services [61] (dollars - millions)
139	v41881759	**5**	Health care and social assistance [62] (dollars - millions)
140	v41881776	**5**	Federal government public administration [911] (dollars - millions)
141	v41881777	**5**	Defence services [9111] (dollars - millions)
142	v41881779	**5**	Provincial and territorial public administration [912] (dollars - millions)
143	v41881780	**5**	Local, municipal and regional public administration [913] (dollars - millions)

Tables 329-00(46,38,39) Industrial price indexes, 1997=100

144	v1575728	**5**	Transformer equipment (index, 1997=100) [P5648]
145	v1575754	**5**	Electric motors and generators (index, 1997=100) [P5674]
146	v1575886	**5**	Diesel fuel (index, 1997=100) [P5806]
147	v1575925	**5**	Light fuel oil (index, 1997=100) [P5845]
148	v1575903	**5**	Heavy fuel oil (index, 1997=100) [P5823]
149	v1575934	**5**	Lubricating oils and greases (index, 1997=100) [P5854]
150	v1575958	**5**	Asphalt mixtures and emulsions (index, 1997=100) [P5878]
151	v1575457	**5**	Industrial trucks, tractors and parts (index, 1997=100) [P5329]
152	v1575493	**5**	Parts, air conditioning and refrigeration equipment (index, 1997=100) [P5365]
153	v1575511	**5**	Food products industrial machinery and equipment (index, 1997=100) [P5383]
154	v1575557	**5**	Trucks, chassis, tractors, commercial (index, 1997=100) [P5429]
155	v1575610	**5**	Motor vehicle engine parts (index, 1997=100) [P5482]
156	v3860051	**5**	Motor vehicle brakes (index, 1997=100) [P5512]
157	v3822562	**5**	All manufacturing (index, 1997=100) [P6253]
158	v3825177	**5**	Total excluding food and beverage manufacturing (index, 1997=100) [P6491]
159	v3825178	**5**	Food and beverage manufacturing [311, 3121] (index, 1997=100) [P6492]
160	v3825179	**5**	Food and beverage manufacturing excluding alcoholic beverages (index, 1997=100) [P6493]
161	v3825180	**5**	Non-food (including alcoholic beverages) manufacturing (index, 1997=100) [P6494]
162	v3825181	**5**	Basic manufacturing industries [321, 322, 327, 331] (index, 1997=100) [P6495]
163	v3825183	**5**	Primary metal manufacturing excluding precious metals (index, 1997=100) [P6497]

Table 176-0001 Commodity price index, US$ (index, 82-90=100)

164	v36382	**5**	Total, all commodities (index, 82-90=100) [B3300]
165	v36383	**5**	Total excluding energy (index, 82-90=100) [B3301]
166	v36384	**5**	Energy (index, 82-90=100) [B3302]
167	v36385	**5**	Food (index, 82-90=100) [B3303]
168	v36386	**5**	Industrial materials (index, 82-90=100) [B3304]

Tables 176-00(46,47), 184-0002 Stock market statistics

169	v37412	**5**	Toronto Stock Exchange, value of shares traded (dollars - millions) [B4213]
170	v37413	**5**	Toronto Stock Exchange, volume of shares traded (shares - millions) [B4214]
171	v37414	**5**	United States common stocks, Dow-Jones industrials, high (index) [B4218]
172	v37415	**5**	United States common stocks, Dow-Jones industrials, low (index) [B4219]
173	v37416	**5**	United States common stocks, Dow-Jones industrials, close (index) [B4220]
174	v37419	**5**	New York Stock Exchange, customers' debit balances (dollars - millions) [B4223]
175	v37420	**5**	New York Stock Exchange, customers' free credit balance (dollars - millions) [B4224]
176	v122620	**5**	Standard and Poor's/Toronto Stock Exchange Composite Index, close (index, 1975=1000) [B4237]
177	v122628	**1**	Toronto Stock Exchange, stock dividend yields (composite), closing quotations (percent) [B4245]
178	v6384	**5**	Total volume; Value of shares traded (dollars - millions) [D4560]
179	v6385	**5**	Industrials; Value of shares traded (dollars - millions) [D4558]
180	v6386	**5**	Mining and oils; Value of shares traded (dollars - millions) [D4559]

Table 176-0064 Foreign exchange rates

181	v37426	**1**	United States dollar, noon spot rate, average (dollars) [B3400]
182	v37437	**1**	United States dollar, 90-day forward noon rate (dollars) [B3401]
183	v37452	**1**	Danish krone, noon spot rate, average (dollars) [B3403]
184	v37456	**1**	Japanese yen, noon spot rate, average (dollars) [B3407]
185	v37427	**1**	Norwegian krone, noon spot rate, average (dollars) [B3409]
186	v37428	**1**	Swedish krona, noon spot rate, average (dollars) [B3410]
187	v37429	**1**	Swiss franc, noon spot rate, average (dollars) [B3411]
188	v37430	**1**	United Kingdom pound sterling, noon spot rate, average (dollars) [B3412]
189	v37431	**1**	United Kingdom pound sterling, 90-day forward noon rate (dollars) [B3413]
190	v37432	**1**	United States dollar, closing spot rate (dollars) [B3414]
191	v37433	**1**	United States dollar, highest spot rate (dollars) [B3415]
192	v37434	**1**	United States dollar, lowest spot rate (dollars) [B3416]
193	v37435	**1**	United States dollar, 90-day forward closing rate (dollars) [B3417]
194	v41498903	**1**	Canadian dollar effective exchange rate index (CERI) (1992=100) (dollars)

Table 176-0043 Interest rates

195	v122550	**1**	Bank rate, last Tuesday or last Thursday (percent) [B14079]
196	v122530	**1**	Bank rate (percent) [B14006]
197	v122495	**1**	Chartered bank administered interest rates - prime business (percent) [B14020]
198	v122505	**1**	Forward premium or discount (-), United States dollar in Canada: 3 month (percent) [B14034]
199	v122509	**1**	Prime corporate paper rate: 1 month (percent) [B14039]
200	v122556	**1**	Prime corporate paper rate: 2 month (percent) [B14084]
201	v122491	**1**	Prime corporate paper rate: 3 month (percent) [B14017]
202	v122504	**1**	Bankers' acceptances: 1 month (percent) [B14033]
203	v122558	**1**	Government of Canada marketable bonds, average yield: 1-3 year (percent) [B14009]
204	v122485	**1**	Government of Canada marketable bonds, average yield: 3-5 year (percent) [B14010]
205	v122486	**1**	Government of Canada marketable bonds, average yield: 5-10 year (percent) [B14011]
206	v122487	**1**	Government of Canada marketable bonds, average yield: over 10 years (percent) [B14013]
207	v122515	**1**	Chartered bank - 5 year personal fixed term (percent) [B14045]
208	v122493	**1**	Chartered bank - non-chequable savings deposits (percent) [B14019]
209	v122541	**1**	Treasury bill auction - average yields: 3 month (percent) [B14007]
210	v122484	**1**	Treasury bill auction - average yields: 3 month, average at values (percent) [B14001]
211	v122552	**1**	Treasury bill auction - average yields: 6 month (percent) [B14008]
212	v122554	**1**	Treasury bills: 2 month (percent) [B14082]
213	v122531	**1**	Treasury bills: 3 month (percent) [B14060]
214	v122499	**1**	Government of Canada marketable bonds, average yield, average of Wednesdays: 1-3 year (percent) [B14028]
215	v122500	**1**	Government of Canada marketable bonds, average yield, average of Wednesdays: 3-5 year (percent) [B14029]
216	v122502	**1**	Government of Canada marketable bonds, average yield, average of Wednesdays: 5-10 year (percent) [B14030]
217	v122501	**1**	Government of Canada marketable bonds, average yield, average of Wednesdays: over 10 years (percent) [B14003]
218	v122497	**1**	Average residential mortgage lending rate: 5 year (percent) [B14024]
219	v122506	**1**	Chartered bank - chequable personal savings deposit rate (percent) [B14035]
220	v122507	**1**	Covered differential: Canada-United States 3 month Treasury bills (percent) [B14036]
221	v122508	**1**	Covered differential: Canada-United States 3 month short-term paper (percent) [B14038]
222	v122510	**1**	First coupon of Canada Savings Bonds (percent) [B14040]

Table 176-0051 Canada's official international reserves

223	v122396	**5**	Total, Canada's official international reserves (dollars - millions) [B3800]
224	v122397	**5**	Convertible foreign currencies, United States dollars (dollars - millions) [B3801]
225	v122398	**5**	Convertible foreign currencies, other than United States (dollars - millions) [B3802]
226	v122399	**5**	Gold (dollars - millions) [B3803]
227	v122401	**5**	Reserve position in the International Monetary Fund (IMF) (dollars - millions) [B3805]

Table 176-0032 Credit measures

228	v36414	**5**	Total business and household credit; Seasonally adjusted (dollars - millions) [B165]
229	v36415	**5**	Household credit; Seasonally adjusted (dollars - millions) [B166]
230	v36416	**5**	Residential mortgage credit; Seasonally adjusted (dollars - millions) [B167]
231	v36417	**5**	Consumer credit; Seasonally adjusted (dollars - millions) [B168]
232	v36418	**5**	Business credit; Seasonally adjusted (dollars - millions) [B169]
233	v36419	**5**	Other business credit; Seasonally adjusted (dollars - millions) [B170]
234	v36420	**5**	Short-term business credit; Seasonally adjusted (dollars - millions) [B171]

Table 176-0025 Monetary aggregates

235	v37148	**5**	Currency outside banks (dollars - millions) [B1604]
236	v37153	**5**	Canadian dollar assets, total loans (dollars - millions) [B1605]
237	v37154	**5**	General loans (including grain dealers and installment finance companies) (dollars - millions) [B1606]
238	v37107	**5**	Total, major assets (dollars - millions) [B1611]
239	v37111	**5**	Canadian dollar assets, liquid assets (dollars - millions) [B1615]
240	v37112	**5**	Canadian dollar assets, less liquid assets (dollars - millions) [B1616]
241	v37119	**5**	Total personal loans, average of Wednesdays (dollars - millions) [B1622]
242	v37120	**5**	Business loans, average of Wednesdays (dollars - millions) [B1623]
243	v41552793	**5**	Currency outside banks and chartered bank deposits, held by general public (including private sector float) (dollars - millions)
244	v41552795	**5**	M1B (gross) (currency outside banks, chartered bank chequable deposits, less inter-bank chequable deposits) (dollars - millions)
245	v41552796	**5**	M2 (gross) (currency outside banks, chartered bank demand and notice deposits, chartered bank personal term deposits, adjustments to M2 (gross) (continuity adjustments and inter-bank demand and notice deposits)) (dollars - millions)
246	v41552797	**5**	Currency outside banks and chartered bank deposits (including private sector float) (dollars - millions)
247	v37130	**5**	Residential mortgages (dollars - millions) [B1632]
248	v41552798	**5**	M2+ (gross) (dollars - millions)
249	v37135	**5**	Chartered bank deposits, personal, term (dollars - millions) [B1637]
250	v37138	**5**	Total, deposits at trust and mortgage loan companies (dollars - millions) [B1639]
251	v37139	**5**	Total, deposits at credit unions and caisses populaires (dollars - millions) [B1640]
252	v37140	**5**	Bankers' acceptances (dollars - millions) [B1641]
253	v37145	**5**	Monetary base (notes and coin in circulation, chartered bank and other Canadian Payments Association members' deposits with the Bank of Canada) (dollars - millions) [B1646]
254	v37146	**5**	Monetary base (notes and coin in circulation, chartered bank and other Canadian Payments Association members' deposits with the Bank of Canada) (excluding required reserves) (dollars - millions) [B1647]
255	v37147	**5**	Canada Savings Bonds and other retail instruments (dollars - millions) [B1648]
256	v41552801	**5**	M2++ (gross) (M2+ (gross), Canada Savings Bonds, non-money market mutual funds) (dollars - millions)
257	v37152	**5**	M1++ (gross) (dollars - millions) [B1652]

Table 282-0087 LFS, SA, Canada and provinces

258	v2062811	**5**	Canada; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
259	v2062815	**1**	Canada; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
260	v2063000	**5**	Newfoundland and Labrador; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
261	v2063004	**1**	Newfoundland and Labrador; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
262	v2063189	**5**	Prince Edward Island; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
263	v2063193	**1**	Prince Edward Island; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
264	v2063378	**5**	Nova Scotia; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
265	v2063382	**1**	Nova Scotia; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
266	v2063567	**5**	New Brunswick; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
267	v2063571	**1**	New Brunswick; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
268	v2063756	**5**	Quebec; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
269	v2063760	**1**	Quebec; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
270	v2063945	**5**	Ontario; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
271	v2063949	**1**	Ontario; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
272	v2064134	**5**	Manitoba; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
273	v2064138	**1**	Manitoba; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
274	v2064323	**5**	Saskatchewan; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
275	v2064327	**1**	Saskatchewan; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
276	v2064512	**5**	Alberta; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
277	v2064516	**1**	Alberta; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)
278	v2064701	**5**	British Columbia; Employment; Both sexes; 15 years and over; Seasonally adjusted (persons - thousands)
279	v2064705	**1**	British Columbia; Unemployment rate; Both sexes; 15 years and over; Seasonally adjusted (rate)

Table 282-0088 Employment by industry

280	v2057603	**5**	Total employed, all industries; Seasonally adjusted (persons - thousands)
281	v2057604	**5**	Goods-producing sector; Seasonally adjusted (persons - thousands)
282	v2057605	**5**	Agriculture [1100-1129, 1151-1152]; Seasonally adjusted (persons - thousands)
283	v2057606	**5**	Forestry, fishing, mining, oil and gas [1131-1133, 1141-1142, 1153, 2100-2131]; Seasonally adjusted (persons - thousands)
284	v2057607	**5**	Utilities [2211-2213]; Seasonally adjusted (persons - thousands)
285	v2057608	**5**	Construction [2361-2389]; Seasonally adjusted (persons - thousands)
286	v2057609	**5**	Manufacturing [3211-3219, 3271-3279, 3311-3399, 3111-3169, 3221-3262]; Seasonally adjusted (persons - thousands)
287	v2057610	**5**	Services-producing sector; Seasonally adjusted (persons - thousands)
288	v2057611	**5**	Trade [4111-4191, 4411-4543]; Seasonally adjusted (persons - thousands)
289	v2057612	**5**	Transportation and warehousing [4811-4931]; Seasonally adjusted (persons - thousands)
290	v2057613	**5**	Finance, insurance, real estate and leasing [5211-5269, 5311-5331]; Seasonally adjusted (persons - thousands)
291	v2057614	**5**	Professional, scientific and technical services [5411-5419]; Seasonally adjusted (persons - thousands)
292	v2057615	**5**	Business, building and other support services [5511-5629]; Seasonally adjusted (persons - thousands)
293	v2057616	**5**	Educational services [6111-6117]; Seasonally adjusted (persons - thousands)
294	v2057617	**5**	Health care and social assistance [6211-6244]; Seasonally adjusted (persons - thousands)
295	v2057618	**5**	Information, culture and recreation [5111-5191, 7111-7139]; Seasonally adjusted (persons - thousands)
296	v2057619	**5**	Accommodation and food services [7211-7224]; Seasonally adjusted (persons - thousands)
297	v2057620	**5**	Other services [8111-8141]; Seasonally adjusted (persons - thousands)
298	v2057621	**5**	Public administration [9110-9191]; Seasonally adjusted (persons - thousands)

Tables 228-00(01,41) Merchandise imports and exports Canada, SA

299	v183474	**5**	Imports, United States, including Puerto Rico and Virgin Islands (dollars - millions) [D398058]
300	v183475	**5**	Imports, United Kingdom (dollars - millions) [D398059]
301	v183476	**5**	Imports, Other European Economic Community (dollars - millions) [D398060]
302	v183477	**5**	Imports, Japan (dollars - millions) [D398061]
303	v191559	**5**	Exports, United States, including Puerto Rico and Virgin Islands (dollars - millions) [D399518]
304	v191560	**5**	Exports, United Kingdom (dollars - millions) [D399519]
305	v191561	**5**	Exports, Other European Economic Community (dollars - millions) [D399520]
306	v191562	**5**	Exports, Japan (dollars - millions) [D399521]
307	v21386488	**5**	Imports, total of all merchandise (dollars - millions)
308	v21386489	**5**	Imports, Sector 1 Agricultural and fishing products (dollars - millions)
309	v21386492	**5**	Imports, Sector 2 Energy products (dollars - millions)
310	v21386495	**5**	Imports, Sector 3 Forestry products (dollars - millions)
311	v21386496	**5**	Imports, Sector 4 Industrial goods and materials (dollars - millions)
312	v21386500	**5**	Imports, Sector 5 Machinery and equipment (dollars - millions)
313	v21386505	**5**	Imports, Sector 6 Automotive products (dollars - millions)
314	v21386509	**5**	Imports, Sector 7 Other consumer goods (dollars - millions)
315	v21386512	**5**	Imports, Sector 8 Special transactions trade (dollars - millions)
316	v21386514	**5**	Exports, total of all merchandise (dollars - millions)
317	v21386515	**5**	Exports, Sector 1 Agricultural and fishing products (dollars - millions)
318	v21386518	**5**	Exports, Sector 2 Energy products (dollars - millions)
319	v21386522	**5**	Exports, Sector 3 Forestry products (dollars - millions)
320	v21386526	**5**	Exports, Sector 4 Industrial goods and materials (dollars - millions)
321	v21386531	**5**	Exports, Sector 5 Machinery and equipment (dollars - millions)
322	v21386535	**5**	Exports, Sector 6 Automotive products (dollars - millions)
323	v21386539	**5**	Exports, Sector 7 Other consumer goods (dollars - millions)
324	v21386540	**5**	Exports, Sector 8 Special transactions trade (dollars - millions)

Table 026-0008: Building permits, values by activity sector; Canada

326	v4667	**5**	Total residential and non-residential (dollars - thousands) [D2677]
327	v4668	**5**	Residential (dollars - thousands) [D2681]
328	v4669	**5**	Non-residential (dollars - thousands) [D4898]
329	v4670	**5**	Industrial (dollars - thousands) [D2678]
330	v4671	**5**	Commercial (dollars - thousands) [D2679]
331	v4672	**5**	Institutional and governmental (dollars - thousands) [D2680]

US interest rates from Federal Reserve Board of Governors

332	FYFF.M	**1**	Interest Rate: Federal Funds (Effective) (% Per Annum, NSA)
333	FYGM3.M	**1**	Interest Rate: US Treasury Bill, Sec. Mkt. 3-Month (% Per Annum, NSA)
334	FYGM6.M	**1**	Interest Rate: US Treasury Bill, Sec. Mkt. 6-Month (% Per Annum, NSA)
335	FYGT1.M	**1**	Interest Rate: US Treasury Bill, Sec. Mkt. 1-Year (% Per Annum, NSA)
336	FYGT5.M	**1**	Interest Rate: US Treasury Bill, Sec. Mkt. 5-Year (% Per Annum, NSA)
337	FYGT10.M	**1**	Interest Rate: US Treasury Bill, Sec. Mkt. 10-Year (% Per Annum, NSA)

Dex Canadian Bond Indexes from Datastream

338	SCM2AUN(RY)	**1**	DEX Capital Corporate, AA Universe
339	SCM2ALG(RY)	**1**	DEX Capital Overall, AA Long Term
340	SCM2AMT(RY)	**1**	DEX Capital Overall, AA Mid Term
340	SCM2AMT(RY)	**1**	DEX Capital Overall, AA Short Term

Moody's US Bond Indexes from Federal Reserve Board of Governors

338	FYAAAC.M	**1**	Bond Yield: Moody's AAA Corporate (% Per Annum)
338	FYBAAC.M	**1**	Bond Yield: Moody's BAA Corporate (% Per Annum)