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# The Impact of the Global Crisis on Canada: What Do Macro-Financial Linkages Tell Us?

*Rupa Duttagupta and Natalia Barrera*

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**The Impact of the Global Crisis on Canada—What Do Macro-Financial Linkages Tell Us?**

**Prepared by Rupa Duttagupta and Natalia Barrera[1]**

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**Abstract**

This paper builds a Bayesian VAR estimation model of growth for Canada, by focusing specifically on the role of external and domestic financial indicators, including credit conditions. A variance decomposition shows that financial conditions explain one-third of the total variability in Canada's real GDP growth, although changes in U.S. real GDP growth still account for a larger share of volatility in Canadian growth. A macro-financial conditions index built from the VAR's impulse responses shows that U.S. real GDP growth and lending standards will increasingly bear on Canada's growth, implying that a normalization of the U.S. economic and financial conditions is key for a sustained recovery in Canada.

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Contents                                                                 Page

## I. INTRODUCTION

The global financial crisis underscored the importance of understanding risks that can propagate in an economy through its cross-country and macro-financial linkages (c.f., IMF, 2009a). Canada's experience in the crisis is worth highlighting—notwithstanding its relatively strong fundamentals as it entered the crisis (see IMF, 2009b, and Ratnovski and Huang, 2009), the Canadian economy underwent a deep recession, largely due to its close economic and financial ties with the United States. Canada was not only hit by slumping external demand, but also massive spillovers from global financial shocks, resulting in sharp increases in money and credit market spreads and exceptional tightening in lending standards. This paper focuses on how these financial conditions, both foreign and domestic— which are not always in sync with monetary policy indicators—affect Canada's real economic activity.

Our paper builds on the recent literature analyzing Canada's macro-financial ties with the United States. Klyuev (2008) finds that a quarter of the total financing of Canadian businesses is raised from the United States. The author uses a structural monetary VAR model with U.S. and Canadian variables, and estimates that a percentage point increase in the U.S. 3-month T-bill rate, other things being equal, leads to a decline of more than one percentage point in Canada's real GDP growth after 3 quarters. When the impact of the U.S. financial shock is decomposed into trade and financial channels, and latter channel appears to be larger. Swiston and Bayoumi (2008) find that a one percent shock to U.S. real GDP shifts Canadian real GDP by ¾ of a percentage point in the same direction, with financial spillovers more important than trade in recent decades. Our paper is among the first few that examine the role of both U.S. and Canadian credit availability for Canadian businesses, besides other indicators of external and domestic credit conditions, in determining Canada's growth. For this, we use data on U.S. and Canadian non-price lending standards for large corporations (from these countries' Senior Loan Officers' Surveys, SLOS) as measures of credit availability for Canadian businesses.[2]

The Bank of Canada's Senior Loan Officer Survey is a quarterly survey of the business-lending practices of 11 major Canadian financial institutions (see Faruqui and others, 2008). The measure of non-price lending conditions is based on survey questions on general lending standards, limit of capital allocation, and non-price terms of credit (e.g., collateral, covenants, credit scores, and so on), which complement the information contained in pricing conditions (i.e., interest rates), and hence together with the latter provide a much fuller picture of credit availability and financial conditions in the economy.[3]

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[2] The Bank of Canada constructs a high frequency financial conditions index using domestic financial indicators, including overall lending standards (see http://credit.bank-banque-canada.ca/financialconditions for details). See Bayoumi and Melander (2008) and Swiston (2008) for the impact of the U.S. lending standards on U.S. real economic activity.

[3] Note that the measure, like its U.S. counterpart, indicates the direction of change in lending conditions (i.e., an increase in the indicator shows that the share of the financial institutions experiencing a tightening of credit conditions has increased) rather than providing any information on the magnitude of the tightening.

The paper builds a macro-financial conditions index for Canada that considers the role of both economic and financial indicators in driving Canada's growth. The "macro" part of the index accounts for external demand conditions, while the "financial" part accounts for external and domestic financial conditions. It is important to recognize that, in the model, U.S. variables essentially proxy for all external conditions—i.e., not just US idiosyncratic shocks but also other shocks that could be external even to the US economy but propagate through the latter. The underlying estimation analysis is done with a Bayesian VAR model (BVAR)—drawing on Österholm and Zettelmeyer (2008). The BVAR model uses "informative priors" about the steady state values of the model variables to reduce the potential loss in estimation precision that could be caused by the generous parameterization of VARs. This is especially important given that the sample is constrained by the availability of Canadian lending standards data series, which starts in the second quarter of 1999. The Baynesian VAR model restricts contemporaneous causality to be in one direction, whereby all U.S. variables can affect Canadian variables contemporaneously, but not vice-versa (although Canadian variables can affect their U.S. counterparts in subsequent periods), which is a reasonable assumption given that Canada is indeed a small open economy that is much more prone to be significantly affected by external spillovers from the United States rather than the other way around.

Impulse-response functions underscore the impact of financial shocks on Canada's growth. A shock to U.S. non-price lending standards—one standard deviation equal to a net tightening of about 10 percentage points (pp)—reduces Canadian growth (y-o-y) by close to ½ pp in six quarters. The impact of Canadian lending standards is somewhat weaker in size—a net tightening by 10 pp reduces real GDP growth by 0.2 pp in two quarters. The larger effect of a tightening in U.S. SLOS on Canadian growth likely reflects the indirect effects of U.S. lending standards through lower U.S. growth, as well as tighter Canadian lending standards. Indeed, a 10 pp shock to the U.S. SLOS tightens the Canadian SLOS by 6 pp in the same direction immediately, while the economic impact of the Canadian SLOS on its U.S. counterpart is insignificant not just contemporaneously (which is by construction) but also in subsequent periods. Also, a widening of the U.S. high-yield spread (a one-standard-deviation shock equaling 123 basis points) dampens Canadian growth by 0.15 pp in four quarters.

The results also confirm the strong spillover effects of external demand shocks to Canadian growth, supporting previous findings (Swiston and Bayoumi, 2008; Klyuev, 2008). For instance, a one pp increase in U.S. real GDP growth (year-over-year) increases Canadian growth by a bit more than ¾ percentage points almost immediately.

External conditions play a very important role in explaining Canada's growth variance and prospects for recovery. Given its large trade concentration with the United States, it is hardly surprising that U.S. growth is the largest contributor to Canada's growth variability over the long run, at 46 percent. Financial conditions—both in the United States and in the domestic market—account for another 33 percent, and the oil price comes next (13 percent). Oddly enough, the contribution of Canadian growth to its own variance declines from 40 percent to a little over 8 percent in the long run, likely reflecting increasing exposure to the U.S.

economy, and hence greater synchronization with U.S. business cycles, during the past ten years.

Scenario analysis—using alternative paths for U.S. recovery and domestic financial conditions—corroborates Canada's vulnerability to the United States and to domestic credit conditions. Finally, a macro-financial condition index built from the coefficients of the baseline model tracks real GDP growth well, forecasts a protracted recovery for Canada over the next year, and stresses that the U.S. economy, and U.S. and domestic financial conditions will pose the main drag on growth in the near term.

The rest of the paper is organized as follows. Section II presents the empirical analysis in five parts—first it presents some stylized facts about the data; then it describes the BVAR model and discusses the estimation results and robustness checks; third it discusses the out of sample forecasts for Canada's growth under alternative scenarios for U.S. real GDP growth and domestic credit conditions; and finally, it builds a Canadian macro-financial conditions index. Section III concludes.

## II. EMPIRICAL ANALYSIS

### A. Data and Stylized Facts

The Bank of Canada's Senior Loan Officer's Survey for non-price lending standards on corporate lending is used as a measure of lending conditions in Canada. It covers information on price and non-price terms of business lending conditions from the perspective of financial institutions (at a quarterly frequency beginning in the second quarter of 1999). At the end of each quarter, respondents are asked questions covering their lending practices for businesses, including qualitative changes in price and non-price parameters and, if there were a change, the reasons for tightening or easing standards. As expected, the Canadian SLOS is strongly correlated with its U.S. counterpart (Figure 1).



Figure 1. Canada: Banks' Lending Standards for Corporations and Real GDP Growth

Source: Haver Analytics.
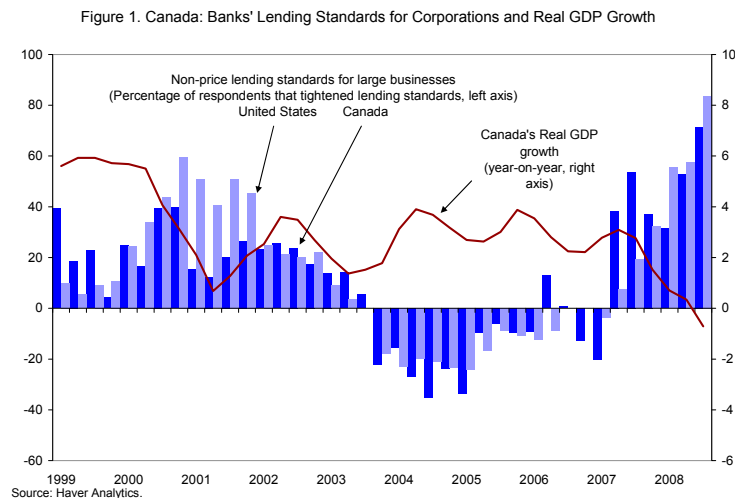
Also, both the U.S. and Canadian SLOS are negatively correlated with current and future levels of real activity in Canada (Figure 1, Table 1), which is not surprising given that one-quarter of the total financing of Canadian businesses is raised in the United States (see Klyuev, 2008). Thus, both the U.S. and Canadian SLOS appear to be good proxies for overall conditions of credit availability in Canada—for instance, the deceleration in Canadian real growth in early 2000s and more recently coincided with a sharp tightening of one or both lending standards.

Surprisingly though, the correlation between lending standards and current and future levels of economic activity is stronger for the U.S. SLOS, possibly reflecting direct and indirect effects. Besides the direct negative effect of tighter U.S. SLOS on Canadian growth through tighter external credit conditions for Canadian businesses, there are potentially two other indirect negative effects—one of tighter U.S. SLOS on U.S. real GDP growth and hence Canadian growth, and another of tighter U.S. SLOS resulting in tighter Canadian SLOS through financial linkages across North-American financial institutions and markets. Indeed, Table 1 also shows a strong positive correlation between U.S. SLOS and current and future levels of Canadian SLOS.

Table 1. Correlations between US and Canadian Financial Variables and Canadian Real GDP Growth
(sample: 1999Q2–2008Q4)

|  | Canada Real GDP (y/y) | | | | | Canada SLOS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
|  | t | t+1 | t+2 | t+3 | t+4 | t | t+1 | t+2 | t+3 | t+4 |
| U.S. SLOS (percent increase in tightening of loans to large firms) | -0.23 | -0.30 | -0.31 | -0.27 | -0.21 | 0.82 | 0.74 | 0.66 | 0.54 | 0.39 |
| U.S. three-month T-bill | 0.61 | 0.45 | 0.25 | 0.02 | -0.15 | -0.02 | 0.17 | 0.31 | 0.44 | 0.61 |
| U.S. high yield spread to 10 year treasury bond | -0.17 | -0.24 | -0.32 | -0.29 | -0.21 | 0.71 | 0.58 | 0.42 | 0.29 | 0.11 |
| Canada SLOS (percent increase in tightening of loans to large firms) | -0.03 | -0.10 | -0.21 | -0.20 | -0.08 | 1.00 | 0.78 | 0.58 | 0.50 | 0.50 |
| Canada three-month T-bill | 0.60 | 0.38 | 0.13 | -0.07 | -0.14 | 0.16 | 0.30 | 0.38 | 0.46 | 0.56 |
| Canada REER | 0.30 | 0.22 | 0.05 | -0.12 | -0.19 | 0.24 | 0.10 | 0.13 | 0.21 | 0.27 |
| Canada high yield spread to 10 year treasury bond | -0.07 | 0.00 | -0.01 | -0.05 | -0.13 | 0.45 | 0.36 | 0.27 | 0.19 | 0.05 |
| Canada: real equity prices (deflated by implicit price deflator) | 0.50 | 0.54 | 0.53 | 0.34 | 0.01 | -0.47 | -0.27 | -0.18 | -0.14 | -0.10 |
| Canada real home prices (deflated by CPI) | -0.13 | -0.15 | -0.11 | -0.07 | -0.07 | -0.58 | -0.52 | -0.43 | -0.27 | -0.20 |

Source: Bloomberg; Finance Canada; Haver Analytics and staff estimates.

Other domestic and U.S. financial indicators are also strongly correlated with current and future levels of economic activity. For instance, the U.S. and Canadian high-yield spread (to 10-year treasury bonds) is positively (negatively) correlated with current and future levels of Canada's SLOS (real GDP growth), and again the relationship is stronger with the U.S. high-yield spread than the Canadian high-yield spread. Canadian real GDP growth is negatively correlated with monetary policy tightening (proxied by the three-month t-bill rate), although the negative association kicks in after three quarters showing the lagged effect of monetary policy on real activity. [4] Finally, Canada's real GDP growth is negatively correlated with the real effective exchange rate (with lags) and real home prices.

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[4] Note that the bivariate correlations in Table 1 are not indicative of causation, for which one would need to look at the Bayesian VAR estimates (Section IIB).

## B. The Bayesian VAR model

**Methodology[5]**

The Bayesian VAR model (BVAR), developed by Villani (2009), assumes that the forecaster has potentially useful information on the steady-state values of the variables used in the model, i.e., an informative prior would make forecasts converge to a level that the forecaster judges reasonable. If the forecaster is correct, this leads to a substantial improvement in the forecasting performance of BVAR compared with a standard VAR. The model is given by:

$$G(L)(x_t - \Psi) = \eta_t \tag{1}$$

Where,

$G(L) = I - G_1 L - \ldots - G_p L^p$ is a lag polynomial of order $p$,

$x_t$ is a $n \times 1$ vector of stationary macroeconomic variables,

$\eta_t$ is a $n \times 1$ vector of *iid* error terms with $E(\eta_t) = 0$ and $E(\eta_t \eta_t') = \Sigma$, and

$\Psi$ provides the steady state of the series in the system.

The prior on $\Sigma$ is given by $p(\Sigma) \propto |\Sigma|^{-\frac{(n+1)}{2}}$, the prior on $vec(G)$ – where $G = (G_1 \ldots G_p)'$ – is given by $vec(G) \sim N_{pn^2}(\theta_G, \Omega_G)$, and the prior on $\Psi$ is given by $\Psi \sim N_n(\theta_\psi, \Omega_\psi)$.

This choice of priors means that the prior on $\Sigma$ is non-informative; the priors on the vectors of dynamic coefficients $vec(G)$ and steady-state parameters $\Psi$ will, on the other hand, generally be informative (discussed in more detail below).

The baseline model comprises a VAR (x) of nine variables, with the first five being proxies for external macro and financial conditions, followed by Canadian real GDP growth, and three proxies for domestic financial conditions (Equation 2).

$$x = (y^{US} \ \text{p-oil}^{world} \ SLOS^{US} \ i^{US} \ HYS^{US} \ y^{Canada} \ SLOS^{Canada} \ i^{Canada} \ REER^{Canada}) \tag{2}$$

Where,

$y^{US}$ = U.S. real GDP growth[6], p-oil$^{world}$ = world oil price growth (simple average of three spot prices—Dated Brent, West Texas intermediate, and the Dubai Fateh), SLOS$^{US}$ = a proxy for

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[5] This sub-section draws on Österholm (2008), Österholm and Zettelmeyer (2008), and Abrego and Österholm (2008), which have the details.

[6] All growth rates are expressed as year-on-year averages. For similar specifications see Österholm and Zettelmeyer (2008) and Abrego and Österholm (2008).

credit availability from the U.S. Senior Loan Officers' Survey (non-price lending conditions for C&I lending to large corporations, $SLOS^{Canada}$ = the Canadian counterpart to $SLOS^{US}$; $i^{US}$ = U.S. three-month t-bill rate as a proxy for U.S. monetary conditions; $HYS^{US}$ = U.S. high-yield spread relative to the 10-year treasury bond yield, $y^{Canada}$ = Canadian real GDP growth rate; $i^{Canada}$ = Canada's three-month t-bill rate as a proxy for domestic monetary conditions; and $REER^{Canada}$ = growth in the real effective exchange rate. The quarterly data go from the second quarter of 1999 to the fourth quarter of 2008. The sample period is constrained by data availability for Canadian non-price SLOS, thus making the BVAR estimation technique, wich attaches prior information on parameter values, particularly useful.

All variables are endogenous as in a standard VAR model, although the U.S. variables are assumed to be exogenous for the Canadian variables. We use a Cholesky decomposition of the variance-covariance matrix to identify independent standard normal shocks, where the variables are ordered as in Equation (2). Thus, U.S. real GDP growth is contemporaneously independent of all shocks except its own, world oil price growth contemporaneously depends only on U.S. growth shocks and its own, and so on. The ordering between the U.S. financial variables (i.e., SLOS, t-bill rates, and high yield spread) supports the view that lending standards and policy interest rates should contemporaneously affect market interest rates, but not vice versa.[7]

The BVAR model incorporates prior knowledge on the steady-state values of the variables, drawing on previous findings or their historical behavior (Table 2, first column). The steady-state priors for U.S. and Canadian growth are assumed to converge to average growth of real potential GDP as estimated by IMF desks. Priors for world oil price and U.S. t-bill rate and high-yield spread draw on Österholm and Zettelmeyer (2008), while the prior for the Canadian t-bill rate is assumed to converge to its U.S. counterpart in the steady state. Finally, steady-state priors for the SLOS variables and the Canadian real effective exchange rate are largely based on historical averages. The posterior distributions are close to the priors, confirming that the chosen priors were reasonable (Table 2, second column).

| Table 2. Steady State Priors (95 percent probability intervals) | | |
|---|---|---|
| | Prior | Posterior |
| US GDP growth | (2.0, 4.0) | (1.8, 2.9) |
| Oil price growth | (-2.0, 4.0) | (-1.5, 4.5) |
| US lending standards | (15.0, 30.0) | (10.6, 22.9) |
| US three-month tbill rate | (3.0, 5.0) | (3.3, 5.0) |
| US high yield spread | (4.0, 6.0) | (4.5, 6.2) |
| Canada GDP growth | (2.0, 3.5) | (2.2. 3.3) |
| Canada lending standards | (12.5, 30.0) | (12.6, 23.7) |
| Canada three-month t-bill rate | (3.0, 5.0) | (3.3, 4.5) |
| Canada real effective exchange rate | (-2.0, 5.0) | (-0.7, 4.2) |

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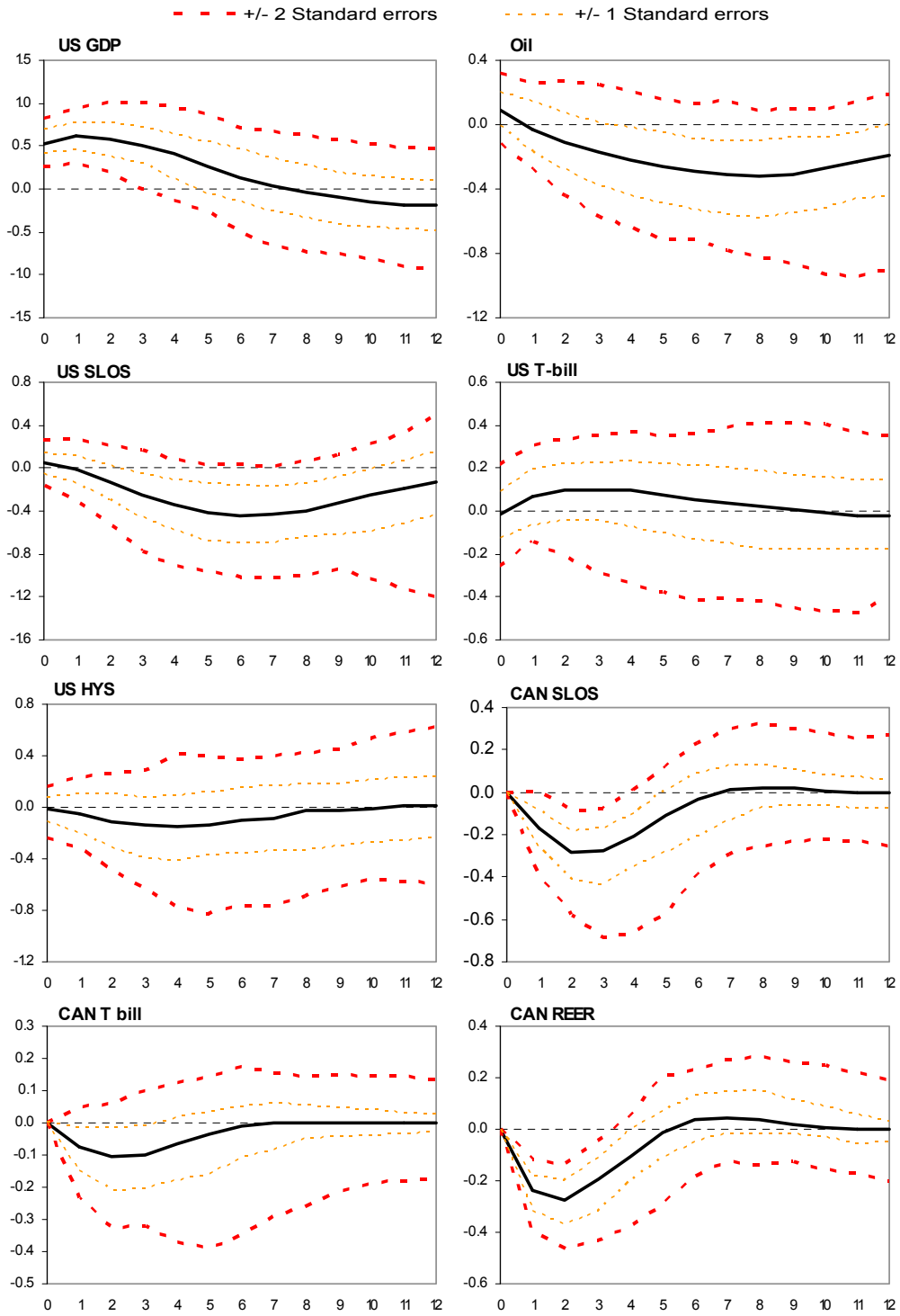[7] See Swiston (2008) for a similar presentation of a monetary VAR model for the United States.

**Impulse-response functions and variance decompositions from the baseline model**

Impulse-response functions show that global economic shocks have a large bearing on Canada's growth (Figure 2). A percentage point increase in U.S. real GDP growth (year-over-year) increases Canadian real GDP growth by about 0.8 pp almost immediately, supporting findings of Klyuev (2008) and Swiston and Bayoumi (2008). A one-pp positive shock to global oil prices has a small negative effect on Canada's growth rate, reducing growth by 0.015 pp in eight quarters, although the effect is economically (and statistically) insignificant, in line with Klyuev (2008).

Shocks to the U.S. and domestic lending standards have a large negative impact on growth. A one-standard-deviation shock to the U.S. SLOS—a net tightening of close to 10 pp—reduces Canada's growth by 0.45 pp in six quarters, while a similar tightening in the Canadian SLOS has a smaller impact, reducing growth by 0.2 pp in two quarters. The impact of changes to the Canadian SLOS on Canada's real GDP occurs relative faster, but wanes out faster too—within six quarters as opposed to beyond 12 quarters for the U.S. SLOS.

Figure 2. Impulse Response Functions of Shocks to Canada's Real GDP Growth

- - - +/- 2 Standard errors          - - - +/- 1 Standard errors

**US GDP**

**Oil**

**US SLOS**

**US T-bill**

**US HYS**

**CAN SLOS**

**CAN T bill**

**CAN REER**

Source: Bloomberg; Haver Analytics; and staff estimates.

The larger overall impact of a change in U.S. SLOS on Canada's real GDP, compared to the Canadian SLOS could reflect the broader effect of changes in the U.S. SLOS on Canadian activity through its impact on, (i) U.S. real growth and hence external demand; (ii) the Canadian SLOS or domestic credit conditions. Indeed, a one-s.d. shock to the U.S. SLOS (a net tightening of about 10 pp) reduces U.S. real GDP growth by close to 0.4 pp in five quarters, and causes a net tightening of 6 pp in the Canadian SLOS immediately (Figure 3). The impact of a tightening in the Canadian SLOS on U.S. SLOS is insignificant both contemporaneously (by construct) as well as in the subsequent periods.

Figure 3. Impulse Response Function of US SLOS Shocks to Canada's SLOS
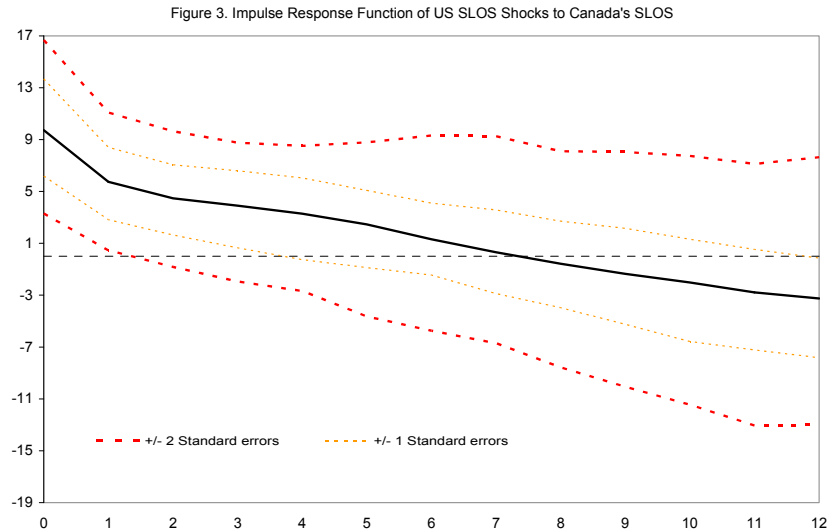


Growth is also dampened by tightening in other financial indicators, including interest rate shocks (Figure 2). A one s.d. shock to the U.S. high-yield spread (123 basis points, bp) shaves off 0.15 pp from real GDP growth in four quarters, while that in the Canadian three-month t-bill rate (18 bp) reduces real GDP growth by a little more than $1/10^{th}$ of a pp in two quarters. However, a counterintuitive result is that a shock to the U.S. T-bill rate has a positive effect on Canada's real GDP growth—a one s.d. increase (40 bp) increasing growth by $1/10^{th}$ of a pp in three quarters. Finally, a one-s.d. shock to the real effective exchange rate (2¾ pp increase) reduces growth by 0.3 pp in two quarters.

The variance decompositions for Canada's real GDP growth confirm that foreign shocks are the most important source of variation in Canada's growth over the long run, with U.S. growth accounting for 46 percent, U.S. financial shocks another 25 percent, and oil prices 13 percent (Figure 4). The contribution of domestic financial conditions increases from 0 percent in the short-term to over 8 percent in 12 quarters. Oddly enough, the contribution of Canadian growth to its own variance declines from 40 percent to 8 percent in the long run—this could reflect the fact that the model is based on a recent sample period (since 1999), when the openness of the Canadian economy to U.S. conditions has increased markedly. Indeed, a simple monetary BVAR model from the early 1990s (excluding data on SLOS and high yield spreads) shows Canadian GDP as the largest contributor to its own variance over the short and medium term.

**Figure 4. Variance Decomposition of Canadian Real GDP Growth**
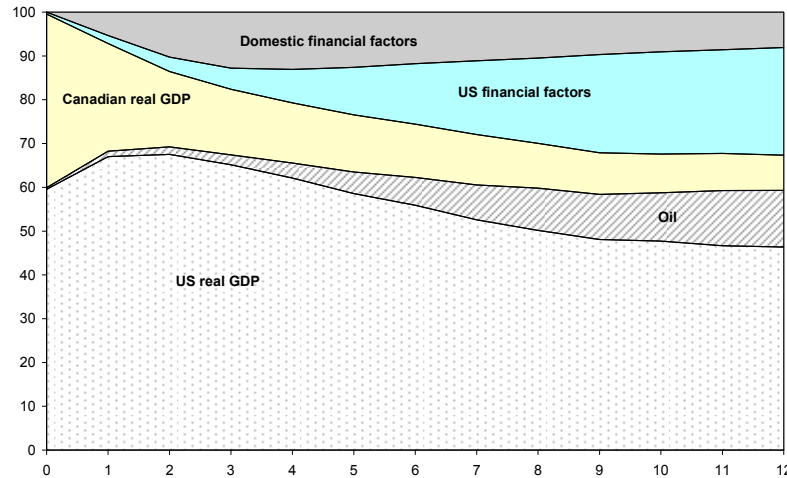


## Alternative specifications

The basic results from the baseline model hold well even under alternative specifications, with other proxies for financial conditions, such as real home prices and real equity prices.[8] Given the small sample size and the relative large number of variables in the baseline BVAR model, the alternative specifications are estimated by replacing the REER with each alternative financial market indicator. We still find that (i) U.S. real GDP growth is the largest contributor to the variance in Canadian growth rate, followed by U.S. financial conditions; (ii) A one-percentage-point shock to U.S. GDP growth increases Canadian growth by 0.7-0.8 pp in one or two quarters; (iii) shocks to the U.S. and Canadian lending standards have a significant impact on Canada's real GDP growth (with a net tightening of U.S. SLOS by 10 pp shaving off 0.4 pp from growth in seven quarters under both specifications, which is larger than the effect of Canadian SLOS, whereby a similar tightening of 10 pp of the latter reduces real GDP growth by about 0.2 in three quarters); and finally, (iv) among the domestic financial variables, the Canadian SLOS is the largest contributor to the variance in real GDP growth.

The impact of the new financial market indicators on real GDP growth is overall negative. A one-standard-deviation shock to real home prices (1.2 pp) initially has a positive effect on real GDP growth which turns negative in four quarters. Thus, the positive effect of higher home prices on real income of home owners is eventually offset by its negative impact on home affordability. The impact of equity price shocks on real GDP growth is also negative— a one-standard-deviation shock to real equity prices (8 pp increase) reduces real GDP growth by 1/10th of a percentage point in four quarters.

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[8] These results are available upon request.

## C.  Out of Sample Forecasts

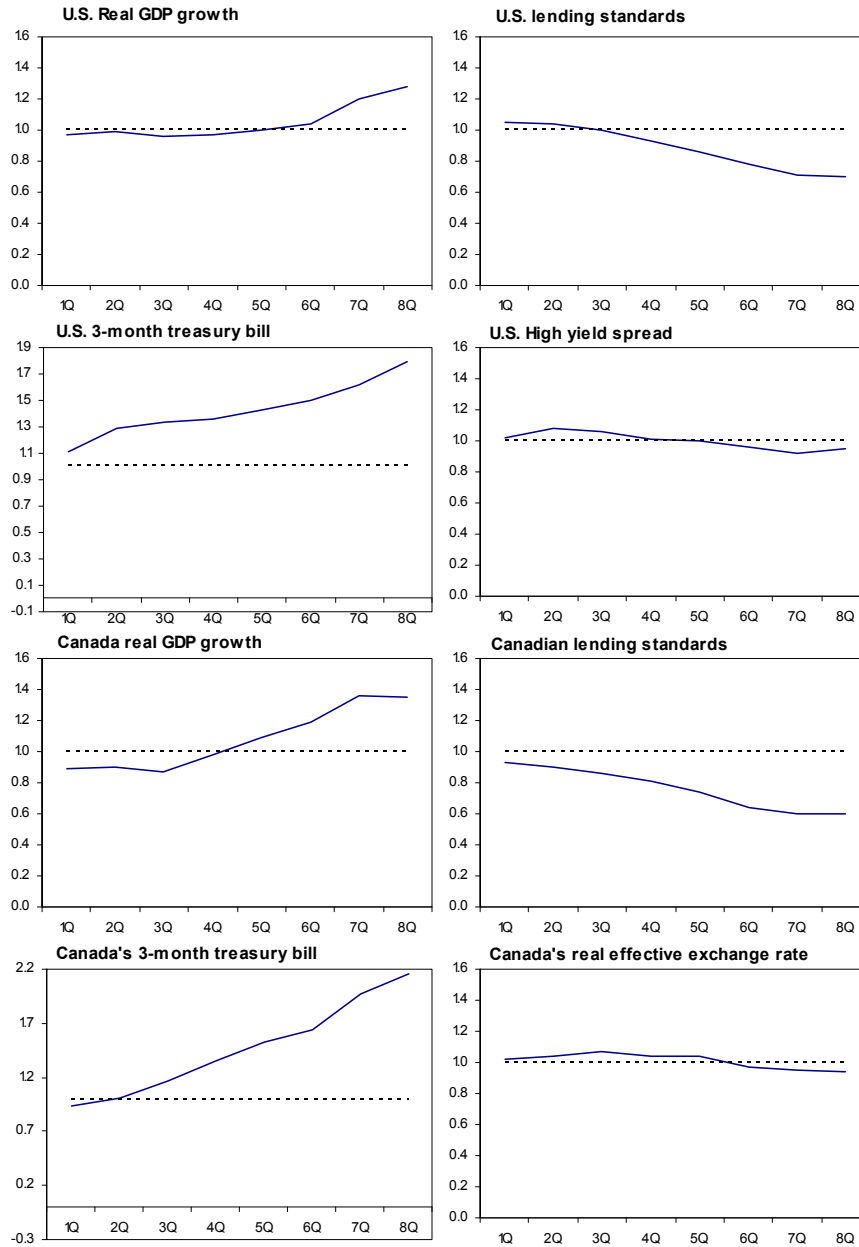**How well does the BVAR forecast Canada's growth?**

This sub-section compares the out of sample performance of the BVAR model for Canada's real GDP growth vis-à-vis the VAR. To do this, the BVAR and VAR model are each individually estimated using data from 1999Q2 to 2005Q4, and used to generate forecasts eight quarters ahead to 2007Q4, and the forecast errors are recorded. The sample is then extended by one period, the models re-estimated with new forecasts for eight periods ahead and so on. Once the sample reaches 2006Q4, forecasting is done over consecutively shorter periods, since the sample with all the actual data ends in 2008Q4. In particular, the last evaluation is done with estimation from 1999Q2 to 2008Q3 and only forecasted one period ahead. The projections for Canada's annual average real GDP growth from the BVAR model are closer to actual outcomes than that for VAR for all years except 2006 (Figure 5).

Figure 5. Actual Versus Projected Real GDP Growth
(year-on-year average growth)
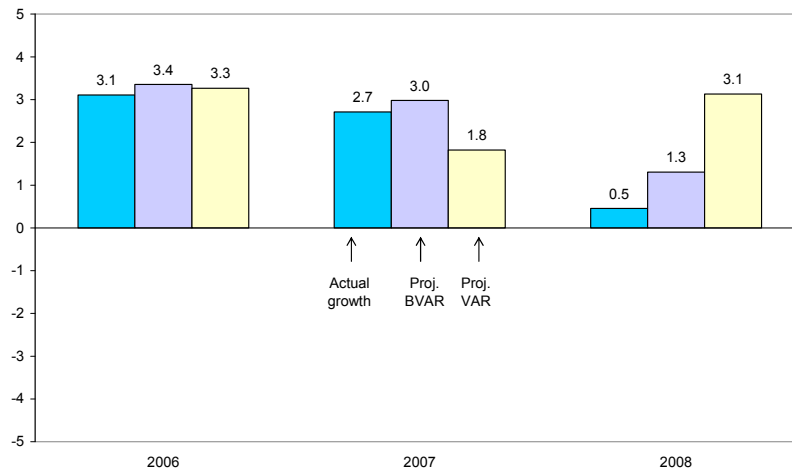


However, the root means square error (RMSE) estimates from the two models—based on the forecasts of each model at one to eight quarters ahead—gives a mixed picture. A relative RMSE (ratio of the RMSE of the BVAR with that of the VAR) that is less than one would imply that the BVAR forecasts better than the VAR at a given horizon. We find that for U.S. and Canadian SLOS the BVAR is generally better, while for U.S. and Canadian real GDP growth, the BVAR outperforms the VAR for the first five-six quarters only, and for policy reaction variables (U.S. and Canadian t-bill rates) the VAR outperforms the BVAR (Figure 6).

**Figure 6. Out of Sample Projections of BayesVAR Versus VAR**
**(Root Mean Square Error Comparisons) 1/**



U.S. Real GDP growth

U.S. lending standards

U.S. 3-month treasury bill

U.S. High yield spread

Canada real GDP growth

Canadian lending standards

Canada's 3-month treasury bill
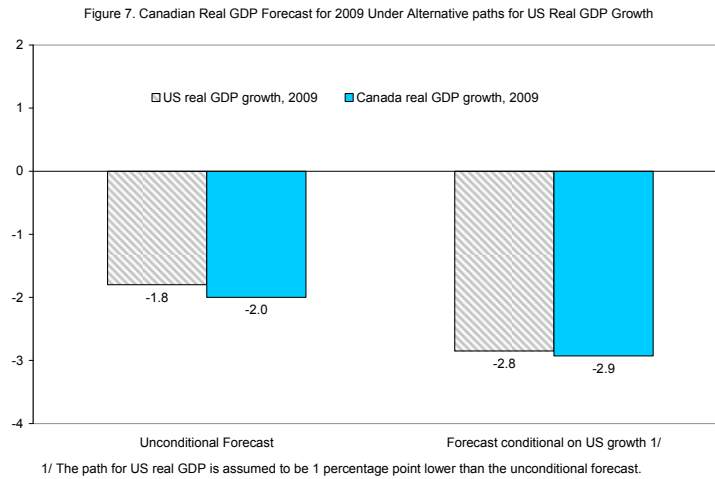
Canada's real effective exchange rate

Source: Authors' calculations.
1/ A value of less than one would imply that the BVAR model is forecasting better than the VAR

**Conditional Forecasts—how does the Canadian outlook depend on prospects for U.S. and domestic financial recovery?**

The out-of-sample exercise confirmed the usefulness of the BVAR model in forecasting Canada's real GDP growth. In this sub-section, we forecast Canada's real GDP growth using the BVAR model, conditional on alternative future paths of external and domestic variables. Figure 7 shows the tight relationship between Canada's economic prospects and the outlook

for external activity. The unconditional model projects U.S. real GDP activity to contract by 1.8 percent and Canadian real GDP to contract by 2 percent in 2009. In the first alternative BVAR specification which is conditional on the underlying projection for U.S. real GDP growth, U.S. real GDP growth in 2009 is assumed to follow the path forecast in the IMF's Spring 2009 WEO, with average annual growth rate 1 pp lower than that projected by the unconditional model (-2.8 percent). The resulting Canadian growth rate is -2.9 percent in 2009, 0.9 pp lower than the rate generated by the unconditional model.[9]

Figure 7. Canadian Real GDP Forecast for 2009 Under Alternative paths for US Real GDP Growth



1/ The path for US real GDP is assumed to be 1 percentage point lower than the unconditional forecast.

Economic recovery will also be affected by the continuation of strained domestic credit conditions (Figure 8). In the second alternative specification, the average value for the Canadian SLOS in 2009 is assumed to be 10 pp tighter than that projected by the unconditional model—i.e., a net tightening of 45 percentage points on average instead of 35 percentage points. The resulting projection for Canada's growth—conditional on the tighter Canadian SLOS—is -2.3 percent in 2009, 0.3 pp lower than the unconditional projection.

Figure 8. Canadian Real GDP Forecast Under Alternative Conditions for Canadian SLOS



1/ The path for Canadian SLOS is assumed to be 10 percentage point tighter than the unconditional forecast.

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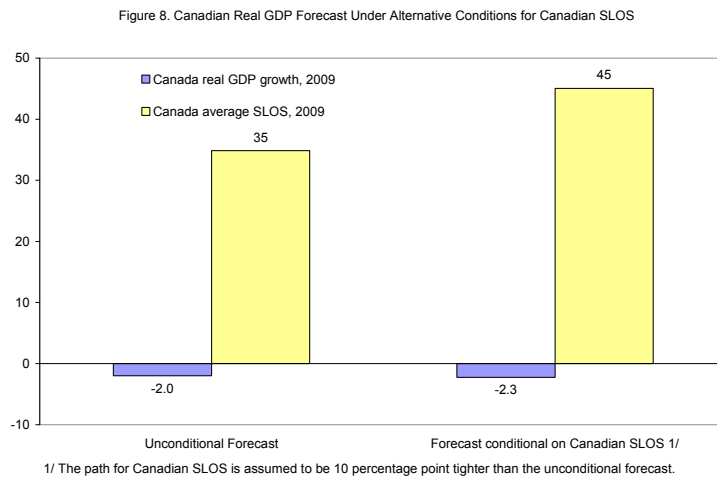
[9] The pass- through from the conditional forecast analyses is not identical to the impulse responses, as the former provides responses of Canada's growth to changes in annual average levels of the underlying variables, while the latter corresponds to responses to shocks to the underlying variable in a particular quarter.
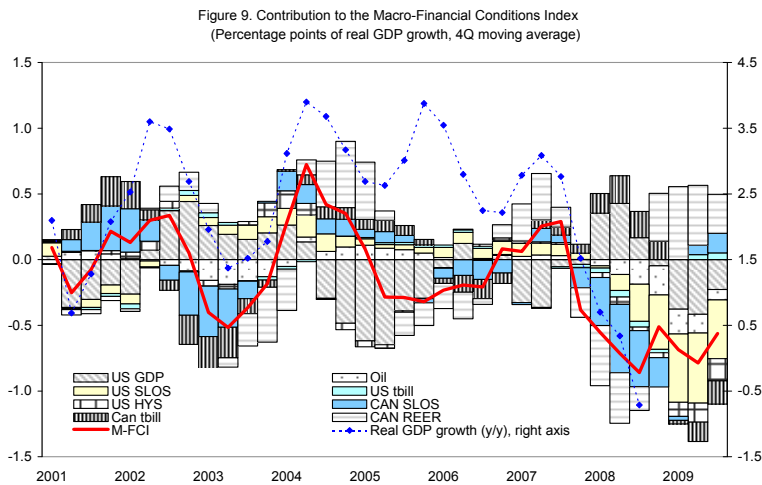
### D. Macro-Financial Conditions Index

The macro-financial conditions index (MFCI) is constructed using the impulse-responses from the baseline BVAR model in Section B. The MFCI measures the impact to Canada's real GDP growth in a given quarter from shocks to the variables in the BVAR model over the previous eight quarters. The macro part of the index accounts for the effect of U.S. real GDP growth and oil prices on domestic real GDP growth, while the financial part accounts for the effects of T-bill rates, high-yield spread, lending standards and real effective exchange rate. With a total of eight variables in the model (excluding domestic real GDP growth), this implies that the MFCI captures the sum of 64 separate terms, and starts in mid-2001.[10]

The macro-financial condition index tracks real GDP growth well, with the correlation at 0.4 (Figure 9).[11]The MFCI's path shows that most of the previous slowdowns in real activity (second halves of 2001, 2003, and 2005, and the ongoing recession) coincided with a tightening of the MCFI, while the subsequent recoveries (2002, 2004) coincided with a relaxing of the index, except for the pickup in growth in early- to mid-2006. In terms of the components contributing to the movements in MFCI, it is interesting to note that while U.S. real GDP growth played a key role in driving the MFCI in the 2001 slowdown, its contribution to the MFCI was positive in the recent crisis (until end-2008). Conversely, financial factors—particularly, the appreciation in the REER, and tighter Canadian lending standards—contributed to the slowdown from end-2007, partly offset by monetary easing. However, the projected values of the MFCI for 2009 show that U.S. real GDP growth, and U.S. and Canadian lending standards will increasingly bear on growth, which will be only somewhat offset by a projected positive contribution from REER depreciation.[12] Thus, a normalization of



Figure 9. Contribution to the Macro-Financial Conditions Index
(Percentage points of real GDP growth, 4Q moving average)

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[10] See Swiston (2009) for a description of the construction of a financial conditions index.

[11] The MFCI also relates well with the Bank of Canada's weekly financial conditions index, which shows a persistent tightening of financial conditions in the Canadian economy from mid 2008 until the end of the year.

[12] Recent data appear to suggest that US economic conditions have indeed continued to bear on Canadian prospects; and lending standards in both economies remain tight as well—although less so than before. However, contrary to the model's projection, the real exchange rate has also continued to be a drag on growth.

external real activity and domestic financial conditions will be crucial for a sustained pickup in domestic real economic activity.

### III. CONCLUSION

This paper sheds a fresh perspective on the close macro-financial ties between Canada and the United States, by focusing on the impact of both U.S. and Canadian financial conditions—including non-price lending standards—in driving Canada's real economic prospects. It builds a mean-adjusted BVAR model of Canadian growth that focuses on the role of external and domestic financial conditions—such as corporate spreads and lending standards—beside other standard variables such as U.S. growth, oil prices, real effective exchange rate, and U.S. financial and monetary conditions. Assessing the independent role of lending standards is crucial to understanding how credit availability (from the supply side) affects economic conditions and hence growth. That is particularly important now in light of the huge credit strains both in the United States and in Canada. In fact, this is among the few papers analyzing the role of Canadian lending standards to explain growth, in part because of its recent availability. In addition, we study the importance of U.S. lending standards to explain economic activity in Canada after controlling for domestic conditions. As it turns out, the U.S. lending standards have a bigger influence on Canada's growth than the Canadian lending standards, in part because of indirect effects through changes to U.S. real GDP growth and Canadian lending standards.

The BVAR model initially assumes steady-state values for the model variables (U.S. growth, oil price, U.S. non-price business lending standards, U.S. 3-month t-bill, U.S. high-yield spread, Canadian growth, Canadian non-price business lending standards, Canada's 3-month t-bill, and Canada's real effective exchange rate). The posterior distributions are very similar to these priors implying that the initially chosen values were reasonable. Out-of-sample tests show that the BVAR model projections for Canada's real GDP growth for 2006-08 are pretty close to the actual outcome, more so than a VAR-based model. However, comparisons between the model (using root mean-squared errors) shows that while the BVAR generally outperforms the VAR for forecasting the financial variables in the model, it has a relatively mixed performance with respect to the other variables.

Variance decompositions confirm the high vulnerability of Canada's growth to external conditions. In particular, U.S. real GDP growth continues to explain almost half the variability in Canadian growth over the long run. This is closely followed by external and domestic financial conditions, which explain 1/3rd of the variability of domestic growth, and by oil prices, which explain another 13 percent. Surprisingly, the contribution of Canada's real GDP growth to its own variability is very small, at less than 10 percent over the long run, confirming the high degree of synchronization of the Canadian business cycle with that of the United States over the last decade.

Impulse-responses show a strong impact of changes in U.S. and domestic financial conditions on Canada's growth. Scenario analysis for 2009, based on alternative paths of underlying U.S. growth and domestic credit conditions show that these factors are major conditioning variables determining the prospects for Canadian recovery. Finally, a macro-financial index that is constructed from the coefficients of the BVAR model confirms that

both U.S. economic and credit conditions will increasingly pose a drag on growth in the near term. These findings underscore that policies that address the stability of U.S. financial and economic conditions are also key for a sustained pick up in Canadian activity.

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