Real Implications of Financial Linkages Between Canada and the United States

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Abstract

This paper documents the extent of financial linkages between Canada and the United States and explores the impact of changes in U.S. financial conditions on financial conditions and real economic activity in Canada. It shows that close to a quarter of financing by Canadian corporations is raised south of the border, with some variation across instruments. Empirical analysis using structural vector autoregression establishes that a tightening in U.S. financial conditions has significant implications for real activity in Canada. For example, a one percentage point increase in the 3-month T-bill rate, other things being equal, leads to a decline of slightly more than one percentage point in Canada’s real GDP growth after 3 quarters. That decline can be decomposed into three channels: the direct financial channel, where the slowdown is attributed to a rising cost of funds for Canadian companies raising capital in the United States; the indirect financial channel, where growth is hampered as financial conditions in Canada tighten in response to a tightening in the United States; and the trade channel, which goes through a slowing in the U.S. economy, and correspondently lower demand for Canadian exports. As would be expected from the high degree of reliance on U.S. financing, the direct financial channel proves dominant in the short term.

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I. Introduction

The ongoing turmoil in global financial markets has underscored the importance of financial linkages between countries, as well as the impact of financial conditions on real economic activity. This paper develops a simple empirical framework to explore these issues, using the example of two closely integrated economies—Canada and the United States.

With over three quarters of Canadian merchandise exports destined for the United States, the implications of trade linkages between the two countries for Canada’s business cycle have been studied extensively (see, for example, Ambler and others, 2004). Much less examined are the implications of financial linkages, even though they are also quite substantial. This paper documents the extent of financial linkages and explores the impact of changes in U.S. financial conditions on financial conditions and real economic activity in Canada.

We consider three ways in which a tightening in U.S. financial conditions could have an impact on real GDP growth in Canada. First, tighter financial conditions would slow the U.S. economy, leading to a reduction in demand for Canadian exports. We call this a trade channel. Second, tighter financial conditions in the United States tend to lead to tighter financial conditions in Canada. This could result from Canadian monetary policy following that of the United States, or from capital mobility between the two countries. Tighter financial conditions in Canada make it more expensive for Canadian firms to raise funds for investment and for working capital, resulting in slower economic activity. We term this an indirect financial channel. Finally, Canadian firms raising capital in the United States will be directly affected by tighter financial conditions there. This is a direct financial channel.

The empirical methodology we use to study these responses is based on structural autoregression (SVAR). In our baseline we employ a widely used three-variable system (inflation, real GDP growth, short-term interest rate) for each country. Unlike in single country work, we link these systems through a block exogeneity assumption, under which U.S. variables can affect Canadian variables, but not the other way around, which appears to be a reasonable approximation given the relative size of the two economies. We find substantial impact of changes in U.S. real GDP growth and interest rates on both real GDP growth and interest rates in Canada. The impact of tighter U.S. financial conditions on Canada’s output growth is effected primarily through the financial channel, with the direct channel more important in the short term and the indirect channel in the medium term. A number of extensions show the robustness of these findings and yield several other interesting results.

This paper is organized as follows. The next section examines the extent to which Canadian corporations rely on the United States for funding. Section 3 presents a simple model of real-financial linkages. Section 4 lays out an econometric framework for exploring real and financial linkages between the two countries and presents the results of our basic specification. Section 5 explores the transmission mechanism of U.S. financial shocks to Canadian real activity, focusing on the decomposition of the impulse response into the three channels. Section 6 provides several extensions and robustness checks. The last section concludes.
II. Financial linkages

Given the close geographic proximity, the extent of financial flows between Canada and the United States is hardly surprising. The stock of U.S. claims on Canadian assets equaled 53 percent of Canada’s GDP at the end of 2006. The commonalities of language, culture, and business environment, as well as openness to trade in goods, services, and assets facilitate cross-border flows of capital. In addition, the size and sophistication of U.S. financial markets make them an attractive source of capital, as they may offer features and liquidity not available in Canada.¹

In Canada, banks are the main source of short-term corporate credit, while long-term financing is dominated by equity (38 percent of long-term corporate credit outstanding at the end of 2006) and bond financing (34 percent), with the rest accounted for by trust units,² rapidly growing securitization, and other vehicles. The extent of reliance of Canadian non-financial corporations on U.S. financing is documented in Freedman and Engert (2003), who show that in the early 2000s just under 40 percent of outstanding Canadian corporate bonds were issued in the United States,³ while the share of foreign (primarily U.S.) placement of new Canadian stocks was around 20–25 percent.

More recent data confirm these findings. Figure 1 shows that in the 2000s Canadian corporations relied on foreign markets for 20 to 60 percent of their bond issuance. Of course, “foreign” does not necessarily mean “U.S.,” but it is a received wisdom that for Canada it largely does—the fact that is confirmed by a close correspondence between the net issuance of U.S. and all foreign bonds by Canadian corporations,⁴ particularly since the mid-1990s (Figure 2). The percentage of Canadian stocks held by U.S. residents has stayed between 15 and 20 percent in recent years (Figure 3). According to BIS data, foreign loans account for 20 to 40 percent (depending on whether mortgage lending is included or excluded) of total bank loans to the Canadian non-bank sector (Figure 4), although the share of U.S. banks in that number is not clear.

¹ For example, the market for high-yield bonds is virtually non-existent in Canada (Calmès, 2004).
² Income trusts are flow-through entities that became popular in Canada in the late 1990s and particularly early this decade due to their tax advantages. A series of recent government measures have sought to eliminate these advantages, halting further expansion of that sector.
³ The fraction of Euro-USD bonds varied between 5 and 9 percent, and the share of other non-Canadian bonds was negligible.
⁴ A breakdown by country for gross issuance of foreign bonds is not available.
Figure 1. Canadian corporate bonds: gross new issues

Figure 2. Net issuance of foreign bonds by Canadian corporations
Figure 3. Percentage of shares of Canadian companies held by U.S. residents

Figure 4. Foreign loans to Canadian non-bank sector as percentage of bank loans to Canadian non-financial corporations

Sources: Haver Analytics; and IMF staff calculations.

Sources: Bank of Canada; Bank for International Settlements; and IMF staff calculations.
All in all, it appears that about one quarter of financing is raised by Canadian corporations south of the border. This sizable dependence on U.S. funding sources gives rise to the vulnerability of Canada’s real economy to changes in U.S. financial conditions. Canadian firms and households may also be exposed to U.S. financial conditions through their holdings of U.S. assets, which have increased in recent years.\(^5\)

### III. Model

Given the extent of financial linkages between Canada and the United States, the idea that tighter financial conditions in the latter would temper output growth in the former does not appear controversial. Still, we use a simple model to illustrate the effect and to help introduce certain concepts.

In the model, a representative Canadian firm uses capital \(K\) to produce output with a diminishing marginal product of capital (MPK). Capital depreciates fully in one period. To produce, the firm needs to purchase capital using funds borrowed domestically \((D)\) or abroad \((D^*)\). The funds are available at the interest rates \(i_{\text{CAN}}\) and \(i_{\text{US}}\), both of which increase in the amount borrowed. We will assume that the rate for domestic borrowing is initially lower than for foreign borrowing, reflecting the cost of accessing the foreign market; but it rises faster with growing domestic indebtedness, due to the smaller size and liquidity compared to the U.S. market. We abstract from exchange rate issues.\(^6\) The model is admittedly very simple, but it captures the conventional channel through which financial conditions affect the real economy.

The demand and supply curves for funds are drawn in Figure 5. The former is simply the MPK curve. The latter combines the domestic and foreign interest rate schedules as functions of borrowing. As discussed above, the Canadian schedule starts lower but is steeper than the U.S. schedule, so up to a certain point Canadian companies would borrow domestically, and then switch to U.S. financing once the cost of borrowing the first U.S. dollar equals the marginal cost of domestic borrowing.\(^7\) Hence, the effective interest rate schedule facing Canadian borrowers initially coincides with the Canadian schedule, and then runs parallel to the U.S. schedule. The total capital installed will equal the sum of domestic and foreign borrowing, and will determine in turn the amount of output produced.

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\(^5\) For example, the stock of portfolio investment in U.S. assets by Canadian residents stood at 13 percent of GDP at the end of 2006.

\(^6\) One could think of these interest rate schedules as corrected for expected exchange rate movements; the schedules would not coincide given that domestic and foreign borrowing are not perfect substitutes.

\(^7\) In a more elaborate setting, we could have three groups of firms: one that borrows primarily in the United States (exporters, whose revenues are denominated in U.S. dollars, and subsidiaries of U.S. companies) and responds to changes in the U.S. interest rate; one that borrows mostly domestically, and is affected by Canadian financial conditions; and one that diversifies its borrowing, as in our model. The implications for the economy would be essentially the same as in the simple model.
Figure 5. Determination of capital level.
If the U.S. interest rate schedule shifts up, representing a tightening of financial conditions in that country, the effective Canadian schedule will shift up as well (Figure 6). As a result, Canadian firms will borrow less in the United States (and somewhat more in Canada, bidding up the Canadian interest rate) and less overall, lowering their capital intensity and production.\(^8\) We call the resulting reduction in output the *direct* effect.

**Figure 6. Direct impact of tightening in U.S. financial conditions.**

\(^8\) Even though capital does not depreciate as fast as our model assumes, and not all capital purchases have to be financed by external funds, there is little doubt that tighter financial conditions hamper output growth by making working capital more expensive and by crimping investment (as well as lowering household consumption through the wealth effect and tighter credit).
If the Canadian interest rate schedule also shifts up in response to a tightening of financial conditions in the United States, there will be an additional, *indirect* effect on output, stemming from higher cost of domestic finance (Figure 7). Financial conditions in Canada may be affected by financial conditions in the United States both through the demand channel (with U.S. funding more expensive, more borrowers would switch to the Canadian market, bidding up the interest rate there) and the supply channel (cost of raising funds for financial institutions will go up, and they will pass that increase to their borrowers). Confidence effects may also play a role. The relative size of the direct and indirect effects depends on the relative steepness of the Canadian and U.S. interest rate schedules and on the magnitude of the response of the former to the shift in the latter. As long as our assumptions about access to and depth of the markets hold (so that the U.S. schedule intersects the Canadian one from above, and thus the United States is the marginal lender) and the reaction of the Canadian schedule to a shift in the U.S. schedule is no greater than one for one, the direct effect will be larger.\(^9\)

**Figure 7. Indirect impact of tightening in U.S. financial conditions.**

\(^9\) In a variation with heterogeneous firms, discussed in footnote 7, the relative magnitude will also obviously depend on the proportion of the firms in each category.
IV. Empirical analysis

We now proceed to examine empirically the links between financial conditions in the United States and real activity in Canada. We start by running a simple six-variable structural vector autoregression (SVAR) that includes the CPI inflation rate, the real GDP growth rate, and the 3-month T-bill rate for each country. The interest rate is our measure of financial conditions. The growth rate and the inflation rate are the measures of economic activity that both affect (including through the monetary policy reaction function) and are affected by the interest rate.

Given the relative economic size of the two countries, we assume that Canadian variables do not have an effect on U.S. variables, either simultaneously or with lags. This block exogeneity (Hamilton, 1994, p.309) assumption, similar to the approach taken by Cushman and Zha (1997) and by Dungey and Pagan (2000), reduces the number of parameters that require estimation and thus allows more precise estimates.

Within each block, we make the standard assumption of the following ordering of the variables: inflation, real growth, and the interest rate. Inflation is the most inertial variable. The interest rate, as a financial variable, is the most fast-moving one. It reflects, among other things, monetary policy or anticipation thereof, based (at least in part) on growth and inflation. Given the lags in monetary policy transmission, the interest rate reacts faster to the shocks to output and inflation than they react to changes in the interest rate. This ordering is quite popular in the literature, although by no means is it unique or without critics.10

In terms of cross-linkages, we allow U.S. variables to have a simultaneous impact on corresponding Canadian variables as well as on the Canadian variables that come later in the ordering. So, for example, a shock to the U.S. real GDP growth will simultaneously affect the U.S. interest rate, Canada’s real GDP growth, and Canada’s interest rate. There are no restrictions on the impact of lagged U.S. variables on U.S. or Canadian variables.

We use quarterly data from the first quarter of 1983 through the first quarter of 2007, aiming to have as many observations as possible, but confining our sample to staying within the epoch of the “great moderation” (Stock and Watson, 2002), since the macroeconomic environment was quite different in the preceding period. Inflation and output growth are annualized quarterly growth rates of seasonally adjusted CPI and real GDP series. With quarterly data, four is a natural choice for the number of lags in the VAR.11

The impulse response functions for the estimated system are exhibited in Figures 8–10. The solid lines represent impulse responses, and the dashed lines confine analytically constructed

10 See Christiano and others (1999) for a discussion of various identification schemes.

11 The results for the six-variable model were very similar when only three lags were used.
95-percent confidence bands. The magnitude of a shock is one unit of the corresponding variable, i.e. one percentage point. The responses are calculated for 16 quarters.

Figure 8 shows the responses of U.S. variables to U.S. shocks. The picture looks quite familiar. A shock to the inflation rate leads to a spike in inflation, a drop in output, and higher interest rates. A shock to GDP growth pushes inflation, output growth, and interest rates up. A spike in the interest rate is quite persistent, and leads over time to lower output growth. The only perverse response is a rise in inflation in reaction to a positive interest rate surprise, but this price puzzle is by no means unique to this paper. All in all, this set of impulse responses conforms with our priors and gives us fair confidence that U.S. shocks are identified reasonably well.

Figure 8. Impulse response functions in the basic model: U.S. block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.

12 Confidence bands constructed using parametric bootstrap are virtually indistinguishable from analytical ones. The results are available upon request.
Responses of Canadian variables to Canadian shocks are found in Figure 9. Inflation shows less persistence than in the United States, and the impact of inflation shocks on output growth and the interest rate is small. The magnitude of inflation and interest rate responses to output shocks is also insignificant. This may reflect the open character of the Canadian economy—domestic shocks play a relatively minor role. The price puzzle is present, but much less pronounced than in the United States. The output response to changes in the interest rate appears somewhat more sluggish.

**Figure 9.** Impulse response functions in the basic model: Canada block
Finally, Figure 10—the focus of our attention—presents the responses of Canadian variables to U.S. shocks. Confirming the conventional wisdom, we find a strong response of Canada’s real GDP to a shock to the U.S. GDP growth (the middle pane), with a change in Canada’s growth peaking at about one half of the U.S. impulse. We can also see that tighter financial conditions in the United States tend to lead to tighter financial conditions in Canada (bottom right pane), in line with anecdotal evidence. An increase in the U.S. interest rate leads to an approximately equal rise in the Canadian rate. This does not mean that the Bank of Canada follows the stance of the Federal Reserve irrespective of the cyclical positions of the two economies—the interest rate shock in our system is orthogonal to the systematic response of monetary policy to fluctuations in output and inflation. A key finding, which we probe deeper in the next section, is the fact that a tightening of financial conditions in the United States leads to a statistically significant reduction in real GDP growth in Canada (bottom middle pane).

Figure 10. Impulse response functions in the basic model: cross block

Response of

\[ p_{can} \]

\[ y_{can} \]

\[ i_{can} \]

Shock to

\[ p_{usa} \]

\[ y_{usa} \]

\[ i_{usa} \]

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.

13 Under the block exogeneity assumption, the responses of U.S. variables to shocks emanating from Canada are nil.
Variance decomposition (Figure 11) demonstrates that foreign shocks are an important source of variation in Canada’s real GDP growth, accounting for over 40 percent of forecast error variance at horizons longer than a year. Within that group, shocks to U.S. output growth are the most significant.

![Figure 11. Shares of forecast error variance of Canada's real GDP growth due to different shocks](image)

“Gratuitous” interest rate volatility—changes that are not identified as responses to demand or supply shocks and hence captured as interest rate shocks in the econometric model—was quite low in the sample period, and U.S. interest rate shocks account for slightly over 5 percent of the forecast error variance for Canada’s real GDP growth at horizons over one year. At the same time, as our results indicate, a large financial shock in the United States would have a substantial impact on the Canadian economy.

V. Transmission of U.S. financial shocks to Canada

As discussed above, the negative response of the Canadian real GDP growth to an increase in the U.S. interest rate may come through one of three channels. First, tighter financial conditions in the United States lead to lower growth in the United States (see Figure 8, bottom middle pane), which would then lead to lower demand for Canadian exports and hence lower growth in Canada (Figure 10, middle pane). We call this the trade channel. Second, higher interest rates in the United States tend to lead to higher interest rates in Canada (Figure 10, bottom right), which

14 While the standard deviations of the U.S. interest rates and real GDP growth rates were very close in the sample period (2.3 percentage points and 2.2 percentage points, respectively), the standard deviation of the shocks to the U.S. interest rate was estimated at 0.3 percentage point—quite a bit lower than 1.8 percentage points for U.S. real GDP growth.
in turn will dampen output (Figure 9, bottom middle). We call this the *indirect financial channel*. Finally, the *direct financial channel* would primarily reflect a reduction in investment by Canadian firms using U.S. financing and represent a slowdown in Canada that is not ascribed to lower U.S. growth or higher Canadian interest rates.

Figure 12 presents the decomposition. The thick solid black line is the total response of Canada’s growth to a one percentage point shock to the U.S. interest rate—same as in the bottom middle pane of Figure 10. To isolate the financial channels, we shut down the trade channel by setting to zero the coefficients of Canadian variables on contemporaneous and lagged U.S. growth in the SVAR. The result is shown by the thick solid gray line. We can observe that the bulk of the impact of higher U.S. interest rates on Canadian growth, particularly in the short run, comes through the financial rather than trade channel.

![Figure 12. Decomposition of impulse response of Canada's real GDP growth to one percentage point increase in U.S. 3-month T-bill rate in baseline regression.](image)

To isolate the direct financial channel (the dotted black line), we shut down the indirect channel by holding the Canadian interest rate constant. The indirect channel (the dashed gray line) is

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15 Shutting down the trade channel by setting the coefficients of only Canada’s GDP growth on U.S. growth to zero or by holding U.S. growth constant yields nearly identical results.

16 Disallowing only the response of Canada’s interest rate to the U.S. interest rate results in a virtually identical decomposition.
then obtained as a residual. The direct channel accounts for most of the short-run decline in output growth. In the medium term the response switches to the other side. The way we interpret this is that facing constant U.S. demand and unchanged Canadian interest rates, but higher U.S. interest rates (that is the experiment captured in the direct financial channel), Canadian firms that rely primarily on the United States for their funding initially reduce their output and investment; later, however, they can switch to alternative sources of finance (domestic credit or retained earnings) and make up some of the lost ground. The indirect channel is relatively small, but quite persistent, keeping growth near the trend in the medium term by offsetting the rebound in the direct channel.

We conclude that U.S. financial conditions are quite important for Canada—a one percentage point increase in the short-term interest rate in the United States leads to a decline in real GDP growth in Canada of up to 1¼ percentage points. The impact is largely fed through the financial channel, in the first instance affecting the firms relying on U.S. funding, and with more lingering effects through tightening financial conditions in Canada.

VI. Sensitivity analysis and extensions

Including the oil price and the exchange rate.

We expand our system to include two macroeconomic variables that are particularly relevant for an open, commodity-exporting economy like Canada—the oil price and the exchange rate. The oil price is an important driver of inflation in both Canada and the United States. It can also affect output. Sims (1992) suggested that including oil prices in VARs can improve the identification of monetary shocks. The value of the freely floating Canadian dollar plays the role of a shock absorber for Canada, reacting to commodity price movements and other developments differentially affecting Canada and the United States.

Figures 13-15 show impulse responses with the annualized quarterly growth rates of the West Texas Intermediate (WTI) price and the price of the Canadian dollar in U.S. dollars included in the regressions. The oil price is placed in the U.S. block, first in the ordering, and assumed to be able to affect simultaneously all Canadian variables as well as all U.S. variables, and not to be affected by Canadian variables. On the assumption that the exchange rate is the fastest-moving variable, it is placed last in the Canadian block.
Figure 13. Oil price and exchange rate included. U.S. block

Response of

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
The inclusion of oil prices does not change substantially the impulse responses of the other variables. It does reduce the magnitude of the price puzzle (an upward jump in inflation in response to a positive interest rate shock) by almost a half, but does not eliminate it completely. As expected, a positive demand shock in the United States pushes oil prices up. Higher oil prices lead to higher inflation and interest rates in both the United States and Canada. They also push down real GDP growth in the United States, while the impact on Canada is close to zero on average, reflecting Canada’s endowment in hydrocarbon resources.

The impulse responses involving the exchange rate look largely as expected. The Canadian dollar appreciates after a shock to the Canadian interest rate (although after an initial drop) and after positive shocks to output or inflation (probably reflecting expectations of tighter monetary policy in response). It also appreciates in response to a rise in oil prices, which is a terms-of-trade improvement for Canada. A shock to the U.S. interest rate leads to a depreciation of the Canadian dollar. A positive shock to the exchange rate (an appreciation) leads on average to a slight decrease in Canada’s interest rate (consistent with the Bank of Canada policy of counteracting exchange rate movements not caused by changes in the demand for Canadian goods and services) and depresses Canadian output. Perversely, inflation appears to pick up in Canada in response to currency appreciation—another manifestation of the price puzzle.

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17 The effect on Canada is smaller, probably due to higher gasoline taxes in that country and the tendency of its currency to appreciate on higher oil prices.
Figure 14. Oil price and exchange rate included. Canadian block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Figure 15. Oil price and exchange rate included. Cross block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
The profile, magnitude, and decomposition of the impulse response of Canada’s GDP growth to a one percentage point shock to the U.S. interest rate is very similar to the case without oil (Figure 16).

**Figure 16.** Decomposition of the impulse response of Canada's real GDP to one percentage point increase in U.S. 3-month T-bill. Oil price and exchange rate are added to baseline regression.

The thin solid line in this Figure shows the direct effect where the response of the exchange rate to the interest rate differential is suppressed. If the U.S. interest rate goes up, and is not followed by the Canadian rate (the mental experiment we use to define the direct financial channel), the Canadian dollar will likely depreciate against the U.S. dollar. This, in turn, would stimulate Canada’s GDP by boosting net exports. That mechanism may partly offset the direct financial effect and lead to its underestimation. As can be seen, the effect is minor—fixing the exchange rate barely affects the location of the line showing the propagation of the interest rate shock via the direct channel.

Including stock prices

Borrowing is not the only way to raise capital. We extend our baseline regression by including the growth rates of stock price indices for the United States and Canada (S&P500 and TSX/SP300, respectively). We put the stock indices last in each country’s block, assuming they
are the most reactive variables. The impulse response functions of this eight variable SVAR are presented in Figures 17-19.

In the United States, stock prices go down on inflationary surprises, but do not appear to react strongly to output or interest rate. A jump in stock prices pushes up the interest rate and predicts higher output growth and, after about three quarters, inflation.

Figure 17. Stock price included. U.S. block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.

18 The forward-looking nature of financial variables complicates identification, and evidence drawn from VARs that include stock prices should be interpreted cautiously. See Sellin (2001) for an informative survey.
In Canada, stocks exhibit a pronounced negative response to higher interest rates and a pronounced positive response to higher output. They also appear to go up, after about a year’s delay, on inflation. One could speculate that the concurrence of higher inflation and higher stock prices may reflect a heavy representation of energy companies in Canada’s stock market, although the timing of the response makes this rationalization not very probable. Higher output follows a positive stock market surprise, while the response of the interest rate and inflation is small.

Figure 18. Stock price included. Canadian block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Finally, Figure 19 confirms the extent of real and financial linkages between the United States and Canada. Higher output growth in the United States leads to higher output growth in Canada. Canadian stocks go up when U.S. stocks go up (and nearly as much), and Canadian interest rates rise in response to higher U.S. interest rates. Regarding the importance of U.S. financial conditions for Canada’s real economy, we note, as before, that a shock to U.S. interest rates pushes Canadian GDP growth rate down; and we can also see that higher stock prices in the U.S., which imply easier financial conditions, lead to higher output growth in Canada.

Figure 19. Stock price included. Cross block

Response of

\begin{align*}
\text{Response to} & \quad \text{Impulse response functions; dashed lines - 95 percent confidence bands.}
\end{align*}
Including spreads on long-term corporate bonds

As a complementary measure of financial conditions we include the spreads of U.S. and Canadian corporate long-term bond yields over corresponding 10-year Treasury rates. As can be seen from Figure 20, wider corporate spreads in the United States appear to have a negative impact on Canadian GDP growth, although the results are not statistically significant. Wider U.S. spreads also trigger wider spreads in Canada. The impact of higher 3-month T-bill rate on Canadian real GDP growth, interest rate and inflation in this specification is close to that in the baseline.

Figure 20. Spreads on long-term corporate bonds added. Cross block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Including financial conditions indices

Obviously our baseline measure of financial conditions—the yield on the three-month Treasury bill—does not capture those conditions fully. Adding other asset prices to the baseline specification one by one alleviates that concern only partially, as it still leaves many potentially useful variables out. The problem should not be exaggerated, as various asset prices tend to be highly correlated. Still, a more encompassing and at the same time parsimonious approach would be to use a single, comprehensive measure of financial conditions.

Fortunately, researchers at both central banks and private sector institutions have been working on developing such measures, called financial conditions indices (FCI), and using them for some time. Unfortunately, the task of capturing financial conditions in one index is quite complex and can be solved only imperfectly, and both construction and use of FCI has been subject to numerous criticisms. Gauthier and others (2004) provide a comprehensive survey and suggest several new FCIs for Canada. Incidentally, they find that FCIs that use U.S. stock prices and high-yield bond spreads are better predictors of Canadian output than indices that include Canadian financial variables—a result consistent with the main theme of this paper.

Recognizing the weaknesses, we include FCIs in a robustness check rather than in our baseline regression. The indices we use are similar to the Goldman Sachs FCI for Canada and the United States. Both indices include measures of real short-term market interest rates, real exchange rate, and equity valuation. The U.S. index also incorporates the real yield on long-term corporate bonds, while the Canadian index adds the slope of the yield curve. Higher values represent tighter financial conditions. The construction of the indices is discussed in Klyuev (2008).

The impulse response functions from the specification that includes the FCIs are reproduced in Figures 21–23. The results are largely similar to those in the baseline, but a few differences emerge, particularly in the U.S. block (Figure 21). For one, the price puzzle disappears—tighter financial conditions are associated with lower inflation. Second, the output responds more sharply to a tightening in the FCI than to an increase in the 3-month rate. This is not surprising, given that FCIs are explicitly designed not only to reflect current financial conditions, but also to be able to predict GDP growth at short horizons (Dudley and Hatzius, 2000). Third, the responses of the FCI to inflation and output shocks is more front-loaded and less persistent than those of the interest rate, and shocks to the FCI itself also induce less persistent movements in the index than is the case for the interest rate.
Figure 21. FCI is used as a measure of financial conditions. U.S. block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Similar observations can be made about the Canadian block (Figure 22). Notably, inflation surprises elicit a sharp tightening of financial conditions as measured by the FCI. At the same time, a positive shock to output appears to loosen financial conditions. This may reflect our ordering assumption, where comovements between real GDP growth and the FCI are attributed to growth moving first and the FCI reacting. If, in fact, looser financial conditions can stimulate real GDP growth within the quarter, this correlation would be misinterpreted in our identification scheme. This simultaneity problem may be more severe for the FCI than for the interest rate if stock prices and exchange rates (variables included in the FCI) are more forward-looking than the short-term interest rate and if the economy reacts faster to them. Both conditions may well be true.

Figure 22. FCI is used as a measure of financial conditions. Canadian block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Finally, in the cross block (Figure 23) we still observe that a tightening of financial conditions in the United States leads to a substantial decline of real GDP growth in Canada, which lasts about two years. Tighter financial conditions in the United States also lead to tighter financial conditions in Canada (although with less persistence than for interest rates), and GDP growth surprises in the United States move Canadian growth in the same direction and with about half the magnitude. In the forecast error variance decomposition, shocks to U.S. financial conditions account for 6–8 percent of variance in Canada’s real GDP growth at the 6–16 quarter horizons, compared to the 5 percent share of U.S. interest rate shocks.

Figure 23. FCI is used as a measure of financial conditions. Cross block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
While these results are broadly similar to our baseline, the decomposition of the impact of the U.S. financial shock on the Canadian output is not. As can be seen from Figure 24, when the U.S. real GDP growth is held constant, Canadian growth does not appear to respond in a coherent fashion to U.S. financial conditions, but rather oscillates wildly around the zero line. Averaging these fluctuations out, one would conclude on the basis of that picture that the financial transmission channel does not work, and all the impact of tighter U.S. financial conditions on Canada comes through slower growth in the United States. A further decomposition shows that the indirect channel behaves in the expected way, but the direct channel exhibits a perverse swing, with growth accelerating in Canada if financial conditions tighten in the United States but not north of the border. One could rationalize that by noting the forward-lookedness of financial variables included in the FCI. Divergence between U.S. and Canadian FCIs, on which this exercise is predicated, could arise if there were bad news for U.S. growth and good news for Canadian growth, which would be incorporated into the respective FCIs, for example, via stock prices. In addition, given the FCI’s intended use as a predictor of GDP growth several quarters ahead, its composition may be biased in a way that overstates the impact of financial conditions on GDP growth, hence exaggerating the significance of the trade channel in our decomposition.

Figure 24. Decomposition of impulse response of Canada's real GDP growth to one unit increase in the U.S. FCI.

To summarize, taken at face value, SVARs with the FCIs instead of the interest rates confirm the importance of U.S. financial conditions for growth and financial conditions in Canada, but do not confirm the importance of the direct financial channel in the transmission of U.S. shocks to Canada. However, given how controversial the use of financial condition indices is, both the confirmation and the rejection should be taken with a grain of salt.
Filtering data

One may be concerned that the degree of cyclical interdependence in our regressions may be exaggerated if Canada and the United States followed similar long-term trends—such as common productivity shocks or simultaneous disinflations. To address these concerns, we detrend the data using HP filter\textsuperscript{19} and apply our SVAR to detrended data.

Figure 25. Filtered data. U.S. block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.

\textsuperscript{19} Specifically, we apply the HP filter with a smoothing parameter of 1600 to the logs of CPI and real GDP and to the interest rates. The growth rates of the cycle components of CPI and GDP and the cycle component of the interest rates then enter the regression.
The impulse response functions from this SVAR look similar to those obtained on raw data (Figures 25-27). The price puzzle appears smaller in the detrended data, and the interest rate shocks are less persistent. The response of the Canadian output to a shock to the U.S. output is a bit smaller in the short run and changes sign in the medium run. The decline of Canada’s real GDP growth in response to a tightening in U.S. financial conditions remains large and statistically significant. The share of U.S. interest rate shocks in the variance decomposition of Canada’s real GDP growth rises to 10 percent in this specification.

Figure 26. Filtered data. Canadian block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Figure 27. Filtered data. Cross block

Response of

p_can, y_can, i_can

p_usa, y_usa, i_usa

Shock to

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
It should be noted, however, that with detrending the significance of the direct financial channel appears to decrease, while that of the indirect financial channel rises substantially (Figure 28).

**Figure 28.** Decomposition of impulse response of Canada's real GDP growth to one percentage point increase in U.S. 3-month T-bill rate. Filtered data.

*Changing time period*

Since the monetary regime was changed in Canada in February 1991 with the introduction of inflation targeting (IT), we rerun the baseline SVAR on the period 1991Q1-2007Q1. The impulse response functions are shown in Figures 29-31.
Figure 29. Short sample. U.S. block

Response of

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Figure 30. Short sample. Canadian block

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Figure 31. Short sample. Cross block

Response of

Shock to

p_can

y_can

i_can

Note: Solid line - impulse response functions; dashed lines - 95 percent confidence bands.
Qualitatively the picture looks similar to that obtained over the longer period. However, with the shorter sample and less variability, the shocks and responses are more difficult to identify, and the confidence bands are wider. The response of Canadian growth to U.S. interest rates is somewhat smaller, but more protracted. The decomposition (Figure 32) looks similar to the full period, although the direct effect appears smaller. The response of Canadian GDP growth and interest rates to corresponding U.S. variables is also a bit smaller, and the interest rate reaction is also noticeably less persistent. Canadian interest rates appear to go down rather than up in response to an inflation shock in the United States. We have too few degrees of freedom to make conclusive comparisons between the inflation targeting and the pre-IT periods, but our results are consistent with the notion that Canada has become somewhat less dependent on the United States in the last decade.

**Figure 32.** Decomposition of impulse response of Canada's real GDP growth to one percentage point increase in U.S. 3-month T-bill rate.  
Period 1991Q1 - 2007Q1
VII. Conclusion

In this paper we have established that in addition to substantial trade linkages, Canada and the United States are connected through financial markets. Canadian corporations raise about one quarter of their financing south of the border, with bonds playing a particularly important role. As a result, financial conditions in the United States have substantial influence over both financial conditions and real economic activity in Canada.

Using a SVAR approach, we have confirmed that shocks to U.S. real GDP growth have a considerable impact on Canadian GDP growth, with the coefficient of about one half. We have also found that financial shocks are transferred almost one-for-one from the United States to Canada. Finally, a tightening of financial conditions in the United States leads to a statistically and economically significant slowdown in Canada’s real GDP growth. The direct financial channel, affecting Canadian firms raising funds in the United States, is particularly important in the short run. The indirect financial channel, where the impact on real activity is fed through the influence of U.S. financial conditions on those in Canada, exhibits smaller magnitude, but more persistence. The finding that U.S. financial shocks have a major impact on financial conditions and real GDP growth in Canada, and, to a somewhat lesser extent, the decomposition of the latter effect, are robust to a number of specification changes, with various measures of U.S. financial conditions affecting financial conditions and real activity in Canada.

These results imply that a substantial financial shock emanating from the United States—like the one we are witnessing now—may have severe implications for the Canadian economy. Despite tentative indications that Canada has become somewhat less dependent on its southern neighbor in the recent period, the extent of both real and financial linkages between the two countries remains large, and their interplay creates a transmission mechanism for foreign shocks that should not be overlooked.
References


