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# The Ill Wind that Blows from Europe: Implications for Canada's Economy

*A recent decision by the German Constitutional Court reminds us that the eurozone is still not out of danger. This paper shows that contagion from European financial shocks would negatively affect Canada's economy, and that Canada would not be insulated from these shocks by its inflation targeting policy and floating exchange rate. Should such a crisis in the eurozone occur, flexibility would be required and the Bank of Canada might once again have to resort to forward guidance to manage expectations, while underscoring its determination to meet its inflation target.*

Pierre L. Siklos

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## THE STUDY IN BRIEF

Speculation about the consequences of a break-up of the eurozone, a worsening sovereign debt crisis or a prolonged recession in the European Union have all in recent years made the headlines. At first glance, the effect that such events might have on the Canadian macroeconomy might appear small. After all, Canada's trade in goods and services and financial flows to and from the euro area are dwarfed by our economic relationship with the United States. Significant spillover effects, however, likely would arise out of any major economic or financial shock originating from the globe's largest economic block (as measured by gross domestic product, GDP). The sovereign debt crisis in the eurozone exposed major fault lines in the economic stability of the common currency area. The indirect exposure of Canadian banks – and of the Canadian economy more generally – from a eurozone economic shock ought to represent a pressing source of concern for Canada's policymakers.

The continued uncertain outlook for the global and US economy also suggests that there is a real danger of another “perfect storm” such as the one that affected the world economy in 2008 and 2009. Canada might not escape next time around with only a short-lived recession, nor is it a given that its financial sector would emerge largely unscathed, notwithstanding Canada's reputation for the quality of its financial regulation and supervision.

This *Commentary* estimates a small macroeconomic model for Canada that explicitly incorporates financial sector influences. Then, foreign shocks with real and financial elements from the eurozone and the United States are added to the model to investigate the potential for spillover effects. The study also considers some counterfactuals, by imagining a large, negative and permanent economic shock from the eurozone, and compares the results with estimates based on observed data.

The *Commentary* concludes that negative shocks from the real and financial sectors of the US and eurozone economies do spillover into the Canadian economy. Clearly, US shocks dominate, but eurozone shocks cannot be ignored. Counterfactual experiments suggest that, under eurozone worst-case scenarios, Canada's economy would suffer a substantial drop of almost 8 percent in real GDP after two and a half years.

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## The Canadian economy seems to have weathered reasonably well the various crises that have afflicted the advanced economies over the past five years.

Nevertheless, the global financial crisis did result in one of the deepest, if shortest, recessions in Canada in decades (see Cross and Bergevin 2012), and the continuing possibility of a turn for the worse in the eurozone ought to concern Canada's policymakers. Preparing for such a scenario, however, requires us to establish empirically the potential effect of "shocks" – unexpected changes in macroeconomic or financial variables – in the eurozone on the Canadian economy.<sup>1</sup> In this *Commentary*, I thus quantify the degree to which Canadians should indeed fear the consequences of the ill wind that continues to blow from the European continent. My secondary aim is to evaluate the extent to which shocks from the United States also affect the Canadian economy.

The financial crisis reminded policymakers that conditions in financial markets are transmitted to the goods-and-services-producing sector of the economy, and globalization has contributed to amplifying these links. More memorably, however, the events of 2008–09 underscored the virulence of financial shocks. Even if the direct exposure of Canadian financial institutions to economic conditions in the eurozone is small, this cannot prevent contagion of the kind the world economy has experienced more than once over the past five years.

Few imagined that fiscal difficulties in Greece eventually would lead Mario Draghi, president of the European Central Bank (ECB), to utter the now famous words, "the ECB is ready to do whatever it takes to preserve the euro" (Draghi 2012). Lost in the headlines, however, were the strings attached to Draghi's remarks. First, the ECB can act only within its mandate, which precludes the lender-of-last-resort function to which most central banks can turn. The ECB so far has successfully pushed the limits of its mandate, although in February 2014 the German Constitutional Court declared that the ECB exceeded its mandate with its program of Outright Monetary Transactions (OMT), whereby the ECB reserves the right to buy government bonds (albeit with conditions attached). Second, progress on the planned banking union and attempts to forge a closer fiscal union are stalled, as sovereignty appears increasingly to trump the desire for "an ever closer union." Finally, structural reforms in several eurozone economies – such as France, Italy and Spain – have not yet materialized on a scale at which many had hoped.

The news from Europe is getting better, but considerable risks remain. Unemployment in the eurozone, at 12 percent of the labour force, remains practically at record high levels; consensus forecasts

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1 Clearly, shocks from the eurozone would affect the US economy simultaneously. To avoid complicating the analysis, such shocks to the US economy are incorporated implicitly in the estimates 2 percent in this study. I return to this issue below.

of economic growth during 2013 were consistently revised downward after the end of 2012 – indeed, year-over-year growth rates of real gross domestic product (GDP) were negative from the first quarter of 2012, through the third quarter of 2013, and only modest economic growth is forecast for 2014.<sup>2</sup> Plus, new worries have surfaced over the threat of deflation, while the European Commission prepares to investigate the large current account surpluses Germany has accumulated. News from the United States is more optimistic, although economic growth there is well below historical norms.

The confluence of these and other economic threats contributes not only to raise economic uncertainty, but also to highlight the pervasive policy uncertainty that exists throughout the global economy. This policy uncertainty, whether it originates from the United States or from the eurozone, has potential real economic effects on Canada (see, for example, Colombo 2013). Here, however, I focus more narrowly on how economic prospects in the eurozone might affect the Canadian economy. I proceed as follows. First, I provide a broad overview of economic performance in Canada, the United States and the eurozone. I then describe the framework I use to think about how the three economies might be linked to one another and what the data can tell us about the potential for economic spillovers to Canada from the world's two largest economies.

The essence of the framework recognizes the important role of credit conditions to the real economy, as this represents a key element in the transmission of shocks from the financial sector – notably, the crucial bank lending channel, since much of the lending in Canada and, especially, the eurozone is intermediated through banks.

Next, I present the empirical evidence, in two parts. First, I explore the real and financial links in the Canadian economy and the influence of eurozone and US real and financial factors on Canada's real GDP. Second, I try to imagine some worst-case scenarios, such as a large downturn in the eurozone economy, and their possible repercussions on the Canadian economy. I attach no particular value to the likelihood of a calamitous shock such as the break-up of the eurozone; rather, I simply provide some estimate of the potential upper bound for the effect of renewed severe stresses on the common currency area. But even if a break-up of the eurozone is no longer imminent, the build-up of political and economic tensions does not appear to have eliminated the likelihood of a major economic downturn in that region. Effectively, I equate even a partial break-up of the eurozone as akin to a large negative economic shock. Presumably, a lesser shock would have quantitatively smaller negative effects on the Canadian economy. As well, since my calculations, while based on observed data, are counterfactual, it is too much to expect a high level of precision in the estimates.

The analysis shows that while clearly the effect of US shocks on the Canadian economy dominate those from the eurozone, contagion from European shocks, particularly financial shocks, would negatively affect Canada's economy, which would likely not be insulated by its inflation targeting policy and floating exchange rate. Under such circumstances, flexibility would be key and the Bank of Canada might once again have to resort to forward guidance to manage expectations while underscoring its determination to meet its inflation target.

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2 Based on data from European Central Bank, "Statistical Data Warehouse" (Frankfurt-am-Main); available online at <http://sdw.ecb.europa.eu/home.do>.

## THE MACROECONOMIC ENVIRONMENT IN CANADA, THE UNITED STATES AND THE EUROZONE

Canada ranks far down the list of the European Union's most important trading partners.<sup>3</sup> The EU, however, is Canada's second-largest source of foreign direct investment and its second most important trading partner in the services sector (see, for example, European Commission and Government of Canada 2008). Europe is important to Canada for other reasons as well. Canadian politicians frequently have touted the need to diversify Canada's trade, and the EU-Canada trade agreement completed in October 2013 is a significant step in this direction. Accordingly, if EU-Canada economic relations intensify, the effect of shocks in the eurozone can only be amplified.

Likewise, if the United States were to conclude a similar agreement with the EU, as is currently being negotiated, it would only reinforce the size and speed with which spillover effects from the EU are transmitted to Canada.<sup>4</sup> Although Canada's financial institutions have little direct exposure to the EU economy, the Bank of Canada pointed out at the height of the eurozone crisis that, "[i]f the sovereign debt crisis in Europe continues to intensify, it would further weaken global economic

growth and prompt a general retrenchment from risk. In turn, the weaker global outlook would fuel sovereign fiscal strains and impair the credit quality of bank loan portfolios" (Bank of Canada 2012, 2).

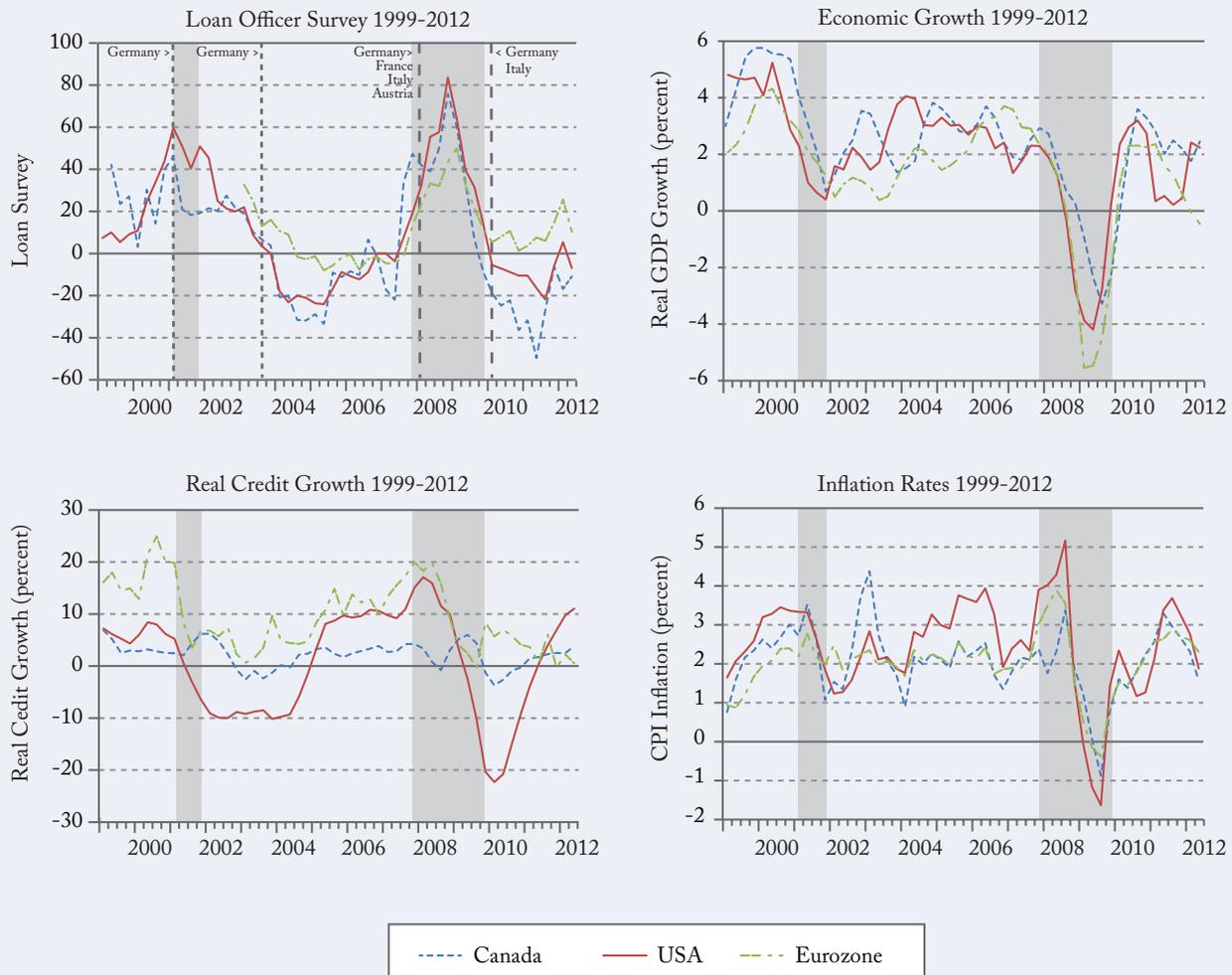
Whether a major shock in the eurozone is caused by a break-up of the common currency area or a serious flare-up of the eurozone sovereign debt crisis, the deterioration of economic conditions in Europe would exercise a direct influence on Canada, as well as indirectly through its effect on the US economy.<sup>5</sup> Accordingly, in the empirical exercise that follows, I focus on quantifying the joint impact of both channels.

To determine the likelihood that an ill wind from the European continent would affect Canada, I consider four key macroeconomic aggregates for the Canadian, US and eurozone economies: a numerical measure of whether credit conditions are tightening or loosening in their respective economies, based on surveys of senior loan officers in financial institutions;<sup>6</sup> the growth rate of real GDP; the growth of (real or inflation-adjusted) credit; and inflation rates in consumer prices (see Figure 1 and Table 1; for data sources and more detailed definitions, see the Appendix).

From the top left panel of Figure 1, which also identifies the peaks and troughs in business cycles in Germany, France, Italy and Austria, we see that

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- 3 According to the European Commission, Canada was the EU's twelfth-largest trading partner in 2012, accounting for only 1.8 percent of its external trade; see European Commission, "Trade: Countries and Regions, Canada" (Brussels, 2013); available online at <http://ec.europa.eu/trade/creating-opportunities/bilateral-relations/countries/canada/>.
  - 4 In contrast, a trade agreement with the Association of South East Asian Nations is still being negotiated, and since financial markets, in particular, in parts of the Asia-Pacific are less open, financial links with the eurozone are relatively more developed; see, for example, Yoshino (2012).
  - 5 One can also imagine other indirect effects that might not be entirely negative. A deterioration of EU trade with Asia – most notably China – could prompt China to stimulate its economy, thereby mitigating some of the negative effects on the North American economy. Since the extent to which a Chinese stimulus policy would reverberate abroad is unclear, I do not consider this scenario.
  - 6 Tightening refers to the aggregate view, held by bank loan officers, about whether obtaining credit is becoming more difficult (a non-price form of tightening) or costly (such as through higher interest rates or other charges); loosening, obviously, refers to the opposite sentiment among bank loan officers.

Figure 1: Key Economic Aggregates, Canada, US, and Eurozone, 1999-2012



Note: Shaded areas represent periods of US recession as defined by the National Bureau of Economic Research (NBER).

Sources: See data appendix.

parts of the eurozone have been in recession for a significant portion of the past decade. In addition, recessions in Europe and the United States have tended to overlap each other.

With the exception of real credit growth, there is a common element in both economic growth and inflation among the three economies (see Table 1 for summary statistics). Moreover, the recession of 2008–09, as distinct from the recession of the

early 2000s, was characterized by a sharp U-shaped pattern in real GDP growth. The recovery of growth is apparent by 2010 in the US and Canadian economies and has been sustained there ever since, while the eurozone experienced another sharp reversal in early 2012. The recession there likely ended in the second half of 2013.

Canada's inflation rate over the period generally remained centred around the 2 percent inflation

target, with occasional noticeable spikes – ordinarily when commodity prices changed quickly. Although the inflationary experience of all three economies has been broadly similar, inflation in the United States has tended to be persistently higher than in Canada or the eurozone. Nevertheless, all three economies experienced a brief bout of deflation at the height of the financial crisis – that is, during the second half of 2009 – and fears of deflation returned in late 2013. The greatest divergence among the three economies pertains to real credit growth, which was most stable in Canada while the United States experienced large swings. Notice, particularly for the United States, that credit growth tended to peak just as the economy was about to enter into a recession. There was also rising and very strong real credit growth in the eurozone in the years leading up to the sovereign debt crisis that began in 2010. Recessions in Germany and the global financial crisis are most likely responsible for putting a stop to these developments.

The survey of loan officers (Figure 1, top left, panel A) reveals a persistent tightening of lending standards up to 2007. Interestingly, after the 2009 recession, there was a growing divergence in loan officers' views about the direction of change in credit standards, with a continued loosening of standards in the United States, at least until 2010 and again in early 2012, while standards tended to tighten in Canada from 2010 and relaxed a bit through 2011 and 2012. It is instructive that these developments took place despite largely unchanged policy interest rates in both countries. Meanwhile, in the eurozone, lending standards

tended to tighten until the end of 2007, followed by a loosening trend before a tightening of standards again beginning in 2012.

The potential link between economic conditions and credit conditions can also be illustrated via a simple correlation, as shown in Figure 2 and Table 2. The figure shows the relationship between lending standards (right-hand scale) and real GDP growth forecasts one year ahead from the monthly *Economist Poll of Forecasters* (left-hand scale) for the three economies; in all three cases, the two time series broadly move in opposite directions. One notable difference, however, is that loan officers in the eurozone are also surveyed about their perceived demand for loans, not only about tightness or ease in the supply of loans and, as one would expect, the demand for loans is pro-cyclical – that is, loan demand rises when economic prospects improve.<sup>7</sup>

Note also that real GDP growth forecasts typically fall sharply during recessions. Unconditional correlation coefficients between the loan officers' survey measure and real GDP growth forecasts, as well as the correlation between the loan survey results and the level of real credit, are all negative and highly statistically significant (see Table 2). Results such as these clearly indicate that financial sector performance has repercussions for real economic activity. The potential for external financial and real shocks to influence the Canadian economy is affected by both the size of the trade relationship between Canada and its US and eurozone partners and by the globalized nature of financial markets.

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7 Canadian and US series that proxy credit conditions conflate (loan) demand and supply, because these countries' loan officer surveys provide evidence only about lending standards even though, clearly, borrowers' demand for funds also matters. For example, a reduction in loan demand might well be a response to an ongoing economic slowdown. Is this "identification" problem an important one? In a forthcoming study, a colleague and I suggest its effect appears to be empirically negligible with respect to US and Canadian data (see Siklos and Lavender, forthcoming).

**Table 1: Summary Statistics for Key Economic Aggregates, Canada, the United States and the Eurozone (1999 Q1 – 2012Q2)**

Variable	Economy	Mean	Standard Deviation
Real GDP growth	Canada	2.42	1.90
	United States	1.99	2.03
	Eurozone	1.43	2.11
Inflation	Canada	2.09	0.88
	United States	2.47	1.23
	Eurozone	2.04	0.77
Real credit growth	Canada	2.20	2.41
	United States	0.88	10.02
	Eurozone	9.42	6.58
Policy interest rate ( <i>percent</i> )	Canada	2.86	1.61
	United States	2.58	2.16
	Eurozone	3.16	1.22
Lending survey	Canada	5.87	28.76
	United States	11.46	26.76
	Eurozone	10.95	14.86

Note: Growth rates for each series are 100 times the fourth log difference; inflation is based on a consumer price index measure; the policy rate is the nominal indicator of monetary policy in the three economies. The loan survey is described in the text; for the eurozone, the data refer to loan officers' views about conditions for the supply of credit eurozone.

Source: See the Appendix.

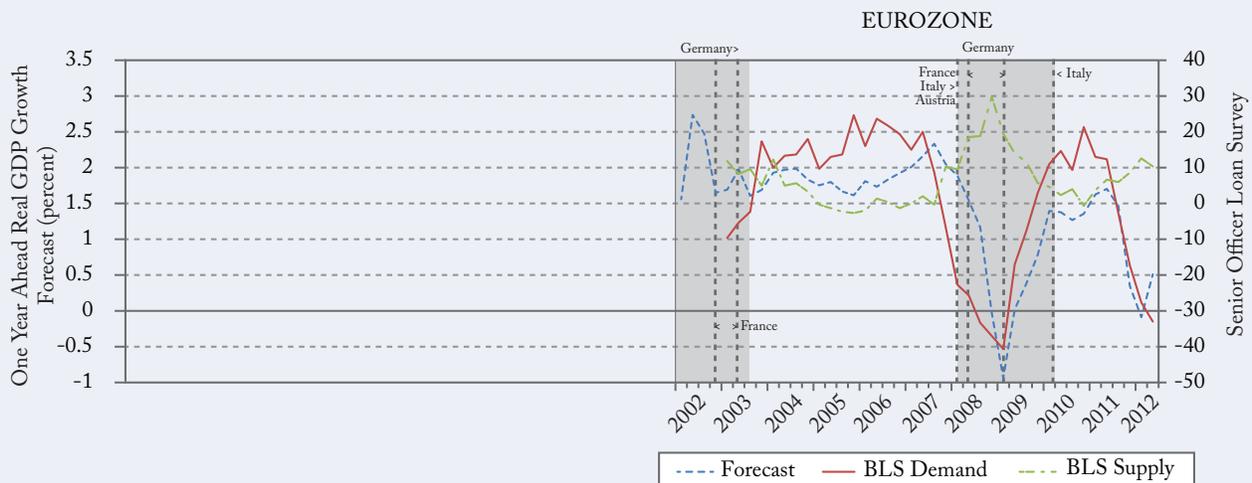
## A FRAMEWORK FOR EXPLORING REAL FINANCIAL LINKS

Standard macro models from before the financial crisis typically did not incorporate an important role for the financial sector. Here, however, I estimate a model that asks the following question: After controlling for observable Canadian factors, what effect do real economic and financial factors from the eurozone and the United States have on Canadian macroeconomic outcomes – most notably, real GDP growth? (For technical details underlying the model, see the Appendix.)

It has been known for several decades that impediments to the efficient allocation of credit

are an important influence on the effectiveness of monetary policy. As well, the interest rate reflects not only the cost of borrowing, but also non-price elements such as transactions costs, monitoring costs and, more generally, asymmetric information. It is largely for this reason that the US Federal Reserve, the Bank of Canada and the ECB survey loan officers to determine how they perceive the looseness or tightness of lending standards. Of course, all surveys suffer from biases. Although these central banks have explicitly stated that the surveys are useful, the information they collect is qualitative in nature, the number of institutions they cover can be small and there might well be some reporting biases. Nevertheless, including

**Figure 2: Senior Loan Officer Surveys and GDP Growth Forecasts, Canada, the United States and the Eurozone**



Source: See Appendix.

**Table 2: Correlations: Loan Surveys, Credit and GDP Growth Forecasts, Canada, the United States and the Eurozone**

	Canada	United States	Eurozone
SLOS, GDP growth forecast	-0.31 (0.02)	-0.54 (.00)	-0.60 (.00)
SLOS, real CREDIT	-0.31 (0.02)	-0.54 (.00)	-0.60 (.00)

Note: Unconditional correlation coefficient, with p-value in parenthesis, between the variable pairs shown in the first column. SLOS is the Senior Loan Officer Survey (called Loan Survey in the eurozone), GDP growth forecast is the one-year forecast for real GDP growth in the three economies, real credit is the amount of loans outstanding deflated by the GDP deflator. See the text and the Appendix for more details.

loan officer survey data in conventional macro models improves the forecasting performance of these models. Finally, as shown previously, there is a strong connection between such surveys and forecasts of economic growth.

To obtain estimates of the strength of the links between real and financial factors in the Canadian economy, I begin with a benchmark model in which real GDP, prices, loans, loan officers' surveys and central bank policy rates interact with one another. (The results of these interaction are shown in Figure A1 in Appendix.) I also use this methodology to examine separately the links between the US and eurozone economies. Next, I extract information from the US and eurozone benchmark models and augment the benchmark Canadian model with summary indicators derived from the separately estimated US and eurozone models to determine their effect on the Canadian economy.

Accounting for spillovers effects from the United States and the eurozone is essential if one is to speculate on the potential effect on the Canadian economy of a shock to the single currency area. Because samples are short (covering approximately 15 years), my empirical strategy amounts to reducing the complexity of the US and eurozone elements of the macro model that enter the model of the Canadian economy. Indeed, I augment the Canadian model with the addition of two variables

that proxy real and financial conditions in each of the US and eurozone economies and that affect economic activity in Canada. It is reasonable to assume that these factors are exogenous to the Canadian economy – after all, one expects the US and eurozone economies potentially to affect the Canadian economy but not vice versa. I also assume that it takes at least one quarter for US or eurozone economic shocks to affect Canadian macroeconomic conditions.

## EMPIRICAL RESULTS AND DISCUSSION

The results I present below rely on quarterly observations covering the 1999–2012 period. In the current context, a novel aspect of this empirical work is my adding survey data compiled by the Bank of Canada, the US Federal Reserve and the ECB, since the remaining data appear in many standard macro models used in policy analyses of the kind presented here. Another novel aspect of the estimation strategy is that I estimate the separate influence of eurozone shocks on the Canadian economy; it is commonplace to consider how the US economy influences the Canadian economy, although it is less common to ask how US financial sector shocks affect Canada's economic activity.

## Evaluating the Effect of US and Eurozone Shocks on the Canadian Economy

My focus is mainly on the effect of the eurozone and US economies on aggregate economic activity in Canada. To be sure, a severe recession in the eurozone likely would affect more than just real GDP, but since much of the recent discussion in policymaking circles has centred on the problem of slow or inadequate economic growth, it seems appropriate to narrow the focus of the analysis.

To evaluate the significance of shocks on Canada's economic performance, I estimate, over a period ten quarters ahead, the effect of a shock of a given size on Canada's real GDP.<sup>8</sup> The resulting estimates are called "impulse responses." I assume that other variables in the model are held constant – for example, the effect of a shock stemming from a change in the Bank of Canada's policy rate is based on the assumption that the other variables in the system do not change. I arbitrarily define a shock as equivalent in size to 1 percent of all the estimated shocks.<sup>9</sup>

When no explicit allowance is made for shocks that come from abroad, a tightening of standards – that is, an increase in the proportion of loan officers who perceive that loan standards have tightened or are expected to do so in the coming quarter – produces a drop in real GDP in all three economies. This is precisely what one would expect, for example, when monetary policy is tightened.

The peak effect takes place around five to six quarters following the introduction of the shock in all three economies, and the negative effect dissipates after ten quarters. The relative importance of adding data from the loan survey is underscored by examining the explanatory power of the various shocks included in the model on real GDP. In the case of Canada, after ten quarters almost half the variation in real GDP is explained by changes in the perceived tightness of lending standards. Only shocks from the past history of real GDP and the GDP deflator come close to explaining as much of the variation in real GDP.<sup>10</sup>

The responses of the other variables in the model are broadly comparable across the three economies – recall that I estimate the same model separately for US and eurozone data. It is worth noting, however, the important differences in the reactions of real GDP to a monetary policy shock. A rise in the Bank of Canada's policy rate has a modest dampening effect on Canada's real GDP. In contrast, a rise in the US federal funds rate has a negative effect on US real GDP that rises over time but stabilizes around the tenth quarter – in other words, the cumulative effect becomes larger over time (but at a declining rate). Since the model assumes that the effects are symmetric, this also implies that a fall in the federal funds rate has a positive economic effect. A tightening of monetary policy in the eurozone has an even larger negative effect on the euro area economy, although the

8 Over time, one would expect the effect of shocks, on average, to dissipate. The size of a shock can also be measured in terms of its standard deviation since this is scaled as a percentage.

9 In technical terms a shock is defined as 1 standard deviation (or 1 percent) of the residuals in the estimated model (see the appendix). The residuals represent that part of a relationship which cannot be explained by the past history of the variables included in the model (sometimes referred to as the 'fundamentals'). To quantify the effect of a shock, the analyst must also decide on a rank order of the variables in the model. In the current case, the specification for real GDP comes first, while the Bank of Canada's policy rate is the last variable in the model. What this means is that real GDP is assumed to affect all the other economic variables while simultaneously being influenced by these variables. In contrast, the Bank of Canada's policy rate influences all the other determinants of Canada's economic conditions but is set independently of them.

10 References to real GDP refer to the effect of various shocks on the level of this series.

effect dissipates after ten quarters.<sup>11</sup> A couple of explanations are likely for these differences in the effect of monetary policy in Canada and in the other two economies. First, exchange-rate effects likely loom larger in Canada, and the strong appreciation of the Canadian dollar throughout much of the period might have reduced the effect of policy rate changes on Canada's real GDP. Second, the Bank of Canada's inflation targeting might well have reinforced its ability to anchor inflationary expectations by relying on fewer policy rate changes.

An overarching concern in exercises such as this is the reliability of the results, particularly when one can only rely on 15 years or so of data for Canada and the eurozone; these concerns are less problematic for the US case, where almost three decades of data are potentially available. To test the results, suppose one can create separate indicators for real and financial conditions. In other words, for each of the three economies, one combines all six of the macroeconomic indicators I use to characterize the shocks hitting the Canadian economy and that influence movements in Canada's real GDP. The combination reduces the number of variables to two: one summarizing real economic conditions, and the other the financial factors driving the Canadian economy (again, see the Appendix for details). One can interpret a rise in these two factors as consistent with improving macroeconomic or financial conditions, while a drop signifies the opposite (see Figure 3). Looking at the Canadian experience, it is striking that a recession, whether it takes place in Canada or the United States, is accompanied by a sharp deterioration of financial conditions. The drop was especially precipitous during the 2008–09 global financial crisis, which, not surprisingly, coincided with a recession. Notice, however, that in all three economies a worsening of

financial conditions was far more pronounced than the fall in real conditions.

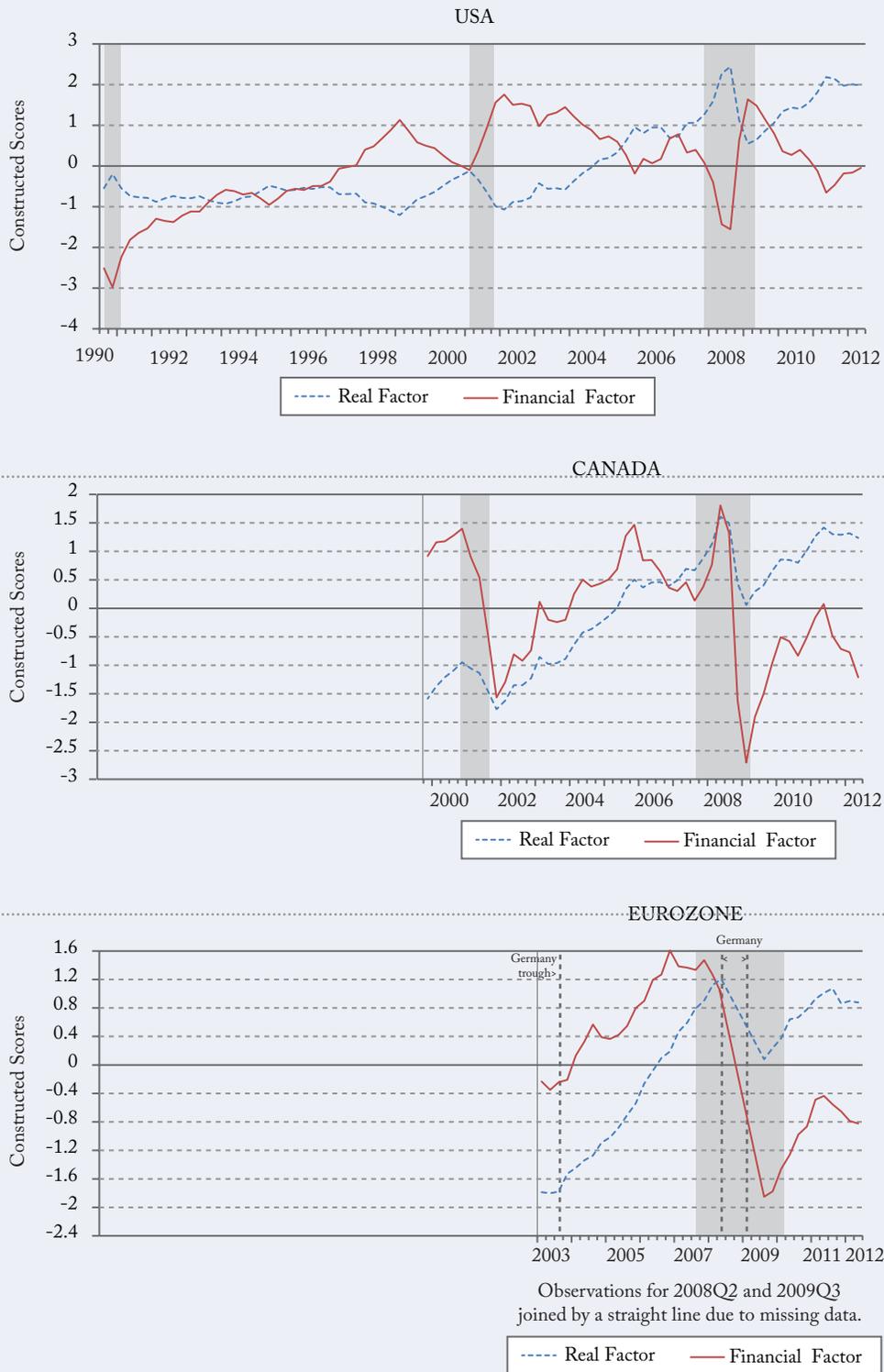
Financial and economic factors are usually positively related to each other, but the strength of the correlation can be time dependent. For example, in the United States, there was a slow deterioration of financial conditions following the 2001 recession, while real conditions steadily improved until the financial crisis of 2008–09. Figure 3 shows two other interesting features. First, whereas peaks in economic and financial conditions were more or less coincident in both Canada and the United States, financial conditions peaked ahead of economic conditions in the eurozone. Second, both economic and financial factors deteriorated somewhat at the end of the period; the deterioration is particularly noticeable for Canada. This suggests that, should similar developments take hold in the United States and the eurozone, the two factors might well deteriorate further.

Next, I consider variants of the model that add US and eurozone real and financial shocks to the benchmark Canadian specification (Figure A2 from the Appendix adds external shocks from the US and the eurozone to the benchmark model). This allows me, for example, to evaluate the effect of domestic shocks when foreign shocks are added. The addition of foreign shocks indirectly highlights the role of the exchange rate as a “shock absorber” that permits an evaluation of the Bank of Canada's ability to implement an independent monetary policy. Although the Bank and many economists have touted the insulating properties of the current monetary policy regime, a less optimistic assessment of the role of exchange-rate flexibility is now being voiced more frequently. The difficulty is that an appreciation of the Canadian dollar might have a negative effect on trade in goods and services, but,

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11 Variants of the basic model that control for recessionary periods in the three economies, for example, had no discernible effect on the conclusions.

Figure 3: Real and Financial Factors, Canada, the United States and the Eurozone



Note: For Canada and the United States, the shaded areas are periods of recession according to Cross and Bergevin (2012) and the National Bureau of Economic Research, respectively; periods of recession for the eurozone are shown for Germany – see the text for details.

in the absence of any change in monetary policy, prompts an inflow of capital if further appreciations are expected.<sup>12</sup> The global financial crisis amplified this phenomenon and possibly exacerbated the effect of exchange-rate movements.<sup>13</sup> This illustrates the asymmetric effects of exchange-rate movements on the real and financial sectors of the economy. When one adds US and eurozone real and financial shocks, shocks from a Canadian source become considerably smaller. Indeed, whereas a negative domestic financial shock produces a small negative response by Canada's real GDP, adding US shocks to the Canadian model essentially replaces the effect of domestic financial shocks on the Canadian economy.

I then consider the effect of real and financial shocks from the United States and the eurozone on Canada's real GDP. Figure 4 reveals that positive real shocks from the United States have a small positive effect on Canada's real GDP output in the first two quarters, then turn modestly negative to neutral over the following eight quarters. It might seem counterintuitive that a positive US real shock can have a negative effect on the Canadian economy, but consider that, although the profile of real factors was similar in the two economies during the 2000s, the behaviour of financial factors differed substantially (see Figure 3). Furthermore, it is likely that Canada's monetary policy response, together with an appreciation of the exchange rate, might well have combined to offset, if not reverse, the positive effect of an initially positive US real

shock. In contrast, a positive financial shock – that is, an improvement in US financial conditions – has an increasingly positive effect on Canada's real GDP, although declining towards zero by around seven quarters after the initial shock. The profile of eurozone real and financial shocks from the eurozone is somewhat similar to the effect of shocks from the United States, although their effect on Canada's real GDP is roughly one-tenth of the US effect (as indicated by the different orders of magnitude of the two vertical axes in Figure 4).

These results confirm the difficult balancing act policymakers must perform when faced with changes in external economic conditions. Central bankers are keenly aware that monetary policy can be a blunt instrument for dealing simultaneously with real and financial imbalances (see, for example, Boivin, Lane and Meh 2010).

### What if the Eurozone Falter?

Is it possible to devise counterfactuals that might provide some clues about the economic consequences of a large shock from the eurozone? A break-up of the eurozone is the most talked about shock, but a severe economic crisis in the area might come from several other sources, such as the failure to create a credible banking union, the inability of the ECB to introduce additional policy easing once the policy rate reaches the zero lower bound, a realization that sovereign debt in some eurozone economies is unsustainable and fiscal

12 This phenomenon has led policymakers in some emerging market economies, such as Brazil, to herald a coming “currency war.” An important difference between Canada's position and that of many emerging market economies is that, in Canada, inflation expectations remain stable. Nevertheless, there is relatively little room left for further declines in the Bank of Canada's policy rate, and the “safe haven” effect also might lead to further currency appreciation from time to time.

13 The deputy governor of the Bank of Canada, John Murray, has noted that “flexible exchange rates, which have a great deal to recommend them, have failed to live up to their initial optimistic billing. (Canada's positive experience with a flexible exchange rate through the 1950s and early 1960s might have contributed to this overly sanguine assessment.) Their stabilizing properties were shown to be more limited than previous enthusiasts had credited” (Murray 2011).

reversals that threaten the credibility of the revised Stability and Growth Pact. All such events could deliver a large negative global shock. Of course, one cannot predict with a high level of confidence what form such a shock might take, in part because there are potential effects that cannot be readily quantified, as noted above.

To estimate the potential negative economic consequences of a eurozone shock, I consider two counterfactual exercises. Admittedly, these are “worst-case” scenarios, but they at least have the virtue of providing a maximum value of sorts for the effect of the ill wind that might blow our way from the eurozone. In the first exercise, I assume that real and financial conditions permanently return to levels reached during the height of the eurozone’s sovereign debt crisis. In the second, I assume that real and financial factors deteriorate at the rate experienced in some of the countries worst hit by the crisis – for example, Greece.

The counterfactual exercise begins with estimates based on the case discussed earlier (see Figure 4). Next, I impose the condition that real and financial factors in the eurozone remain unchanged from their trough reached in early 2009 (see Figure 2). In the second counterfactual, I assume that conditions in the entire eurozone deteriorate, beginning in 2009, at the same rate as in Greece during this period. Not surprisingly, this results in a rapid worsening of real and financial conditions.<sup>14</sup> I then ask what effect a change in these counterfactual real and financial conditions would have on Canada’s real GDP (see Table 3).

The first set of estimates in Table 3 – in the column labelled “realized” – show the effect of actually observed real and financial shocks from the United States. Improvements in real economic conditions in the US had a positive effect on

Canada’s real GDP, as one would expect. Similarly, worsening financial conditions in the US led to an improvement in Canada’s real GDP – one might term this the “safe haven” effect. If one now substitutes the two counterfactual experiments described above for the observed real and financial conditions, both financial shocks reduce Canada’s real GDP, and the effect is twice as large in the case of the eurozone’s going the way of Greece.

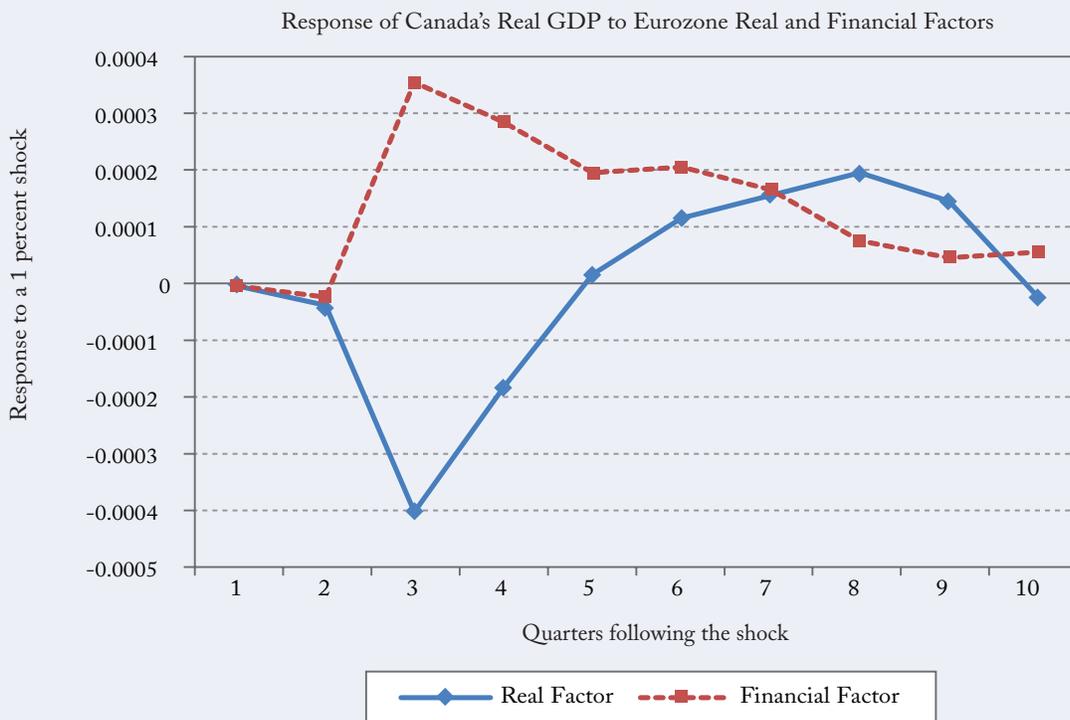
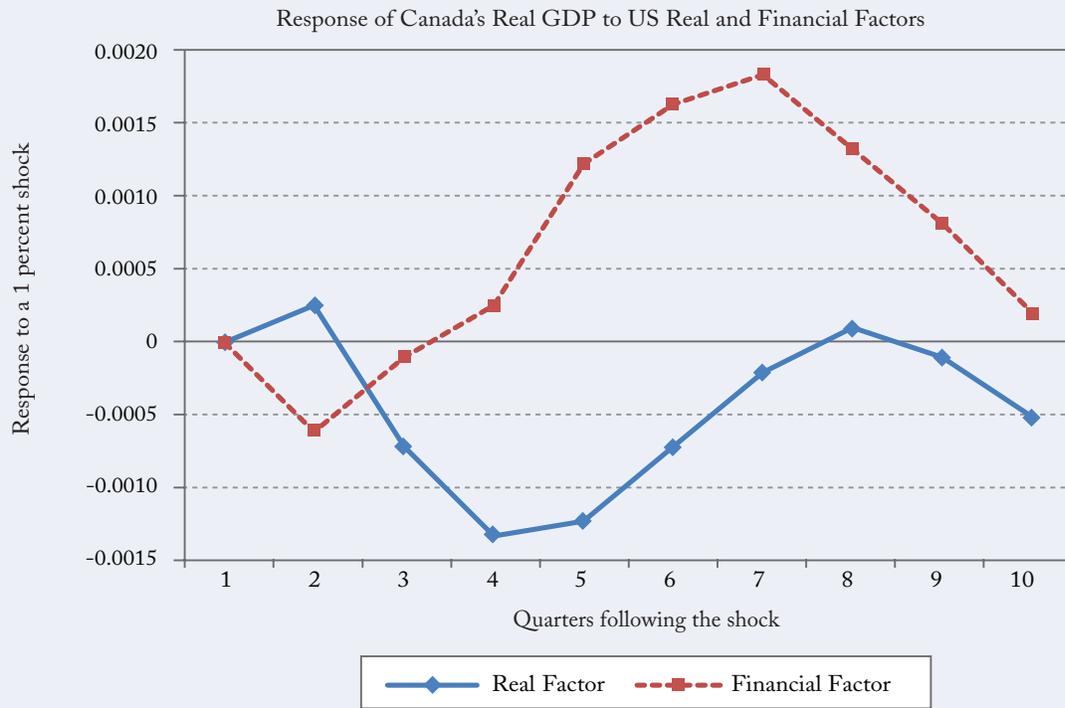
Suppose one allows “normal” times to be interrupted by a permanent shock from the eurozone. In normal times, aggregate demand and monetary policy shocks dissipate after about ten quarters. If credit and financial conditions were to deteriorate as in Greece during the height of the debt crisis, aggregate demand shocks have a negligible effect on the Canadian economy – about 1 percent, although this is not statistically significant – but the credit shocks cumulatively reduce Canada’s real GDP growth by 7.75 percent, again after ten quarters. Clearly, an ill wind from the eurozone could have a significantly negative real effect on Canada’s real economy.

## POLICY DISCUSSION AND IMPLICATIONS

The empirical evidence highlights the important role financial shocks play in influencing real economic outcomes. Despite Canada’s reputation as having a sound regulatory environment in banking and finance, stress tests of the kind successfully put in place in the United States – unlike the less credible ones so far carried out in the eurozone – could contribute to assuaging any worries about Canada’s ability to withstand external financial shocks. Research is under way in this area at the Bank of Canada (see, for example, Côté 2012)

14 To facilitate interpretation, I use a positive sign for improvements and a negative sign for deteriorations in real and financial conditions.

Figure 4: "Impulse Responses" by Canada to US and Eurozone Shocks



Note: The values in the figure trace the impact on real GDP, in each quarter, following an initial shock.

**Table 3: Dependent Variable: Logarithm of Canadian Real GDP**

	Estimated Coefficient (standard error)		
	Realized (US to Canada)	Counterfactual 1: Eurozone growth at 2009 trough	Counterfactual 2: Eurozone growth deteriorates as in Greece after 2008
Real Factor: $f_t^{R,EZ}$	0.05 (.00)*	0.00 (0.01)	0.01 (0.01)
Financial Factor: $f_t^{F,EZ}$	0.03 (.00)	-0.01 (.004)**	-0.02 (0.01)**

Note: Estimated via ordinary least squares.  $f_t^i$  are the estimated or counterfactual real (R) and financial (F) factors from the eurozone (EZ). The counterfactuals are as described in the text and where the counterfactual values begin in 2009Q2. Counterfactual 1 imposes the condition that real and financial factors remain unchanged from their trough reached in early 2009 in the eurozone (see Figure 2). In counterfactual 2, the pattern of behaviour in real and financial factors is obtained by effectively assuming real economic conditions in the eurozone deteriorated beginning in 2009 at the same rate as in Greece in that year.

and elsewhere (for example, at the Office of the Superintendent of Financial Institutions). The good news is that the Canadian economy is able to withstand considerable foreign shocks. It is unlikely, however, that Canada's floating exchange-rate system can be relied upon as the only shock absorber. Readers of successive Bank of Canada *Monetary Policy Reports* will have noticed that, despite significant changes in assumptions about the US-Canadian dollar exchange rate, inflation and real GDP growth forecasts appear hardly affected. This could be due to a combination of lower pass-through effects and the anchoring of inflation expectations, underscored by the Bank's commitment to the inflation target. Nevertheless, it is striking that former governor Mark Carney's Hanson Lecture (Carney 2013) essentially ignores the exchange rate in reviewing the effect that the financial crisis had on monetary policy.

Absent changes in the regulatory or general economic environment, together with limitations on the ability to offset shocks through fiscal

or conventional monetary policy instruments, Canadian policymakers might consider a return to the use of "guidance" to manage expectations. For example, if the source of a large negative shock from the eurozone is the belief that the region will experience a Japanese-style deflation and stagnation, then the guidance that underscores the Bank of Canada's determination to meet its inflation target should be beneficial. Although some have argued (for example, Carney 2012) that guidance is useful only in "exceptional" times, there is no reason, *a priori*, why this should be the case. Whether times are normal or not, the central bank must explain itself. What it must avoid is falling into the trap of sticking to an inflexible rule. Until there is any evidence to the contrary, the current inflation-targeting framework provides sufficient latitude to remain flexible and to implement "unconventional" policies during times of crisis. It is the quality of the guidance per se, not the form in which it is provided, that can make the difference when spillovers cannot be contained completely.

The Bank might well have recognized this in its October 2013 policy rate announcement, when it downplayed whether, and for how long, the current policy stance would remain in place.

The Bank of Canada is to be commended for pioneering a calendar-based conditional commitment strategy (see Carney 2013). In future, however, as the US Federal Reserve has demonstrated, this might not be enough. It is unclear whether a commitment subject to thresholds that are not calendar based represents an improvement. As yet, we know too little about the effect of these types of commitment strategies on expectations of inflation or real economic activity to reach any firm conclusions about their desirability. Nevertheless, forward guidance, no matter how well designed, is not good enough. The age-old rule that calls for fiscal and monetary policies to work in concert remains even more important in the face of potential risks from a eurozone break-up or a flare-up of the sovereign debt crisis.

## CONCLUSIONS

It has been said that Canada has had a good crisis. Indeed, experience suggests that Canada has weathered previous financial crises better than has its southern neighbour, owing to relatively stronger and more conservative institutional foundations (see Bordo, Redish and Rockoff 2011). Nevertheless, negative economic spillovers from the eurozone cannot be entirely dismissed despite Canada's more resilient and better supervised financial system. More recently, it is the ongoing sovereign debt crisis in the eurozone that has preoccupied policymakers. More precisely, there are at least two risks going forward in 2014. First, there is the possibility of a significant rise in economic tensions inside the eurozone if one (or more) of its members voluntarily opts out of the common currency. This risk remains real despite continued financial support of these countries from the EU, the ECB

and the International Monetary Fund. Even if the collapse of the single currency is not imminent, there remains the risk of a sovereign debt default if current austerity plans cease to be politically sustainable.

To date, these events remain only possibilities. Nevertheless, by asking how real and financial shocks from the United States and the eurozone might affect the Canadian economy, we can at least determine the potential for certain "worst-case" scenarios to influence Canada's real GDP. Given the historical experience, we can pose some hypothetical questions. If real and financial conditions abroad had not improved from the depths reached at the height of the 2008–09 global financial crisis, what might have happened to Canada's real GDP? Alternatively, if a break-up of the eurozone or sovereign debt defaults led to a deterioration of real and financial conditions in the eurozone on the scale of Greece's experience over the past three years, what would be the effect on Canada's real economy?

From the models I constructed to answer such questions, I find that negative shocks from the real and financial sectors of the US and eurozone economies do spill over into the Canadian economy. Inflation targeting and floating exchange rates do not insulate the Canadian economy fully from foreign shocks. Indeed, financial shocks have had a quantitatively larger effect on the Canadian economy than have real shocks. Clearly, US shocks dominate, but eurozone shocks cannot be ignored. I also find that contagion-type effects from the US and eurozone financial sectors can combine to affect Canadian real economic activity (Table A1). Finally, one counterfactual experiment suggests that Canada's economy would not be able to withstand the worst-case scenarios from the eurozone without serious dislocation. A credit-related shock from the eurozone, on the scale of the Greek experience, could reduce Canada's real GDP by almost 8 percent in the two and half years after the shock.

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## APPENDIX:

### Data Sources and Definitions

The Bank of Canada has conducted a quarterly Senior Loan Officer Survey (C-SLOS) on business lending practices since 1999.<sup>15</sup> The survey is carried out across 11 financial institutions covering roughly 60 percent of total business lending in Canada. The C-SLOS focuses on corporate, commercial and small business loans. Loan officers in the financial institutions surveyed are asked the following question: “How have your institution’s general standards (i.e. your appetite for risk) and terms for approving credit changed in the past three months?” (see Faruqui, Gilbert and Kei 2008). Respondents are asked to indicate whether their business practices have tightened, eased or remained unchanged with respect to pricing of credit, general standards, limit of capital allocation and terms of credit. Non-price information represents a balance of opinion evaluated as the percentage of tightening responses minus the percentage of easing responses. Despite the distinction between price and non-price factors in the measurement of credit standards, the two indicators appear to move in a similar fashion.<sup>16</sup>

In the United States, the Federal Reserve conducts a survey of bank officials, known as the Senior Loan Officer Opinion Survey (US-SLOS), in as many as 60 large banks.<sup>17</sup> The survey conveys a balance of opinion based on the following question: “Over the past three months, how have your bank’s credit standards for approving applications for Commercial & Industrial loans or credit lines – other than those to be used to finance mergers and acquisitions – to large and middle-market firms and to small firms changed?” Respondents are asked to select one of the following answers: a) tightened considerably; b) tightened somewhat; c) remained basically unchanged; d) eased somewhat; e) eased considerably.<sup>18</sup>

Both the Bank of Canada and the Federal Reserve notably attach considerable importance to the survey of lending conditions, and this should be reflected in empirical estimates of the role of credit conditions in the macroeconomy. It is worth mentioning that banks are not the only source of funds. Nevertheless, approximately 75 percent of short-term business credit, likely the most relevant source of financing for business cycle analysis, is obtained through banks (see <http://credit.bankofcanada.ca/businesscredit/>).<sup>19</sup>

In the eurozone, the Bank Lending Survey (BLS) is comparable to those conducted in Canada and the United States, but is more comprehensive – for example, more than 80 institutions in the eurozone have been surveyed since 2003 (see Berg et al. 2005; De Bondt et al. 2010). Initially, the survey covered

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15 See Bank of Canada, “Senior Loan Officer Survey”; available online at <http://www.bankofcanada.ca/publications-research/periodicals/slos/>.

16 In the empirical work in this *Commentary*, I use the non-price balance of opinion from the survey.

17 See United States, Federal Reserve Board, “Senior Loan Officer Opinion Survey on Bank Lending Practices”; available online at <http://www.federalreserve.gov/boarddocs/SnloanSurvey/>.

18 “Tightening considerably” and “easing considerably” responses have twice the weight of “Tightening somewhat” and “easing somewhat.”

19 It is difficult to obtain comparable US figures. Nevertheless, almost 30 percent of credit in the form of commercial and industrial loans from banks or commercial paper is obtained from banks. There is no comparable distinction made between short-term and long-term sources of external finance. See Federal Reserve Bank of St. Louis, [research.stlouisfed.org/fred2](http://research.stlouisfed.org/fred2).

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40 percent of the eurozone, but given differences in banking structures and relative sizes, the distribution of the survey is not uniform and data from individual eurozone member countries are weighted (see Berg et al. 2005, tables 1 and 2). Nevertheless, most lending is intermediated through the banking systems of eurozone economies (see, for example, De Santis and Surico 2013). The question asked is: “Over the past three months, how have your bank’s credit standards as applied to the approval of loans or credit lines to enterprises changed?” Respondents are asked to provide an answer on a scale from “tightened considerably” to “eased considerably.”

In addition to loans to enterprises, the BLS asks similar questions concerning loans to finance the purchase of housing and for the provision of household credit. The survey also asks about loan officers’ expectations for lending conditions over the next three months. Finally, the BLS also requests information about loan officers’ perceptions of loan demand, both over the past three months as well as for a period three months into the future. After some experimentation with both the backward- and forward-looking indicators, as well as with data disaggregated according to the type of loan, the survey data for the three categories – loans to enterprises, for housing purchases and household credit – are aggregated into separate supply and demand indicators of the net percentage of banks reporting tightening or loosening of credit conditions. In the results I report in this study, I use the forward-looking indicator, although the results are essentially the same using the backward-looking indicator.

I obtained macroeconomic and financial asset data for Canada and the United States from the Bank of Canada; Statistics Canada’s CANSIM database; the US Department of Commerce, Bureau of Economic Analysis; and the Board of Governors of the US Federal Reserve System. US real GDP (2005) is seasonally adjusted at annual rates. I calculated the GDP deflator using real (2005) prices and nominal GDP. The monetary policy indicator is the federal funds rate. To proxy commodity prices, I experimented with two series – namely, oil prices (West Texas intermediate crude price per barrel) and the Producer Price Index (PPI; 1982 = 100); all results, however, rely on the oil price proxy, as the conclusions were essentially unchanged when using the PPI.<sup>20</sup>

Turning to Canadian data, the loans variable is annualized Canadian chartered bank business loans. Real GDP is expenditure based using 2002 dollars. The consumer price index (CPI) is based on a 2005 basket of goods. The commodity prices series is the Bank of Canada’s commodity price index (1982–90 = 100) evaluated in US dollars. The overnight rate is the indicator of Bank of Canada monetary policy. Real time GDP and potential real GDP data are from the Bank of Canada.

I proxied expected real GDP growth using the Consensus Forecasts for the United States and Canada one year ahead, the term spread – the three-month commercial paper/treasury bill spread for both the United States and Canada – and an indicator of financial stress in both countries. For the latter, I used the Chicago Federal Reserve’s National Financial Conditions Index, which “measures risk, liquidity and leverage in money markets and debt and equity markets as well as in the traditional and ‘shadow’ banking systems.”<sup>21</sup> The index appears to roughly coincide with recessions – in other words, the value of the

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20 Using nominal or real oil prices makes little difference to the result. Estimates discussed below are based on nominal oil prices.

21 For additional details, see Federal Reserve Bank of Chicago, “National Financial Conditions Index (NFCI)”; available online at <http://www.chicagofed.org/webpages/publications/nfci/index.cfm>.

index rises sharply with the onset of a recession. Similarly, for Canada, the Bank of Canada's Financial Conditions Index (FCI) serves as the measure of financial conditions.<sup>22</sup>

I obtained all eurozone data from the European Central Bank; these data were seasonally adjusted at the source unless otherwise indicated.<sup>23</sup> I deflated bank loans or credit in current dollars or euros by the appropriate GDP deflator to obtain a real measure of outstanding credit. I obtained growth rates by evaluating the log difference of the variables in question (such as prices) and multiplying the result by 100 to arrive at a proxy for the percentage change in the variable. Finally, since the sensitivity of the results might be influenced by financial crises in the United States and the eurozone, I wanted to condition some of the results on these events. A difficulty is that there is no consensus on their precise timing. For example, Laeven and Valencia (2012) date the US financial crisis as having occurred over the period from 2007:Q1 to 2007:Q4, whereas Dominguez, Hashimoto and Ito (2012) specify the timing as from 2008:Q3 to 2009:Q2. There is similarly a difference of opinion about the timing of the crises in individual eurozone countries. Accordingly, I examine three different cases: 2008:Q3–2012:Q2, 2008:Q1–2012:Q1, and 2007:Q1–2012:Q2. Note that I combine the US financial crisis with the sovereign debt crisis in the eurozone for convenience, although conclusions are largely unaffected by defining crisis dates that rely on the chronologies of Laeven and Valencia (2012) or Dominguez, Hashimoto and Ito (2011). The advantage of my approach is that the “crisis” sample is considerably longer and, hence, one can have more confidence in the results.<sup>24</sup>

## Methodological Notes

A conventional macroeconomic model assumes that the chosen variables are temporally related in the following manner:

$$y_t = A_0 + A_1 y_{t-1} + \varepsilon_t \quad (1)$$

where  $y$  is a vector of variables that include the macroeconomic time series which summarize the key economic relations of interest to policymakers. Typically, the contents of the vector would consist of real GDP, the price level or inflation, commodity or oil prices and the central bank's policy rate. Equation (1) explicitly recognizes that all of the variables are endogenous, since, potentially, the past history of each one of the four variables in the vector  $y$  affects all the other variables in the model, with a lag.

The drawback with the standard macro-model formulation is that, when the financial sector is believed to have macroeconomic consequences, equation (1) will produce misleading inferences, since variables that

22 See Bank of Canada, “Financial Conditions Index” available online at <http://credit.bank-banque-canada.ca/financialconditions/fci>. There is some overlap between the FCI and some of the variables used in the estimated model. For example, the FCI includes the C-SLOS and interest rates, although their overall weight is small. Nevertheless, as the FCI also includes housing and equity prices as well as the real exchange rate, each of which has a much larger weight, these elements help to identify demand factors separately from supply factors in credit conditions and their link to macroeconomic conditions.

23 See European Central Bank, Statistical Data Warehouse; available online at <http://sdw.ecb.europa.eu/>.

24 Thus, in the case of the eurozone, the crisis sample is potentially as long as 4½ years out of a total sample of 13½ years.

define credit conditions, such as the volume of loans and the loan officer survey indicator of tightness or ease in credit conditions, are omitted. If one incorporates these omitted variables into the vector  $y$ , one can rewrite equation (1) as follows:

$$y_t^* = A_0 + A_1 y_{t-1}^* + \varepsilon_t, \quad (2)$$

where equation (1) has been modified to incorporate two additional variables that proxy overall credit conditions. Equation (2) is then the benchmark model that captures the essence of real-financial links in the economy.

Nevertheless, accounting for spillover effects from the United States and the eurozone is essential if one is to speculate on the potential effect on the Canadian economy of a collapse of the single currency. To do so, and to maintain the integrity of models such as (1) or (2), I adopted the following strategy. Suppose I capture the influence of the US and eurozone economies by creating two variables that proxy, respectively, the real and financial developments in the two economies. In other words, instead of adding to equation (2) US and eurozone equivalents of the vectors  $y$  or  $y^*$ , I create two new variables called, respectively, real and financial factors separately for the US and eurozone economies. In addition, it is reasonable to assume that these factors are exogenous to the Canadian economy. After all, the US and eurozone economies are expected to affect the Canadian economy but not vice versa. If I then assume that it takes at least one quarter for US or eurozone economic shocks to affect Canadian macroeconomic conditions, I can express the source of spillovers into the Canadian economy as follows:

$$y_t^* = A_0 + A_1 y_{t-1}^* + b_1 f_{t-1}^{R,US} + b_2 f_{t-1}^{F,US} + b_3 f_{t-1}^{R,EU} + b_4 f_{t-1}^{F,EU} + \varepsilon_t, \quad (3)$$

Potentially then, equation (3) contains the six variables in equation (2), all of which are endogenous, and four additional exogenous variables, each lagged one period. Alternatively, I can redefine  $y^*$  to consist of the real and financial factors proxy variables based on Canadian data only. I experimented with both versions of equation (3), although the most parsimonious version forms the basis of the results I discuss in this study. Notice that the real and financial factors, denoted  $f^{R,j}$  and  $f^{F,j}$  ( $j = \text{US, eurozone}$ ), are not in bold, to indicate that they are individual series that summarize shocks from the real and financial sectors of the US and eurozone economies, respectively. Nevertheless, as explained below, their construction follows from statistically combining several individual time series to create a proxy for  $f$ .

If the factors summarizing US macroeconomic and financial conditions are summarized by  $F$ , then, in a first step, the following equation describes the principal components extracted from the vector autoregression based on US data, which can be written as

$$y_t^{US} = \Lambda F_t^{US} + e_t, \quad (4)$$

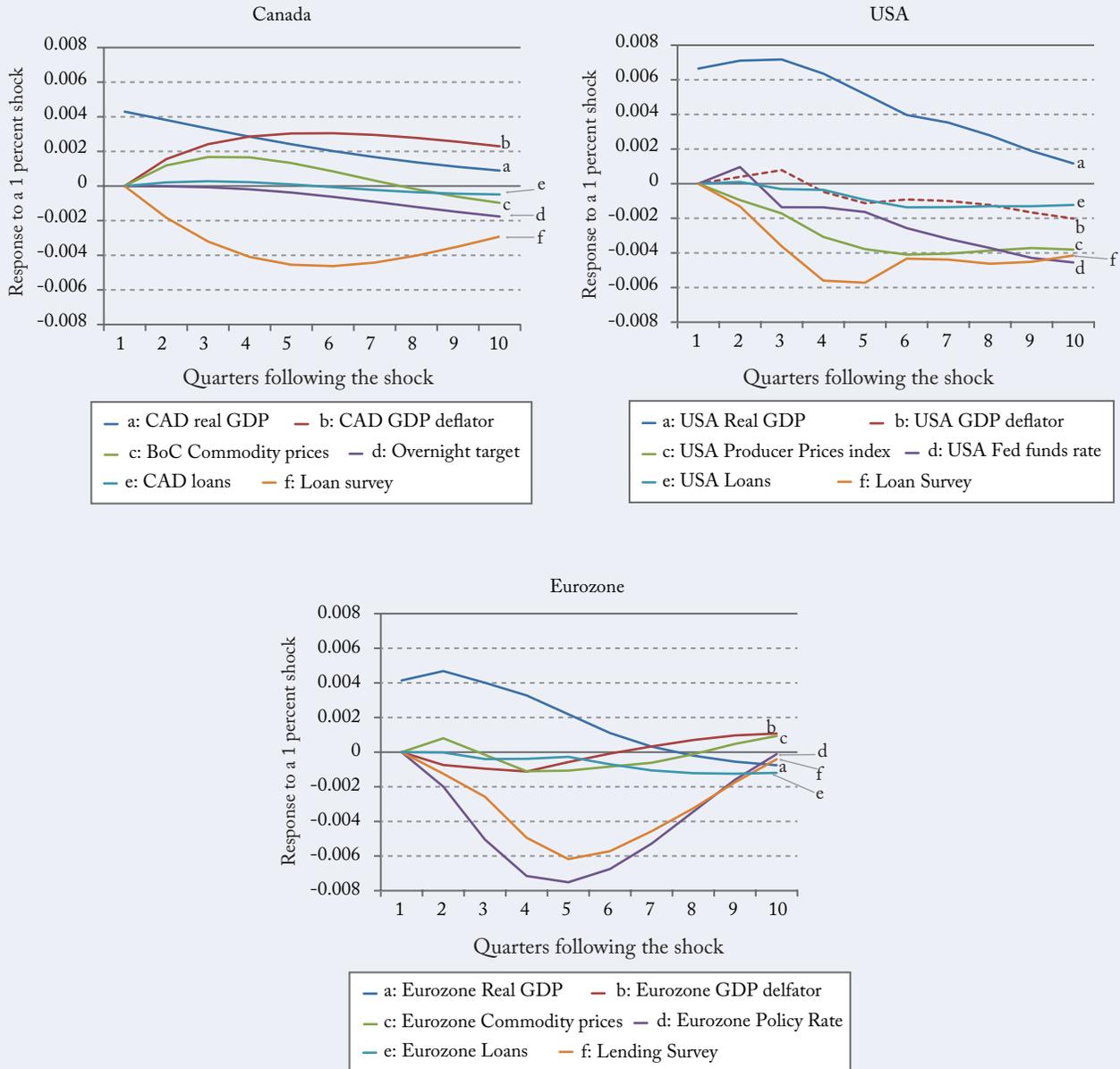
where  $y$  is the vector of endogenous US variables,  $\Lambda$  is the factor loadings (representing the relative weights of the real and financial factors in explaining movements in economic activity) and  $e$  is a zero mean, constant variance error term. For simplicity,  $F$  represents both the real and credit factors emanating in the United States that affect Canada. The method of principal components is used to identify up to two factors – namely, US real or macroeconomic shocks and credit shocks. Since it is unlikely that Canadian factors play a role in US real or credit activity, I do not have to worry about variables in  $y^{US}$  being contaminated by the Canadian equivalents. Suffice it to say that the procedure involves creating series that are essentially a

linear combination of variables that capture in the simplest possible manner the external real and financial links that enter equation (3). Needless to say, I can apply the same strategy to the Canadian data, yielding another alternative to equation (3). Therefore, if I reduce the Canadian-only macro model (equation (2)) into real and financial factors, I can express model (3) as follows:

$$\mathbf{F}_t^* = \mathbf{B}_0 + \mathbf{B}_1 \mathbf{F}_{t-1} + b_1 f_{t-1}^{R,US} + b_2 f_{t-1}^{F,US} + b_3 f_{t-1}^{R,EU} + b_4 f_{t-1}^{F,EU} + \boldsymbol{\varepsilon}_t \quad (5)$$

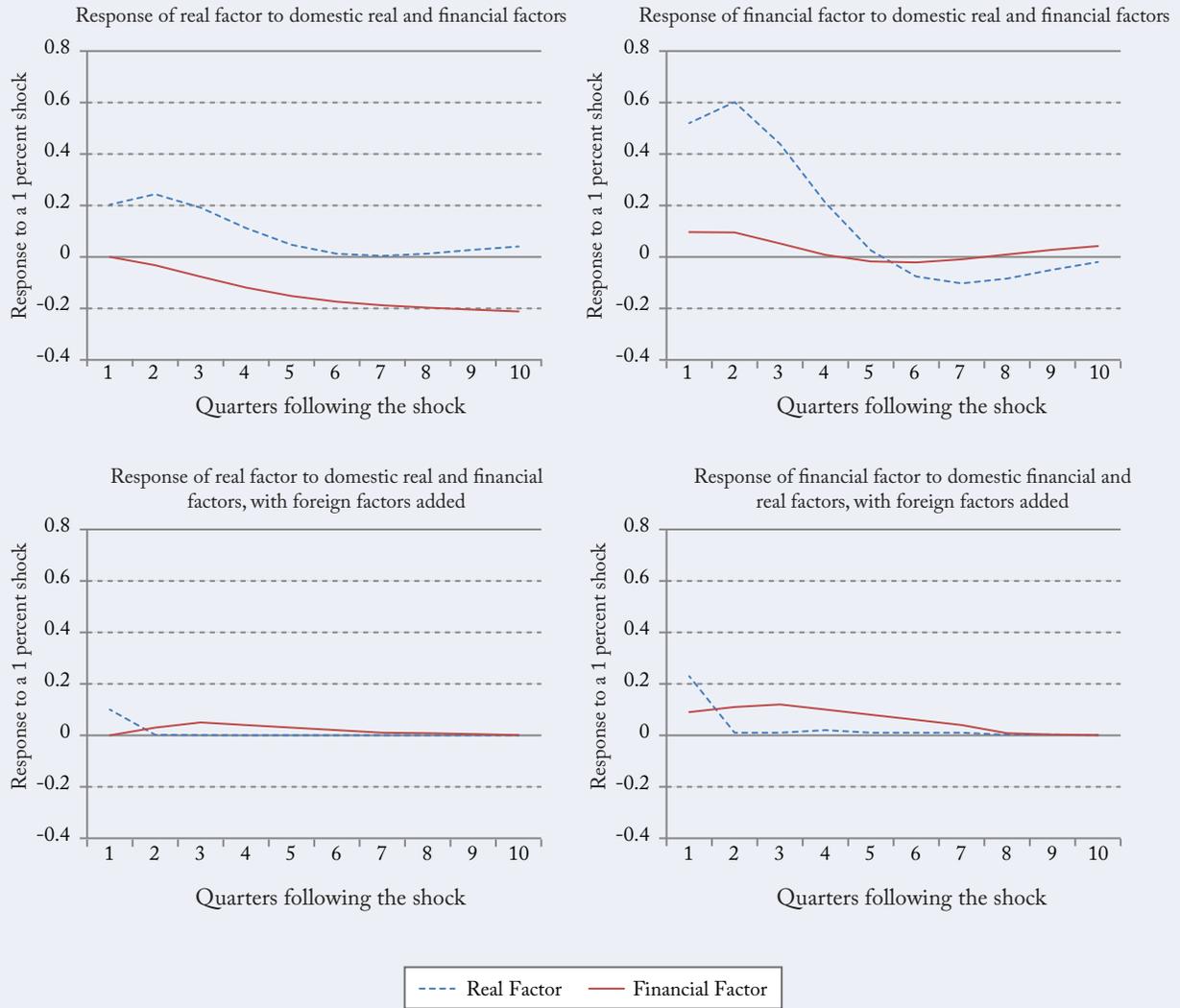
where, instead of expressing the functional relationship between individual Canadian macroeconomic factors,  $\mathbf{y}^*$  is replaced by an indicator of real and financial factors (the vector  $\mathbf{F}$ ) for Canada. The remainder of the specification is as in equation (3) above.

**Figure A1: Response of Real GDP to Economic and Financial Shocks, Canada, the United States and the Eurozone**



Note: Estimates are based on equation (2).

Figure A2: Impact of Domestic and Foreign Shocks on Canada's Real and Financial Factors



Note: Estimates are based on equation (3). The estimates show that domestic shocks become considerably less important when foreign factors are taken into account.

Table A1: Contagion Tests

Contagion Test	Sample 1	Sample 2	Sample 3
USA real to Canada real?	NO	YES	NO
Eurozone real to Canada real?	NO	YES	NO
USA financial to Canada financial?	NO	NO	NO
Eurozone financial to Canada financial?	NO	YES	NO
USA real & financial to Canada real?	NO	YES	NO
Eurozone real & financial to Canada real?	NO	YES	NO

Note: NO means that the null hypothesis of contagion, as defined in the first column, is rejected; YES implies rejection of the same null hypothesis. Sample refers to the assumption made about the crisis sample period. #1: 2008Q3-2012Q2; #2: 2008Q1-2012Q2; #3: 2007Q1-2012Q2. The test is based on the specification:

$$f_t^{i,CAD} = \alpha_{12}f_t^{R,US} + \alpha_{13}f_t^{R,EU} + \alpha_{14}f_t^{F,US} + \alpha_{15}f_t^{F,EU} + \gamma_{12}f_t^{R,US}d_t + \gamma_{13}f_t^{R,EU}d_t + \gamma_{14}f_t^{F,US}d_t + \gamma_{15}f_t^{F,EU}d_t + \varepsilon_t,$$

where  $f$  are the estimated real (R), and financial factors (F),  $i=R, F$ , and US is USA and EU is eurozone. The contagion test is based on the statistical significance of the  $\gamma_{ij}$  coefficients. See Dungey et.al. (2004) for the details. The  $d$  variable represents dummy variables that take on the value of 0 when the economy is not in crisis and 1 when the economy is in crisis. The crisis periods are as defined above. Note also that the series must be adjusted for differences in standard deviation of the series as between the crisis and non-crisis periods.

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