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ABSTRACT

The effects of global shocks on small commodity-exporting economies: New evidence from Canada*

This paper presents a structural dynamic factor model of a small commodity-exporting economy using Canada as a representative case study. Combining large panel data sets of the global and Canadian economies, we first identify those demand and supply shocks that explain most of the volatility in real commodity prices. Next we quantify their dynamic effects on a wide variety of variables for this economy. We are able to reproduce all the main stylized facts documented in the literature about business cycles in these countries. This includes spending and Dutch disease effects which have proven difficult to find in models where the innovations to commodity prices are not properly identified. Our results are quite robust to different identification schemes of the shocks.

JEL Classification: C32, F44 and Q43
Keywords: business cycles, commodity exports, commodity prices, factor models and VARs

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1 Introduction

As illustrated by the development of the Great Recession, growing economic and financial integration imply that shocks originated in one particular country or region are quickly transmitted worldwide. However, the effects of these global shocks and their international propagation mechanisms are hardly uniform across countries.

One of the traditional manifestations of this heterogeneity is the different effect that fluctuations in world commodity prices have on countries either importing or exporting primary resources. While there is a vast research on how an unexpected rise of these prices affects importers (see, e.g., Kilian, 2008, for an excellent review), quite less attention has been devoted to exporters. Our goal here is to contribute to this last stream of the literature by providing a unifying empirical framework which allows to investigate the effects of different global shocks driving commodity prices on a large set of macroeconomic variables pertaining to commodity-exporting economies.

One convenient starting point for the rest of the paper is to begin by gathering together the main stylized facts documented in the literature on how these shocks affect business cycles in this type of economies.

(I) *External balance effect*, according to which trade and current account balances in these economies are usually positively correlated with their terms of trade (i.e., the ratio of export and import prices) and the world prices of exported commodities in real terms. When real commodity prices increase, the value of their exports exceeds the value of imports, leading to an accumulation of foreign assets (or to a reduction of foreign debt), and conversely when prices unexpectedly fall. Moreover, as Kilian, Rebucci, and Spatafora (2009) have illustrated for the specific case of oil-exporting economies, this effect is almost fully due to changes in trade balance of primary commodities.

(II) *Commodity currency effect*, whereby real exchange rates in resource-rich economies are highly volatile and strongly correlated with commodity prices in real terms. Thus, as documented by Cashin, Cespedes, and Sahay (2004) and Chen and Rogoff (2003), an increase in commodity prices results in an appreciation of the real exchange rate, and conversely.

(III) *Domestic spending effect*, meaning that windfall income gains from commodity exports are partially spent inside the economy, driving up domestic demand. Further, relative consumption between a commodity-exporting economy and its trade partners is negatively correlated with its relative price, i.e. the real exchange rate. Notice that this last feature seemingly contradicts one of the main implications of many international real business cycle models. In effect, under the assumption of perfect financial markets, these models predict that consumption should be higher in the country where its price (converted into a common currency) is lower (see, e.g., Backus, Kehoe, and Kydland, 1992). This consumption-real exchange rate anomaly has been popularized in the literature as the *Backus-Smith puzzle* (Backus and Smith, 1993).

(IV) *Investment effect*, according to which an appreciation of the real exchange rate, driven by a rise in commodity prices, leads to a reduction in the relative price of investment goods, which are predominantly tradable, implying a positive correlation between commodity prices and investment (see Spatafora and Warner, 1999).

(V) *Dutch disease effect*, whereby raising commodity prices, again via an appreciation of the real exchange rate, lead to a fall in competitiveness and thus to a decrease in the output of the domestic manufacturing sector, while output increases in the nontradable and commodity sectors. It is noteworthy that, despite the fact that this effect has been widely studied in the literature, there is a striking lack of agreement in the empirical evidence about it. For example, while Spatafora and Warner (1999) provides evidence against this effect, Stijns (2003) provides favourable support.

Two typical features in a wide majority of the research related to the above-mentioned facts has been to assume that fluctuations in world commodity prices are exogenously determined and that other global variables affecting commodity-exporting economies remain unaltered when these prices change. Yet, as Kilian (2009) has convincingly argued in the context of oil price changes, this *ceteris paribus* assumption may be quite misleading. First, it ignores reverse causality from the global macroeconomic variables to commodity prices, so that cause and effect are generally confounded. Secondly, commodity prices are driven by different types of structural shocks, each of which may have direct effects on the global economy as well as indirect effects through changes in those prices.

In view of these shortcomings, our aim here is to test for the fulfillment of the previous list of stylized facts in a representative commodity-exporting economy (Canada) using an empirical methodology which is free from these criticisms. The choice of Canada as an interesting case study is dictated by the fact that its exports cover a wide variety of primary commodities, not only energy resources as have been the focus of the previous literature on this topic. In effect, although energy products represent 23.5% of total merchandise export in 2010, other basic products and materials related to agriculture sector, forestry and mining reach about 40% of Canadian total merchandise exports. An additional advantage is the availability for this country of a fairly rich quarterly data set covering a long period, 1975q1- 2010q4, to be combined with other available data sets capturing aggregate changes at the worldwide level which potentially impinge on the performance of the Canadian economy. It is also worth noticing that, despite the fact that the US is the main trade partner of Canada, exclusive focus on the US economy rather than on worldwide variables to identify global shocks driving commodity prices, may lead to misleading results. For instance, it may significantly underestimate a global commodity demand shock, like the one starting from the late-nineties which was driven to a large extent by developments in East and South Asia, rather than in the US.

Regarding the proposed methodology, we combine several approaches already available in the literature but in a separate manner. First, in line with Kilian (2009) and Kilian and Murphy (2012), we identify the main global shocks driving up the world commodity prices from a structural VAR model containing three common factors. These factors explain, respectively, the volatility of three large sets of macro variables at the worldwide level: global economic activity, global inflation and a world commodity price index in real terms.[1] To check the robustness of our findings, two alternative identification schemes are considered: i) recursive identification and, ii) sign identification (combined with bounds on some elements of the impact matrix as in Kilian and Murphy (2012) and Inoue and Kilian (2011)). In this fashion, we are able to identify three main global shocks during the sample period: (i) a global demand shock (GD hereafter), (ii) a global non-commodity supply shock (GS), and (iii) a global commodity-specific shock (GC).

Examples of positive and negative GD shocks are respectively related to the most salient global expansions and recessions that have taken place since the mid-seventies. Regarding GS shocks, the surge of ICT innovations, productivity growth in emerging economies or the deepening of trade liberalization in the nineties could be associated to positive (favourable) shocks whereas sudden increases in inflation expectations or natural disasters affecting non-commodity exporting countries provide examples of negative (unfavourable) shocks. Finally, negative GC shocks could be related to unforeseen events that affect world commodity prices, ranging from wars or natural disasters in commodity-producing countries to unexpected changes in precautionary demand for these commodities in fear of future supply shortages or to speculative trading (see Kilian and Murphy, 2011). Notice that, lacking commodity supply data (in contrast to Kilian (2009), who uses available information on oil supply data) our GC shocks should be interpreted as accounting for both unexpected changes in the supply and demand of primary commodities which are orthogonal to those changes explained by GD and GS shocks. As mentioned earlier, an example of a GC demand shock may be the significant reduction of commodity demand in 1997-1998 due to East-Asian crisis, which however had very mild effect on global economic activity.

Secondly, once the three shocks have been identified, the next step is to analyze their propagation mechanisms on the Canadian economy, allowing explicitly for dynamic interactions with the global economy. A natural empirical framework for this exercise is

[1] Notice that the set of variables in our model differs slightly from that in Kilian (2009) and Kilian and Murphy (2012). Our model includes global inflation but lacks global commodity supply, given that supply data for many primary commodities are not so readily available as for the oil market.

provided by structural dynamic factor models (SDFM) (Stock and Watson, 2005; Forni, Giannone, Lippi, and Reichlin, 2009) and factor-augmented VARs (FAVAR) (Bernanke and Boivin, 2003; Bernanke, Boivin, and Eliasz, 2005; Mumtaz and Surico, 2009; Boivin and Giannoni, 2007) estimated by modern Bayesian techniques. Both methodologies turn out to be rather convenient to analyze the effect of a small number of structural shocks on a large set of macroeconomic variables often exceeding the number of observations. Thus, in line with (Mumtaz and Surico, 2009; Boivin and Giannoni, 2007), we construct a recursive SDFM model containing two blocks of common factors: (i) the first one corresponding to the global economy, and (ii) the second one pertaining to the Canadian economy.

Therefore, the contribution of this paper is twofold. First, using a SDFM estimated by modern Bayesian techniques, we are able to quantify the dynamic responses of a wide range of aggregate and disaggregate Canadian variables to three global shocks driving real commodity prices, extending in this way previous results which focused exclusively on oil prices. Secondly, we are able to test for the respective role of each of these shocks in reproducing the stylized facts summarized in (I)-(V), generalizing in this fashion previous results which looked at specific facts, like e.g., Kilian et al. (2009) in their analysis of trade balance adjustments.

Our main findings can be summarized as follows. First, we confirm the results obtained by Kilian (2009) and Kilian and Murphy (2012) about commodity prices being driven by a variety of global shocks rather than by any specific one. In particular, we find that GD and GC shocks play a major role in explaining the volatility in real commodity prices. Secondly, an increase in commodity prices generated by either a positive global GD shock or a negative GC shock generate a positive effect on external balances, a commodity currency effect, a Backus-Smith anomaly and a positive investment effect. However, the Dutch disease and domestic spending effects can only be retrieved when the price rise is due to a negative GC shock since a positive GD shock stimulates real output and real expenditures uniformly across industries and sectors. In particular, given that GD shocks contribute significantly to commodity price volatility, this result illustrates why it is so difficult to detect the Dutch disease effect in the data when changes in commodity prices are taken as exogenous.

This rest of the paper is organized as follows. Section 2 presents the main features of the SDFM for a small commodity-exporting economy, including the identification of the global shocks, a brief description of the data and the basics of the estimation strategy. Section 3 reports the empirical results. In particular, using dynamic responses of the global and Canadian economies to the main two shocks explaining the volatility in real commodity prices (i.e., a positive GD and a negative GC shocks), we illustrate the specific channels that give rise to the main stylized facts regarding business cycles in our small commodity-exporting economy. Section 4 concludes. Three appendices provide more details on the data sources and descriptives, as well as further explanations on the estimation and identification methodologies.

2 A Structural Dynamic Factor Model

In this section we lay out a unifying empirical framework which allows for the identification of the main shocks driving the world commodity prices as well as for the analysis of the transmission mechanisms of these shocks to our representative small commodity-exporting economy.

This framework combines two strands in the dynamic econometrics literature. The first one is related to the identification and analysis of the main determinants of changes in commodity prices, mainly applied to the global crude oil market (Kilian, 2009; Lippi and Nobili, 2012; Kilian and Murphy, 2012). An important finding in this literature is that the world commodity prices are driven by many shocks and their effects on the global economy can differ a lot. For example, both a global demand shock and an unanticipated disruption of oil supply generate an increase in oil prices. Yet, while the first shock stimulates global economic activity, the second shock decreases it. In other words, proper identification of the sources of changes in these prices is crucial for the analysis of their impact on the global economy and the formulation of appropriate policy responses.

The second strand in the literature is based on the structural dynamic factor models (SDFM) (Stock and Watson, 2005; Forni et al., 2009) and factor-augmented VARs (FAVAR) (Bernanke and Boivin, 2003; Bernanke et al., 2005; Mumtaz and Surico, 2009; Boivin and Giannoni, 2007). One of the main advantages of these models over standard VARs is that they provide an efficient and convenient way of analyzing the effect of small number of structural shocks on a large set of macroeconomic variables.

2.1 Empirical Model

The model consists of two blocks, as in Mumtaz and Surico (2009) and Boivin and Giannoni (2007). The first block corresponds to the global economy as a whole, while the second block summarizes specific information about the Canadian economy. The state of the economy in these two regions is characterized by a small number K of unobserved factors, $(F_t^{*\prime},\ F_t^{\prime})$, where the vector with asterisks denotes three global factors, $F_t^* = (F_{Y,t}^*,\ F_{\pi,t}^*,\ F_{C,t}^*)'$. Following Mumtaz and Surico (2009), it is assumed that the global factors have an economic interpretation. Specifically, the first factor, $F_{Y,t}^*$, summarizes information about the global economic activity and is extracted from a panel of international series, $X_{Y,t}^*$, characterizing global and regional output, industrial production and trade. The second factor, $F_{\pi,t}^*$ approximates global inflation and is extracted from international data on consumer/producer prices and GDP deflators, $X_{\pi,t}^*$. Finally, the third factor, $F^*_{C,t}$, captures the development of real world commodity price index and is obtained from panel data on the price of a wide variety of primary commodities, $X^*_{C,t}$.[2] The state of the commodity-exporting economy is measured in turn by a large set of macroeconomic and financial series for Canada, X_t, from which the $K-3$ domestic factors, F_t, are extracted. Notice that, in contrast to the global factors, the domestic factors do not receive any specific economic interpretation since they just provide a summary of the business cycle fluctuations in a large panel of domestic variables.

The different panel data sets and the factors are related in the following way:

$$\begin{pmatrix} X^*_{Y,t} \\ X^*_{\pi,t} \\ X^*_{C,t} \\ X_t \end{pmatrix} = \begin{pmatrix} \Lambda^*_Y & 0 & 0 & 0 \\ 0 & \Lambda^*_\pi & 0 & 0 \\ 0 & 0 & \Lambda^*_C & 0 \\ \Lambda_Y & \Lambda_\pi & \Lambda_C & \Lambda_H \end{pmatrix} \begin{pmatrix} F^*_{Y,t} \\ F^*_{\pi,t} \\ F^*_{C,t} \\ F_t \end{pmatrix} + \begin{pmatrix} e^*_{Y,t} \\ e^*_{\pi,t} \\ e^*_{C,t} \\ e_t \end{pmatrix} \tag{1}$$

where $X^*_t = (X^{*\prime}_{Y,t},\ X^{*\prime}_{\pi,t},\ X^{*\prime}_{C,t})'$ and X_t are data for the global and Canadian economies; $F^*_t = (F^*_{Y,t},\ F^*_{\pi,t},\ F^*_{C,t})'$ and F_t denote the corresponding unobservable factors; Λ^*_i and Λ_j are loading matrices for global and domestic factors, respectively; and $e^*_t = (e^{*\prime}_{Y,t},\ e^{*\prime}_{\pi,t},\ e^{*\prime}_{C,t})'$ and e_t are zero-mean measurement errors which are uncorrelated with the corresponding common components. Lastly, notice that the global factors are included explicitly into domestic block of the model as illustrated by the last row of (1).

Regarding the dynamics of the common factors, they are modeled as a restricted structural VAR:

$$\begin{pmatrix} F^*_t \\ F_t \end{pmatrix} = \begin{pmatrix} \Psi_{11}(L) & 0 \\ \Psi_{21}(L) & \Psi_{22}(L) \end{pmatrix} \begin{pmatrix} F^*_{t-1} \\ F_{t-1} \end{pmatrix} + u_t \tag{2}$$

where $\Psi_{ij}(L)$ are lag polynomials of the finite order p, u_t denote reduced-form residuals, such that $u_t \sim N(0, \Omega)$ and $u_t = A_0 e_t$, with the structural shocks $e_t \sim N(0, I)$ and $\Omega = A_0 A_0'$. Notice, that we impose the restriction that domestic factors have no effect on global factors, stressing the small size of the domestic economy.[3] Moreover, it is assumed that global shocks are ordered first and that domestic structural shocks have no contemporaneous effect on global factors. Hence, the right upper $3 \times (K-3)$ block of the matrix A_0 is taken to be zero. Additional identifying restrictions on this matrix will be discussed further below.

[2]The real world commodity price index estimated in this paper is more closely correlated with the measured export price index for primary commodities in Canada than with the real oil price. This is not surprising since, as explained above, Canada exports a wide range of commodities.

[3]Further, an unrestricted VAR model provides very similar dynamic responses of domestic variables to global shocks.

2.2 Data

The database is a large balanced panel of quarterly data from 1975q1 to 2010q4 which spans 266 series characterizing both the global and Canadian economies. The foreign block includes data for the world economy (if available) as well as for the large regional blocks (OECD, EU, G7) and the U.S. This block contains three large categories of variables, namely, real activity, inflation and real commodity prices. Real activity is measured by real GDP, industrial production, volume of exports and imports, plus the index of global real economic activity constructed by Kilian (2009) which is based on representative freight rates for various bulk-dry cargoes. Global inflation summarizes data on implicit price deflators of GDP, consumer and producer prices. Real commodity prices consist of a range of commodity price indices for energy, food, agricultural raw materials, base metals and fertilizers collected by the World Bank.

The data for Canada contain many different real activity indicators, inflation series, exchange rates, financial variables. In addition to these macro variables, a large number of disaggregated deflators and volume series for consumer expenditure drawn from CANSIM is included. Those variables which are nonstationary are first differenced and all variables are demeaned and standardized prior to estimation. More details are given in Appendix C.

Finally, to put the data into perspective, Table 1 summarizes the sectoral composition of the Canadian economy whereas Table 2 illustrates its main business cycle statistics. As shown in Table 1, primary commodity sectors (agriculture, forestry, fishing, mining and quarrying) represents only a small part of the overall GDP (7.7%) and employment (4.8%). Yet, these sectors have a disproportionally large effect on the Canadian trade balance. In particular, net export of primary commodities represents on average 2.8% of GDP, whereas net export of manufacturing goods and of services and utilities reach -0.7% and -1% of GDP, respectively.

As regards Table 2, the main lesson to be drawn is that the business cycle statistics of the Canadian economy, though similar to those observed in the U.S., exhibit important differences which are closely related to the effects of real commodity prices. In particular, the prices of primary commodities are positively correlated with trade balance and negatively correlated with real exchange rate, illustrating somewhat the presence of external balances and commodity currency effects. However, what is more important, at first sight there is no sign of a Dutch disease in Canada since real commodity prices are positively correlated with real output in all sectors, including manufacturing. For this reason, the decomposition of the real commodity price changes into various structural shocks is key to ascertain whether this stylized fact remains absent once we control for the origin of innovations driving changes in commodity prices.

Table 1: Sectoral composition of the Canadian economy: average shares over 1985-2007

	Gross Value Added (% of total GDP)	Employment (% of total employment)	Export (% of the industry production)	Net export (% of total GDP)
Primary Commodity Sector	*7.7*	*4.8*	*36.1*	*2.8*
Agriculture, forestry and fishing	2.6	3.7	23.0	0.6
Mining and quarrying	5.1	1.1	45.9	2.2
Tradable Sector	*17.5*	*14.6*	*46.9*	*-0.7*
Manufacturing	17.5	14.6	46.9	-0.7
Non-tradable Sector	*74.7*	*80.5*	*4.3*	*-1.0*
Utilities	3.0	0.8	5.1	0.1
Construction	5.8	6.1	-	-
Services	65.9	73.7	4.8	-1.1

Data: OECD STAN database, CANSIM Canada, average over 1985-2007

Table 2: Business cycles in Canada: 1985q1-2010q4

	Volatility (% per quarter)	Correlation with GDP	Cross-correlations with (leads/lags of) real commodity price								
			lags					leads			
			-6	-4	-2	-1	0	1	2	4	6
GDP	1.30	1.00	-0.34	-0.27	0.18	0.35	0.43	0.43	0.38	0.20	0.03
primary commodity sector	2.27	0.51	-0.47	-0.29	0.29	0.43	0.35	0.19	0.10	0.04	0.05
tradable sector	3.68	0.91	-0.45	-0.33	0.13	0.35	0.48	0.48	0.40	0.17	0.03
nontradable sector	0.98	0.90	-0.22	-0.21	0.14	0.32	0.43	0.42	0.35	0.19	0.02
Consumption	0.98	0.79	-0.10	-0.07	0.15	0.27	0.41	0.45	0.34	0.01	-0.11
Investment	4.82	0.69	-0.17	-0.12	0.18	0.34	0.38	0.29	0.18	0.00	-0.07
Employment	0.88	0.74	-0.21	-0.06	0.28	0.41	0.44	0.37	0.27	0.10	0.00
Government purchases	1.11	-0.10	-0.08	-0.13	-0.11	-0.06	-0.05	-0.10	-0.15	-0.09	-0.01
Net export (% of GDP)	0.94	0.32	-0.13	-0.12	0.28	0.47	0.60	0.52	0.31	0.13	0.00
Real exchange rate	4.01	-0.12	-0.03	-0.03	-0.09	-0.19	-0.28	-0.31	-0.22	0.15	0.34
Real commodity price	9.10	0.43	-0.17	-0.12	0.28	0.71	1.00	0.71	0.28	-0.12	-0.17
GDP in United States	1.10	0.81	-0.29	-0.27	0.03	0.21	0.37	0.41	0.34	0.09	-0.02

Data sources: CANSIM Canada, OECD; sample period is 1985:1-2010:4; all variables except net export are in logarithms; all variables are filtered with HP-filter; primary commodity sector - agriculture, forestry and fishing, mining and quarrying; tradable sector - manufacturing; nontradable sector - utilities, construction, services.

2.3 Estimation

Following Bernanke et al. (2005), Mumtaz and Surico (2009) and Boivin and Giannoni (2007), the model was estimated using a two-step principal component analysis (PCA). In the first step, the largest PC is extracted from each of the panel data sets $X^*_{Y,t}$, $X^*_{\pi,t}$, $X^*_{C,t}$ and X_t to obtain consistent estimates of the three common factors driving the global economy. In the second step, these factors are used for estimation of the restricted VAR in (2).

Note that, in the first step, we impose the constraint that global factors are included into the PC for domestic block of the model. So, if these global factors are really common components, they should be captured by the PC of X_t. To extract the remaining $K-3$ domestic factors from the space covered by the PC of X_t, we use the approach advocated by Boivin and Giannoni (2007). To do so, the following iterative procedure is adopted at the first step of the estimation. Starting from the initial estimates of $K-3$ principal components F_t from the domestic block of variables X_t, denoted by $F_t^{(0)}$, iteration proceeds through the following steps:

1. Regress X_t on $F_t^{(0)}$ and estimates of the global factors $\hat{F}^*_{Y,t}$, $\hat{F}^*_{\pi,t}$ and $\hat{F}^*_{C,t}$, to obtain $\hat{\Lambda}_Y^{(0)}$, $\hat{\Lambda}_\pi^{(0)}$ and $\hat{\Lambda}_C^{(0)}$

2. Compute $\tilde{X}_t^{(0)} = X_t - \hat{\Lambda}_Y^{(0)}\hat{F}^*_{Y,t} - \hat{\Lambda}_\pi^{(0)}\hat{F}^*_{\pi,t} - \hat{\Lambda}_C^{(0)}\hat{F}^*_{C,t}$

3. Estimate $F_t^{(1)}$ as the first $K-3$ principal components of $\tilde{X}_t^{(0)}$

4. Back to the Step 1.

On the basis of several information criteria for the choice of the number of factors, we end up including 8 common factors for Canada. In any case, the impulse responses do not change significantly if additional domestic factors are considered.[4] This choice implies that the second step in our estimation procedure involves the estimation of a restricted VAR with 11 endogenous variables, namely, 3 global and 8 domestic factors. The use of the AIC criterion indicates that two lags are enough to adequately capture its dynamics. Since this choice implies a large number of free parameters in the VAR system to be estimated using 144 observations for each variable, a Bayesian estimation procedure is used in this restricted VAR. Details about the estimation procedure are given in Appendix A.

[4]Bai and Ng (2002) provide several criteria to determine the number of factors present in the data set, X_t. Their panel information criteria IC_{p1} and IC_{p2}, for example, suggest the presence respectively of 8 and 7 factors in the panel for Canada. However, these criteria do not address directly the question of how many factors should be included in the VAR.

2.4 Identification of Structural Shocks

This section discusses the identification of the three global structural shocks: i) an unanticipated expansion of global demand (GD), $\epsilon^*_{D,t}$, ii) a global supply shock, unrelated to commodity markets (GS), $\epsilon^*_{S,t}$, and iii) a global commodity-specific shock (GC), $\epsilon^*_{C,t}$. The last shock is aimed to catch unanticipated changes in the real commodity prices orthogonal to the first two innovations stemming from an unexpected contraction of the global commodity supply as well as by commodity-specific demand shocks, such as an increase in the precautionary demand on commodities.[5]

Further, as mentioned earlier, since our main goal is to analyze the effect of global shocks on a small commodity-exporting economy, we are only interested in providing an economic interpretation for these shocks. To check how robust our results are, global shocks are identified using two schemes based on recursive ordering and a mixture of sign and impact matrix restrictions. Global factors are ordered first in both schemes, implying that the rest of the world does not react instantaneously to domestic conditions in Canada.

2.4.1 Recursive identification

In the recursive scheme, presented in Table 3, the impact matrix corresponding to the foreign 3×3 block is lower triangular. The global economic activity factor $F^*_{Y,t}$ is ordered first, followed by the real commodity price index $F^*_{C,t}$ and global inflation $F^*_{\pi,t}$ respectively. This ordering implies that the global supply shock has zero contemporaneous effect on both global economic activity and real commodity prices, whereas the commodity-specific shock does not affect immediately real activity. Note that the chosen recursive identification is not without limitations. First, it imposes zero restrictions on some elements of the impact matrix which may not hold exactly. Secondly, as reported by Kilian (2009) and illustrated once again in this paper, the impulse response function (IRF) of the global economic activity to a negative GC shock is mildly anomalous. In principle, it is quite plausible that this shock implies large increase on impact of the real commodity price which subsequently reduces real activity. Nevertheless, the VAR estimates show that this

Table 3: Recursive identification

	GD Shock, $\epsilon^*_{D,t}$	GC Shock, $\epsilon^*_{C,t}$	GS Shock, $\epsilon^*_{S,t}$
Global Economic Activity, $u^*_{Y,t}$	$\times$	0	0
Real Commodity Price, $u^*_{C,t}$	$\times$	$\times$	0
Global Inflation, $u^*_{\pi,t}$	$\times$	$\times$	$\times$

[5] As mentioned earlier, in contrast to Kilian (2009), we cannot explicitly identify commodity supply shocks lacking data on production and supply of many primary commodities. Yet, this is unlikely to be restrictive, since Kilian (2009) and Kilian and Murphy (2012) find that the relative contribution of the oil supply shock to fluctuations in real oil price is minor.

detrimental effect becomes apparent only after one year, whilst a small, but significantly positive, response of the real activity is observed during the first year following the shock.

Thus, to check how robust are the results from the recursive scheme, an alternative identification scheme based upon sign restrictions on the VAR IRFs is also used.

2.4.2 Sign restrictions combined with short-run elasticity bounds

In this second scheme, we impose sign restrictions on the IRFs of global factors to global shocks. In particular, we assume that IRFs accumulated over 4 quarters should have the signs reported in Table 4: These sign restrictions are imposed using the rotation procedure

Table 4: Sign restrictions on impulse response functions

	GD Shock, $\epsilon^*_{D,t}$	GC Shock, $\epsilon^*_{C,t}$	GS Shock, $\epsilon^*_{S,t}$
Global Economic Activity, $F^*_{Y,t}$	+	−	−
Real Commodity Price, $F^*_{C,t}$	+	+	−
Global Inflation, $F^*_{\pi,t}$	+	+	+

proposed by Rubio-Ramirez, Waggoner, and Zha (2010) as described in Appendix B. Accordingly, a GD shock is associated with an increase in global activity, inflation, and real commodity prices. A negative GS shock implies a rise in inflation, and a fall in both real activity and real commodity prices. Finally, a negative GC shock results in increasing commodity prices, higher inflation and declining real activity.

A fundamental problem of the VAR model identified through sign restrictions is that, in contrast to the exactly-identified VAR, it does not provide a point estimate of the IRFs which are only set identified. In other words, it does not imply a unique structural model, characterized by the single impact matrix A_0, but a set of models (and a set of matrices $\mathcal{A}_0 = \{A_0 | A_0 A_0' = \Omega\}$) that satisfy the identifying assumptions. This complicates interpretation of the results because medians (or other quantiles) of the IRFs computed for different time horizons often correspond to different structural models.

To alleviate this problem, we adopt the procedure proposed by Kilian and Murphy (2012), where the set of admissible structural models is narrowed down by imposing bounds on some of the elements in the impact matrix A_0. In particular, they assume a very small short-run elasticity of oil prices to the oil supply as well as a small contemporaneous response of global real activity to oil-market specific demand shocks. Similarly, we impose here the additional restriction on A_0 that the elasticity of the real global activity to commodity-specific shocks is small and cannot exceed 5% in abolute terms: $|A_0(1,2)| \leq 0,05$. This implies that only those structural models satisfying these sign and bound restrictions will be kept for the further analysis.

3 Results

This section reports the empirical results of the SDFM. First, we present the estimates of the three global factors, illustrate their dynamic response to the global shocks and show historical decompositions of these factors in terms of the shocks on the basis of the two above-mentioned identification schemes. Secondly, using data for Canada, we report the main dynamic effects of global shocks on this small commodity-exporting economy. In particular, given that a positive global demand (GD) shock and negative global commodity-specific (GC) shock happen to explain most of the volatility of commodity prices, we restrict our attention to the role of these two shocks in checking whether they can replicate for Canada the stylized facts listed in the Introduction.[6]

3.1 Global common factors and shocks

Figure 1 plots the estimated PC for the real activity, inflation and real commodity prices data sets. These factors match closely the empirical evidence about international business cycles reported by Kose, Otrok, and Whiteman (2003) and Mumtaz and Surico (2009), as well as the main developments in the world commodity markets summarized by Hamilton (2011) and Kilian (2006) in their application to oil markets.

In particular, the global economic activity factor captures the main global downturns between 1975q1 and 2010q4: the double-dip recession at the beginning of 1980s, the downturn in 1991-1993, the East Asian crisis in 1997-1998, the slowdown of the early 2000s after the Dot-com bubble collapse and 9/11 attacks, and finally the Great Recession of the late 2000s. Likewise, it captures the long expansion during the great moderation period. The real commodity price factor in turn reflects the more important events in commodity markets: the turbulence of the 1978-1981 period ignited by the Iranian revolution and outbreak of the Iran-Iraq war, the oil glut of 1980s, falling commodity prices during the East Asian crisis in 1997-1998, rising commodity demand in 2000s and the downturn in commodity markets in 2008-2009. Lastly, the global inflation factor encompasses the stagflation of the 1970s-early 1980s, the rising food and energy prices in 2000s as well as the deflation of the late 2000s.

Figure 2 plots the IRFs of the factors to the three global shocks based on the recursive identification scheme (blue line together with 90% credible interval) and the sign restrictions scheme (shaded area covering 90% credible set). Both schemes provide similar results in general. So, a positive GD shock generates a significant expansion in global

[6]IRFs for the individual domestic variables are generated by Gibbs sampling algorithm. For each iteration, we sequentially draw the variance-covariance matrix of measurement errors from the conditional inverse Gamma distribution, the non-zero elements of loading matrix from the conditional Normal distribution, and the parameters of the restricted VAR from the Normal-Wishart (see Appendix A). These realizations of the parameters are then used to compute IRFs of the Canadian variables to structural shocks. The simulated data from each Gibbs iteration (after truncation) were used to approximate the posterior distribution of these IRFs.

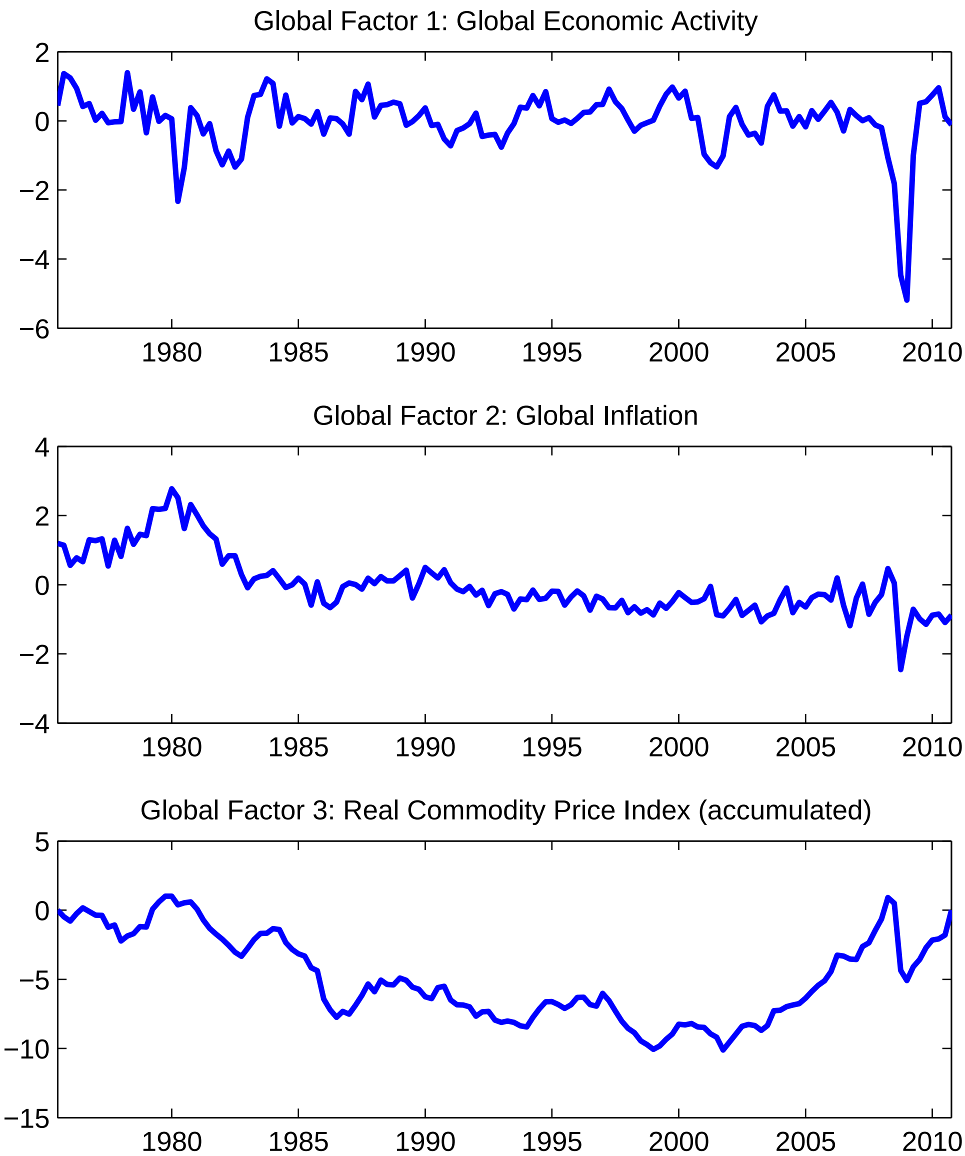

Figure 1: Principal component estimates of international factors

economic activity, increases global inflation and pushes up real commodity prices, with the maximum effect taking place within one year. A negative GS shock leads to a decline in real activity, accelerates inflation and depresses real commodity prices. Lastly, a negative GC shock gives rise to a temporary spike in global inflation and very strong increase in real commodity prices. However, as already mentioned, the adverse effect of this shock on real activity is delayed for one year, and is not very significant under recursive identification.[7] Notice that, by imposing a negative accumulated response of the real activity to a GC shock after four quarters, this last identification scheme avoids the puzzling short-run increase in global activity observed under recursive identification, which is also documented in Kilian (2009).

Figure 3 plots historical decompositions of the global economic activity, global inflation and real commodity prices based on two alternative structural models. It shows the contribution of each of the three global shocks to the development of the three global factors during the sample period. The results are virtually invariant to the method of identification. First, both schemes suggest that most of the volatility in the global real activity factor during this period has to be attributed to GD shocks, although a positive GS shock (possibly due to the raising productivity in emerging economies and larger trade liberalization) also seems to play an increasing role from the middle of 1990s. Further, some GC shocks contributed to economic slowdown in the beginning of 1980s as well as to revival of global economy after the Asian financial crisis in 1997-1998. Secondly, to some extent all the three shocks played an important role in driving the global inflation. While the episode of high inflation in the late 70s-early 80s is mostly attributed to the negative GS shock under recursive identification, sign restrictions point out to a combination of positive GD and negative GC shocks.

Finally, from the viewpoint of our subsequent analysis, the most interesting finding is that a large part of the volatility in real commodity prices during this period is attributed to GC and GD shocks.[8] The former captures the disruption of the oil supply in the late 70s-early 80s, the oil glut of the mid of 80s, the region-specific downturn in 1997-1998 and the speculative episode in commodity prices at the beginning of 2008.[9] The latter

[7]This delayed response of the real output to commodity shock conforms well to the results of Rotemberg and Woodford (1996) for United States, which show that one percent increase in oil prices leads to a reduction in output of about 0.25 percent after five-seven quarters (with statistically significant decline only from quarter 3 onwards).

[8]Though not reported, but available upon request, the (median) variance decompositions for the three global factors point out that the GC shock explains most of the volatility in the real commodity prices (about 80% in the recursive case and 60% in the model with sign restrictions), while the GD shock accounts for approximately 25% in both cases. The GC shock explains practically nothing in the real commodity prices according to the recursive identification scheme and less than 20% according to the sign restrictions scheme. Yet, this shock has mostly statistically insignificant effects on most of the Canadian variables (except on those related to prices).

[9]Since the East Asian financial crisis of 1997-1998 did not generate a strong global recession, our measure of global economic activity fails to account its effect on commodity markets. Moreover, the impact of this crisis was different across commodity groups. Oil prices recovered very quickly, and by the

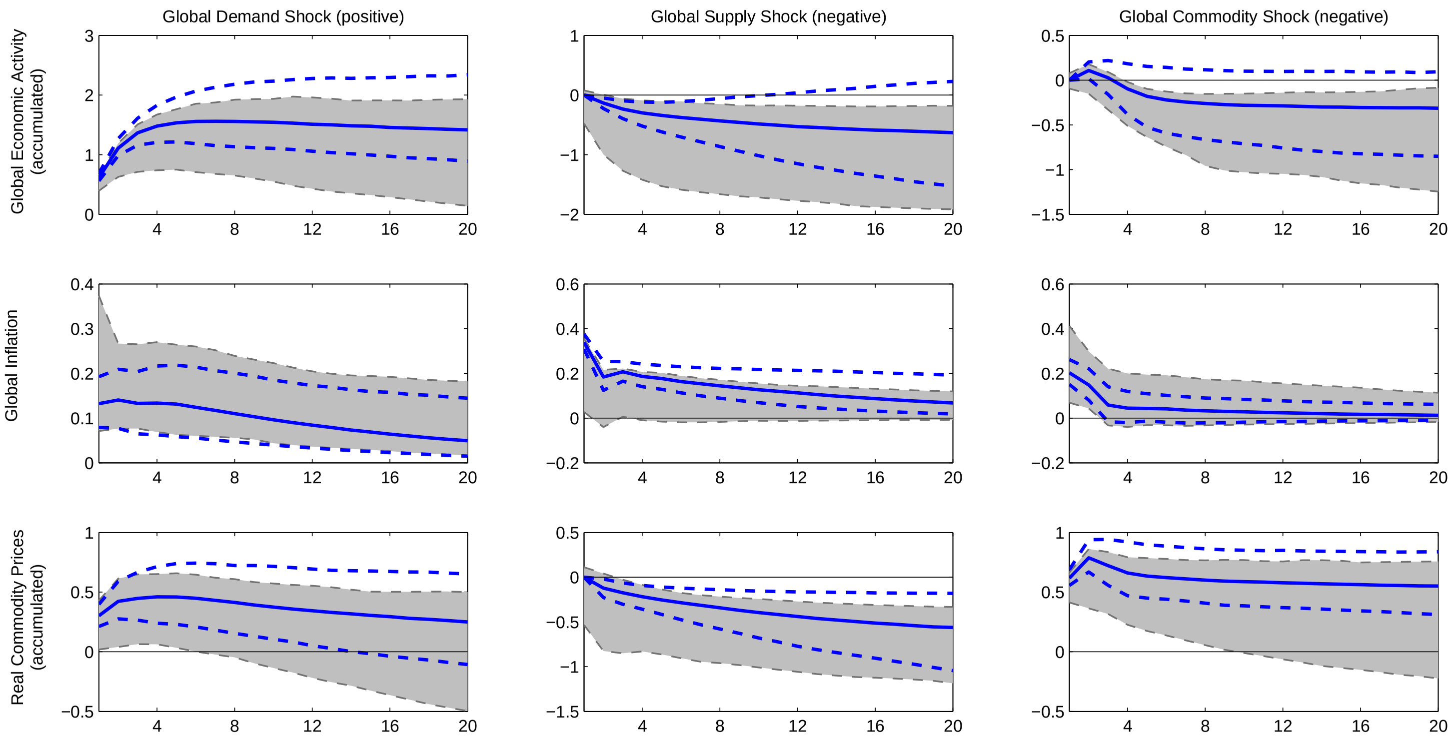

Figure 2: Impulse responses of international factors to global shocks

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

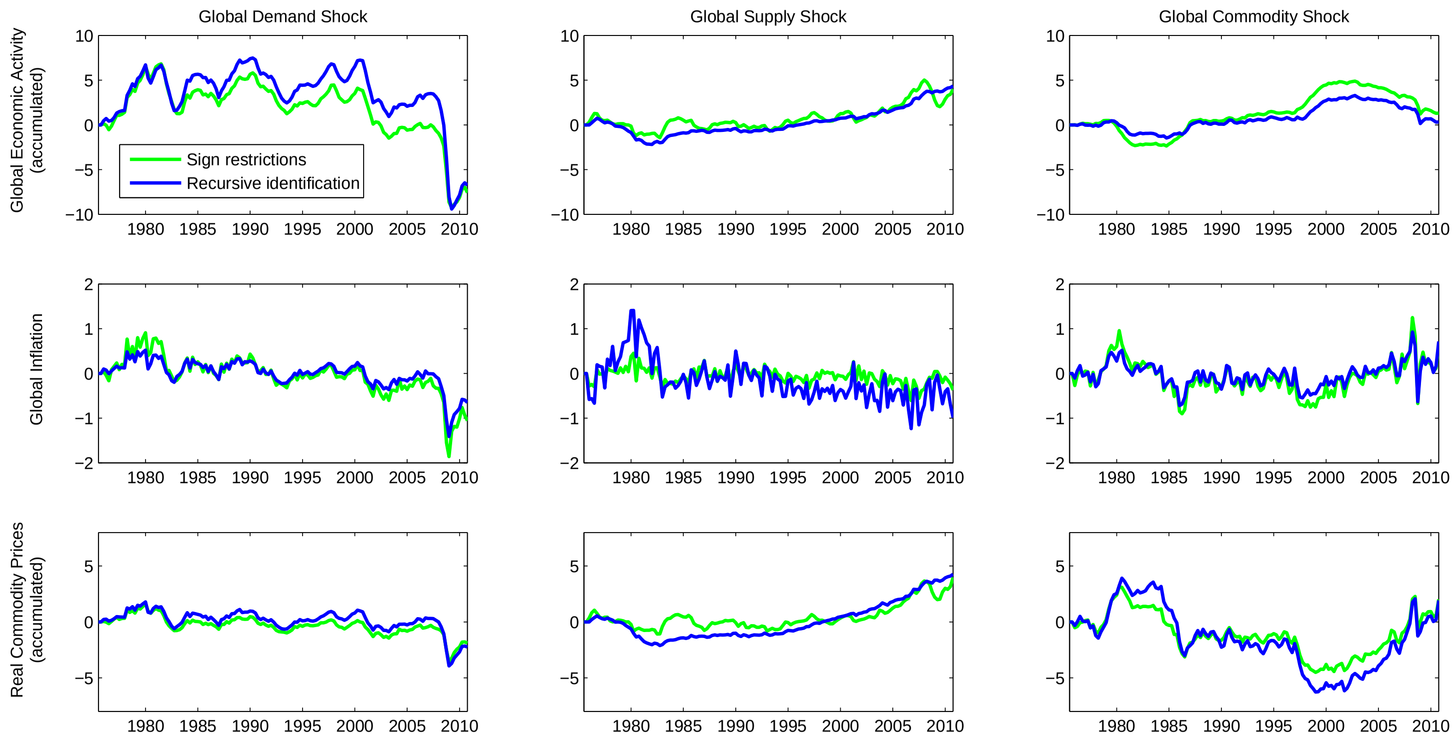

Figure 3: Historical decompositions of the global factors: 1975q1-2010q4

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

indicates that the Great Recession of the late 2000s was behind the falling commodity prices during 2008-2009.

3.2 Transmission of international shocks to a small commodity-exporting economy

In this section we analyze the effects of our identified global shocks on the Canadian business cycle. Since the most interesting dynamics stems from changes in world commodity prices, we will concentrate in the sequel on two global shocks which explain most of the volatility in these prices. These are a negative GC shock and a positive GD shock, whose role in explaining each of the most salient stylized facts discussed earlier will be examined below.

3.2.1 Terms of trade and external balances effects

We begin with the discussion of the results concerning terms of trade and external balances effects (stylized fact I). This effect first predicts that a rise in commodity prices improves Canadian terms of trade. Secondly, when commodity prices are high (low), the current account and trade balances tend to increase (decrease). So far, the evidence for this effect is restricted to oil-exporting economies (see, Kilian et al. (2009)).

Figure 4 plots the IRFs of the terms of trade and external balances (as % of GDP) to the two above-mentioned global shocks.[10] Like in the graphs in the remaining subsections, the first two rows depict IRFs with respect to a negative GC shock, whereas the last two rows do the same for a positive GD shock. As can be observed, both shocks significantly increase real commodity prices and improve Canadian terms of trade. Their effects on external balances are slightly different. A negative GC shock improves trade and current account balances, mainly through an increase in the trade balance of primary commodities. By contrast, there is hardly any effect on the trade balance of other goods. Further, this adverse shock has a strong but protracted negative effect on real exports and no significant effect on real imports, illustrating somewhat one of the manifestations of Dutch disease.

Similarly, a positive GD shock improves the trade balance of primary commodities with one-year delay, while it has no effect on the trade balance of non-commodity goods. Yet, its effect on total trade and current account balances (as % of GDP) is not so strong as in the case of a negative GC shock.[11] Moreover, a GD shock stimulates global economic

end of 1999 they were on the pre-crisis level. By contrast, prices of food, wood, base metals and fertilizers stagnated until the end of 2003. As a result, our measure of commodity-specific shocks differs slightly from the measure of oil-market specific demand shocks computed by Kilian (2009), especially after 1998.

[10] The external balances correspond to current account, trade account (split into goods and services, primary commodities, and goods excluding primary commodities), exports and imports of goods (volume).

[11] A positive GD shock not only improves Canada's terms of trade but also significantly increases its real GDP. As a result both the nominator (external balances in real terms) and denominator (real GDP) rise, and overall effect of this shock on our measure of external balances (in terms of GDP) is not clear.

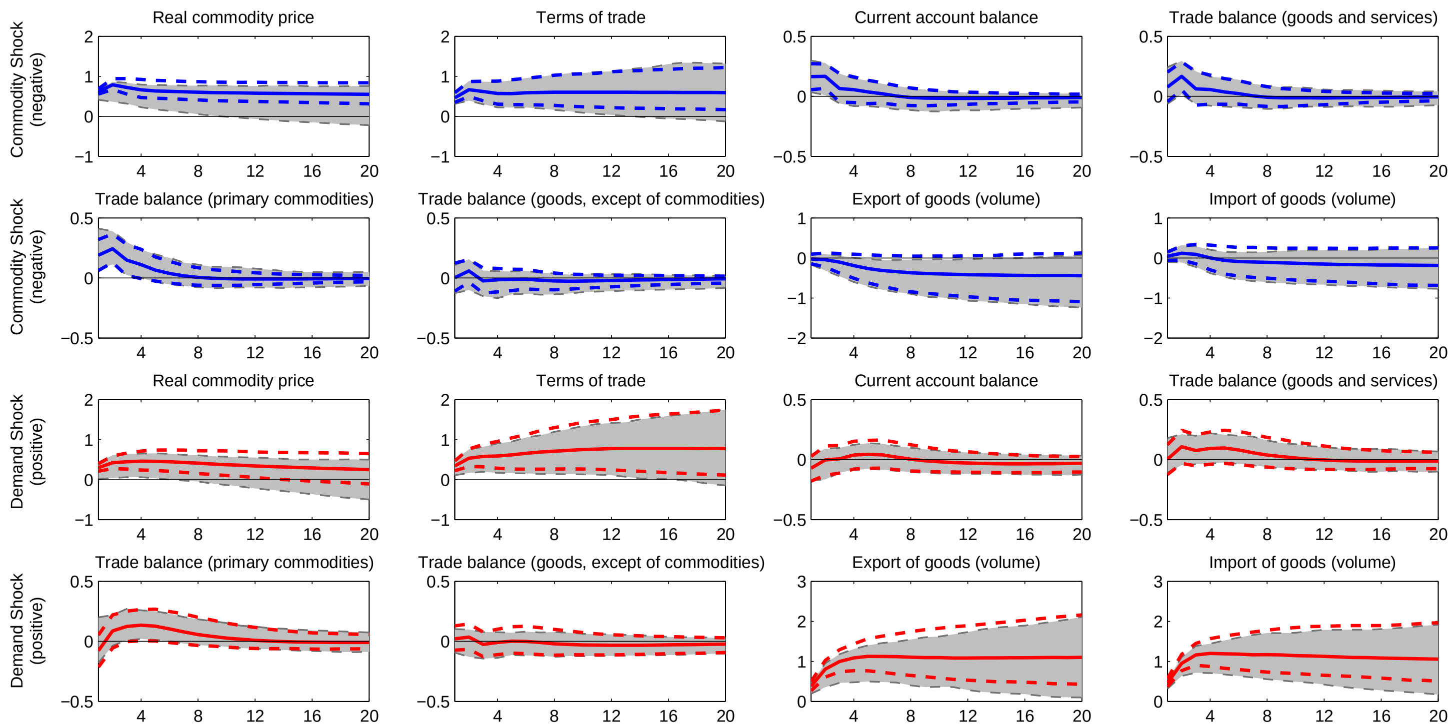

Figure 4: Impulse responses: terms-of-trade and external balances effects

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

activity and international trade, so both real exports and imports increase.

3.2.2 Commodity currency effect and relative prices

Another empirical regularity frequently observed in this type of economies is a commodity currency effect (stylized fact II). More specifically, their real exchange rates are usually very volatile and strongly correlated with prices of the exported commodities. In particular, raising commodity prices result in appreciation of the real exchange rate, and conversely. This effect is well documented in the literature. For example, Cashin et al. (2004) find a long-run cointegrating relationship between the real exchange rates and real prices of exported commodities for 19 out of 58 commodity-exporting economies, while Chen and Rogoff (2003) report similar findings for a few developed resource-rich economies.

Figure 5 illustrates how both shocks result in a short-run appreciation of Canada's real effective exchange rate as well as of its bilateral real exchange rate with respect to US.[12] Moreover, this real appreciations are almost fully due to the appreciation of the nominal exchange rates. For example, the ratio of U.S. and Canadian consumer price indices, $\frac{P_{USA,t}}{P_{CAN,t}}$, barely changes after a negative GC shock and slightly increases in response to a positive GD shock, reflecting the increase in foreign inflation induced by rising global demand.

In line with Betts and Kehoe (2006, 2008), it is convenient to look more closely to the bilateral real exchange rate between these two neighboring economies, $RER_{US,CAN,t}$, by decomposing it into the two following components:

$$RER_{US,CAN,t} = \left(\frac{NER_{US,CAN,t} P^T_{US,t}}{P^T_{CAN,t}} \right) \left(\frac{P^T_{CAN,t}}{P_{CAN,t}} / \frac{P^T_{US,t}}{P_{US,t}} \right) \tag{3}$$

The first component denotes the real exchange rate for traded goods, $RER^T_{US,CAN,t}$. It measures deviations from the law of one price for traded goods between the two countries.[13] To approximate prices of traded goods we use producer price indexes in manufacturing. The second factor, denoted as $RER^N_{US,CAN,t}$, captures cross-country differences in internal relative prices. Thus, if we were to assume that: (i) the prices of traded goods satisfy the law of one price exactly, so that $NER_{US,CAN,t} P^T_{US,t} = P^T_{CAN,t}$, and (ii) the composition of the consumer basket is the same in both countries, the all the dynamics of the real exchange rate should be attributed to relative changes in the prices of non-traded

[12] The real exchange rate is defined here as a price of foreign consumption in terms of consumption in Canada, i.e. $RER_{i,CAN,t} = \frac{NER_{i,CAN,t} P_{i,t}}{P_{CAN,t}}$, where $NER_{i,CAN,t}$ is a nominal exchange rate in terms of Canadian dollar per unit of country i currency, $P_{i,t}$ and $P_{CAN,t}$ are, respectively, foreign and Canadian consumer price indices. So, an appreciation of the real (nominal) exchange rate in Canada means a decrease in $RER_{i,CAN,t}$ ($NER_{i,CAN,t}$).

[13] Notice that this ratio is also affected by any differences in the compositions of the baskets of traded goods across countries.

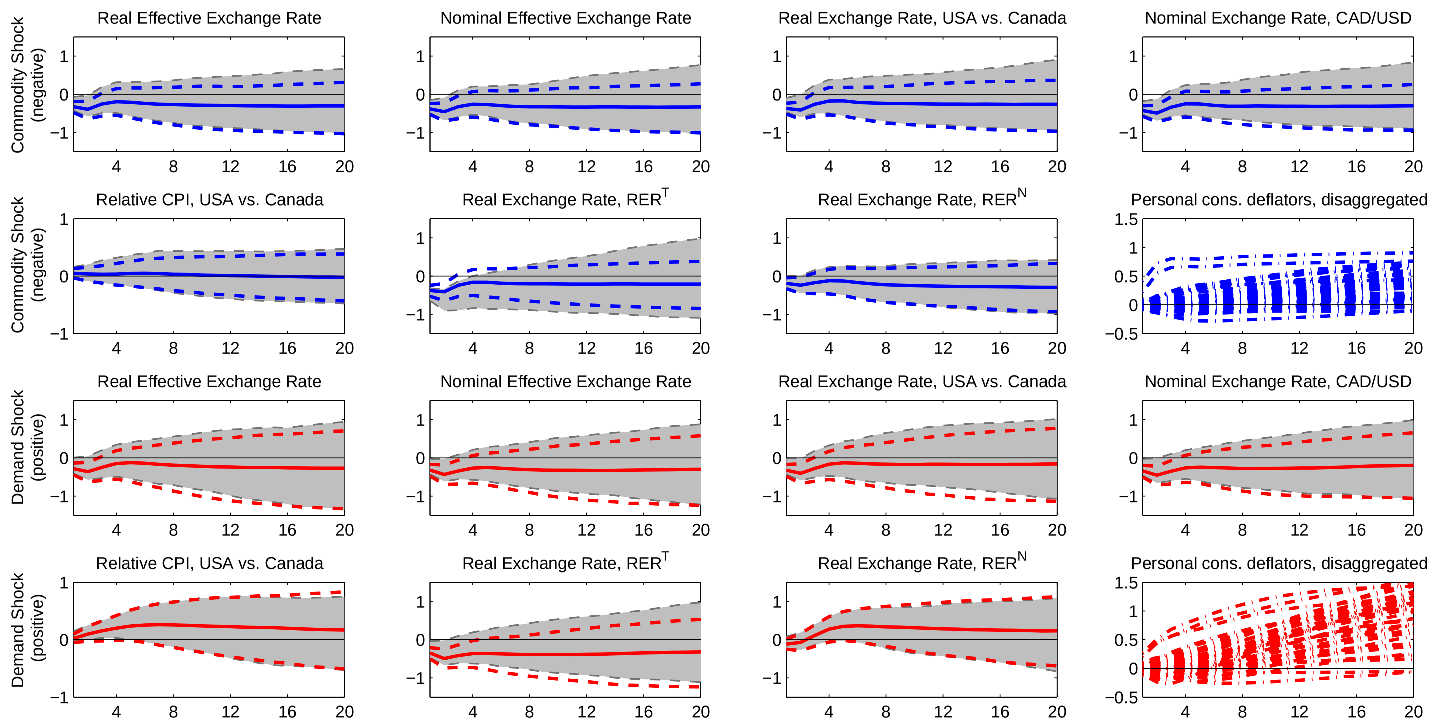

Figure 5: Impulse responses: commodity currency effect and relative prices

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

goods, $\frac{NER_{US,CAN,t}P^N_{US,t}}{P^N_{CAN,t}}$.

The second and fourth rows of Figure 5 plot the IRFs of these different components to the two global shocks. Both shocks significantly appreciate real exchange rate for traded goods, $RER^T_{US,CAN,t}$, invalidating therefore the law of one price. This may well be explained by the deficiency of our price index for traded goods (some goods covered by the PPI are actually non-traded), cross-country differences in composition of the baskets for this index, and by the fact that manufacturing prices in two countries are sticky and set in different currencies (at least for domestic markets).[14] This result implies that the nominal exchange rate changes have a strong short-run effect on the real exchange rate for traded goods. Further, this plot also illustrates a significant, but not so strong, appreciation effect of the negative GC shock on the second (relative price) component of the real exchange rate, $RER^N_{US,CAN,t}$. This finding agrees with the results by Betts and Kehoe (2006) who also find a positive correlation between this bilateral real exchange rate and relative prices in the two countries. By contrast, a positive GD only yields a rather weak internal appreciation on impact.

Finally, the last column in Figure 5 reports the quite a strong heterogeneity in the effect of the two global shocks on the implicit price deflators for disaggregated groups of personal consumption in Canada (as in Boivin, Giannoni, and Mihov, 2009). Both shocks generate strong immediate positive effect on energy prices, whereas the remaining prices exhibit different dynamics. In the long run, however, prices of non-energy goods always go up, reflecting higher production costs in an environment of high commodity prices.

3.2.3 Spending effect and Backus-Smith puzzle

As shown before, soaring commodity prices significantly improve the terms of trade in Canada, generating windfall revenues from its commodity exports. Their overall effect on the economy depends crucially on how this windfall income is spent. A favourable response of external balances in Canada to a negative GC shock (and to a lesser extent to positive GD shock) signals that at least a part of commodity revenues is saved abroad, leveling their effect on the domestic economy. However, the rest of this income is spent inside the country affecting its output and final expenditures (stylized fact III).

Figure 6 illustrates this effect for the different aggregate demand components, employment and capacity utilization in the Canadian economy. A negative GC shock has no significant effect on real GDP, while employment and total industrial capacity utilization are barely affected. This contrast with its strong but delayed negative effect on the common factor capturing global economic activity. Moreover, this shock has a positive and significant impact on final domestic expenditures in Canada. Most of this growth is explained by both an increasing current government expenditure (due to a surge in

[14] Notice, however, that 96% of Canadian exports to the US are priced in USD (Gopinath and Rigobon, 2008).

tax revenues from the commodity sector), and a rise in real private investments. Real personal consumption expenditures also exhibit a small positive response on impact.

By contrast, a positive GD shock stimulates global economic activity and international trade. As a result, it has significant and unambiguous positive effect on real GDP and real final domestic expenditures, as well as on its total employment and industrial capacity utilization. This strong growth is triggered mostly by higher foreign demand and somewhat hides the immediate effect of windfall income from commodity export. Besides, real current government expenditures do not change whereas real government investment gradually decreases, signaling the countercyclical character of fiscal policy.

Next, we examine more closely the effects of the shocks on several components of personal consumption in Canada. Figure 7 depicts IRFs of the real expenditures on large aggregated groups of goods (namely on durable and semi-durable goods, and services), as well as on disaggregated series. The effects of a negative GC shock on the aggregate definitions are very similar to those on total real consumption. However, the dynamic responses of disaggregated goods (except of energy and food) are mostly positive, whereas disaggregated services lack uniform dynamics, pointing out to a small (yet insignificant) substitution effect.[15] Conversely, a positive GD shock has a uniform and strongly positive effect on all aggregated and disaggregated groups of consumption.[16]

Another interesting phenomenon is associated with the relative consumption (the. ratio of real personal consumption expenditures) between Canada and the US. The Backus-Smith puzzle (Backus and Smith, 1993) suggests that relative consumption across countries does not move in any systematic way with its relative price (the real exchange rate). This is in stark contrast to the predictions of many international business cycle models assuming perfect financial markets, which suggest that consumption should be higher in the country where its price, converted into a common currency, is lower. This puzzle is especially pronounced in commodity-exporting economies where a negative correlation between relative consumption and the real exchange rate is often found. Together with the high volatile real exchange rate and its negative correlation with commodity prices, this stylized fact may be interpreted as a signal of imperfections in international risk sharing.

Figure 7 plots the IRFs of the relative consumption between Canada and the US to the two shocks. As shown earlier, a negative GC shock has only a small and short-living

[15] Recall, that a negative GC shock results in an appreciation of the relative price component of the real exchange rate. Besides, we find evidence (not reported here) that the prices of durable consumer goods decrease relative to prices of services after this shock takes place.

[16] Figure 7 reports two counterintuitive negative responses of disaggregated series for services after positive global demand shock. However, it is simply an incidental result of demeaning and normalization procedure, essential for the extraction of principal components. These two series correspond to 'gross imputed rent' and 'gross paid rent' (in constant prices), which barely manifest any volatility except of long-run rising trend. Without normalization (by the standard deviations) these responses were hardly distinguishable from zero.

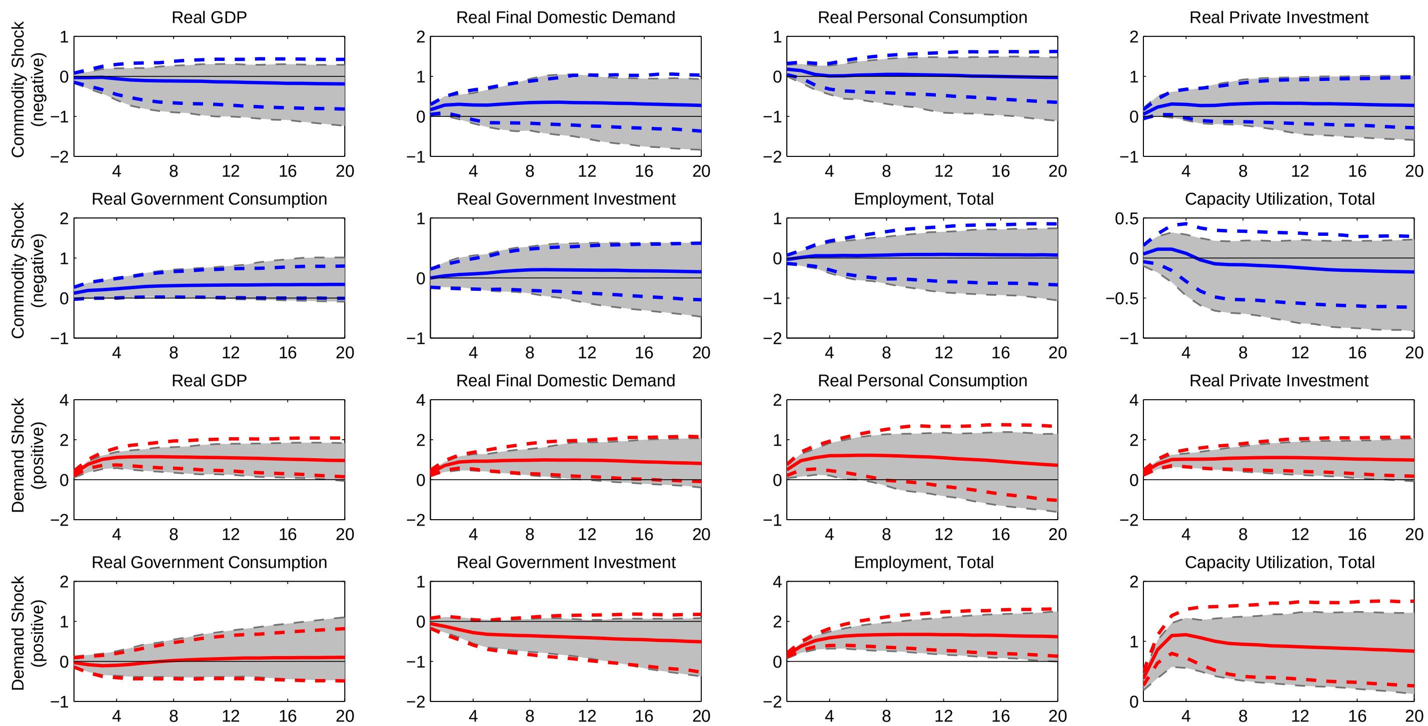

Figure 6: Impulse responses: output and spending effect

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

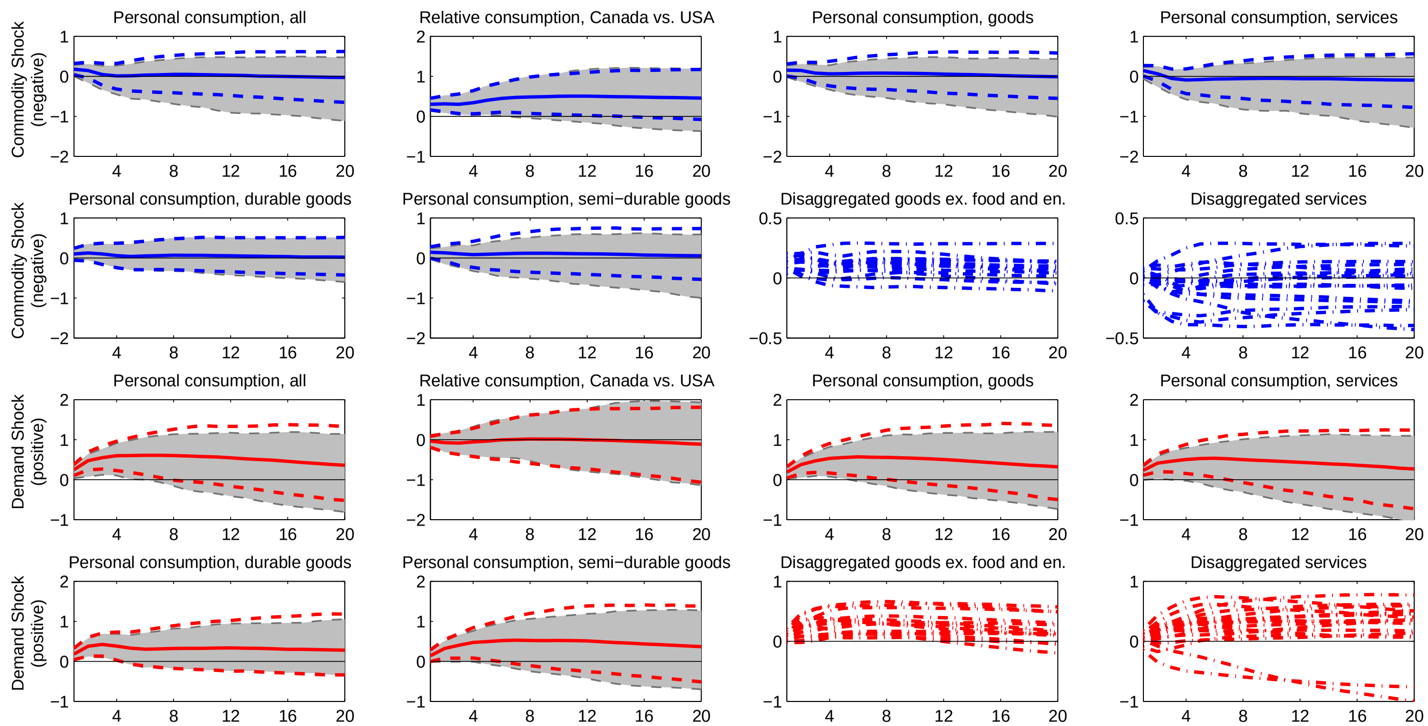

Figure 7: Impulse responses: personal consumption and its components

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

positive effect on real personal consumption in Canada. However, it leads to a strong and persistent positive response of the relative consumption between these two economies. Given that real exchange rate appreciates after this type of shock, the resulting strong negative correlation between relative consumption and its relative price clearly illustrates the Backus-Smith puzzle. By contrast, while a positive GD shock results in a strong growth of personal consumption in Canada, it does not have any significant effect on the relative consumption. Notice, however, that this does not imply the existence of perfect insurance against GD shocks since a full risk-sharing scheme would instead imply a decrease in personal consumption in Canada relative to the US, following its increasing relative price (an appreciating real exchange rate).

3.2.4 Investment effect

We found earlier that a substantial portion of the windfall revenues from commodity export in Canada is channeled into the real private investments in fixed capital. However, in addition to this direct spending effect, there is another indirect propagation mechanism of global shocks to private investment growth. More specifically, an appreciation of the real exchange rate, associated with an increase in commodity prices, results in decreasing relative prices of investment goods, which are predominantly tradable. As a result, investment demand increases (stylized fact IV). As Spatafora and Warner (1999) have documented for oil-exporting countries, a large share this investment boom goes into the nontradable and commodity-producing sectors of the economy.

Figure 8 plots IRFs of the business gross fixed capital formation, as well as its components and prices, to the two global shocks. As shown earlier, a negative GC shock generates an increase in total real investment in Canada. Moreover, in contrast to the consumer price index which increases after a spike in commodity prices, the investment price deflator initially decreases following the appreciation of the nominal exchange rate. Most of this deflation is explained by its tradable component, namely 'machinery and equipment', whereas price deflators of the investments in residential and non-residential structures (produced by non-tradable construction) tend to increase. However, one of the main engines of the increase in private investment after this shock is investment in non-residential structures.

A positive GD shock exhibits similar effects on the price deflators of private investment in fixed capital. Like before, the price index of total investment slightly decreases on impact with most of this decrease explained by investment in machinery and equipment. Yet, in contrast to the negative GC shock, this positive shock results in strong growth of all investment components, including residential investments.

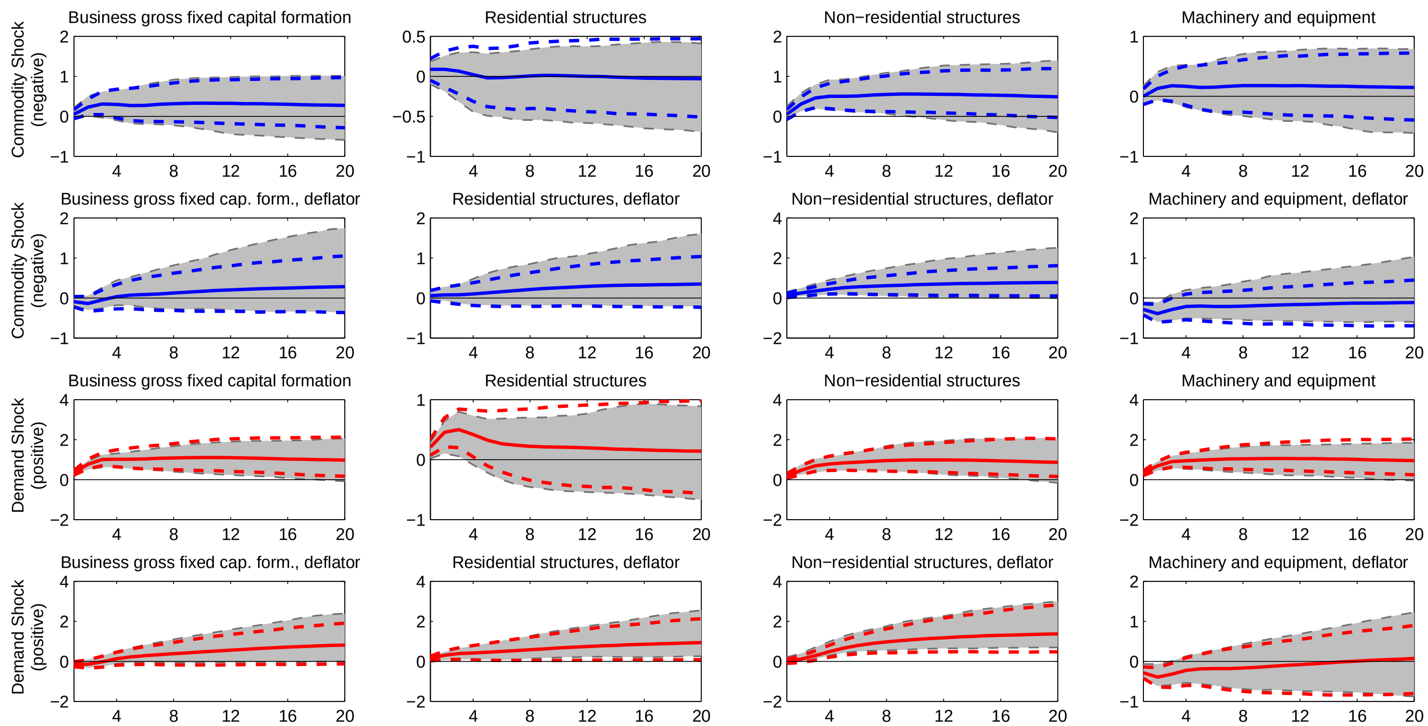

Figure 8: Impulse responses: investment effect

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

3.2.5 Dutch disease

The so-called Dutch disease is perhaps the most famous phenomenon associated with commodity-exporting economies. It captures a negative relationship between an increase in export revenues from primary commodities and a decline in the output of the non-commodity tradable sector, mainly manufacturing (stylized fact V). The underlying mechanism is as follows: an increase in primary commodities exports will appreciate real exchange rate, making non-commodity exports more expensive; as a result, the manufacturing sector becomes less competitive and its output declines, whereas the output of nontradable and commodity sectors increases; simultaneously, labor and capital move from manufacturing to the booming sectors of the economy (see Corden, 1984, for more details).

The Dutch disease effect is well-studied in the literature (see Stijns, 2003, for good review). However, there is striking lack of unambiguous empirical evidence supporting this phenomenon. For example, Spatafora and Warner (1999) fails to detect a contraction in the manufacturing sector of a group of developing oil-exporting countries after an oil price shock. In contrast, using gravity trade model and international trade data, Stijns (2003) reports that a one percent increase in world energy price is estimated to decrease real manufacturing exports from energy-exporting economy by almost half a percent. The main reason of this disagreement is the difficulty in disentangling relative price effects of commodity price fluctuations from their impact on the domestic and global macroeconomic conditions. Besides, fluctuations in commodity prices may be the result of changing global demand or supply.

Our empirical strategy illustrates well why these difficulties may arise. Figure 9 plots impulse responses of the real GDP in the main sectors of Canadian economy, namely in mining, manufacturing, services, utilities and construction, as well as for disaggregated industries in manufacturing and services, to the two shocks. Strikingly, they imply completely different IRFs.

As shown before, a negative GC shock has no any evident effect on the aggregate output. However, real GDP responses for the main sectors are very different, pointing out to Dutch disease symptoms. First, this shock has significant positive effect on commodity-producing tradable sector, mining, with the largest increase after 3 quarters. Nontradable sectors reap the benefits too. So, real GDP in services exhibits a statistically significant increase on impact, while the rise in construction and utilities is highly persistent. On the contrary, output in non-commodity tradable sectors, like in manufacturing, unambiguously falls following declining foreign demand, with the largest decrease in output happening after one year.[17]

Secondly, the IRFs of disaggregated output series for manufacturing and services also

[17] Recall from the Section 3.2.1 that real export is declining too.

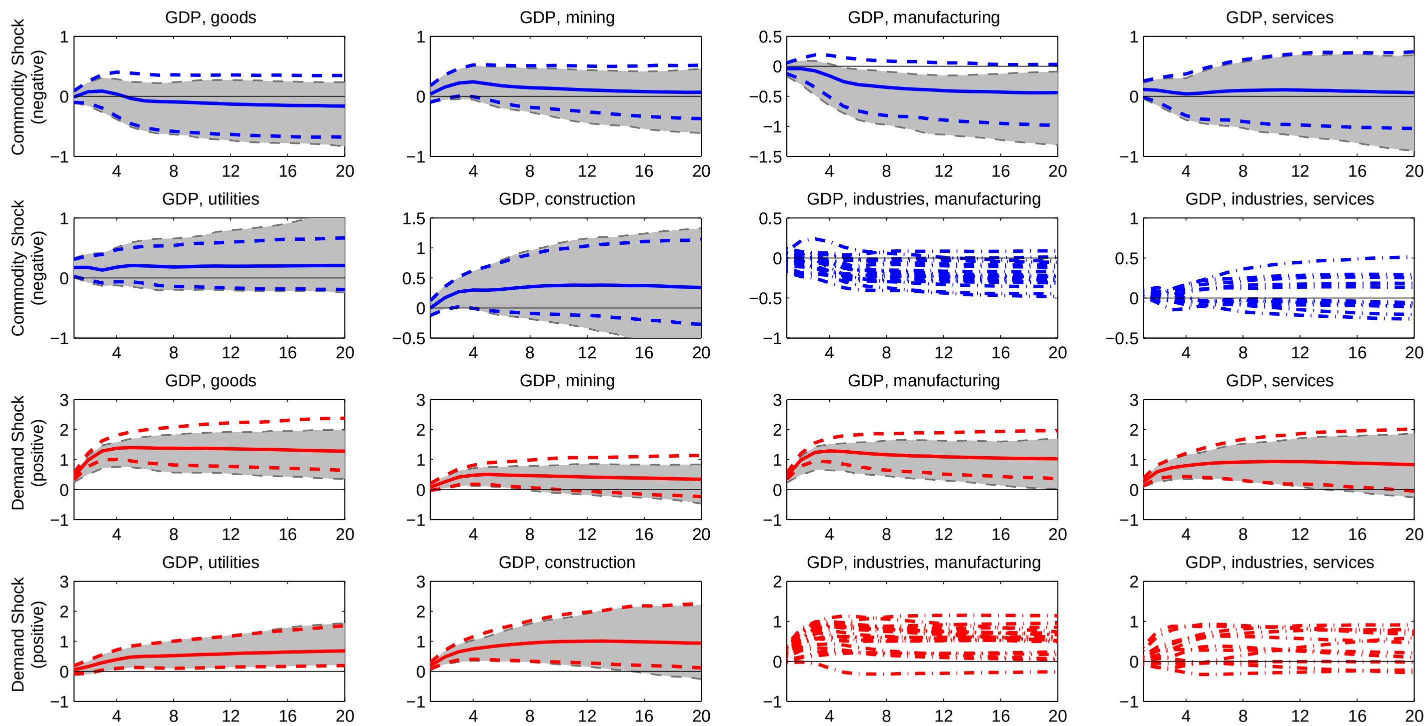

Figure 9: Impulse responses: GDP in industries and Dutch disease

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

exhibit the same pattern. Output in manufacturing industries tends to decrease over time, whereas it slightly increases initially in the different service-producing industries but with IRFs that become quite disperse afterwards.

We have seen that a positive GD shock also increases the real commodity prices and appreciates the real exchange rate. However, in contrast to a negative GC shock, it exhibits a uniform positive effect on real GDP across the different industries, with largest increase in output taking place after 3-4 quarters. Taking into account the contrasting effects of these two shocks, which explain a sizable fraction of the volatilities of commodity prices and of the common factors capturing domestic and global economic activity, it is not all surprising that the the Dutch disease is so often undetectable in the raw data.

Figure 10 supplements this argument by plotting the IRFs of capacity utilization and employment to the two shocks. As can be observed, a negative GC shock has no any significant effect on total industrial capacity utilization. However, this shock implies more intensive capacity utilization in mining, more excess capacity in manufacturing and no any significant response in construction. In contrast, it has no effect on employment in these industries, except in the construction sector where employment slightly increases after 2-3 quarters. Finally, a positive GD shock has a strong and uniform positive effect on both variables across all industries.

4 Conclusions

In this paper we have analyzed the sources and effects of internationally-driven shocks on a small commodity-exporting economy, using Canada as a representative case study. Using a structural dynamic factor model, we quantify the dynamic effects of a wide variety of Canadian variables to two global structural shocks that explain most of the volatility in real commodity prices, namely, a negative commodity-specific shock and a positive global demand shock. We then illustrate the main stylized facts documented in the relevant literature on the effects that unexpected fluctuations in real commodity prices have on the business cycle of small commodity-exporting economies.

Using different identification schemes, our results support previous findings (see, e.g., Kilian, 2009; Kilian and Murphy, 2012, for the specific case of oil-exporting economies) about changes in commodity prices being driven by a variety of global structural shocks. In particular, global demand, commodity-specific and global non-commodity supply shocks all contribute significantly to changes in the real commodity prices during 1975-2010, with the first two shocks explaining most of their volatility. Both positive global demand and negative commodity-specific shocks, which result in increasing commodity prices, generate a favourable effect on external balances, a commodity currency effect, the Backus-Smith anomaly and positive investment effect in Canada. However, only the latter shock leads to the Dutch disease and spending effects. By contrast, a positive innovation in

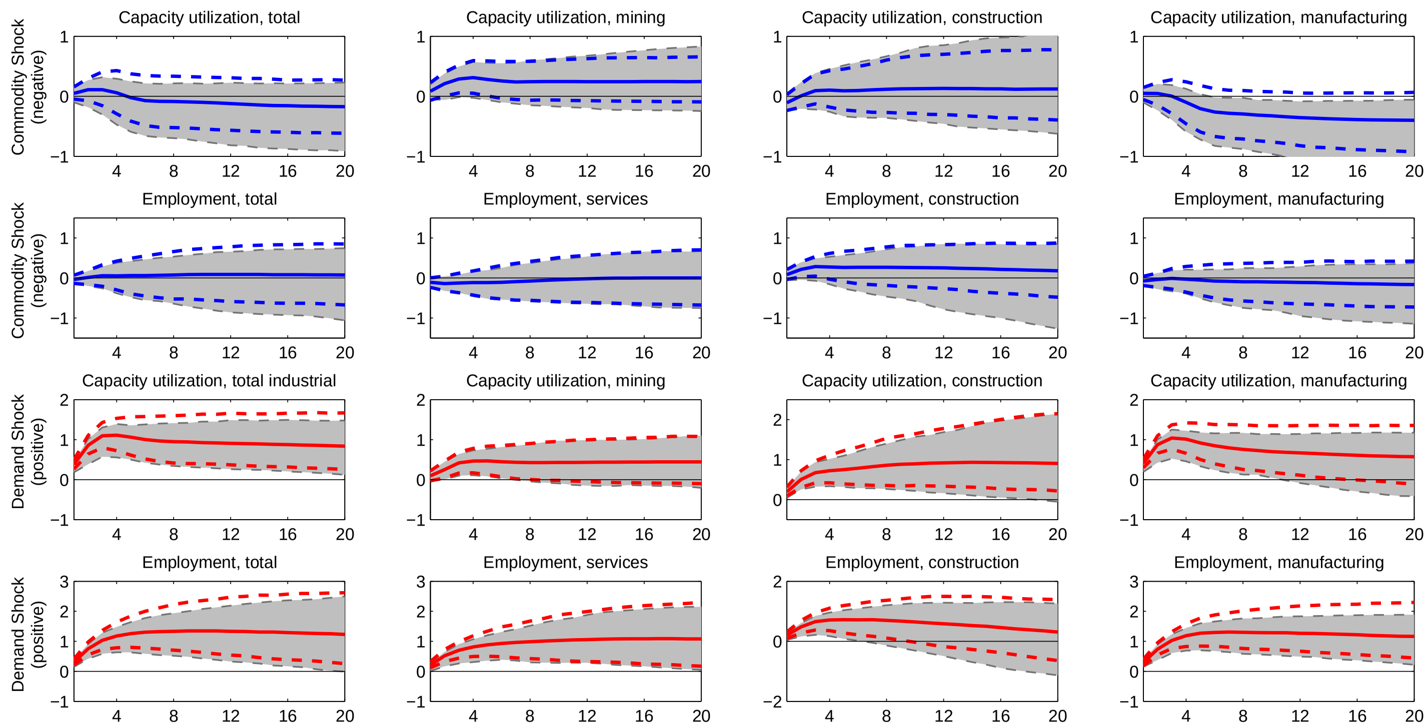

Figure 10: Impulse responses: capacity utilization and employment

recursive identification - solid line together with 90% credible interval; identification by sign restrictions - shaded area covering 90% credible set

global demand stimulates real output and real expenditures uniformly across Canadian industries, without any indication of these two effects. Therefore, ignorance of the different sources of shocks driving changes in commodity prices might explain why these effects are so strikingly absent in the data.

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Appendices

A Estimation method

The restricted VAR in our model has a different set of explanatory variables in each equation and may be estimated as a system of seemingly unrelated regression equations (SURE). In particular, we can write this system as

$$y_t = X_t\beta + \epsilon_t \tag{4}$$

where $y_t = \begin{pmatrix} y_{1t} & y_{2t} & \dots & y_{Kt} \end{pmatrix}'$, $\beta = \begin{pmatrix} \beta_1' & \beta_2' & \dots & \beta_K' \end{pmatrix}'$, X_t is a block-diagonal matrix with blocks x_{kt}' containing the t-th observation of the vector of explanatory variables relevant for the k-th variable and $\epsilon_t = \begin{pmatrix} \epsilon_{1t} & \epsilon_{2t} & \dots & \epsilon_{Kt} \end{pmatrix}'$ with $\epsilon_t \sim N(0, \Sigma)$.

A Bayesian estimator of the restricted VAR is used here (see Koop, Poirier, and Tobias, 2007). A commonly used prior for this model is an independent normal-Wishart prior:

$$p(\beta, \Sigma^{-1}) \propto \phi(\beta|\underline{\beta}, \underline{V}) f_W(\Sigma^{-1}|\underline{H}, \underline{v})$$

with $\phi(\cdot)$ and $f_W(\cdot)$ denoting respectively Normal and Wishart probability density functions.

The conditional posterior distribution of the VAR coefficients is given then by:

$$\beta|y, \Sigma^{-1} \sim N(\overline{\beta}, \overline{V}) \tag{5}$$

where $\overline{V} = \left(\underline{V}^{-1} + \sum_{t=1}^{T} X_t'\Sigma^{-1}X_t\right)^{-1}$ and $\overline{\beta} = \overline{V}\left(\underline{V}^{-1}\underline{\beta} + \sum_{t=1}^{T} X_t'\Sigma^{-1}y_t\right)$.

The posterior for Σ^{-1} conditional on β is computed as:

$$\Sigma^{-1}|y, \beta \sim W(\overline{H}, \overline{v}) \tag{6}$$

where $\overline{H} = \left(\underline{H}^{-1} + \sum_{t=1}^{T}(y_t - X_t\beta)(y_t - X_t\beta)'\right)^{-1}$ and $\overline{v} = T + \underline{v}$.

We assume an uninformative prior by setting $\underline{V}^{-1} = 0$, $\underline{v} = 0$ and $\underline{H}^{-1} = 0$. To approximate the posterior distribution of the model we use a Gibbs sampler that sequentially draws from the normal $\phi(\beta|y, \Sigma^{-1})$ and the Wishart $f_W(\Sigma^{-1}|y, \beta)$.

B Identification using sign and bound restrictions

The sign restrictions are imposed using the procedure proposed by Rubio-Ramirez et al. (2010). Let B_0 be a structural impact matrix computed using the Cholesky decomposition of the reduced form variance-covariance matrix Ω with the global factors ordered first, i.e. $\Omega = B_0 B_0'$. Let $\tilde{Q}$ be identity matrix with the foreign (upper-left) block substituted by any (rotational) orthogonal 3×3 matrix, such that $\tilde{Q}\tilde{Q}' = I$. Then, multiplying the impact matrix B_0 by $\tilde{Q}$ yields a new structural impact matrix $\tilde{B}_0 = B_0 \tilde{Q}$ (with the global factors again ordered first). Notice, that $\tilde{B}_0 \tilde{B}_0' = \Omega$. Drawing repeatedly from the set of orthogonal rotational matrices one can generate a wide range of possible choices for the structural model.

The algorithm consists of the following steps:

1. Compute the Cholesky decomposition B_0^k of the posterior draw k of the reduced form variance-covariance matrix Ω^k with the global factors ordered first.

2. Draw an independent standard normal 3×3 matrix X and let $X = QR$ be the QR decomposition of X with the diagonal of R normalized to be positive. Then Q is a rotational orthogonal matrix and has the uniform (or Haar) distribution. Substitute the upper-left diagonal block of the identity matrix $\tilde{Q}$ by Q.

3. Compute $A_0^k = B_0^k \tilde{Q}$. If this model satisfies the sign and bound restrictions, keep it. Otherwise, move to the next Gibbs iteration.

C Description of data

The available quarterly data span the period 1975q1 to 2010q4. The format contains: i) series code, ii) description, iii) source of data, iv) transformation code and v) variance explained by its common components. The transformation codes are: 1 – no transformation; 2 – first difference; 4 – logarithm; 5 – first difference of logarithm. The data set contains 266 quarterly series with no missing observations. The main sources of data are OECD EO, World Bank GEM, CANSIM and FRED2 databases.

Global Economic Activity Series

	Series ID	Title	Source	Code	R^2
1	GDP-OECD	Real gross domestic product, OECD, SA	OECD	5	0,88
2	GDP-G7	Real gross domestic product, G7, SA	OECD	5	0,80
3	GDP-EU15	Real gross domestic product, EU15, SA	OECD	5	0,67
4	GDP-US	Real gross domestic product, USA, SA	OECD	5	0,50
5	IND-G7	Industrial production index, G7, SA	OECD	5	0,91
6	IND-EU	Industrial production index, OECD Europa, SA	OECD	5	0,78
7	IND-US	Industrial production index, USA, SA	OECD	5	0,69
8	EXP-WORLD	Export (volume), World, SA	OECD	5	0,81
9	EXP-OECD	Export (volume), OECD, SA	OECD	5	0,84
10	IMP-WORLD	Import (volume), World, SA	OECD	5	0,82
11	IMP-OECD	Import (volume), OECD, SA	OECD	5	0,85
12	DCBFR	Index of Dry Cargo Bulk Freight Rates	Kilian (2009)	2	0,09

Global Inflation Series

	Series ID	Title	Source	Code	R^2
1	DGDP-OECD	Deflator of gross domestic product, OECD, SA	OECD	5	0,88
2	DGDP-G7	Deflator of gross domestic product, G7, SA	OECD	5	0,88
3	DGDP-EU	Deflator of gross domestic product, OECD Europa, SA	OECD	5	0,83
4	DGDP-EU15	Deflator of gross domestic product, EU15, SA	OECD	5	0,84
5	DGDP-US	Deflator of gross domestic product, USA, SA	OECD	5	0,88
6	CPI-OECD	Consumer price index, all items, OECD, SA	OECD	5	0,82
7	CPI-G7	Consumer price index, all items, G7, SA	OECD	5	0,92
8	CPI-EU	Consumer price index, all items, OECD Europa, SA	OECD	5	0,70
9	CPI-US	Consumer price index, all items, USA, SA	OECD	5	0,80
10	CPINEF-OECD	Consumer price index, all items, non-food, non-energy, OECD, SA	OECD	5	0,68
11	CPINEF-G7	Consumer price index, all items, non-food, non-energy, G7, SA	OECD	5	0,85
12	CPINEF-EU	Consumer price index, all items, non-food, non-energy, OECD Europa, SA	OECD	5	0,64
13	CPINEF-US	Consumer price index, all items, non-food, non-energy, USA, SA	OECD	5	0,82
14	PPIM-US	Total producer prices, manufacturing, USA, SA	OECD	5	0,43
15	PPIFG-US	Total producer prices, finished goods, USA, SA	OECD	5	0,49

Real Commodity Prices Series

	Series ID	Title	Source	Code	R^2
1	RCP-ENERGY	Commodity price index, constant 2000 US$, Energy, SA	WB - GEM	5	0,54
2	RCP-FOOD	Commodity price index, constant 2000 US$, Agr., Food, SA	WB - GEM	5	0,48
3	RCP-RAW	Commodity price index, constant 2000 US$, Agr., Raw Materials, SA	WB - GEM	5	0,59
4	RCP-METALS	Commodity price index, constant 2000 US$, Base Metals, SA	WB - GEM	5	0,61
5	RCP-FERT	Commodity price index, constant 2000 US$, Fertilizers, SA	WB - GEM	5	0,25

Canadian Economy Series
Gross domestic product, expenditure-based, constant 2002 prices

	Series ID	Title	Source	Code	R^2
1	GDP-CAN	Gross domestic product at market prices, SA	CANSIM	5	0,75
2	PC-CAN	Personal expenditure on consumer goods and services, SA	CANSIM	5	0,88
3	PCG-CAN	Personal expenditure on consumer goods, SA	CANSIM	5	0,75
4	PCDUR-CAN	Personal expenditure on durable goods, SA	CANSIM	5	0,63
5	PCSDUR-CAN	Personal expenditure on semi-durable goods, SA	CANSIM	5	0,78
6	PCNDUR-CAN	Personal expenditure on non-durable goods, SA	CANSIM	5	0,42
7	PCSER-CAN	Personal expenditure on services, SA	CANSIM	5	0,54
8	GC-CAN	Government current expenditure on goods and services, SA	CANSIM	5	0,09
9	GGFC-CAN	Government gross fixed capital formation, SA	CANSIM	5	0,23
10	GINV-CAN	Government investment in inventories, SA	CANSIM	1	0,29
11	BGFC-CAN	Business gross fixed capital formation, SA	CANSIM	5	0,76
12	RES-CAN	Residential structures, SA	CANSIM	5	0,56
13	NRESEQ-CAN	Non-residential structures and equipment, SA	CANSIM	5	0,69
14	NRES-CAN	Non-residential structures, SA	CANSIM	5	0,51
15	EQ-CAN	Machinery and equipment, SA	CANSIM	5	0,57
16	BINV-CAN	Business investment in inventories, SA	CANSIM	1	0,60

17	BNFINV-CAN	Business investment in non-farm inventories, SA	CANSIM	1	0,60
18	BFINV-CAN	Business investment in farm inventories, SA	CANSIM	1	0,06
19	EXP-CAN	Exports of goods and services, SA	CANSIM	5	0,69
20	EXPG-CAN	Exports of goods, SA	CANSIM	5	0,66
21	EXPS-CAN	Exports of services, SA	CANSIM	5	0,24
22	IMP-CAN	Imports of goods and services, SA	CANSIM	5	0,69
23	IMPG-CAN	Imports of goods, SA	CANSIM	5	0,65
24	IMPS-CAN	Imports of services, SA	CANSIM	5	0,45
25	FDD-CAN	Final domestic demand, SA	CANSIM	5	0,85

Gross domestic product, expenditure-based, implicit price deflator

	Series ID	Title	Source	Code	R^2
26	PGDP-CAN	Gross domestic product, SA	CANSIM	5	0,81
27	PPC-CAN	Personal expenditure on consumer goods and services, SA	CANSIM	5	0,93
28	PPCG-CAN	Personal expenditure on consumer goods, SA	CANSIM	5	0,86
29	PPCDUR-CAN	Personal expenditure on durable goods, SA	CANSIM	5	0,65
30	PPCSDUR-CAN	Personal expenditure on semi-durable goods, SA	CANSIM	5	0,79
31	PPCNDUR-CAN	Personal expenditure on non-durable goods, SA	CANSIM	5	0,77
32	PPCSER-CAN	Personal expenditure on services, SA	CANSIM	5	0,86
33	PGC-CAN	Government current expenditure on goods and services, SA	CANSIM	5	0,56
34	PGGFC-CAN	Government gross fixed capital formation, SA	CANSIM	5	0,61
35	PBGFC-CAN	Business gross fixed capital formation, SA	CANSIM	5	0,64
36	PRES-CAN	Residential structures, SA	CANSIM	5	0,37
37	PNRESEQ-CAN	Non-residential structures and equipment, SA	CANSIM	5	0,75
38	PNRES-CAN	Non-residential structures, SA	CANSIM	5	0,54
39	PEQ-CAN	Machinery and equipment, SA	CANSIM	5	0,77
40	PEXP-CAN	Exports of goods and services, SA	CANSIM	5	0,69
41	PEXPG-CAN	Exports of goods, SA	CANSIM	5	0,68
42	PEXPS-CAN	Exports of services, SA	CANSIM	5	0,70
43	PIMP-CAN	Imports of goods and services, SA	CANSIM	5	0,89
44	PIMPG-CAN	Imports of goods, SA	CANSIM	5	0,86
45	PIMPS-CAN	Imports of services, SA	CANSIM	5	0,86
46	PFDD-CAN	Final domestic demand, SA	CANSIM	5	0,94

Exchange rates and external balances

	Series ID	Title	Source	Code	R^2
47	NEER-CAN	Nominal Effective Exchange Rate	BIS	5	0,79
48	NERUS-CAN	Bilateral Nominal Exchange Rate, CAD/USD	CANSIM	5	0,87
49	REER-CAN	Real Effective Exchange Rate	BIS	5	0,79
50	RERUS-CAN	Bilateral Real Exchange Rate, Canada vs. USA	CANSIM	5	0,88
51	RERT-CAN	Real Exchange Rate, traded goods (PPI)	CANSIM	5	0,78
52	RERN-CAN	Real Exchange Rate, internal relative prices (PPI/CPI)	CANSIM	5	0,56
53	CA-CAN	Current account balance, % of GDP, SA	CANSIM	1	0,72
54	TB-CAN	Trade balance (goods and services), % of GDP, SA	CANSIM	1	0,70
55	TBG-CAN	Trade balance (goods, all types), % of GDP, SA	CANSIM	1	0,69
56	TBC-CAN	Trade balance (goods, primary commodities), % of GDP, SA	CANSIM	1	0,66
57	TBNC-CAN	Trade balance (goods, except of primary commodities), % of GDP, SA	CANSIM	1	0,63

Personal expenditures, constant 2000 prices

	Series ID	Title	Source	Code	R^2
58	PCDIF-CAN-US	Personal consumption differential in Canada and USA, logs, SA	CANSIM, FRED2	2	0,53
59	PCFNAB-CAN	Food and non-alcoholic beverages, SA	CANSIM	5	0,19
60	PCAB-CAN	Alcoholic beverages bought in stores, SA	CANSIM	5	0,21
61	PCTOB-CAN	Tobacco products, SA	CANSIM	5	0,16
62	PCMBC-CAN	Men's and boys' clothing, SA	CANSIM	5	0,55
63	PCWGC-CAN	Women's, girl's and children's clothing, SA	CANSIM	5	0,51
64	PCFW-CAN	Footwear, SA	CANSIM	5	0,44
65	PCGIR-CAN	Gross imputed rent, SA	CANSIM	5	0,39
66	PCGPR-CAN	Gross paid rent, SA	CANSIM	5	0,29
67	PCOS-CAN	Other shelter expenses, SA	CANSIM	5	0,29
68	PCEL-CAN	Electricity, SA	CANSIM	5	0,17
69	PCNG-CAN	Natural gas, SA	CANSIM	5	0,36
70	PCOF-CAN	Other fuels, SA	CANSIM	5	0,31
71	PCFC-CAN	Furniture, carpets and other floor coverings, SA	CANSIM	5	0,57
72	PCHA-CAN	Household appliances, SA	CANSIM	5	0,67
73	PCSDF-CAN	Semi-durable household furnishings, SA	CANSIM	5	0,64
74	PCNHS-CAN	Non-durable household supplies, SA	CANSIM	5	0,32
75	PCDCC-CAN	Domestic and child care services, SA	CANSIM	5	0,15
76	PCOHS-CAN	Other household services, SA	CANSIM	5	0,18
77	PCMC-CAN	Medical care, SA	CANSIM	5	0,18
78	PCHC-CAN	Hospital care and the like, SA	CANSIM	5	0,44
79	PCOMC-CAN	Other medical care expenses, SA	CANSIM	5	0,15
80	PCDPH-CAN	Drugs and pharmaceutical products, SA	CANSIM	5	0,16
81	PCNUMV-CAN	New and used (net) motor vehicles, SA	CANSIM	5	0,44
82	PCMVRP-CAN	Motor vehicle repairs and parts, SA	CANSIM	5	0,19
83	PCMFL-CAN	Motor fuels and lubricants, SA	CANSIM	5	0,29
84	PCOAR-CAN	Other auto related services, SA	CANSIM	5	0,21

85	PCPT-CAN	Purchased transportation, SA	CANSIM	5	0,26
86	PCCOM-CAN	Communications, SA	CANSIM	5	0,27
87	PCRSC-CAN	Recreational, sporting and camping equipment, SA	CANSIM	5	0,66
88	PCRES-CAN	Reading and entertainment supplies, SA	CANSIM	5	0,47
89	PCRS-CAN	Recreational services, SA	CANSIM	5	0,26
90	PCECS-CAN	Education and cultural services, SA	CANSIM	5	0,05
91	PCPE-CAN	Personal effects not elsewhere classified, SA	CANSIM	5	0,31
92	PCPC-CAN	Personal care, SA	CANSIM	5	0,27
93	PCRAS-CAN	Restaurants and accommodation services, SA	CANSIM	5	0,46
94	PCFLS-CAN	Financial and legal services, SA	CANSIM	5	0,12
95	PCNPO-CAN	Operating expenses of non-profit organizations, SA	CANSIM	5	0,11

Personal expenditures, implicit price deflator

	Series ID	Title	Source	Code	R^2
96	PPCFNAB-CAN	Food and non-alcoholic beverages, SA	CANSIM	5	0,45
97	PPCAB-CAN	Alcoholic beverages bought in stores, SA	CANSIM	5	0,55
98	PPCTOB-CAN	Tobacco products, SA	CANSIM	5	0,28
99	PPCMBC-CAN	Men's and boys' clothing, SA	CANSIM	5	0,60
100	PPCWGC-CAN	Women's, girl's and children's clothing, SA	CANSIM	5	0,55
101	PPCFW-CAN	Footwear, SA	CANSIM	5	0,58
102	PPCGIR-CAN	Gross imputed rent, SA	CANSIM	5	0,78
103	PPCGPR-CAN	Gross paid rent, SA	CANSIM	5	0,81
104	PPCOS-CAN	Other shelter expenses, SA	CANSIM	5	0,15
105	PPCEL-CAN	Electricity, SA	CANSIM	5	0,38
106	PPCNG-CAN	Natural gas, SA	CANSIM	5	0,23
107	PPCOF-CAN	Other fuels, SA	CANSIM	5	0,56
108	PPCFC-CAN	Furniture, carpets and other floor coverings, SA	CANSIM	5	0,47
109	PPCHA-CAN	Household appliances, SA	CANSIM	5	0,65
110	PPCSDF-CAN	Semi-durable household furnishings, SA	CANSIM	5	0,72
111	PPCNHS-CAN	Non-durable household supplies, SA	CANSIM	5	0,67
112	PPCDCC-CAN	Domestic and child care services, SA	CANSIM	5	0,37
113	PPCOHS-CAN	Other household services, SA	CANSIM	5	0,18
114	PPCMC-CAN	Medical care, SA	CANSIM	5	0,73
115	PPCHC-CAN	Hospital care and the like, SA	CANSIM	5	0,42
116	PPCOMC-CAN	Other medical care expenses, SA	CANSIM	5	0,19
117	PPCDPH-CAN	Drugs and pharmaceutical products, SA	CANSIM	5	0,71
118	PPCNUMV-CAN	New and used (net) motor vehicles, SA	CANSIM	5	0,53
119	PPCMVRP-CAN	Motor vehicle repairs and parts, SA	CANSIM	5	0,68
120	PPCMFL-CAN	Motor fuels and lubricants, SA	CANSIM	5	0,58
121	PPCOAR-CAN	Other auto related services, SA	CANSIM	5	0,19
122	PPCPT-CAN	Purchased transportation, SA	CANSIM	5	0,38
123	PPCCOM-CAN	Communications, SA	CANSIM	5	0,22
124	PPCRSC-CAN	Recreational, sporting and camping equipment, SA	CANSIM	5	0,60
125	PPCRES-CAN	Reading and entertainment supplies, SA	CANSIM	5	0,52
126	PPCRS-CAN	Recreational services, SA	CANSIM	5	0,45
127	PPCECS-CAN	Education and cultural services, SA	CANSIM	5	0,49
128	PPCPE-CAN	Personal effects not elsewhere classified, SA	CANSIM	5	0,33
129	PPCPC-CAN	Personal care, SA	CANSIM	5	0,72
130	PPCRAS-CAN	Restaurants and accommodation services, SA	CANSIM	5	0,74
131	PPCFLS-CAN	Financial and legal services, SA	CANSIM	5	0,19
132	PPCNPO-CAN	Operating expenses of non-profit organizations, SA	CANSIM	5	0,66

Gross domestic product, by industry, constant 2000 prices

	Series ID	Title	Source	Code	R^2
133	GDPBS-CAN	Business sector, goods, SA	CANSIM	5	0,90
134	GDPBSS-CAN	Business sector, services, SA	CANSIM	5	0,70
135	GDPGI-CAN	Goods producing industries, SA	CANSIM	5	0,90
136	GDPSI-CAN	Services producing industries, SA	CANSIM	5	0,68
137	GDPIP-CAN	Industrial production, SA	CANSIM	5	0,92
138	GDPAGR-CAN	Agriculture, forestry, fishing and hunting, SA	CANSIM	5	0,13
139	GDPMIN-CAN	Mining and oil and gas extraction, SA	CANSIM	5	0,29
140	GDPUT-CAN	Utilities, SA	CANSIM	5	0,46
141	GDPCON-CAN	Construction, SA	CANSIM	5	0,45
142	GDPMAN-CAN	Manufacturing, SA	CANSIM	5	0,92
143	GDPFOOF-CAN	Food manufacturing, SA	CANSIM	5	0,19
144	GDPBEV-CAN	Beverage and tobacco product manufacturing, SA	CANSIM	5	0,27
145	GDPTEX-CAN	Textile and textile product mills, SA	CANSIM	5	0,54
146	GDPCLO-CAN	Clothing manufacturing, SA	CANSIM	5	0,34
147	GDPLET-CAN	Leather and allied product manufacturing, SA	CANSIM	5	0,27
148	GDPWOOD-CAN	Wood product manufacturing, SA	CANSIM	5	0,48
149	GDPPAP-CAN	Paper manufacturing, SA	CANSIM	5	0,34
150	GDPPRI-CAN	Printing and related support activities, SA	CANSIM	5	0,35
151	GDPPET-CAN	Petroleum and coal products manufacturing, SA	CANSIM	5	0,31
152	GDPCHE-CAN	Chemical manufacturing, SA	CANSIM	5	0,54
153	GDPPL-CAN	Plastics and rubber products manufacturing, SA	CANSIM	5	0,69
154	GDPNMM-CAN	Non-metallic mineral product manufacturing, SA	CANSIM	5	0,62
155	GDPPRM-CAN	Primary metal manufacturing, SA	CANSIM	5	0,58
156	GDPFM-CAN	Fabricated metal product manufacturing, SA	CANSIM	5	0,67

157	GDPMACH-CAN	Machinery manufacturing, SA	CANSIM	5	0,57
158	GDPCEL-CAN	Computer and electronic product manufacturing, etc., SA	CANSIM	5	0,42
159	GDPTREQ-CAN	Transportation equipment manufacturing, SA	CANSIM	5	0,51
160	GDPFUN-CAN	Furniture and related product manufacturing, SA	CANSIM	5	0,57
161	GDPMISC-CAN	Miscellaneous manufacturing, SA	CANSIM	5	0,23
162	GDPWHT-CAN	Wholesale trade, SA	CANSIM	5	0,55
163	GDPRET-CAN	Retail trade, SA	CANSIM	5	0,44
164	GDPTRAN-CAN	Transportation and warehousing, SA	CANSIM	5	0,51
165	GDPINF-CAN	Information and cultural industries, SA	CANSIM	5	0,36
166	GDPFIN-CAN	Finance, insurance, realestate, etc., SA	CANSIM	5	0,16
167	GDPPR-CAN	Professional, scientific and technical services, SA	CANSIM	5	0,27
168	GDPEDUC-CAN	Educational services, SA	CANSIM	5	0,15
169	GDPHEA-CAN	Health care and social assistance, SA	CANSIM	5	0,35
170	GDPACC-CAN	Accommodation and food services, SA	CANSIM	5	0,46
171	GDPOTHS-CAN	Other services (except public administration), SA	CANSIM	5	0,39
172	GDPPA-CAN	Public administration, SA	CANSIM	5	0,14

Capacity Utilization

	Series ID	Title	Source	Code	R^2
173	CUIND-CAN	Total industrial, SA	CANSIM	5	0,87
174	CUFOR-CAN	Forestry and logging, SA	CANSIM	5	0,12
175	CUMOG-CAN	Mining and oil and gas extraction, SA	CANSIM	5	0,33
176	CUEPG-CAN	Electric power generation, transmission and distribution, SA	CANSIM	5	0,37
177	CUCON-CAN	Construction, SA	CANSIM	5	0,41
178	CUMAN-CAN	Manufacturing, SA	CANSIM	5	0,88
179	CUFOOD-CAN	Food manufacturing, SA	CANSIM	5	0,20
180	CUBEV-CAN	Beverage manufacturing, SA	CANSIM	5	0,18
181	CUTOB-CAN	Tobacco manufacturing, SA	CANSIM	5	0,11
182	CUTEX-CAN	Textiles, SA	CANSIM	5	0,51
183	CUCLO-CAN	Clothing manufacturing, SA	CANSIM	5	0,28
184	CULET-CAN	Leather and allied product manufacturing, SA	CANSIM	5	0,19
185	CUWOOD-CAN	Wood product manufacturing, SA	CANSIM	5	0,49
186	CUPAP-CAN	Paper manufacturing, SA	CANSIM	5	0,28
187	CUPRI-CAN	Printing and related support activities, SA	CANSIM	5	0,24
188	CUPET-CAN	Petroleum and coal products manufacturing, SA	CANSIM	5	0,33
189	CUCHE-CAN	Chemical manufacturing, SA	CANSIM	5	0,42
190	CUPLA-CAN	Plastic products manufacturing, SA	CANSIM	5	0,52
191	CURUB-CAN	Rubber products manufacturing, SA	CANSIM	5	0,41
192	CUNMET-CAN	Non-metallic mineral product manufacturing, SA	CANSIM	5	0,56
193	CUPMET-CAN	Primary metal manufacturing, SA	CANSIM	5	0,56
194	CUFMET-CAN	Fabricated metal product manufacturing, SA	CANSIM	5	0,62
195	CUMAC-CAN	Machinery manufacturing, SA	CANSIM	5	0,53
196	CUCOMP-CAN	Computer, electronic product, etc., SA	CANSIM	5	0,38
197	CUTRAN-CAN	Transportation equipment manufacturing, SA	CANSIM	5	0,49
198	CUFUN-CAN	Furniture and related product manufacturing, SA	CANSIM	5	0,42

Consumer and producer prices

	Series ID	Title	Source	Code	R^2
199	CPI-CAN	Consumer Price Index, all items, SA	CANSIM	5	0,87
200	CPIG-CAN	Consumer Price Index, goods, SA	CANSIM	5	0,76
201	CPIS-CAN	Consumer Price Index, services, SA	CANSIM	5	0,81
202	CPINFE-CAN	Consumer Price Index, all items excluding food and energy, SA	CANSIM	5	0,86
203	CPIF-CAN	Consumer Price Index, food , SA	CANSIM	5	0,38
204	CPIE-CAN	Consumer Price Index, energy, SA	CANSIM	5	0,64
205	PPIM-CAN	Producer Price Index, manufacturing, SA	CANSIM	5	0,75

Employment and labor costs

	Series ID	Title	Source	Code	R^2
206	UNEM-CAN	Unemployment rate, SA	OECD	1	0,65
207	EMPMIN-CAN	Employment, Total, SA	CANSIM	5	0,75
208	EMPMIN-CAN	Employment, Agriculture, SA	CANSIM	5	0,12
209	EMPMIN-CAN	Employment, Fishing , Forestry, Mining, SA	CANSIM	5	0,36
210	EMPMAN-CAN	Employment, Manufacturing, SA	CANSIM	5	0,63
211	EMPCON-CAN	Employment, Construction, SA	CANSIM	5	0,51
212	EMPSER-CAN	Employment, Services, SA	CANSIM	5	0,50
213	WAG-CAN	Hourly earnings, SA	IMF	5	0,41
214	ULC-CAN	Unit labor cost, Total economy (2005=100), SA	OECD	5	0,75
215	ULC-CAN	Unit labor cost, Industry (2005=100), SA	OECD	5	0,67
216	ULC-CAN	Unit labor cost, Manufacturing (2005=100), SA	OECD	5	0,69
217	ULC-CAN	Unit labor cost, Construction (2005=100), SA	OECD	5	0,22
218	ULC-CAN	Unit labor cost, Business services (2005=100), SA	OECD	5	0,60

Monetary and financial indicators

	Series ID	Title	Source	Code	R^2
219	MB-CAN	Monetary base, SA	IMF	5	0,22
220	M1-CAN	Monetary aggregate M1++ (gross), SA	IMF	5	0,28

221	M2-CAN	Monetary aggregate M2+ (gross), SA	IMF	5	0,61
222	M3-CAN	Monetary aggregate M3 (gross), SA	IMF	5	0,59
223	HCRED-CAN	Total household credit, SA	IMF	5	0,62
224	BCRED-CAN	Total business credit, SA	IMF	5	0,74
225	TFR-CAN	Total foreign exchange reserves, SA	CANSIM	5	0,18
226	IRBR-CAN	Bank rate	CANSIM	1	0,79
227	IRPL-CAN	Chartered bank's rate on prime loans	CANSIM	1	0,78
228	IRCPR3-CAN	Prime corporate paper rate: 3 months	CANSIM	1	0,79
229	IRTB3-CAN	Treasury Bill rate, average yield: 3 months	CANSIM	1	0,78
230	IRGCB13-CAN	Government of Canada marketable bonds, av. yield: 1-3 years	CANSIM	1	0,79
231	IRGCB35-CAN	Government of Canada marketable bonds, av. yield: 3-5 years	CANSIM	1	0,80
232	IRGCB510-CAN	Government of Canada marketable bonds, av. yield: 5-10 years	CANSIM	1	0,81
233	IRGCB10-CAN	Government of Canada marketable bonds, av. yield: over 10 years	CANSIM	1	0,81
234	SPTSX-CAN	S&P/TSX Composite Index	CANSIM	5	0,42