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Oil price uncertainty, monetary policy and the macroeconomy: The Canadian perspective

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ABSTRACT

This paper revisits the link between oil price uncertainty and macroeconomy in the context of a net oil exporting country, Canada. Results obtained from alternative Structural VAR models suggest that while shocks to oil price level do not affect the aggregate level of output, the oil price uncertainty exerts considerable impacts on the Canadian economy. It is found that oil price uncertainty makes a major contribution to overall variations in the output level. Results also show that higher oil price uncertainty significantly decreases both output and price levels, resembling an adverse demand shock. Oil price uncertainty causes output to decline in most of the sub-sectors including durable and non-durable manufacturing. It is found that the Central Bank of Canada reacts with an expansionary monetary policy to oil price uncertainty shocks.

1. Introduction

The nature of the link between oil price and macroeconomic activity is probably one of the most important, controversial and inconclusive issues in the area of energy economics. In the standard textbook analysis, a positive oil price shock is often considered as an adverse supply shock and is believed to cause a reduced level of output and a high rate of inflation, a situation which is termed 'stagflation'. The simple model of AD-AS appeared to fit well with the oil price shocks and stagflation observed in the US economy in the 1970s. However, several other relevant studies find that the evidence of a negative relationship between oil price shock and aggregate output level became relatively weak for the periods after 1986 (see Hooker, 1996; Mork, 1989).

One explanation for the weakening inverse relationship between oil price and output in recent times is that changes in the oil price often affect the economy in an asymmetric way.[1] An increase in oil price may adversely affect economic activity, but a fall in oil price may not necessarily increase the output level. In particular, if a fall in oil price increases uncertainty about changes in the oil price, then a part of the increased output will be offset by lowering of the output level due to increased uncertainty.[2] Mork (1994) showed that prior to 1986, oil price shocks were predominantly positive and it was in 1986 when we first observed large declines in the world oil price. Therefore, it might be the volatility[3] (or uncertainty) in the oil price rather than the level of the oil price that was linked to the aggregate level of output in recent years. As a matter of fact, since the mid-1980s, the world oil price has been volatile and one should ideally include volatility and uncertain oil price behavior in any econometric model that attempts to explain the role of oil price changes in the macroeconomy.

The adverse effects of oil price uncertainty on aggregate economic activity can be explained by the theory of irreversible investment under uncertainty premiered by Bernanke (1983) and Henry (1974). According to this theory, irreversible investments are postponed during the periods of uncertainty which, in turn, causes temporary declines in aggregate output level. In a recent paper, Yoon and Ratti (2011) show that increased energy price uncertainty makes US manufacturing firms cautious by reducing the responsiveness of investment spending to sales growth. It is thus apparent that an increase in oil price uncertainty may have an adverse effect on the economy through the demand

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[1] For literature on the asymmetric impact of oil price shock on macroeconomic activity, see Mork (1989), Davis (1987), Balke et al. (2002), Mork et al. (1994), Lee et al. (1995), Davis and Haltiwanger (2001), Hamilton (1996, 2003, 2011), and Cunado and Perez de Gracia (2003).

[2] Elder and Serletis (2010) find evidence that accounting for oil price uncertainty tends to exacerbate the negative dynamic response of real output to a positive oil shock, while dampening the dynamic response of real output to a negative oil price shock.

[3] Throughout the paper we use the term 'volatility' and 'uncertainty' interchangeably.

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channel. Hamilton (2003, p. 366) documented some interesting examples of how a consumer's decision is affected by oil price uncertainty:

> "If you are very unsure about where gas prices are headed, you might be inclined to postpone a new purchase [of a car] until you have a better idea of where the market stands. Energy prices and availability may be quite relevant for a host of other durable goods purchases, including housing. How long a commute to work are you willing to put up with? How energy-efficient should your appliances, windows, and insulation be? …When energy prices and availability are as uncertain as they were in early 1974, it is rational to postpone such commitments until better information is available".

From the policymakers' point of view, oil price shocks pose the difficult challenge of balancing the trade-off between high inflation and high unemployment. Previous relevant literature suggests that the central banks' policies have mostly been restrictive in response to a positive oil price shock. However, if oil price uncertainty affects an economy through the aggregate demand channel (an adverse demand shock), a restrictive policy would worsen the situation and the monetary authority should instead choose an expansionary policy.

In the current paper we attempt to have a fresh look at the relationship between oil price uncertainty and macroeconomic activity in the Canadian context. Canada's crude oil production has risen steadily over the past two decades and, today, Canada is one of the leading oil producing industrialized economies of the world. Canada has a unique oil market feature, with crude oil exported from the west and Atlantic offshore and imported into the eastern and central regions. Canada is the largest exporter of crude oil to the United States, with almost 100% of its crude oil being exported to the United States. Most importantly, today Canada is indeed the only country in the G-7 which is a net exporter of crude oil. These distinct characteristics of Canada make the analysis of the relationship between oil price and the Canadian economy an interesting area for research. In particular, as a net oil exporting country, the Canadian economy may experience a positive rather than a negative impact from an oil price (level) shock.[4] However, as in any other economy and regardless of the pattern of changes in oil price levels, we can expect declining economic activity in Canada if oil price uncertainty increases.

Although there are numerous empirical papers studying the relationship between oil prices and an economy (especially the US economy), surprisingly, very few studies focused on analyzing the direct effect of oil price uncertainty on an economy. Recently, Elder and Serletis (2009, 2010, 2011), Bredin et al. (2011), and Rahman and Serletis (2012) have used some variants of GARCH-in-Mean model to show that increased uncertainty about changes in the price of oil is associated with a lower average growth rate of real economic activity in Canada and/or other G-7 countries. Rahman and Serletis (2010) have used the Smooth Transition VAR Model to show that an oil price shock reduces the output growth in the US more in a high oil price volatility regime than a low volatility regime. While these studies make important contributions to the literature of oil price uncertainty, their approach is restricted to the indirect effects of oil price uncertainty as they primarily focus on the response of output level (or growth) to oil price changes in the presence of oil price uncertainty.

In the current paper we attempt to identify shocks to oil price uncertainty and examine the direct impacts of oil price uncertainty shocks on the output level. Our approach differs from previous relevant studies in Canada. We use a multivariate SVAR model (as opposed to a bivariate GARCH-in-Mean model) to examine the dynamic impacts of the shocks to oil price and oil price volatility on output and other macroeconomic variables in Canada. This approach is similar to that of Ferderer (1996), which attempts to show the relationship between oil price volatility and output growth in the US economy in a VAR framework. However, Ferderer (1996) uses recursive VAR where monetary policy is assumed to be exogenous in the contemporaneous period. We believe that a central bank can react fairly quickly to a disturbance, including an oil price shock, and one needs to incorporate such reactions into the VAR system in order to analyze the monetary policy response. Unlike Ferderer (1996), we thus use a structural VAR model and take into account the Central Bank's reactions to the oil price shock in order to explicitly examine how Canadian monetary authority responds to a shock to oil price uncertainty. Using a number of structural VAR models, we have shown that oil price uncertainty acts like an adverse demand shock and causes significant negative impacts on the output level. We have also found that the Central Bank's policy is largely expansionary when there is a shock to oil price uncertainty in Canada.

The rest of the paper is structured as follows. In Section 2 we introduce some stylized facts on the relationship between oil price uncertainty and macroeconomic activity in Canada. The SVAR framework for our empirical analysis is presented in Section 3. Section 4 discusses the results, and Section 5 concludes the paper.

2. Oil price uncertainty and macroeconomic activity: some stylized facts

In a series of papers Hamilton (1983, 1996, 2003, 2011) stressed that oil price increases are often followed by declines in the output level. In this section we report some stylized facts regarding the inverse relationship between oil price and the economic activity in Canada. Fig. 1 shows a plot of the world price of crude oil (in log form) along with a log of the industrial production in Canada covering January 1986 to April 2011. The growth of industrial production slowed somewhat during the 2000s, when oil price was extremely volatile. There was a sharp increase in the world oil price in the early 1990s, which apparently coincides with the decline in industrial production during 1990 and 1991. Apart from this, just by looking at the figures, it is difficult to establish any negative relationship between oil price and industrial output. There is a sharp fall in the output level in 2009, but it is not clear whether there was a link between the falling output and rising oil prices in earlier periods. Note, too, that there was an abrupt decline in the oil price in 2008, which was immediately followed by a sharp decline in the industrial output. Hence, it is evident that the pattern of the relationship between oil price and industrial production in Canada is not readily discernible by simply visualizing their dynamics and growth path, as depicted in Fig. 1.

Fig. 2 plots the Canadian unemployment rate and oil price. Apparently, there is no positive correlation between the trends in these two series. In fact, there seems to be an inverse relationship between oil price and Canadian unemployment, especially for the periods after the year 2000.

Figs. 1 and 2 indicate that movements in oil prices cannot fully explain future movements in macroeconomic activity in Canada. However, a quick scrutiny of both figures reveals that oil prices have been subjected to frequent fluctuations over time. Implicit in this phenomenon is that economic activity may well relate to oil price volatility. In other words, oil price volatility or uncertainty may have an important influence on economic activity. To explore this further, we examine the simple correlations between leading economic indicators in Canada and alternative measures of oil price uncertainty. Significant correlations would suggest that oil price uncertainty in the current period may be related to future economic activities. Here we have used four alternative measures of oil price uncertainty, which are explained below.

The first of these measures, the monthly standard deviation, is similar to that used by Ferderer (1996). The daily crude oil price data (in log form) are used to compute the standard deviation of oil price for each month. Data in this standard deviation series are expected to reflect oil price volatility or uncertainty in respective months. The higher the standard deviation, the higher will be the oil price

[4] Peersman and Van Robays (2012) showed that whereas net oil and energy-importing countries typically face a permanent fall in economic activity, the impact of an oil price increase is insignificant or even positive in net energy-exporting countries if the rises in oil price originate from the supply of oil.