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Why are crude oil prices high when global activity is weak?☆

Ronald A. Ratti [a,1], Joaquin L. Vespignani [b,*]

[a] University of Western Sydney, School of Business, Australia

[b] University of Tasmania, School of Economics and Finance, Australia

HIGHLIGHTS

- Positive shocks to global liquidity significantly increase real oil prices.
- Global liquidity is important in rise in oil price since GFC.
- Liquidity significantly increases global oil production.
- Increased liquidity significantly increases global aggregate demand.

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ABSTRACT

There have been substantial increases in liquidity in recent years and real oil prices have almost returned to the high levels achieved before the global financial crisis. Unanticipated increases in global real M2 led to statistically significant increases in real oil prices. The historical impact of global real M2 on the real price of crude oil is important in the recovery of oil prices over 2009 to 2011.

1. Introduction

Given that global liquidity has risen substantially in recent years, the question arises of whether there has been spill-over from liquidity to crude oil prices. There has been a substantial increase in nominal M2 for the largest four economies from 13,500 billion U.S. dollars in 1997 to 45,000 billion U.S. dollars in 2011. Real oil prices have been much higher over the last third of this period. The spot price per barrel of West Texas Intermediate crude oil (WTI) rose from $58.14 in January 2007 to $140 in June 2008. Concurrent with the global financial crisis (GFC) and the weak global economy, the spot price for WTI fell to $41.68 in January 2009. However, the spot price for WTI rebounded to $133.93 in April 2011 while global economic activity remained subdued.

Fig. 1 shows the monthly percentage change in real oil prices and global real M2. Major changes in real oil prices are tracked by changes in global real M2. A diversion in the series is observed during the GFC. The sharpest monthly drops in real oil price occur in the last three months of 2008. Over 1997–2011 the largest monthly increase in real oil price occurs in March 2009. The largest increase in global real M2 occurs in December 2008. The large increases in global real M2 at the end of 2008 are in response to the GFC and follow a series of small increases and decreases in global real M2 from April to September 2008. It is shown in a historical decomposition of structural shocks that from the middle of 2008 through 2009 global aggregate demand and oil-specific demand shocks contribute to real oil price decline while shocks to global real M2 contribute to recovery in real oil price. The null hypothesis that global M2 does not Granger cause real oil prices is rejected at least at the 10% level over a range of 1, 3 and 6 lags.

Belke et al. (2010) show that global liquidity has risen sharply since 2001 and find significant impacts on an OECD commodity

* Corresponding author. Tel.: +61 3 62262825.
E-mail addresses: r.ratti@uws.edu.au (R.A. Ratti), Joaquin.Vespignani@utas.edu.au (J.L. Vespignani).
[1] Tel.: +61 2 9685 9346.

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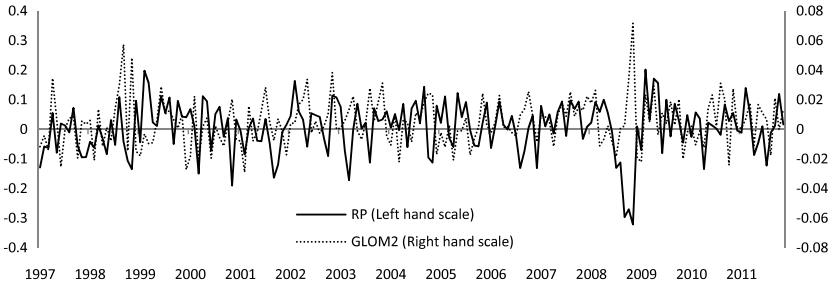

Fig. 1. Monthly global real M2 vs. real oil price (series in log-difference form). Notes: *GLOM2* is real M2 of the U.S., Eurozone, Japan and China. *RP* is real oil price. The price of oil is WTI. Real values are obtained by dividing nominal values by the U.S. CPI.

price index (dominated by oil with a weight of 63%). Anzuini et al. (2012) find support for a significant (but small) effect of U.S. monetary policy on oil prices from 1970–2008.[2]

In this paper we seek to determine the influence of structural oil price shocks and liquidity as it arises from the major economies on the price of crude oil. A structural VAR model is employed in the analysis.

2. Methodology

Consider a structural vector autoregression model (SVAR) constructed with monthly data from 1997:1 to 2011:12, with the following variables: global oil production (GO_t), real aggregate demand (AD_t), real oil prices (RP_t), and global real M2 in U.S. dollars ($GLOM2_t$).[3] Global M2 is constructed by aggregating M2 in U.S. dollars of the Eurozone, U.S., China and Japan. Monthly data for China are available from 1997:1. (GO_t),(RP_t) and ($GLOM2_t$) are first different stationary variables.[4] Real aggregate demand is measured by the index of global real economic activity constructed by Kilian (2009) based on equal-weighted dry cargo freight rates. AD_t is stationary.

The SVAR model can expressed as:

$$B_0 X_t = \beta + \sum_{i=1}^{3} B_i X_{t-i} + \varepsilon_t, \tag{1}$$

where three lags are determined by the Akaike Information Criterion (AIC) and ε_t denotes the vector of serially and mutually uncorrelated structural innovations. The vector X_t can be expressed as $X_t = [\triangle \log(GO_t), AD_t, \triangle \log(RP_t), \triangle \log(GLOM2_t)]$. Model restrictions are based on Kilian (2009), to the extent possible, given the inclusion in our model of the global M2. The identification restrictions on $B_o X_t$ are imposed as follows:

$$B_o X_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -b_{20} & 1 & 0 & 0 \\ -b_{30} & -b_{31} & 1 & 0 \\ -b_{40} & -b_{41} & -b_{42} & 1 \end{bmatrix} \begin{bmatrix} \triangle \log(GO_t) \\ AD_t \\ \triangle \log(RP_t) \\ \triangle \log(GLOM2_t) \end{bmatrix} \tag{2}$$

3. Empirical results

3.1. Impulse response function results

Fig. 2 shows the responses of the variables in the SVAR to one-standard deviation structural innovations. In the first column are shown the responses of global oil production, global real aggregate demand, global real price of oil and global real M2 to a structural (positive) innovation in global oil production. The effect of an unanticipated supply disruption on global oil production is very persistent and highly significant. An unanticipated negative innovation in global oil production does not cause a significant effect on the real price of oil, but does cause a significant negative effect on global real aggregate demand. A disruption to global oil production causes decline in global real M2 that is significant in the second and third months.

In the second column of Fig. 2 a positive global real aggregate demand shock has a persistent positive effect on global oil production that is statistically significant between the third and eleventh months. An unanticipated global real aggregate demand expansion has a significant effect on global real aggregate demand that rises over time. A positive global real activity shock has a positive effect on real oil prices that is statistically significant for about five months. A positive shock to global real activity does not significantly affect global real M2.

The effects of an oil market-specific demand shock are shown in column 3 of Fig. 2. In the third row of column 3 a positive shock in oil market-specific demand has a large and persistent positive effect on the real price of oil. This effect is highly statistically significant and rises in magnitude over the first three months. An oil market-specific demand shock is associated with significant effects on global oil production and significant increases in global real aggregate demand. A positive oil market-specific demand shock increases global real M2 in the first months.

In the fourth column are shown the responses of the variables to structural innovations in global real M2. In response to an unanticipated increase in global real M2 there are significant and persistent increases in global oil production and in global real aggregate demand. After a positive shock to global real M2, an increase in global oil production builds up over the first five months and is statistically significant after the third month. The rise in global real aggregate demand is statistically significant over all twenty months. The increase in real oil prices is statistically significant between the fifth and ninth months.

In summary, global real M2 has statistically significant effects on real oil prices, global aggregate demand and global oil production. Many of the other results over 1997:01–2011:12 in Fig. 3 are comparable and similar to those found by Kilian (2009) for 1973:1–2007:12. A brief mention will be made of findings that are different. Over 1997:01–2011:12 an unanticipated negative innovation in global oil production causes a significant negative effect on global real aggregate demand, whereas over 1973:1–2007:12 the result is at best marginally significant. A positive oil market-specific demand shock has a positive significant effect (at one standard error confidence bands after the second month) on global oil production over 1997:01–2011:12, but not over 1973:1–2007:12.

3.2. Historical decomposition of real oil price

The cumulative contribution to the real price of oil of the structural shocks to global oil production, global real aggregate

[2] Glick and Leduc (2012) do not find evidence of an effect of recent U.S. monetary policy shocks (specifically quantitative easing) on commodity prices.

[3] The variables: oil prices and global M2 are deflated by the United States (U.S.) consumer price index (CPI). The M2 in the four biggest economies (accounting for 65% of the world economy in 2011) is used as a proxy for global liquidity.

[4] As indicated by the Augmented Dickey Fuller and confirmed by the Dickey Fuller GLS, the Phillips–Perron and the Kwiatkowski–Phillips–Schmidt–Shin.

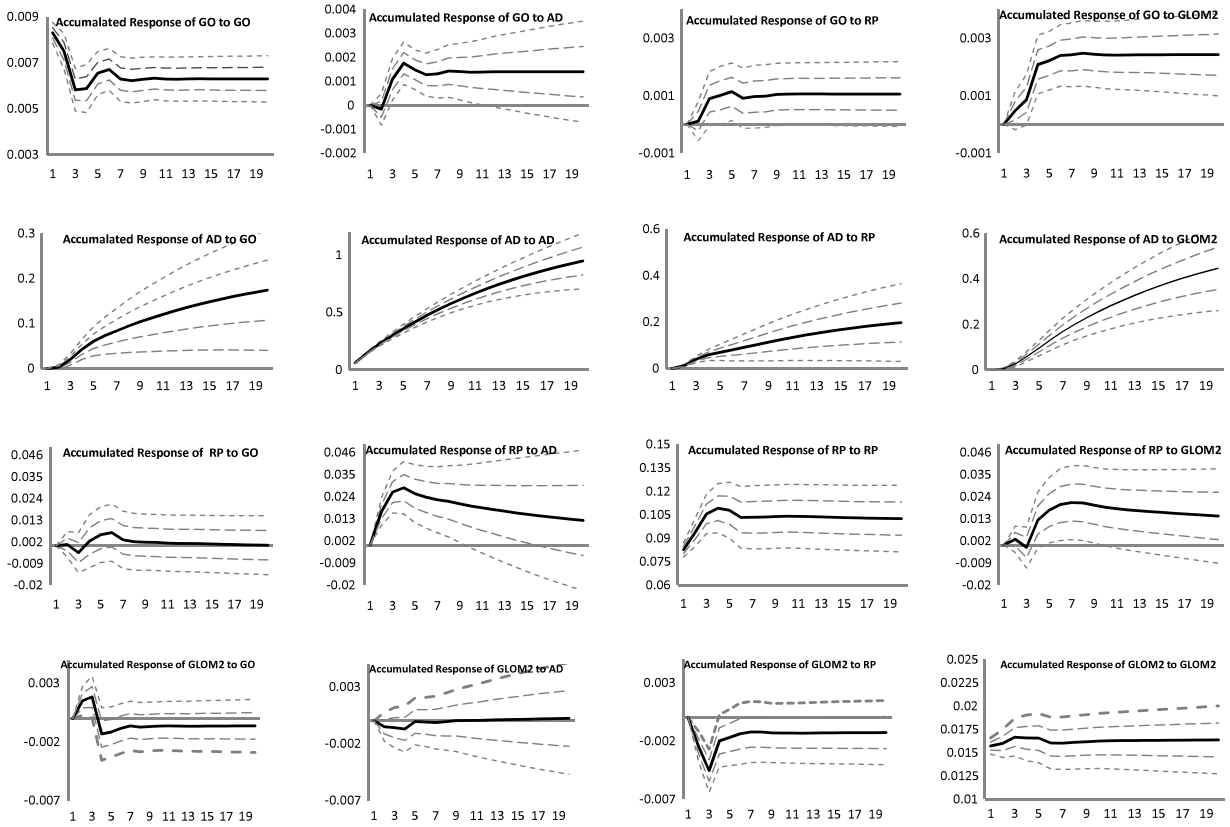

Fig. 2. The impulse response effects of the structural shocks: 1997:01–2011:12. Notes: *GO* is global oil production, *AD* is global demand for commodities (*RP* is real oil price, *GLOM2* is real M2 of U.S., Eurozone, Japan and China. The dashed lines represent one and two standard error confidence bands around the estimates of the coefficients of the impulse response functions. The confidence bands are obtained using Monte Carlo integration as described by Sims (1980), where 5000 draws were used from the asymptotic distribution of the VAR coefficient.
Source: From Kilian (2009).

demand, oil-specific demand and global real M2 are reported in Fig. 3, from estimating the SVAR model in Eqs. (1) and (2). [5] The cumulative contributions of structural shocks to real oil price reported in Fig. 3 are annual averages of the monthly data (the moving average of the last 12 months) to improve the readability of the plot. The monthly data are not annualized.[6] Striking facts from Fig. 3 are that the cumulative contribution to real oil price of shocks to global oil production are comparatively small, of shocks to oil-specific demand are comparatively large, and the contribution to real oil prices of shocks to global real aggregate demand and global real M2 are of intermediate and comparable size.

The early part of the period in Fig. 3 reflects the recovery from the Asian financial crisis and world petroleum consumption returning to strong growth in 1999 and then the onset of recession in the U.S. beginning in March of 2001. In Fig. 3 the rapid increase in oil price leading to a peak in June 2008 is associated with positive global real activity, low spare production capacity, and positive structural shocks to global real M2.[7] The fall in oil price from July 2008 to January 2009 is associated with the global financial crisis during late 2008, recession in the U.S. over December 2007 to June 2009, and weak growth in Europe. This is reflected in Fig. 3 in that the cumulative contribution of structural shocks to global real aggregate demand turn negative in mid-2008 and early 2009. OPEC decreases production target from September 2008 to January 2009. The contribution to real oil price of oil-market specific precautionary demand is also very small or negative at the end of 2008 and beginning of 2009.

The cumulative impact of global real M2 on the real price of crude oil is substantial in the recovery of oil price during 2009 and 2010. Cumulative effects of positive structural shocks to global real aggregate demand contribute to the rise in oil price from January 2009 through April 2011 only through the latter half of the period. Oil specific precautionary demand made a cumulative contribution to real oil prices at the end of 2009 and during 2011.[8]

[5] Note that in Fig. 3 the cumulative effects of all four shocks on oil price are mostly positive. An examination shows that this is explained by the realization of shocks in *AD*, *RP*, and *GLOM2* being persistently positive in the earlier portion of the sample. By controlling for the initial condition of the cumulative shocks, a more balanced contribution to real oil prices is observed. However, results shown in Fig. 3 represent outcomes that may be an important feature of the data.

[6] It should be noted that a reading of 0.01 on the vertical axis in Fig. 3 indicates a 1% increase in real oil price of oil per month, equivalent to a 12.7% increase at an annualized rate.

[7] On the production side, Hamilton (forthcoming) notes the cumulative contribution of shocks to real oil price is related to a number of factors. A general strike in Venezuela reduced oil production at the end of 2002 and the beginning of 2003, and that the U.S. attack on Iraq starting in March 2003 further reduced oil production. Additional factors contributing to the stagnation of oil production from 2002–2008 include instability in places like Iraq and Nigeria, a fall in production from the North Sea and from fields in Mexico and Indonesia, and that Saudi production was lower in 2007 than in 2005. During 2011 oil production is disrupted in Libya and there is political turmoil in several Middle Eastern countries.

[8] Our results are robust to different lag structure, alternative monetary aggregates and when different indicator for aggregate demand is used. We note that our results are similar in magnitude and statistical significance with lag structures between three to eighteen in the SVAR model, with standard errors become larger due to reduction of degrees of freedom. Our results are robust to use of global M1 or global M3 instead of global M2 as monetary aggregate and when OECD country industrial production (reported by OECD) replaces Kilian's measure of global aggregate demand.

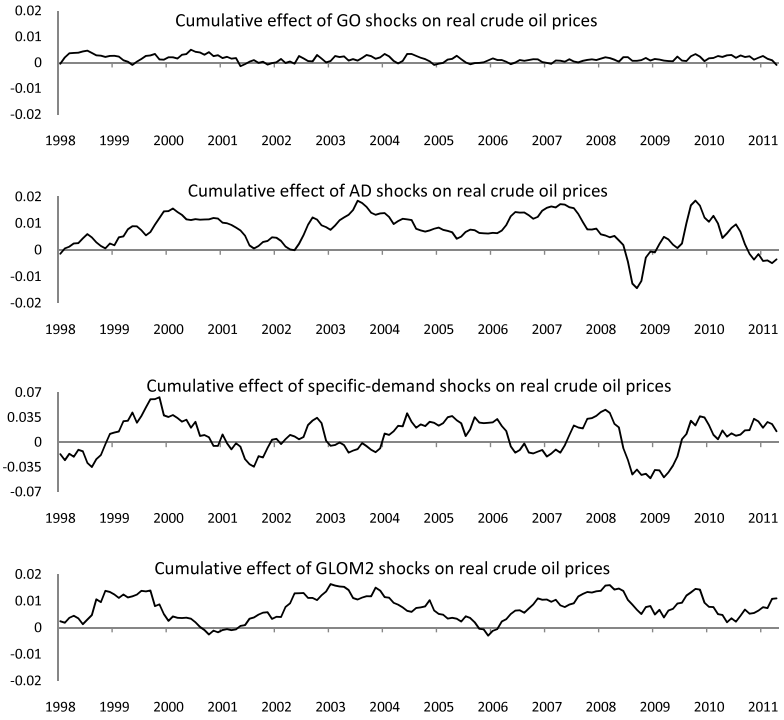

Fig. 3. Cumulative effect of structural shocks on real price of oil. Notes: *GO* is global oil production, *AD* is global demand for commodities, *RP* is real oil price, *GLOM*2 is real M2 of U.S., Eurozone, Japan and China.
Source: From Kilian (2009).

4. Discussion and conclusion

There have been substantial increases in liquidity in recent years and real oil prices have returned to high levels following the global financial crisis. Unanticipated increases in global real M2 led to statistically significant increases in real oil prices. The historical contributions of shocks to global real aggregate demand and to global real M2 to real oil prices 1997:01–2011:12 are of comparable size. The historical impact of global real M2 on the real price of crude oil is important in the recovery of oil price during 2009 and 2010.

Barsky and Kilian (2002) argue that change in monetary policy regimes was a key factor behind the oil price increases of the 1970s and show that the substantial increase in industrial commodity prices that preceded the increase in oil prices in 1973–1974 is consistent with the view that rising demand based on increased global liquidity drove oil prices higher. Alquist et al. (2012) confirm the Gillman and Nakov (2009) findings that monetary factors Granger cause oil prices in the post-war period up until 1997. The issue is whether there is a liquidity effect on oil prices in the last few years. It is likely that the real oil price rise is due to real factors for which real M2 (M1 or M3) is a proxy.

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