Buffer vs. Speculation: A Review on the Role of Crude Oil Inventory

By 13

1. INTRODUCTION

Crude oil inventories generally respond to oil supply and demand shocks in two conflicting ways. In the event of an oil supply disruption, for example, oil inventories can be released onto the market to cover supply shortages and to help mitigate the upsurge in oil prices, called buffer inventory. Or, they can be hoarded now and sold later at higher prices in order to achieve arbitrage margin, referred to as speculative inventory. In order to fully understand the changing dynamics of the oil market, therefore, it is crucial to identify the role and behavior of crude oil inventories properly. Although studies on the behavior of oil inventories are fairly numerous, the empirical emphasis has typically been on either buffer or speculative motive of oil inventories with few studies considering both effects on the oil market together.

In this article, therefore, we are intended to contribute to the literature by examining the role and behavior of crude oil inventories in an integrated econometric model that encompasses the two different views together. The empirical focus is thus on detecting whether oil inventories react to oil demand and supply shocks as the buffer to the market or as the facilitation of speculative trading. Since the behavior of oil inventories likely depends on where oil prices are headed, for a careful analysis we split our sample into two distinct periods and sign-restricted structural vector autoregressive (SVAR) model is applied to them.

Soohyeon Kim is a PhD student and Eunnyeong Heo is a Professor at the Department of Energy Resources Engineering, Seoul National University. Jungho Baek is a Professor at the School of Management, University of Alaska Fairbanks. Corresponding author: Soohyeon Kim. Email: kimssoo@snu.ac.kr

See footnote at end of text.

2. DISENTANGLING BUFFER AND SPECULATIVE INVENTORIES

In an effort to properly detect the behavior of oil inventories, the first task is to define oil demand and supply shocks used for the analysis. A positive demand shock is defined as the shock that shifts demand curve rightward and hence increases the price level. In this article, this shock coincides with the period of rising and high oil prices between January 2003 to June 2008 (2003:M1-2008:M6), considering significant growth in oil demand oil demand caused by strong economic conditions in oil-importing countries (i.e., China, India and Brazil). On the other hand, a positive supply shock is defined as the shock that shifts supply curve rightward and hence decreases the price level. This shock is associated with the period of low oil prices between July 2009 and February 2016 in the article (2009:M7-2016:M2), given an increase in unconventional shale. Following the definitions, sign restrictions are imposed on the SVAR model, based on the economic theory: an oil price is decreased by a positive supply shock but increased by a positive demand shock.

The second task is then to determine the direction of oil inventories in response to oil demand and supply shocks. Under a positive demand shock, for example, oil inventories could be increased now for the anticipation of higher prices to gain arbitrage margin. Or, oil inventories could be decreased by releasing them onto the market to mitigate the current price increase. In our analysis, therefore, if a positive demand shock leads to a decline (rise) in oil inventories, it implies buffer (speculative) inventories. Similarly, under a positive supply shock, oil inventories are likely to be reduced now by selling them in the market before oil prices fall even further, while they may be increased by absorbing the oversupply of crude oil. Therefore, if a positive supply shock results in an increase (decrease) in oil inventories, it implies buffer (speculative) inventories.

3. VARIABLES AND DATA SOURCES

The first variable is the world crude oil production as a proxy for the oil supply variable and is collected from the U.S. Energy Information Administration (EIA). The second variable is the weighted average of industrial production index for major oil consuming countries, which can be a proxy for world oil consumption. The industrial production indices are obtained from the Organization for Economic Cooperation and Development (OECD). West Texas Intermediate (WTI) crude oil prices (real, 2005=100) are taken from the EIA and used as a proxy for the world crude oil price in this article. We incorporate two types of inventory variables: global and U.S.[1] crude oil inventories. First for global crude oil inventories, a proxy inventory is used to address the lack of open and accurate data, following Kilian and Murphy (2014)'s approach; the U.S. crude oil inventories from EIA are scaled by the ratio of OECD commercial petroleum inventories from EIA over U.S. petroleum inventories from IEA. Second for the U.S.

inventories, EIA's U.S. oil crude oil inventories excluding Strategic Petroleum Reserve (SPR) was used.

4. EMPIRICAL RESULTS

To assess the effects of oil demand and supply shocks on oil inventories, the impulse response functions (IRFs) are calculated for 12 future months after estimating the SVAR model. The values are multiplied by a thousand for the sake of convenience of discussion (Figure 1).

The impulse responses during 2003:M1-2008:M6 show that the response of global crude oil inventories to a demand shock is positive for the first three months, with the highest response (+5.66) in the initial month, indicating a dramatic increase in the inventories, thereby exhibiting speculative behavior. The response caused by demand shock, however, turns negative in the third month with the highest response (-1.41) in the fifth month, providing evidence of buffer behavior. On the other hand, the response of oil inventories to a positive supply shock is negative for the first three months but insignificant. After three months, however, the supply shock responses turn positive, indicating that oil inventories play a buffer role after revealing a short period of speculative behavior. Notably, given the absolute values and significance, speculative trading seems to be more pronounced with demand shock than with supply shock.

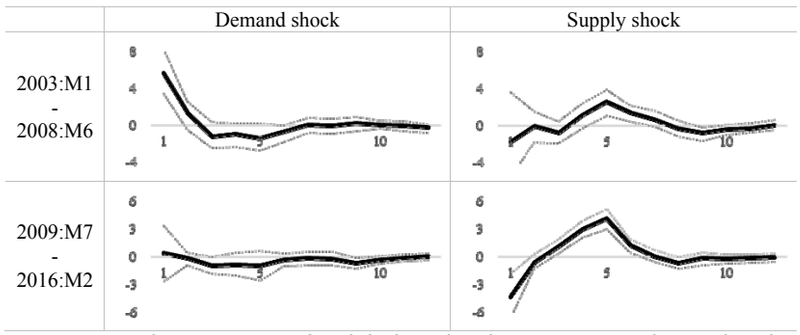

Figure 1. Impulse responses of a global crude oil inventories to demand and supply shocks

The impulse responses during 2009:M7-2016:M2 show that the response of global crude oil inventories to a positive demand shock seems to be rather insignificant. On the other hand, the response of oil inventories to a positive supply shock turns out to be significantly negative for the first two months, with the highest response (-4.37) in the initial month, suggesting an inventory reduction on a speculative motive. Then, responses triggered by supply shock spike to its highest (+4.14) in the fifth month, apparently indicating a buffer function absorbing a glut of oil. Given the absolute values of responses in both shocks, demand shock apparently on the inventory change is outweighed by supply shock impact during the period of low oil prices.

To assess what extent each shock derives changes in global crude oil inventories, forecast error variance decompositions (FEVD) are also calculated for completeness. The results support that in the period of 2003:M1-2008:M6, oil prices demand shock (29.81%) is more important than supply shock (24.04%) in explaining changes in oil inventories. During 2009:M7-2016:M2, on the other hand, the contribution of supply shock (22.69%) to oil inventories is larger than that of demand shock (18.80%).

5. CONCLUDING REMARKS

Oil inventories could react to oil demand and supply shocks either as the buffer to the market or as the facilitator of speculative trading, or both. However, empirical studies that have addressed both behaviors together have been rather sparse. In this article, therefore, we divide the full sample into two distinct periods – 2003:M1-2008:M6 and 2009:M7-2016:M2 and assess the dynamic effects of oil demand and supply shocks on oil inventories in the framework of sign-restricted SVAR. We find that demand shock is the important relative factor in oil price spike during the first period, while supply shock is the main cause for the drop-in oil prices during the second period. We also find that during both periods oil inventories appear to reveal speculative behavior in the early stage of shocks, but later on play a buffer role in mitigating the impact of shocks. In this light, we infer that when examining the effect of oil inventories on the global oil market, researchers need to incorporate both buffer and speculative effects in their models. To our knowledge, these are new findings that have not been documented in the literature yet and hence the main contribution of this article.

Footnote

[1] The results from U.S. crude oil inventories are left out in this article for the limit of pages. The responses of U.S. inventories are found to be consistent with those of global inventories.

References

Kilian, L., and Murphy, D. P. 2014. The role of inventories and speculative trading in the global market for crude oil. *Journal of Applied Econometrics*. 29(3): 454-478.