The Effect of Oil-Price Shocks on Asset Markets: Evidence from Oil Inventory News

Ron Alquist, Ph.D.
Vice President, AQR Capital Management

Reinhard Ellwanger, Ph.D.
Senior Economist, Bank of Canada

Jianjian Jin, Ph.D.
Senior Analyst, Investment Strategy and Risk Department, British Columbia Investment Management Corporation, Canada

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This paper quantifies the reaction of U.S. equity, bond futures, and foreign exchange returns to oil-price shocks. Using instrumental variables methods based on U.S. oil-inventory announcements, the authors find that equity prices decrease in response to higher oil prices before the 2007/08 crisis but increase after it. The U.S. dollar tends to depreciate against a basket of currencies in response to positive oil-price shocks, and this effect is larger after the financial crisis. By contrast, oil-price shocks have a modest effect on bond futures returns. The authors argue that changes in risk premia help to explain the time-varying effect of oil-price shocks on U.S. equity returns.

Introduction

Oil-price fluctuations have important implications for the terms-of-trade, investment, output, and other macroeconomic aggregates of both oil-importing and oil-exporting economies. Even before oil-price shocks are fully transmitted to the real economy, the prices of financial assets adjust to reflect market expectations about the response of macroeconomic fundamentals to such shocks. Recent empirical research has related oil-price fluctuations to variation in equity market returns (Kilian and Park, 2009; Ready, 2017), exchange rates (Chen *et al*., 2010), and interest rates (Datta *et al*., 2018; Kilian and Zhou, 2019).

However, because oil-prices and asset prices move for a variety of reasons -- for example, oil prices and asset prices mutually influence each other and respond jointly to macroeconomic developments -- identifying the effects of oil price fluctuations on asset prices remains a significant challenge. The authors address this challenge by using the information contained in weekly U.S. oil inventory news to investigate and quantify the effect of oil-price shocks on the returns of different financial assets and the shifts in expectations that the changes in returns reflect.

Changes in oil inventories are a fundamental feature of oil markets and play a central role in the intertemporal relationship between current and future supply and demand conditions (Alquist and Kilian, 2010; Kilian and Murphy, 2014). As such, higher-than-expected (lower-than-expected) U.S. oil inventories lead to systematic decreases (increases) in oil prices in the minutes following the announcement. By combining variation in oil prices and a comprehensive, high-frequency data set of the returns of different

financial assets, including stocks, bonds, and exchange rates, the authors study how information about oil-market fundamentals is transmitted to asset prices and the broader economy.

Dr. Reinhard Ellwanger, Ph.D., Senior Economist, Bank of Canada, presenting at the JPMCC's 3rd Annual International Commodities Symposium, which was held at the University of Colorado Denver Business School in August 2019.

Data

The data for commercial U.S. inventories of crude oil, gasoline, and distillate inventories are from the U.S. Energy Information Administration's (EIA's) *Weekly Petroleum Status Report*, which is typically released on Wednesday at 10:30 am Eastern Time. Ahead of each release, Bloomberg collects market participants' expectations about crude oil, gasoline, and distillate inventories. This set of expectations permits the authors to measure the news component of the change in each type of inventory by subtracting the expected change in inventories from the actual change of inventories reported in the release.

The financial asset data are the intraday price series of the S&P 500 Exchange-Traded Fund (ETF) and eight sector-level ETFs, U.S. Treasury bond futures, and selected foreign exchange rates, including those of both commodity-exporting and importing countries. The sample period for the equity and bond returns is 2003M10 to 2017M10, while the exchange rate data start from 2006 or later.

Methodology

The empirical approach is based on instrumental variables (IV) estimation methods that use the three types of inventory news as instruments for nearby WTI futures returns during a narrow window of 15 minutes around the announcement. The predicted values of the oil futures returns are then used as the principal explanatory variables for the various asset returns during the announcement window.[1] Because the inventory news is determined before the EIA release, they are uncorrelated with other macroeconomic news during the announcement. Hence, the IV estimates identify the response of asset returns to oil-market-specific news. Moreover, if their principal effect on the returns of other assets works through the price of oil, the IV strategy identifies the causal effect of oil-price shocks on asset returns. As the authors show, the inventory news explains a significant share of the variation in oil futures prices around the announcement, which is a necessary condition for the IV approach to be valid.

The regressions are estimated using the weekly data from October 2003 to October 2017. Existing evidence suggests that the relation between oil-price fluctuations and asset returns shifted around the time that the financial crisis began. This shift has been documented in reduced-form correlations at a variety of different frequencies (see, e.g., Lombardi and Ravazzolo, 2016; Ait-Sahalia and Xiu, 2016), as well as in the context of structural oil market models (Foroni, *et al*., 2017; Datta *et al*., 2018). The authors' empirical specification includes an interaction term with a time dummy that takes on the value of 1 after September 2008. This specification permits the authors to compute different effects for the pre-crisis and post-crisis period and use conventional t-statistics to test for a structural break around this date.

Results

The empirical results support existing evidence of a structural break in the relation between oil-price shocks and asset returns around September 2008. The authors document that before the 2007/08 crisis, higher oil prices are associated with lower equity market returns, while after the crisis, higher oil prices are associated with higher equity market returns. Both effects are economically significant: a 10% increase in oil prices is associated with a 0.8% decline (1.1% increase) in the aggregate stock market in the pre-crisis (post-crisis) period. Interestingly, the pattern observed in aggregate equity market returns is pervasive across different sectors, including those with limited direct exposure to energy prices, such as health care. The authors also find that the sector ETF that is the most responsive to oil-price fluctuations is the consumer discretionary fund. This result is consistent with the idea that oil-price shocks affect the U.S. economy through their effect on the discretionary income of consumers (Baumeister and Kilian, 2016).

The estimates for bond returns follow the reverse pattern. Bond futures returns tend to increase with higher oil prices pre-crisis and to decrease with higher oil prices after the crisis. While these results suggest that nominal interest rates became increasingly aligned with oil-price fluctuations, the estimates are economically small and indicate that the effects of oil price changes on nominal interest rates are limited. Finally, higher oil prices are associated with a depreciation of the U.S. dollar against a broad range of currencies. This depreciation is particularly strong against currencies of oil exporters (such as the Canadian dollar) and those of other commodity-exporting countries (the Australian dollar). Interestingly,

however, the U.S. dollar also depreciates relative to the currencies of other oil-importing economies, the Euro and the British Pound.

Further, the paper provides evidence for different interpretations of its findings, particularly the time-varying response of U.S. stock market returns to oil-price shocks. For example, oil inventory news might reflect different structural oil-price shocks in the post-crisis period. The authors investigate whether the informational content of U.S. oil inventories about global oil supply or demand conditions changed over time but find little evidence for this claim.

A different interpretation has highlighted the usefulness of investigating the response of stock market returns through their three primitive drivers: expected interest rates, dividends, and risk premia (Boyd *et al*., 2005). The response of interest rates to oil prices, in combination with the time-varying effect of oil prices on equity returns, suggests that oil prices may have become increasingly related to equity risk premia in the post-crisis period. More generally, the results show that oil-price changes associated with inventory news have, on average, a more negative effect on U.S. stock returns than other types of news, highlighting the importance of this transmission mechanism for oil market-specific news.

Conclusion

The authors study the transmission of news from oil markets to financial assets. They find that equity and exchange rate returns react strongly to oil-price shocks, but that bond futures do not. Interestingly, they find equity prices, both in the aggregate and across most sectors, respond differently to oil-price shocks before and after the financial crisis. They attribute this difference to the time-varying equity risk premia across different stages of the business cycle.

Endnotes

Dr. Ellwanger presented on this topic at the JPMCC's 3rd Annual International Commodities Symposium during the "Issues on Mineral and Oil Markets" session, which took place on August 13, 2019. The symposium, in turn, was organized by Professor Jian Yang, Ph.D., CFA, the J.P. Morgan Endowed Chair and JPMCC Research Director at the University of Colorado Denver Business School.

For further coverage of the crude oil markets, one can read past *GCARD* articles on these markets.

1 In practice, the IV estimations are implemented using a 2SLS procedure, which accounts for estimation uncertainty in the 2nd stage regression.

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Author Biographies

RON ALQUIST, Ph.D.
Vice President, AQR Capital Management

Dr. Ron Alquist is a Vice President at AQR Capital Management. He has published his research in both academic and practitioner journals. He received his Ph.D. from the University of Michigan.

REINHARD ELLWANGER, Ph.D.
Senior Economist, Bank of Canada

Dr. Reinhard Ellwanger is a Senior Economist in the International Economic Analysis department at the Bank of Canada. He received a Ph.D. from the European University Institute in Florence (Italy) in 2015.

Dr. Ellwanger had previously contributed an article to the Summer 2019 issue of the *GCARD* on the "Simple Economics of Global Fuel Consumption."

JIANJIAN JIN, Ph.D.
Senior Analyst, Investment Strategy and Risk Department, British Columbia Investment Management Corporation, Canada

Dr. Jianjian Jin is a Senior Analyst in the Investment Strategy and Risk Department of British Columbia Investment Management Corporation. Prior to that he was a Senior Analyst at the Bank of Canada. He received his Ph.D. in Economics from Northwestern University.