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OIL AND MACROECONOMIC UNCERTAINTY

By Andrea Bastianin* and Matteo Manera †

In this article we discuss the concepts of macroeconomic uncertainty, oil price uncertainty and oil price shocks. Given the relevance of oil and macroeconomic uncertainty in both academic research and the political sphere, we illustrate how economic uncertainty can be operationally defined and empirically measured. After surveying some common proxies of macroeconomic uncertainty, we describe our proposed measure of oil price uncertainty, and we illustrate the contribution of its underlying components, namely uncertainties related to oil consumption and production, economic activity and oil inventories.

Keywords: Macroeconomic Uncertainty, Oil Price Uncertainty, Oil Price Shocks, Oil Price

JEL Classification: C32, C58, E44, Q41, Q43

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Introduction

A "shock" to a specific macroeconomic variable is defined as an unpredictable change in that variable. The concept of "macroeconomic uncertainty" can be visualized as the inability to fully predict the behavior of the very many variables which form the structure of an economic system. Therefore, it is evident that macroeconomic shocks and macroeconomic uncertainty are related, the linkage being the unforecastable components of the underlying economy.

Following these definitions and concentrating on the oil market, oil price shocks, which are unpredictable changes in the price of crude oil, have been blamed for a variety of negative effects on world economies (see e.g. Bastianin and Manera, 2014, Froggatt and Lahn, 2010, Kilian, 2014 and *The Economist*, 2012), and are generally perceived to occur when there is a high degree of uncertainty about oil market fundamentals.

There are both theoretical and empirical arguments that justify why macroeconomic uncertainty is so often quoted by policy makers, economists and in the headlines of newspapers.

The so-called "real option theory", for instance, suggests that decision-making is affected by macroeconomic uncertainty because it raises the option value of waiting. In other words, given that the cost of wrong investment decisions is very high, uncertainty makes firms (and, in the case of durable goods, also consumers) more cautious. As a consequence, economic agents tend to postpone investment, hiring and consumption decisions to periods of lower uncertainty, which in turn can generate cyclical fluctuations in macroeconomic aggregates.

Moreover, many empirical studies have shown that, at least in the short-run, macroeconomic uncertainty has negative effects on growth (for a survey, see Bloom, 2014). Macroeconomic uncertainty and, in particular, oil price uncertainty, have also been identified among the prime suspects for driving the Great Recession of 2007-09 and slowing down the subsequent recovery (Stock and Watson, 2012).

Finally, macroeconomic uncertainty is not only a topic for academic research, but is also a practical concern for policy makers around the globe. As an example, in 2009 Gordon Brown and Nicolas Sarkozy wrote an op-ed in the Wall Street Journal stating that: "The oil market is complex, but such erratic price movement in one of the world's most crucial commodities is a growing cause for alarm. The surge in prices last year gravely damaged the global economy and contributed to the downturn. The risk now is that a new period of instability could undermine confidence just as we are pushing for recovery."

Given the relevance of oil and macroeconomic uncertainty in both academic research and the political sphere, we dedicate the remaining part of this article

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to illustrate how economic uncertainty can be operationally defined and empirically measured.

Operating measures of oil and macroeconomic uncertainty

Loosely speaking, macroeconomic uncertainty echoes the difficulty to predict the future evolution of a macroeconomic variable of interest. More formal and widely accepted definitions of uncertainty were provided by the Chicago economist Frank Knight, who defines uncertainty as a sequence of random events whose odds of happening cannot be measured, and keeps uncertainty distinct from risk, which is instead related to random episodes with known, or at least measurable, probability of occurrence (Knight, 1921). This theoretical definition, however, is not empirically helpful, since most measures of economic uncertainty are based on both predictable and unpredictable components.

A case in point is the Market Volatility Index (VIX, henceforth) issued by the Chicago Board Options Exchange. The VIX, also known as "fear index", represents the investors' expectations of stock market volatility over the next month. While this measure is clearly forward-looking and, as can be seen in Figure 1, it is characterized by jumps in correspondence of major economic and political events, VIX is also a predictable component driven by factors associated with risk, in addition to economic uncertainty (see Bekaert et al., 2013).

Other oft-used empirical measures of uncertainty are based on the variability, across individuals, of forecasts provided by participants to surveys such as the ECB's Survey of Professional Forecasters. One problem with these measures is that it is not clear to what extent they capture uncertainty over future outcomes, rather than disagreement among forecasters.

Recently, Jurado et al. (2015) have provided an alternative measure of macroeconomic uncertainty that is forward-looking and directly related to "whether the economy has become more or less predictable" (Jurado et al., 2015, p. 1178). Macroeconomic uncertainty is measured by taking the sample average of the volatility of the unforecastable component of a number of economic and financial variables *[Note 1]*.

While a large and growing body of literature, both theoretical and empirical, has addressed the questions of how to measure macroeconomic uncertainty and whether it matters for the business and financial cycles (Bloom, 2014), the number of studies focusing on oil price uncertainty is more limited.

The measurement of uncertainty in the global market for crude oil starts from the premise that the volatility of oil prices can adequately represent the uncertainty deriving from the complex set of variables that contribute to price determination. The literature has developed measures of oil uncertainty based on backward-looking, as well as on forward-looking proxies of the variance of oil prices (Elder and Serletis, 2010; Jo, 2014). Alternative measures of oil price uncertainty are grounded on the implied volatility of options on NYMEX futures (Kellog, 2014). This last approach is also followed by the U.S. Energy Information Administration, which publishes the Energy Price Volatility and Forecast Uncertainty report as a supplement to the Short-Term Energy Outlook (see EIA, 2009).

A new measure of oil price uncertainty

A common feature of existing oil uncertainty measures is that they are based on the volatility of a single oil price series. However, since the characteristics that a specific crude should satisfy in order to be considered a "benchmark" are not univocally identified (see, among others, Bastianin et al., 2014), practitioners tend to use more than one crude price to track the dynamics of the reference price of oil. A case in point is Platts, a leading energy price reporting agency, which relies both on Brent and WTI to assess the price of refined oil products during periods when the NYMEX market is unexpectedly closed.

For this reason, we have recently developed a measure of oil uncertainty for the global oil market that takes into account the uncertainty related to the difficulty of forecasting a set of oil price series. Our measure of oil uncertainty has been presented and discussed at the Fourth International Workshop on "Recent Evolutions of Oil and Commodity Prices", organized by the Fondazione Eni Enrico Mattei, Milano, 4-5 June 2015. Specifically, we have drawn on the methodology of Jurado et al. (2015) to construct a new measure that aggregates price uncertainty for WTI, Brent, Dubai and the acquisition cost of imported crude oil for U.S. refiners. These variables are widely acknowledged to represent the price of crude oil of different qualities, as well as four of the most closely tracked reference oil prices.

Figure 2 illustrates our proposed measure of oil price uncertainty. As in the case of other measures of uncertainty and stock market volatility (see Bastianin and Manera, 2014 for a survey), our index is negatively correlated with the business cycle, that is it rises during contractions and falls during expansions, with a correlation coefficient with the growth rate of industrial production in the U.S. equal to -0.40.

Oil price uncertainty has steadily increased since the 1970s, displaying a partial turnaround only after the recent financial crisis. Its dynamics reflects the behavior of a multitude of variables that contribute to the formation of price in the world market for crude oil, such as oil consumption and production, the global business cycle, as well as oil inventories.

Figure 3 shows that uncertainties on oil consumption (Figure 3, panel b) and production (Figure 3, panel d) have steadily fallen since the 1970s. The pattern of the uncertainty related to the global business cycle is similar (Figure 3, panel c), except that it is increasing since 2005. Lastly, uncertainty on oil inventories (Figure 3, panel e) has remained remarkably constant.

The contemporaneous rise of oil price uncertainty (Figure 3, panel a) and a fall in oil production uncertainty (Figure 3, panel d) is not difficult to motivate. Recent modifications of energy intensity trends in many industrialized countries, as well as a multitude of structural transformations of the global market for crude oil have generated a change in the elasticities of oil demand and oil supply which are capable to account for the rise of oil price uncertainty and the fall of oil production uncertainty. For instance, with the development of the oil futures market in the 1980s consumers and producers have hedging opportunities that might have contributed to reduce their responsiveness to oil price changes (Baumeister and Peersman, 2013).

Conclusions

We have illustrated that the measurement of macroeconomic uncertainty, and oil uncertainty in particular, is inherently a difficult task, essentially because of the intrinsic unobservable nature of uncertainty. Although many attempts have been made, the literature is far from reaching a consensus view on the appropriate way of measuring oil price uncertainty, how to incorporate this measure in macroeconomic models and how serious are its impacts on the global business and financial cycles. These facts suggest a promising avenue for perspective academic research and policy debate.

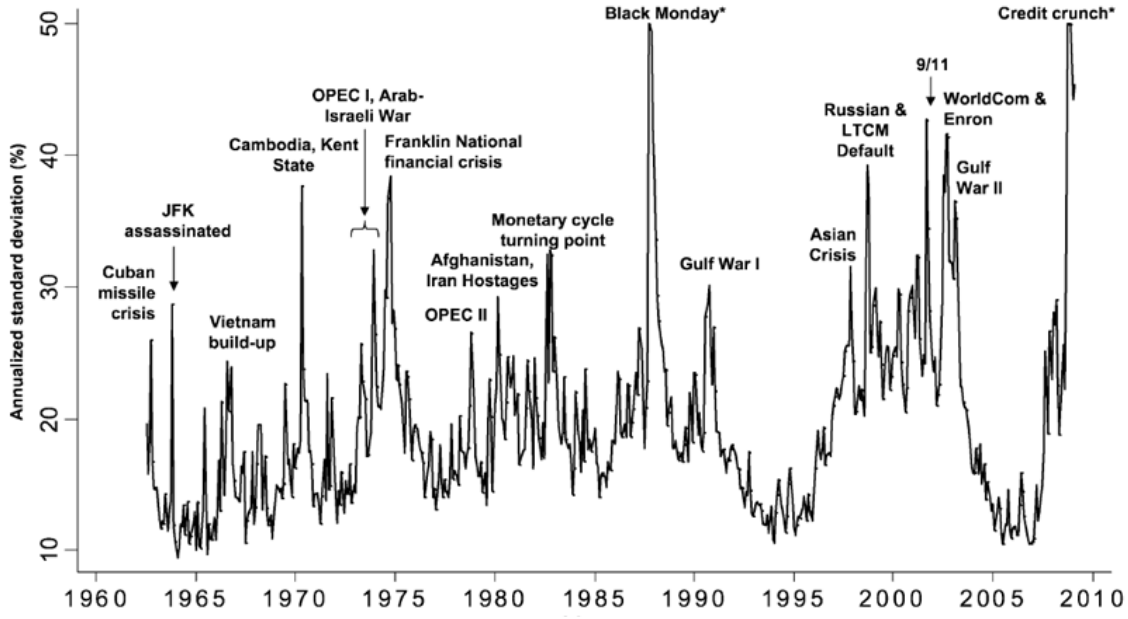
Notes

[Note 1] More specifically, the approach of Jurado et al. (2015) entails the following steps. A large number of economic variables are collected so as to represent the economy under analysis. For each of these variables a forecast is produced using a combination of the past values of all the variables in the dataset. A forecast error is constructed as the difference between the actual and the forecast values. The volatility of the forecast error for each variable, or individual uncertainty, is modeled and estimated as a linear function of its own past values plus a stochastic component. This procedure is repeated for each variable in the dataset and

the measure of macroeconomic uncertainty is computed by averaging the individual uncertainties.

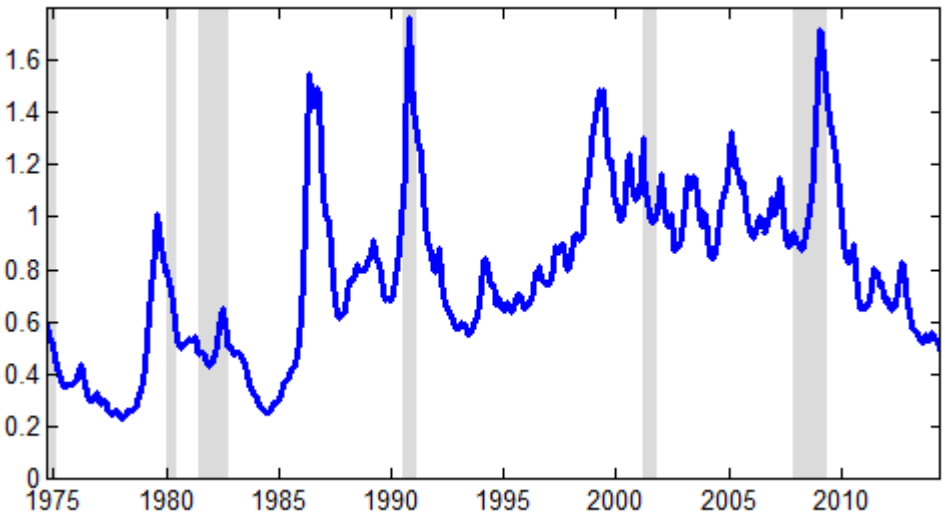
Figures

Figure 1 - Chicago Board Options Exchange Market Volatility Index (VIX)



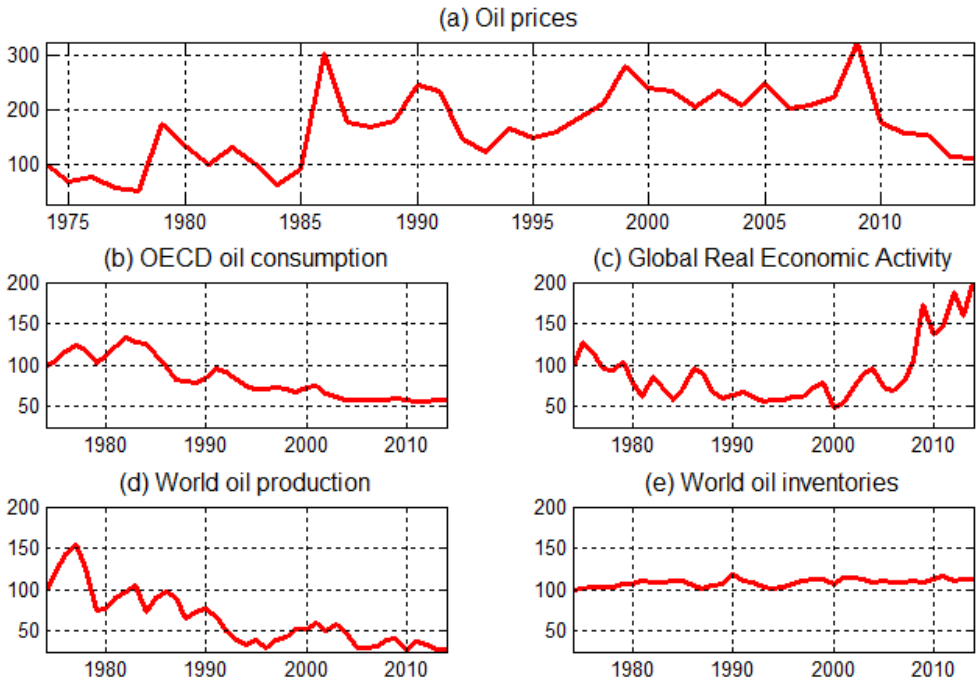
Source: Bloom (2009).

Figure 2 - Oil price uncertainty 1974:10 – 2014:6



Notes: Shaded areas represent the following U.S. recession periods: Nov. 1973-Mar. 1975; Jan. 1980-Jul. 1980; Jul. 1981-Nov. 1982; Jul. 1990-Mar. 1991; Mar. 2001-Nov. 2001; Dec. 2007-Jun. 2009.

Figure 3 - Uncertainty of oil price and its fundamentals: 1974 – 2014



Notes: This figure shows the uncertainty associated with: Oil prices (panel a), OECD oil consumption (panel b), Global real economic activity, as measured by the Kilian's index (panel c), World oil production (panel d) and World oil inventories (panel e). All series have been normalized to 100 in 1974, so that a value above 100 indicates an increase.

References

Bastianin A. and Manera, M. (2015)."How Does Stock Market Volatility React to Oil Shocks?", Working Papers 2014.110, Fondazione Eni Enrico Mattei.

Bastianin, A., Galeotti, M. and Manera, M. (2014) "Forecasting the oil–gasoline price relationship: Do asymmetries help?," *Energy Economics*, 46(S1): S44-S56

Baumeister, Christiane, and Gert Peersman (2013) "The Role of Time-Varying Price Elasticities in Accounting for Volatility Changes in the Crude Oil Market." *Journal of Applied Econometrics*, 28, 1087–1109.

Bekaert, G., Hoerova, M., and Lo Duca, M. (2013). "Risk, uncertainty and monetary policy," *Journal of Monetary Economics*, 60(7): 771-788.

Bloom, N. (2009). "The impact of uncertainty shocks". *Econometrica*, 77(3):623-685.

Bloom, N. (2014). "Fluctuations in Uncertainty", *Journal of Economic Perspectives*, 28(2), 153-76.

Brown, G. and N. Sarkozy (2009) "We must address oil-market volatility", *The Wall Street Journal*, July 8, 2009, http://www.wsj.com/articles/SB124699813615707481

EIA, (2009) "Short-Term Energy Outlook Supplement: Energy Price Volatility and Forecast Uncertainty", available online at: http://www.eia.gov/forecasts/steo/special/pdf/2009_sp_05.pdf

Elder, J. and A. Serletis. (2010) "Oil Price Uncertainty", *Journal of Money, Credit and Banking*, 42, 1137–59.

Froggatt, A. and G. Lahn (2010), "Sustainable Energy Security: Strategic Risks and Opportunities for Business", Chatham House-Lloyd's 360° Risk Insight White Paper, http://www.chathamhouse.org/publications/papers/view/109360, June 1, 2010.

Jo, S. (2014) "The Effects of Oil Price Uncertainty on Global Real Economic Activity", *Journal of Money, Credit and Banking*, 46(6): 1113-35.

Jurado, K., Ludvigson, S. C., and Ng, S. (2015). "Measuring Uncertainty", *American Economic Review*, 105(3):1177-1216.

Kellogg, R. (2014). "The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling", American Economic Review, 104(6): 1698-1734.

Kilian, L. (2014) "Oil Price Shocks: Causes and Consequences", *Annual Review of Resource Economics*, 6, 133-154.

Knight, F. (1921). "Risk, Uncertainty, and Profit", Boston, Mass.: Hart, Schaffner & Marx/Houghton Mifflin.

Stock, J.H. and M. Watson (2012) "Disentangling the Channels of the 2007-2009 Recession", *Brookings Papers on Economic Activity*, 81-135.

The Economist (2012) "Another oil shock? The right and wrong ways to deal with dearer oil", *The Economist*, March 10, 2012, http://www.economist.com/node/21549941.

Links

International Workshop on "Recent Evolutions of Oil and Commodity Prices"