Journal of Banking & Finance
Volume 37, Issue 1, January 2013, Pages 206-226

Oil price dynamics, macro-finance interactions and the role of financial speculation

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https://doi.org/10.1016/j.jbankfin.2012.08.027

Abstract

What is the role of financial speculation in determining the real oil price? We find that while macroeconomic shocks have been the main real oil price upward driver since mid-1980s, financial shocks have sizably contributed since early 2000s as well, and at a much larger extent since mid-2000s. Even though financial shocks contribute 44% out of the 65% real oil price increase over the period 2004–2010, the *third oil price shock* is a *macro-finance* episode: macroeconomic shocks actually largely account for the 2007–2008 oil price swing. While we then find support to the demand side view of real oil price determination, we however also find a much larger role for financial shocks than previously noted in the literature.

Highlights

► We assess the contribution of financial speculation to real oil price determination. ► We find that macroeconomic shocks are the main oil price driver since mid-1980s. ► Financial shocks also matter since mid-2000s, more than previously noted. ► This is consistent with the progressive financialization of the oil futures market. ► The third oil price shock is however a macro-finance episode.

Introduction

After about two decades of stability, both nominal and real oil prices have been increasing since 2003 (US$ 30 per barrel), with unprecedented volatility in 2008, as nominal oil prices peaked up at US$ 140 in July, to bottom down at US$ 40 in December; oil prices have mostly been increasing thereafter, achieving a new peak in April 2011 (US$ 110).

Recent trends, hikes and volatility have indeed revived the debate on the factors contributing to oil price determination, and two main explanations for the *third oil price shock* have so far been proposed in the literature: firstly, increasing oil demand, due to rapid growth in emerging countries and stable OECD oil consumption (Kilian, 2008, Kilian, 2009a, Kilian, 2009b) or to expansionary monetary policies (Frankel, 2007, Calvo, 2008, Kilian, 2010), in the face of stagnant oil production; secondly, increased speculation in the oil futures market since mid-2000s (Davidson, 2008, Krugman, 2008, Krugman, 2009, Masters, 2009, Masters and White, 2008).

While strong empirical support for the economic growth hypothesis is found in the literature (Kilian and Murphy, 2010, Kilian and Hicks, forthcoming, Hamilton, 2009a, Hamilton, 2009b, Baumeister and Peersman, 2008, Dvir and Rogoff, 2010), the empirical evidence in favor of the excess liquidity explanation is weak. For instance, Barsky and Kilian, 2002, Barsky and Kilian, 2004, Kilian, 2010 point to a positive linkage between liquidity conditions and the real oil price over the 1970s; yet, beyond any effect exercised through real activity and inflation, there is little evidence of liquidity and interest rate direct effects (see also Anzuini et al., 2012; SPS Name, SPS Year; Frankel and Rose, 2010). Moreover, the impact of liquidity on the real oil price is only transitory, and therefore unlikely to account for the 2008 episode (Erceg et al., 2011).

On the other hand, the narrative evidence on the contribution of excess speculation to recent oil price dynamics is based on the steady increase in the market share of non-hedging open interest positions in the US commodity futures and option markets,[1] following the financial liberalization provisions contained in the US Commodity Futures Modernization Act (CFMA) passed in 2000.[2]

Since 2005 *contango*, rather than *backwardation* as over the 1980s and 1990s, has prevailed in the oil futures market: the increased presence of non-commercial investors, seeking portfolio diversification, might have indeed lead to a reversal in the receipt of the premium, i.e., from arbitrageurs to oil producers, rather than the other way around (Hamilton and Wu, 2011). This might also be indicative of a structural shift in inventories management, as contango (backwardation) is in general associated with a high (low) level of inventories, which may be induced by speculative behavior (Gorton et al., 2008). Alquist and Kilian (2010), actually document that the twelve-month oil futures spread $\left(future_t^{12} - spot_t\right)$ is strictly related to precautionary/speculative oil demand shocks; yet, the latter linkage, as well as the entire oil futures price term structure (Fattouh and Scaramozzino, 2011), has undergone structural change since 2004.

Albeit heterogeneous behavior in the oil futures market – crucial condition for financial speculation to be destabilizing – is actually documented in various papers (Vansteenkiste, 2011, Reitz and Slopek, 2008, ter Ellen and Zwinkles, 2010, Ciffarelli and Paladino, 2010), the empirical evidence on its effects is controversial.

For instance, some studies, based on US Commodity Futures Trading Commission (CFTC) data, find that speculation has dampened price volatility since mid-2000s, by increasing oil futures market liquidity (Brunetti et al., 2010, Buyuksahin et al., 2009). Moreover, there is no evidence of Granger causality from trading positions to futures oil prices, but some support to the view that oil prices lead trading positions (Buyuksahin and Harris, 2011, Alquist and Gervais, 2011, Irwin and Sanders, 2012). Also, both hedging and non-hedging traders in the oil futures market would herd (Buyuksahin and Harris, 2011); yet, herding behavior by hedge funds, by being countercyclical, is not destabilizing (Boyd et al., 2009). Differently, other papers find herding behavior by speculators contributing to the 2008 price hike (Frankel and Rose, 2010), the thirteen-week change in the imputed positions of index investors and in the managed-money spread positions predicting weekly oil futures price returns (Singleton, 2011), (negative) Granger causality from the Working's-T index to oil futures prices (Manera et al., 2012), endogeneity of crude oil – and other individual commodities – futures prices relative to Commodity Linked Note (CLN) trades (Henderson et al., 2012), and support for hedging pressure mechanisms (Melolinna, 2011, Acharya et al., 2012, Mou, 2011, Etula, 2010, Hong and Yogo, 2011).

Within the framework of structural vector autoregressive models, Kilian and Murphy (2010) also find evidence against any role of financial speculation in the recent oil price episode, while according to Juvenal and Petrella (2011) and Lombardi and Van Robays (2011), speculative (non-fundamental) financial shocks account for 15% of the real oil price increase between 2004 and 2008 and a 10% real oil price overshooting between August 2007 and June 2008, respectively. Finally, Phillips and Yu, 2011, Gilbert, 2010 point to a speculative bubble in the real oil price, originating in March 2008, and therefore posterior to the collapse of the housing bubble dated June 2007, consistent with the theory of migrating bubbles of Caballero et al., 2008a, Caballero et al., 2008b, Shi and Arora, 2012 yield supporting evidence for the latter finding.

In the light of the contrasting empirical evidence, the current paper then aims at assessing the role of financial speculation in the recent oil price episode, providing original contributions under different perspectives.

Firstly, large-scale modeling of the oil market-macro-finance interface is implemented, considering macro-financial data for fifty countries, including OECD and emerging economies, and a detailed description of oil physical and futures market conditions. Single country macro-financial data are used to estimate the *unobserved* factors driving the global business and financial cycle; additional *observed* US financial factors, proxying for expectations about future fundamentals and economic/financial fragility conditions are also considered: the size and value Fama and French (1993) factors, the Carhart (1997) momentum factor, the Pastor and Stambaugh (2003) liquidity factor, the Adrian et al. (2012) leverage factor and the Bagliano and Morana (2012) economic/financial fragility index, in particular.

The careful and large-scale modeling of the oil market macro-finance interface surely is an important novelty of our study; while Kilian and Murphy (2010), by including inventories in their model, do allow for a financial oil demand component and, indirectly, for the effect of future fundamentals on oil demand, our contribution, by conditioning on risk factors, is the first attempt to *directly* measure their effects; by including measures of excess speculation, our study also aims at disentangling the fundamental and non-fundamental components of financial oil demand, similar to Juvenal and Petrella, 2011, Lombardi and Van Robays, 2011, which are left indistinct in Kilian and Murphy (2010); yet, relatively to Juvenal and Petrella, 2011, Lombardi and Van Robays, 2011, disentangling is more accurate as, by conditioning on risk factors, liquidity, interest rates and portfolio's diversification opportunities, non-fundamental speculative shocks can be identified. We do find that without a careful description of the financial side, shocks and transmission mechanisms which are important to the understanding of the working of the oil market would go neglected.

Secondly, the proposed modeling approach sheds new insights on the determination of the real oil price: while we confirm that, at least since mid-1980s, macroeconomic shocks have been the major upward driver of the real oil price, we also find a sizable contribution of oil market supply side and financial shocks since early 2000s. In general, differently from oil market supply side shocks, macroeconomic and financial shocks had a stabilizing effect on nominal oil price volatility.

The impact of financial shocks has surely been remarkable since mid-2000s, contributing 44% out of the 65% real oil price increase over the period 2004 through 2010. Yet, the third oil price shock is a *macro-finance* episode: macroeconomic shocks account for 58% out of the 68% real oil price run up over the 2007(2)–2008(2) period, and financial shocks for 6% in 2007(4); moreover, the −67% and −31% contractions in 2008(4) and 2009(1) are also largely accounted for by macroeconomic shocks (−40% and −26%), with financial shocks (−14% and −7%) also sizably contributing; the 54% real oil price increase over the 2009(2) through 2009(4) period is finally equally accounted for by macroeconomic (21%) and financial (20%) shocks.

In 2010, following the subprime crisis and the large oil (and other commodities) price swings, regulatory reforms aimed at promoting financial stability were then launched in the US[3] and EU.[4] With reference to the commodity derivatives market, among other provisions, the latter reforms reintroduce position limits for financial investors, to safeguard price discovery in the futures market. More recently, a proposal for the introduction of a EU global financial transaction tax[5] has been put forward; such a provision, if endorsed at a global level, would also contribute to indirectly controlling OTC trading and speculative positions in commodities futures markets.

While the results of this study would then provide empirical support to the regulatory changes proposed and implemented since 2010, they would not however be consistent with an explanation of the third oil price episode neglecting the contribution of macroeconomic developments.

The paper is organized as follows. In Section 2 the econometric methodology is introduced, while in Section 3 the data are presented. Then, in Section 4 specification and estimation issues are discussed, while in Sections 5 Forecast error variance decomposition, 6 Impulse response analysis, 7 Historical decomposition: the oil price-macro-finance interface the empirical results are presented. Finally, conclusions are drawn in Section 8.

Section snippets

The econometric model

The econometric model is described by two blocks of equations. The first block refers to the *observed* ($\mathbf{F}_{2,t}$) and *unobserved* ($\mathbf{F}_{1,t}$) global macro-financial factors and oil market demand and supply side variables ($\mathbf{O}_t$), collected in a $r\times 1$ vector $\mathbf{F}_t = \left[\mathbf{F}'_{1,t}\mathbf{F}'_{2,t}\mathbf{O}'_t\right]'$, while the second block refers to q macro-financial variables for m countries, collected in a $n\times 1$ vector $\mathbf{Z}_t$ ($n=m\times q$). The joint dynamics of the "global" macro-finance-oil market interface (the global economy thereafter) and the "local"…

The data

We use seasonally adjusted quarterly macroeconomic time series data for 31 advanced economies (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, United Kingdom), five advanced emerging economies (Brazil, Hungary, Mexico, Poland, South Africa), and 14 secondary…

The global oil market-macro-finance interface model: specification and estimation

The global model for the oil market macro-finance interface in (1) counts 33 endogenous variables, collected in the vector $\mathbf{F}_t = \left[\mathbf{F}'_{1,t}\mathbf{F}'_{2,t}\mathbf{O}'_t\right]'$, with $\boldsymbol{\kappa}_t=\boldsymbol{\kappa}$. For PC-VAR estimation, 12 principal components of $\mathbf{F}_t$, jointly accounting for 80% of total variance, and three lags are selected, according to Monte Carlo results (Morana, 2012a) and specification tests. Hence, 36 parameters are estimated for each of the 33 equations in the model. Note that, given the sample size available, the estimation of an…

Forecast error variance decomposition

Median forecast error variance decompositions are computed up to a horizon of 10years (40 quarters). Results for the oil market variables are reported in Table 1, for selected horizons; for expository purposes, we denote as very short-term the horizon within two quarters, short-term the horizon between 1 and 2years, medium-term the horizon between three and five years, and long-term the 10-year horizon. Rather than focusing on the contribution of each structural shock, results are discussed…

Impulse response analysis

Concerning the transmission mechanisms of the structural shocks, the impulse response analysis is reported in Fig. 1, Fig. 2 for the real oil price and in Table 2, Table 3, Table 4 for all the oil market variables, over selected horizons, as for the forecast error variance decomposition analysis. In all cases median cumulated responses have been computed with 90% significance bands; significant figures at the 10% level, are shown in bold.…

Historical decomposition: the oil price-macro-finance interface

In order to gauge the effects of various categories of shocks on the level of the real oil price and nominal oil price volatility, as for the forecast error variance decomposition analysis, in Fig. 3, Fig. 4 the cumulative historical decomposition (net of base prediction) for the real oil price growth rate and nominal oil price volatility changes, over the period 1986:4 through 2010:3, is reported. To facilitate visual inspection, the initial value is set equal to zero in all cases and a spline …

Conclusions

In 2010, following the subprime crisis and the large oil (and other commodities) price swings, regulatory reforms aimed at promoting financial stability were launched in the US and EU. With reference to the commodity derivatives market, among other provisions, the latter reforms reintroduce position limits for financial investors, to safeguard price discovery in the futures market from potential distortions yield by excess speculation. More recently, a proposal for the introduction of a EU…

Acknowledgements

The paper benefited from comments by participants at the Fondazione Eni Enrico Mattei (FEEM) workshops on “Oil Prices and Financial Speculation”, Milan, July and November 2011; the University of Limerick workshop on “New Directions in Modeling International Finance”, Limerick, November 2011; the 20th Symposium of the Society for Non-linear Dynamics and Econometrics, Instanbul, April 2012; the Bank of England, MMF and CAMA workshop on “Understanding Commodity Prices”, London, May 2012; the 15th…

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