The effect of the financial sector on the evolution of oil prices: Analysis of the contribution of the futures market to the price discovery process in the WTI spot market

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ABSTRACT

The aim of this article is to empirically measure the contribution of the futures market to the price discovery process in the spot market for benchmark crude oils, specifically that for West Texas Intermediate (WTI). For this purpose, we test the hypothesis that the recent evolution of the financial markets has affected the future oil market so as to increase its contribution to the price discovery process of the spot market. We modeled the relation between WTI spot and future prices as a cointegration relation. By using the Kalman filter technique, it was possible to obtain a time-varying measure of the contribution of future markets to the price discovery mechanism. The results show that in the case of WTI, the contribution of the futures market has been increasing, especially between 2003 and 2008 and then again after the start of 2009, evidencing the growing importance of factors particular to the financial markets in determining oil prices in recent years. During 2009, the spot prices adjusted to agents' future expectations rather than to the current supply and demand conditions.

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1. Introduction

The "price of oil" is a variable with a significant impact on the economy of virtually all countries, be they petroleum importers or exporters. For large consuming countries, this impact is the result of the dominant presence of fossil fuels to supply the energy needs of the transport sector, for both freight and passengers. According to the International Energy Agency (IEA, 2008), oil accounted for around 36% of global final energy consumption in 2006, while in the transport sector, which is responsible for 27.5% of total final energy consumption, petroleum products accounted for 94.5% of final energy use. In turn, for the main producing nations, the oil price affects the economy both through the trade balance and the fiscal balance, because oil exports in many of these countries account for over 80% of revenues and foreign exchange, according to the Organization of Petroleum Exporting Countries (OPEC, 2010).

Data from the U.S. Department of Energy show that in the past 20 years oil prices have fluctuated hugely.[1] Although most of the

1990s were marked by a certain stability, with the spot price of WTI fluctuating around US$15/bbl to US$20/bbl, at the end of that decade, after an economic crisis that dragged the price down close to US$10/bbl, a process of steady rise began, with ever higher prices successively setting new records during the 2000s, peaking at US$145/bbl in July of 2008. Then there was a sharp decline caused by the global economic crisis at the end of 2008, taking WTI down to US$40/bbl, after which it recovered to above US$75/bbl in 2010. It is currently threatening to break new record highs.

For these reasons, it is worth studying in detail the factors behind movements in the "price of oil". According to Energy Intelligence (2007), more than 180 oil streams are traded in the world, each one with its own characteristics and price. Indeed, petroleum is not a homogenous commodity. Therefore, before trying to determine the factors behind these price movements, it is necessary to identify which crude oil(s) is(are) most relevant for analysis.

According to Mabro (2005), the oil market underwent substantial transformations in the 1980s, and these changes still serve to define the market fundamentals. Until the collapse of oil prices in 1986, the most relevant crudes in terms of pricing were those sold by the large producing countries in the Middle East, whose prices were set by those nations' governments. These were called "government selling prices" or "official selling prices" (GSPs or OSPs). Nevertheless, even in this period the spot market for trading of physical deliveries

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[1] The prices presented in this paragraph are in current dollars.

Nomenclature

S_t	Logarithm of the spot WTI price
F_t	Logarithm of the first month future WTI price
β_t	Term that corresponds to the difference between the spot and future prices and aggregates information on the risk premium, convenience yield, storage costs and financial costs
α^S_t	Adjustment coefficient of the spot price error correction equation
α^F_t	Adjustment coefficient of the future price error correction equation
ε^F_t	White noise present in the future price error correction equation
c^F_1 and c^F_2	Coefficients that accompany the deterministic terms in the future price error correction equation
c^S_1 and c^S_2	Coefficients that accompany the deterministic terms in the spot price error correction equation
ε^S_t	White noise present in the spot price error correction equation
A_{2t}	State variable analogous to the coefficient α^S_t
A_{1t}	State variable analogous to the coefficient α^S_t
δ	Measure of the contribution of the future market to the price discovery process
δ_t	Measure of the contribution of the future market to the price discovery process over time
η_{1t}	White noise of the equation that describes the evolution of state A_{1t}
η_{2t}	White noise of the equation that describes the evolution of state A_{2t}

Subscripts

t	Time

Superscripts

S	Term referring to the spot price
F	Term referring to the future price

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was already relevant, and although the spot market only accounted for about 5% of global oil transactions (Energy Intelligence, 2007), the prices in this market influenced the formation of the GSPs or OSPs of the producing countries.

In 1986, as described by Mabro (2005), the first oil sale contract appeared using a formula containing a spot price as a benchmark for the price level, plus a spread.[2] That practice then started to disseminate to the various exporting countries until it became the main basis of the oil price formation architecture, as it still is today. In general lines, for a determined oil stream, crude oils said to be benchmarks are used as references for the level of prices, while the specific price of the stream in question is defined through a differential in relation to the price of the benchmark crude. According to Mabro and Horsnell (1993)) and Bacon and Tordo (2005), this differential is influenced by a series of factors, among them the physical chemical properties of the particular crude involved, its refinery yield, supply and demand conditions, commercial strategy of the producer, logistics and geopolitical aspects.

Because of this underlying importance, the price of benchmark crudes has become a focus of analysis. Unlike the crude oils from the Middle East, whose prices were basically administered in the 1960s and 70s, the prices of benchmark crudes are defined by competitive mechanisms. This occurs between a large number of buyers and sellers engaged in daily transactions with physical deliveries of oil, permitting definition of the price.

Over time, however, the markets for benchmark oils have become more sophisticated and complex, due to two main factors:

a) Under the system of administered prices, the prices changed according to a defined frequency and after a certain degree of evaluation of the political and market conditions by those responsible for setting the OSPs/GSPs. In contrast, the prices defined in a competitive market vary several times a day, as a result of instantaneous and decentralized assessments of the market conditions by the participants. This level of uncertainty and volatility results in greater risk for the participants, a risk that in turn prompted the development of hedging mechanisms to manage it.

b) In theory the physical markets in which benchmark crudes are traded depend on a relatively broad base to exist. As shown by Mabro (2005), with the passage of time the output of these benchmark crudes declined and the volume of transactions in these markets also diminished. This fact led to squeezes[3] and hampered the use of these prices to value other transactions, because the spread of new information about the market in terms of prices was impaired.

The development of markets for derivatives (mainly for future contracts) for these oils performed an important role in solving the problems raised by the above authors. According to Garbade and Silber (1983), the transfer of risk and the contribution to the price discovery process are the main two advantages of futures markets for the organization of economic activity.

The price discovery function is defined in Garbade and Silber (1983) as the ability of a market to quickly reflect the arrival of new information in terms of price variations. In the case of petroleum, the market for future contracts helps transmit information to the spot market.

In the debate over the reasons for the movement of oil prices in the past decade, the role played by the evolution of financial markets has been a constant theme in the literature. As can be seen in Kaufmann (2011), Interagency Task Force on Commodity Markets (2008) and Medlock III and Jaffe (2009)), among others, this evolution is the reason behind the existence of "speculative" impacts on prices. These "speculative" impacts, in turn, are contrasted with the so-called "fundamentals", which are interpreted as the physical factors of the oil market: supply, demand, reserves and stocks.

Based on the fact that the evolution of the financial markets more directly affects the prices of future oil contracts than spot prices, this article seeks to empirically measure the degree of contribution of financial markets to the price discovery process in the spot markets for benchmark crudes. Therefore, we test the hypothesis that the recent evolution of the financial markets has affected the market for future oil contracts so as to expand its contribution to the price discovery process of benchmark crudes. The non-rejection of this hypothesis provides evidence to support the idea that the evolution of petroleum futures markets can be related to the growing importance of financial factors in driving the price movements of benchmark oils.

In terms of expected results, in carrying out an extensive analysis of the Granger causality with a range of oil types in both the spot and futures market in various regions, Kaufmann and Ullman (2009) concluded that the future prices of light crude on the New York Mercantile Exchange (NYMEX), along with the spot prices of Dubai crude,

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[2] That contract was developed by Pemex and used WTI crude as a reference for crude oil sales by Mexico to the United States.

[3] As described by Mabro and Horsnell (1993), a squeeze is a type of transaction in which an agent buys a high percentage of the available goods in a given market, assuming control over prices in that market to obtain financial advantages. Squeezes occur more often in markets where physical availability is limited.