



# Precious metals, cereal, oil and stock market linkages and portfolio risk management: Evidence from Saudi Arabia



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## ABSTRACT

This paper examines the time-varying linkages of a major oil-based frontier stock market with major commodity futures markets including WTI oil, gold, silver, wheat, corn and rice, and draws implications for portfolio risk management. For this purpose, we consider the bivariate DCC–FIAPARCH model with and without structural breaks. Our empirical results reveal evidence of asymmetry and long memory in the conditional volatility and insignificant dynamic conditional correlations between the considered commodity and Saudi stock markets except for the silver–Tadawul pair. Moreover, we assess the implications for mixed commodity–stock portfolios and find strong evidence of diversification benefits, hedging effectiveness and downside risk reductions. This result underscores the usefulness of including commodities in a traditional portfolio of risk management for investors in the Saudi market. These findings are also useful for both portfolio risk managers and designers of policies aimed at using commodities to preserve or stabilize oil exporters' purchasing power.

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## 1. Introduction

The financialization<sup>1</sup> of commodity markets has attracted a great deal of attention from market participants and scholars. In fact, global investors and portfolio managers find in these markets new ways to diversify their portfolio investments. Interestingly, the financialization of commodities motivate investors to choose commodities as a refuge during periods of stress in traditional asset markets, especially if macroeconomic shocks tend to work on the commodity and stock prices in opposite directions (Silvennoinen and Thorp, 2013). Designing strategies for optimal asset allocation, portfolio optimization, downside risk reductions and hedging requires firstly a good modeling of time-varying correlations between the commodity and equity markets. Therefore, combining investments in commodities that have low or negative correlations with equity assets should provide better

diversification properties than a portfolio without commodities (Sadorsky, 2014). Thus, a mixed commodity–stock portfolio may provide more expected returns and low risks than a stock only portfolio.

Different commodity markets such as the gold market can serve the role of flight-to-quality during times of financial crises. As shown in various studies, gold can behave as a hedge asset in tranquil periods and a safe haven during turmoil periods.<sup>2</sup> Given the recent global food crisis that happened in 2007–2008, the increasingly rising oil prices and the greater demand for biofuels, the global prices of cereal crops have gone up at least threefold for wheat and corn or even fourfold for rice from mid-2005 to 2008.<sup>3</sup> Global investors, portfolio managers and policy makers have paid great attention to commodity markets after the dramatic price spikes since this is contemporaneous to a massive arrival of financial investors seeking diversification (Delatte and Lopez, 2013). In fact, many institutional managers have embraced commodities as a profitable alternative asset, relying on low correlations with conventional assets, a positive co-movement of commodity prices with

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<sup>1</sup> The commodity financialization process refers to a situation in which the price of an individual commodity is not only determined by its primary supply and demand, but also by several financial factors and investors' behavior in relevant derivative markets. More popularly, this financialization is understood to underline the vastly expanded role played by financial motives, financial markets, financial actors and financial institutions in the operation of domestic and international economies, thereby in this case resulting in increasing their roles in commodities markets (Casey, 2011).

<sup>2</sup> Baur and McDermott (2010) and Reboredo (2013) provide illustrative applications of the safe haven topic.

<sup>3</sup> For example, the Europe Brent oil spot price moved up from \$99 per barrel in June 2005 to \$143.95 per barrel in July 2008 for the first time in its history (source: Energy Information Administration). The US HRW wheat FOB (Gulf) price varied from \$152 per ton in June 2005 to \$532 per ton in February 2008. The Thailand 100% Grade B rice (US 3YC corn FOB) price was \$292 (\$99) per ton in June 2005, and reached its maximum price of \$1057 (\$315) in May (July) 2008 (source: International Grain Council).

inflation and a tendency to backwardation in the futures curve (Chong and Miffre, 2010).

On the other hand, commodity prices including oil, precious metal and cereal assets are widely linked with the financial, economic and geopolitical events. So far, the literature has largely studied the linkages between stock and commodity markets (mostly oil or gold) and across commodity markets.<sup>4</sup> Little attention has been paid to the interrelationships between different essential commodity prices and stock markets and their practical implications for portfolio investments of major oil-based frontier countries like Saudi Arabia. This major oil producer is among the G20 countries, the largest economy in the Middle East and North Africa (*thereafter* MENA) and houses the greatest market capitalization stock market in this region.<sup>5</sup> It is worth noting that volatile food prices affect developing countries more than developed countries because they are more commodity dependent. Among the developing countries, the cereal prices are of particular importance to Saudi Arabia, because this country is one of the largest importers of this commodity and itself is also a major producer and exporter of the oil commodity.

This paper addresses the following questions which are under-researched in the literature. Do linkages exist between those related and seemingly unrelated commodity and stock markets, particularly for oil-based frontier markets whose economies are also important importers of commodities? How do those linkages evolve over time? Are there any diversification benefits and risk reductions of adding different commodity assets to equities of major oil exporters which are also commodity importers? Providing answers to these questions are crucial to understanding how these different markets related to each other, particularly during structural breaks (*thereafter* SB) that may usher in major events.

Motivated by the above inquiries, this study intends to investigate the dynamic correlations between the international major commodity futures price returns and the daily returns of the Tadawul stock index of Saudi Arabia. We also evaluate if the considered commodities provide protection against extreme stock market movements by pointing out the diversification gains obtained when those commodities are included in traditional portfolios. For this purpose, we use the daily data of six influential international commodity futures markets, namely gold, silver, Brent oil, wheat, corn and rice as well as the Saudi stock index from June 1, 2005 to August 13, 2014, while taking into account certain statistical characteristics of the data such as structural breaks, asymmetry, fat tails and long memory, which are pertinent to the specification of the models. Those properties also have implications for market contagion and portfolio risk management which is one of the objectives of this study.

From a methodological viewpoint, we accordingly employ the bivariate Dynamic Conditional Correlation Fractionally Integrated Asymmetric Power ARCH (DCC–FIAPARCH) model under the student-t distributions. This model accommodates different influential stylized facts of financial time return series of the conditional variance processes. Our empirical framework nests the FIAPARCH model of Tse (1998) and the DCC specification of Engle (2002), which allows one to synergize their advantages. Specifically, the FIAPARCH model offers the flexibility to model the conditional second moment taking into account the long memory property, the predictability structure of the return volatility and the volatility asymmetric characteristics (i.e., the leverage effects). For its part, the DCC model allows us to capture the evolving conditional correlations among the sample markets with respect to market

conditions. This extended model is also less restrictive regarding the number of variables included, compared to other multivariate volatility models such as the full BEKK–GARCH model and the VEC–GARCH model. Interestingly, the estimated parameters of the DCCs allow one to evaluate in depth changes in correlations during the tranquil/volatile periods.

Our paper adds to and differs from the related literature in the following regards. First, it particularly analyzes the spillover effects among a set of six international, essential and strategic, commodity futures prices covering various sectors (energy, precious metals and cereals) and the largest stock market in the MENA which is also oil-based. Second, we consider the potential impacts of structural breaks on the different commodity–stock nexuses, using the modified iterative cumulative sum of squares (ICSS) algorithm of Sansó et al. (2004). Third, we re-estimate the bivariate DCC–FIAPARCH model with sudden change dummies. Finally, since the knowledge of cross commodity–stock market linkages is useful for Saudi Arabia investors seeking diversification benefits and investment protection against the downside risk, we analyze the implications of our empirical results on risk reduction effectiveness and downside risk reductions, using different analytical measures. More precisely, we estimate and compare the results of applying the Value-at-Risk (VaR), the Expected Shortfall (ES), the Semivariance (SV), and the Regret (Re) to three different portfolios composed of commodity and stocks with the risk of a benchmark portfolio composed exclusively of stocks.

The empirical results suggest strong evidence of time-varying conditional correlations between the silver commodity futures and the stock markets in Saudi Arabia and also highlight the importance of sudden changes in the relationship between the considered markets. On the other hand, by comparing the market risks for different portfolios (i.e., an optimally weighted portfolio, an equally weighted portfolio and a hedged portfolio), we find evidence of risk diversification and downside risk reduction benefits that confirm the usefulness of including commodities in a stock portfolio of a major oil producer and exporter.

The remainder of this study is organized as follows. Section 2 presents a review of the related literature. Section 3 provides the methodology used in this study. Section 4 describes the data and conducts some preliminary analyses. Section 5 discusses the empirical results. Section 6 provides concluding remarks.

## 2. Literature review

Several studies provide evidence of significant linkages between commodity markets. Narayan and Sharma (2011) show that oil prices affect U.S. firms' returns differently, depending on their sectoral locations. More interestingly, they find that those prices affect firms' returns based on different regimes for five out of the 14 sectors. Recently, Narayan and Sharma (2014) document that oil prices are a significant determinant and predictor of firms' return volatility.

Narayan et al. (2013) investigate the relevance of commodity futures (oil, gold, platinum and silver) in predicting commodity spot returns and conclude that they do. Moreover, the authors show how investors can use this information of the futures market to devise trading strategies and make profits. Based on dynamic trading strategies, they suggest that all commodities are profitable and that profits are structural break-dependent.

Sari et al. (2010) find strong evidence of significant transmission of volatility and dependence between gold and oil returns. Mensi et al. (2014a) address the dynamic returns and volatility spillovers across international energy and cereal commodity markets while accounting for the presence of three types of OPEC news announcements. Gorton and Rouwenhorst (2004) find negative correlations between commodity futures returns and equity and bond returns. This result is primarily due to the different behaviors commodity futures have over a business cycle. Choi and Hammoudeh (2010) show two possible volatility regimes for strategic commodity prices (i.e., Brent oil, WTI oil, copper, gold and

<sup>4</sup> Many studies have researched the oil–stock nexus (see, Hammoudeh et al., 2004; Filis et al., 2011; Mensi et al., 2014b among others). Other works examine the comovement between gold and stock markets (see, Baur and McDermott, 2010 among others). On the other hand, some researchers investigate the cross-market linkages among the oil and gold markets (see, Soytaş et al., 2009; Reboredo, 2013 among others) and the oil–agricultural relationships (see, Nazlioglu et al., 2013; Mensi et al., 2014a among others).

<sup>5</sup> Qatar, UAE and Saudi Arabia are the best performing frontier markets in 2014. <http://www.bloomberg.com/visual-data/best-and-worst/best-frontier-markets-2014-countries>.

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